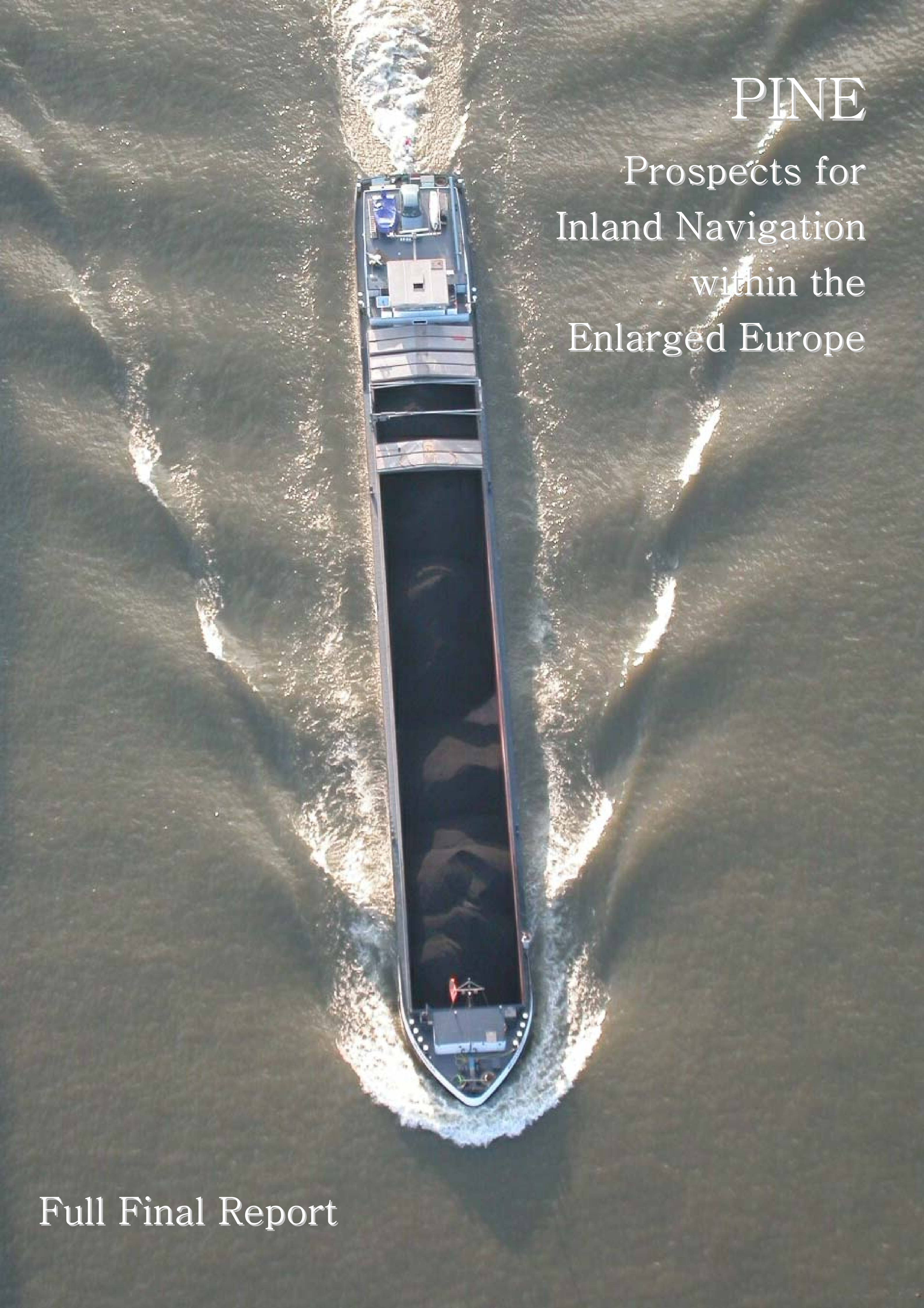
PINE

Prospects for Inland Navigation within the Enlarged Europe



Full Final Report

The outcomes and results of the PINE project are put down in three main deliverables:

- Full Final Report
- Final Concise Report
- Summary

The complete Full Final Report is structured as follows:

Part A	Supply side
Part B	Demand side
Part C	Policy and legislation
Part D	Modes and competition
Part E	Potentials of IWT
Part F	SWOT Analyses

Appendix 1 Fleets
Appendix 2 Costs structure fleets
Appendix 3 Inventory of Waterways.doc
Appendix 4 Analysis of Ports
Appendix 5 RIS

The Conclusions and Recommendations are included in the Full Concise Report.

Cover Photo: Hubert van Strien

PINE

Prospects of Inland navigation within the enlarged Europe

Full Final Report

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

PINE

Prospects of Inland navigation within the enlarged Europe

Part A Supply side

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Chapter 1 IWT characteristics and performance

1.1 Introduction

In this chapter, the general system characteristics of inland navigation are described while distinguishing advantages and shortcomings of IWT. Whether a certain characteristic is favourable or not can be derived from a comparison with competing modes.

The analysis is focussed on freight costs and performance criteria (speed, reliability, flexibility etc.), supplemented by the aspect of safety and some other transport conditions (loading structure, network and navigability etc.). Also the effects that these criteria have on the transport structure as it is defined by commodity types, sizes of shipments, transport distance and transport relations, are included.

In this chapter, the characteristics of IWT and of competitive modes are differentiated neither by regions nor by market segments nor have they been matched with the user's demands. These analyses are treated in part D (Modes and competition). Though it was not practicable to completely ignore these aspects they are not treated in any detail but only touched in the context.

1.2 Method of working

For this analysis, a number of relevant reports about inland navigation have been reviewed. To some specific issues information has been gained from expert interviews. However, problems have sometimes been arisen regarding the fact that experts do have their subjective view on things that may therefore be not in line with other report findings or expert statements. This was for example the case concerning the evaluation of possibilities and problems in intermodal transport. As these expert appraisals were always substantiated with (e.g. technical) facts they have been included in the report though being aware of for example emphasising on different intermodal loading units in different text passages.

1.3 Major strengths and weaknesses

In general, inland navigation is a slow mode that has its strength in the high payloads of vessels. Thus, IWT is suitable for all kinds of mass goods, both liquid and dry bulk. A particular affinity applies to hazardous goods since waterway transport is considered to be very safe.

From these characteristics it follows that most volumes carried by inland navigation consist of traditional bulk goods like ores, metal wastes, solid and liquid mineral products and building materials.

Another main feature is the relatively low network forming capacity. The backbone of IWT is represented by natural navigable rivers, supplemented by man-made canals connecting the most important rivers with each other. The present European network, however, does not necessarily follow major cargo flows. Road or rail haulage is therefore required to fill the gaps, supplying freight storage centres and consignees sited away from waterways.

Operational costs per tonne-kilometre are low compared to other surface transport modes. According to the UN, IWT costs are as low as one sixth of road costs and between one third and a half of rail costs. However, this cost argument has to be put into perspective, as it is generally true for single mode carriages but not for door-to-door transports including transhipment and pre/end haul. The total cost advantage of IWT depends much on the length of transport on waterways and the distance of the consignee to or from the transhipment point. Last but not least there are different types of transhipment, closely related to the commodity as well as to port facilities and these result in different costs. In unfavourable situations the costs of transhipment are double the waterway transport costs. On the other hand, many examples show that intermodal transport with inland navigation is efficient. Thus, even with additional costs in intermodal transport, as compared to direct road transport, the very low costs of IWT more than compensate the additional costs of transhipment and road haulage if the main leg is long enough.

From the economic point of view IWT is a low cost mode as well. The maintenance and operating costs of infrastructure are comparatively low. In addition, emissions of ships per tonne-kilometre are very low[1].

On the other hand calculations in Germany of infrastructure expenses not covered by the various modes show that inland navigation ranges between road transport with the highest cost coverage per tonne-kilometre and rail transport with the lowest coverage.

With regard to flexibility, IWT is at a disadvantage because its most common ship type, the self-propelled vessel, is built for certain commodity types.

---

[1] For detailed statistics on costs and emissions we refer to the chapter 4 and the Annex.

Seasonal peaks in demand therefore cannot easily be accommodated. Medium-term shifts in demand often require modifications of ships that may be costly or even not possible at all. In addition, IWT is clearly less flexible than road, rail and maritime transport: in case of problems along the route, the vessel can rarely be re-routed.

1.4 IWT in comparison to other modes

In order to range IWT within overall goods transport (excluding ocean shipping) Table 1 compares the supply characteristics of the competing modes.

Characteristics	**Inland Waterway**	**Rail**		**Road**	**Air** 1)
		all	**combined**		
Network size	EU15: 30'000 km EU25: 37'200 km	EU15: 156'000 km EU25: 207'000 km		EU15: 51'000 km Motorway + 270'000 km nat. highways; CC13: 4'800 km motorway	
Commodity type; mode of appearance	dry bulk, liquid bulk, container; specially bulky shipments; dangerous goods	all except perishables	container, swap bodies	all	all except dangerous goods
Shipment size	large, depending on waterway class and ship configuration	train loads, wagon loads	depending on train length	up to ca. 28 t	small
Commercial speed	Slowest mode ex. Basel-Rotterdam (860km, 72h) : 12kmh (see foot note 1)	Scheduled (complete) trains: 50-60 kmh	ex. Brindisi-Gothenborg (3186km, 109h): 29kmh	ex. Basel-Rotterdam (788km, 21,65h) : 36,4kmh ; Barcelona-Warsaw (2726km, 88h) : 31kmh	overnight for most relations
Punctuality (jit)	sporadic congestion problems only	predominantly night traffic	scheduled services	guaranteed delivery time	overnight transport, guaranteed delivery time
Reliability (problems)	Climate: high, low water levels; ice	meteorological problems, labour conflicts		major congestion, accidents, snow & ice, labour conflict problems	minor meteorological problems, labour conflicts
Safety	high	medium		major problem	limited
Energy consumption/ emissions	lowest/lowest (difference between downstream and upstream	medium/emissions depending on type of traction		high/high	high/high

Characteristics	**Inland Waterway**	**Rail**	**Road**	**Air** [1)]
Costs	lowest costs of all modes	medium/significant level of subsidies	high/prices to large extent below cost	Premium

1) Within Europe, over 80% of airfreight is transported by truck

Table 1. Goods Transport Characteristics – comparison by mode
Sources: DG TREN, RECORDIT, PINE Consortium

The following comments further clarify the supply characteristics of IWT in relation to other modes:

Network size

Total length of inland waterway in the European Union is at present 29’500 km of classified rivers and canals, increasing to 36’500 km in the enlarged Union. Compared to the existing railway lines in the same areas, inland waterways are less than one fifth. In a part of the areas concerned, rail lines run parallel to IWWs.

Commodity type and mode of appearance

IWT is particularly suitable for both dry and liquid bulk commodities. In the past decades, container transport has developed on the large navigable waterways. Transport of new cars in large quantities has also become possible. A niche market is the transport of large items exceeding dimensions suitable for road and rail transport. Perishable goods are rarely suitable for IWT. Efforts are being made to standardise swap bodies in such a way that they can be stacked but this is only a potential for the future.

Shipment size

Small size ships carry generally up 500 tonnes of bulk commodities, medium and large size ships up to 2’000 tons of dry bulk and up to 3’000 tons of liquid bulk. A pusher convoy with two barges can carry over 5’000 tonnes of dry bulk. This equals approximately 125 railway wagons of 40 tons each, or 250 road trucks of 20 tons payload each. The largest container ships can today load over 400 TEUs.

Commercial speed

IWT is clearly the slowest motorised mode of transport, achieving nevertheless a speed of up to 12 km/h for example on the Basel-Rotterdam downstream link (source: RECORDIT).[2] Commercial speed of trains can vary significantly, depending on breaks in the transport chain. Complete trainloads (bloc trains) travel faster, with a commercial speed of 50-60 km/h. An example for combined transport: between Brindisi in Italy and Gothenburg in Sweden 29 km/h on a length over 3000 km with several scheduled combined transport services. However, wagon loads usually travel at reduced speeds of 20-30 km/h. In comparison, long distance road transport with one driver only (which is usual) achieve between 30 and 40 km/h.

Punctuality

Scheduled and just-in-time delivery services by IWT have few problems, as there are no major congestion points in the system networks. Travel times and transhipment times can normally be calculated in advance except where queues build up in front of locks and port facilities.

Reliability

The term ‘reliability’ is not objectively defined and interpreted in many ways. Therefore, reliability is often judged in a subjective way. It is not our intention to contribute here to this discussion. Nevertheless, in most of the cases logistic concepts rely on just in time delivery which actually is not synonymic to a short transport time. In this context IWT is quite competitive to road and rail if there are no physical restrictions that may undermine a just in time delivery. On the other hand, one of the main weaknesses of IWT is the dependency on meteorological conditions. Waterways may be closed temporarily due to low water levels after continued dry seasons, but also due to high water levels after heavy rainfalls in the river feeding areas. Low water levels are less frequent in the canals and canalised rivers. In cold winter seasons, icing of waterways, in particular of canals, may also lead to temporary closing down of operations.

Safety

Very few accidents have been recorded in IWT. Statistical information from Eurostat to compare with other modes of transport is not available.

---

[2] This is a speed estimation according to the indications in RECORDIT, deliverable 3 (page 31: length of way 860 km, page 198: transit time 3 days downstream, 4 days upstream).

Energy consumption and emissions

In IWT, energy consumption depends mainly on whether the ship moves downstream or upstream. On average, energy consumption is lower than in rail transport.

On the emission side, IWT performs better than rail with diesel traction. A comparison with electric rail traction is difficult, because it depends on the type of primary energy used to produce the electric current.

Costs

From recent cost and price comparisons in the RECORDIT project we conclude that inland waterway has the lowest costs and usually pays no infrastructure charges. Prices in IWT tend to cover costs adequately which is not the case for example in the area of road transport where market prices tend to be below cost levels reflecting all social and safety requirements imposed by law. Rail transport remains highly subsidised Continued internal cross-subsidisation does not allow to estimate the extent to which rail shipments are subsidised.

The pricing of infrastructure is a politically sensitive matter where progress is slow (see part C on policy and legislation). Studies initiated by the European Commission are underway for most of the transport infrastructures including inland waterways. Since inland waterways are not exclusively dedicated to transportation, the charging issue is even more complex compared to other modes.

1.5 Operating structure

The logistics, fleet and ship level form a functional chain that as a whole forms the IWT service. All of these levels are not necessarily combined within one company. The existence of a high number of owner-operators, traditionally in Western Europe and an ascending factor in Eastern Europe, has already been mentioned. These parties restrict themselves to the operational functions at the ship level. Only a very limited number of shippers take care of the functions at the upper levels themselves. Normally these functions are carried out by intermediary parties. Large forwarding companies function at the logistics level, and sometimes at fleet level as well. There are many small and medium sized brokers, operating at fleet level, connecting the shippers, often represented by large forwarding companies, with the owner operators The number of shipping companies operating at all three levels is very limited. Some medium-sized and large companies operate at the logistics and fleet levels, but use the ships of the owner-operators instead of their own vessels, which they used to have in the past.

In summary, during the last decades the functional chain in IWT has been split up in many separate organisations, a process of ‘vertical disintegration’. This results in strong internal competition with each other and, at the same time, weakens the negotiating position of the small and medium-sized IWT companies in their dealings with shippers or freight forwarders.

To conclude, the consequence of the structure of IWT enterprises is:

- An increasing number of parties involved in the establishment of the transport service.
- Weakness in negotiations, communications and co-operation.
- Lack of forwarding knowledge in a broader sense of an understanding of the relevant aspects of the whole logistic chain.

1.6 Transport distance

There is no minimum or critical distance in IWT. If the loading and unloading sites are close to the water, even a short distance is cost-effective and cheaper than other modes. Transhipment does imply higher costs; especially where the transhipment of heavy goods is followed by increasing transport costs for pre haul and end haul.

With regard to the question as to the distance at which IWT is still cost effective if one or two transhipments are necessary, the following can be said: a general rule of thumb to cost equality concerning the necessary additional distance for an additional act of transhipment does not exist. The reason is that too many parameters play a role. Take for example the truck toll: If a transport is conducted today via road between a point A and another point B, it may become cheaper to use IWT on longer distances after the introduction of the truck toll. Even a necessary transhipment might be included in this calculation as the whole transport chain must be looked at and this also contains costs for storage, the precisely timed periodic transport and the calculated empty voyages. Therefore the ‘break even point‘, where the IWT becomes cheaper than other modes cannot be generally calculated.

A significant amount of IWT concerns chemical goods. As the chemical industry is mostly located in the neighbourhood of water (i.e. rivers, canals) these transports do not need transhipment and are therefore as well suitable for short distance transport. This conclusion is also valid for many other types of carriage in certain regions (e.g. in the Netherlands) and for different commodities, particularly raw materials (in connection with the location of manufacturing companies on waterways).

1.7 Transport conditions

There are certain limitations to the shipment of different goods:

- Requirements concerning the quality of transport and the character of the shipping space.
- General transhipment and transport requirements, e.g. prohibition on shipping different specific goods on one vessel, especially in tankers.

Tanker shipping

A voluntary abandonment of vessel degasification has been in operation since 2001; the process will be prohibited in 2006. Whilst 15 years ago the shipping companies actually called for degasification they reversed their position on degasification of fuel and similar goods transport, because the process emits high volumes of hydrocarbons and thus contributes to the greenhouse effect. Without proper degasification it is not allowed to load unrelated fuels such as heavy fuel oil or avgas. Certain chemicals also need total degasification.

Dry goods shipping

There are no special cleaning requirements for transporting different dry goods. A normal procedure is sufficient in most cases to ensure an unobjectionable transport of a different sort of goods. Exceptions are of course made for certain goods, e.g. foodstuffs.

Except for certain prohibitions concerning the transport of different goods on one ship, there are virtually no restrictions: The ship's hold can be divided into sections, the floor can be made of metal or wood and the goods may be loaded in containers, as bulk cargo or general cargo.

Intermodal loading units

In inland transport there are several different loading units whose dimensions and other typical characteristics diverge in relation to the kind of carriage for which they are conceived. This is what makes an integration of IWT not a simple decision of just changing a mode within a transport chain. There have to be some prerequisites of changing a single transport into an intermodal transport.

The most common boxes in road transport today are trailers. They are optimised for quick charging and discharging and can easily be combined with the truck. Their dimensions are oriented on the size of the part loads which usually is a standardised pallet.

Swap bodies, on the other side, are used for combined transport. Their characteristics are oriented towards road and rail carriage with quick and cost-efficient transhipment/loading technology. Their dimensions are in function of maximised capacity on train wagons which is the most important efficiency criterion in rail transport.

Intermodal transport with IWT first of all competes with single road transport. Suitable loading units therefore have to be harmonised with road trailers, i.e. they should have the same dimensions to get the maximum of pallets in it, as this is the efficiency criterion in here. But they also must be stackable and need metal fittings for top lifting. According to experts, the 45 feet pallet-wide containers that are also used in short sea shipping are adequate to fulfil these prerequisites.

To involve IWT in logistic chains there are also concepts to carry trailers and swap bodies on barges. In some cases, for example in combination with container transport, this may be an added value to shippers if vessels do not have maximum load. But normally a carriage of those boxes would be far from cost-covering as trailers and swap bodies are neither stackable nor do they have the right dimensions with regard to the optimal use of vessel capacity. Even if research has already been carried out in the field of stackability questions arise of standardisation and the implementation of a new generation of trailers and swap bodies in inland transport; such questions strongly depend on broad acceptance by shippers, forwarders and logistic providers. A potential of 2.6 to 4.5 million units has been calculated for inland navigation, but up to now hardly any units have been shipped.

To conclude, intermodal transport with IWT first of all needs intermodal loading units that are suitable to this mode. That means a choice of intermodal transport must precede a decision upon the relevant transport mode(s) on the part of the shipper or the forwarder.

Regular transports

There are several examples of scheduled services in IWT which show that this could be an efficient market sector if certain conditions are respected on the quantity of goods transported. Different load factors in upstream and downstream operations must not always be a precondition, as transport on the Rhine clearly demonstrates: Two thirds of tonnage moves upstream whereas only one third moves downstream. This is due to the transport of ore, oil imports and overseas containers from the North Sea ports to their hinterlands. Tanker shipping companies have already organised a closed circuit of up- and downstream transports. Nevertheless the share of empty trips down river exceeds 50% in this sector.

In the case of scheduled container services, empty containers return to the seaports. To avoid this waste of capacity, within a project called SIKZNEB[3], 24 inland terminals in Belgium, Germany and the Netherlands have joined forces to improve the efficiency of container transport by waterway, developing an independent IT platform for the exchange of boxes. Participating terminals in the project agree to electronically communicate the offer and demand of empty boxes to a central unit, which repositions them by searching capacity for the load. The central unit is an independent actor to prevent terminals from competing with each other on the same loads. This is a good example for efficient co-operations between competing actors.

Hub and spoke systems

The growth in container volumes by barge and the increase of the number of seaports and inland terminals involved go hand in hand with fundamental spatial developments in the European inland terminal network.

---

[3] See www.incodelta.nl and www.inlandnavigation.org/documents/INE_Waterways_2.pdf.

Moreover, organisational changes in the industry have an impact on traffic concentration and dispersion dynamics. In this context, the use of hub-and-spoke type networks, in combination with fixed-length shuttle services for freight, are increasingly under discussion.

There are several academic projects concentrating on an optimised inland hub concept for container transport in the European hinterland, using operations research procedures. One project of the university in Antwerp investigates the feasibility of a centralisation of maritime container flows in only one or two inland hubs in the Rhine basin. In another approach the optimisation problem focuses on a system that is operated on an inland waterway network with a dedicated fleet of barges and tugboats to transport products from several source plant loading points to multiple distribution sites at other locations along the waterway network. The aim is to determine the proper fleet sizing and appropriate resource allocation to meet potential delivery requirements in a timely manner. Constraints of the optimisation problem are floating water depths and restrictions on loading heights that influence ship types, loading volumes and schedules of the barge fleet.

Hub and spoke systems are already well known in aviation as well as in rail and road operations. A search in the internet detects a number of EU funded projects upon hub and spoke concepts, dedicated to enlarge the contribution of environmentally friendly modes, especially rail and short sea shipping (organisation of feeder transports). But there is still a lack of projects where IWT is involved (e.g. in PACT and Marco Polo program). The INE-organisation (Inland Navigation Europe) therefore suggests complementary actions to also enhance the setting up of inland waterway hub and spoke systems.

1.8 Conclusions

It can be summarised that the important advantage of IWT is its large capacity and therefore the ability to carry all sorts of bulk goods at minimum transportation costs per tkm. This is also the case for large numbers of containers covering general cargo.

The main shortcoming of IWT is its limited geographic scope, which causes additional costs of transhipment and further road or rail haulage to link the waterways to shippers or freight storage sites. Furthermore, on some inland waterways there are weather dependencies, which may have an impact on its reliability.

Evaluating the strengths and weaknesses of IWT we can draw the following conclusions:

- The characteristics of IWT show more similarity to rail services than to road services. Market potentials can therefore be found more easily in transports that are typical for rail rather than for road. This concerns the transportation/loading structure defined by commodity types, transport distances, origin-destination-relations, sizes of shipments and – in the case of bulk or container transport – loading units.

- Compared to other transport modes the low cost criterion is quite important for inland navigation. As IWT cannot match other system characteristics of road or rail transport (speed, flexibility, direct accessibility from starting to arrival point and in some cases reliability) these disadvantages must be reasonably compensated by carrying large quantities at low transport prices per tonne or per unit. Transhipment costs (regular transhipment as well as in case of reliability guarantees) must be absorbed by competitive freight rates.

- Limitations in flexibility must be counterbalanced by organisational measures (e.g. telematics solutions for transhipment, all in offers for door-to-door transport). However, the current operating structure of IWT does not seem suitable for strengthening logistic services. Market participants tend to exhibit strong individualism, and therefore often lack the willingness to enter into strategic alliances and commercial co-operation.

- To compensate the lack of network forming in inland navigation requires a better degree of organisation of the transport chain. IWT must be more integrated in logistic processes. There are many chances to compete with single road transport by forming intermodal transport chains with suitable loading units but this requires first of all the willingness of shippers and forwarders to change their well working single mode concepts.

- The system characteristics of modes can be influenced by the policy framework. For example a more comprehensive inclusion of all economic (and environmental) costs of transport in the freight rates would probably strengthen IWT in competition and, at the same time, make more transparent which infrastructure investments would in the longer term be most efficient and economic. It should also take into account that the choice of location in industry and logistical concepts are influenced by such general political, legal and economic conditions. State aid is also needed concerning investments in better transhipment facilities as well as in investigations upon hub and spoke systems, as both aspects are prerequisites for a cost-effective and therefore competitive intermodal transport with IWT.

1.9 References

1. Potential and future of German inland navigation [PLANCO 2003],

2. RECORDIT Deliverable 3 [Gruppo CLAS 2002],

3. INLATRANS [PLANCO 2001],

4. EUDET – Evaluation of the Danube Waterway as a Key European Transport Resource [EBD, IMPETUS, ÖIR 1999],

5. Shifting cargo to inland waterways [EBD, ANAST, ÖIR 1998],

6. White Paper on trends in and development of inland navigation and its infrastructure [UN ECE 1996],
7. Towards a European Policy to IWT industry [NEA/PLANCO 1991].

Chapter 2 Enterprises

2.1 Introduction

This chapter provides an overview of the development and present situation of enterprises in the IWT sector. To start with, it may be said that the liberalisation of transport in general and IWT in particular, added to the reduction of the fleet capacities has markedly changed the situation of the enterprises.

In Germany, France and the Netherlands, the IWT sector is very important and a reasonable set of statistical data on the structure and development of the IWT enterprises is available. In the countries with a less significant IWT sector, statistical information is scarce, in particular on enterprises. For example, for Italy, the UK or Finland little such information is available and to make matters worse, different statistical sources often report different figures, mostly due to different definitions. Nevertheless it is possible to draw some conclusions, provided a single data source is used, e.g. for comparisons over time or between countries. This will become clear when detailed data are discussed below.

Few financial data are available. For one thing, reporting requirements are in many countries different for owner-operators and larger enterprises. Moreover, a recent Prognos survey (‘Frachtenbörse’) reveals that the ‘owner-operators’ often do not even know their own financial figures, due to a lack of understanding. Many self-employed operators calculate their freight tariffs on the basis of their variable expenses only. In any case, financial data are considered commercially sensitive and disclosed only to the legally required extent.

The breakdown of enterprises by the number of vessels may disguise the real situation, as many operators have entered into contracts with large shipping companies who organise the orders and fix the price. Entering into such contracts inhibits the idea of generally negotiating them and makes the owner-operators even more dependent on the shipping companies. IWT organisations stress that long-term contracts tie operators to shipping companies and therefore stabilise freight rates. But this is sometimes contested with the argument that in practice long-term contracts hardly exist and that hence the price level fluctuates considerably. All this suggests that there is no price stability in the IWT market. Whilst the shipping companies dominate the market, price instability forces them into short-term planning, which results in economic insecurity for the owner-operators.

Changes in the structure of enterprises and development of financial indicators should normally be part of market observation. However, the European Commission’s inland waterway market observation contract did not include these aspects (see ECORYS 2002)[4]. No information is available concerning investments or profits in the IWT branch.

2.2 Method of working

Enterprise data for the IWT sector have been researched from publicly accessible sources of national statistics and international organisations. Our observations for the EU in general and especially for the accession countries are, however, handicapped by scarce or conflicting statistics.

The Common Questionnaire of Eurostat, ECMT and UNECE collects enterprise data; reporting by governments is on a voluntary basis. As a result, there are many gaps for western and eastern countries alike.

At the national level, enterprise data can be obtained in two ways: either from general enterprise statistics or from transport related surveys by identifying the owners of registered vessels. Enterprise statistics report such enterprises whose main or reported activity is inland navigation. Some of these may have ceased with IWT but not reported any change in the scope of activity. Transport related surveys identify many ship-owner companies whose main economic activity is in a different sector; this is true for own account fleet operators but also to some extent for commercial operators. Statistics from these two sources may provide a very different picture. We face the same situation with regard to employment and other enterprise related indicators.

Enterprise data in the European Commission’s Energy and Transport in Figures publication obviously provides data from Eurostat enterprise statistics.

We have also requested as part of our PINE survey enterprise data from national administrations involved in the IWT sector. But again, there are major data gaps. We are, therefore, not in a position to report data on enterprises and employment for accession countries except some individual countries.

We have focussed our efforts on the changes of enterprise data over the year. Restructuring of companies lead to mergers on the one side, to split ups on the other side. Therefore, changes in the number of enterprises do not necessarily imply changes in the overall fleet and the composition of enterprises by fleet size. The structure has to be observed separately.

---

[4] The contract ended at the end of 2002; since then, no inland waterway market observation system is operating on behalf of the European Commission.

In the case of CEECs where reliable figures cannot be obtained, we have also consulted with experts familiar with the region who were able to indicate recent trends and dominating enterprises. Experts referred to the very limited statistics available. Also, increasingly, data are confidential and registration is deficient.

2.3 Structure of enterprises

The following indicators illustrate the enterprise structure of the inland waterway transport sector:

- Total number of enterprises
- Number of enterprises by number of vessels

Figure 1 indicates the number of enterprises in the IWT sector for EU Member States in 2000. The three countries with the highest numbers of IWT-enterprises are the Netherlands, Germany and France. With nearly 3700 enterprises the Netherlands have the highest number in Europe, representing on its own almost half (47%) of total IWT enterprises in the Union with presently 15 Member States.

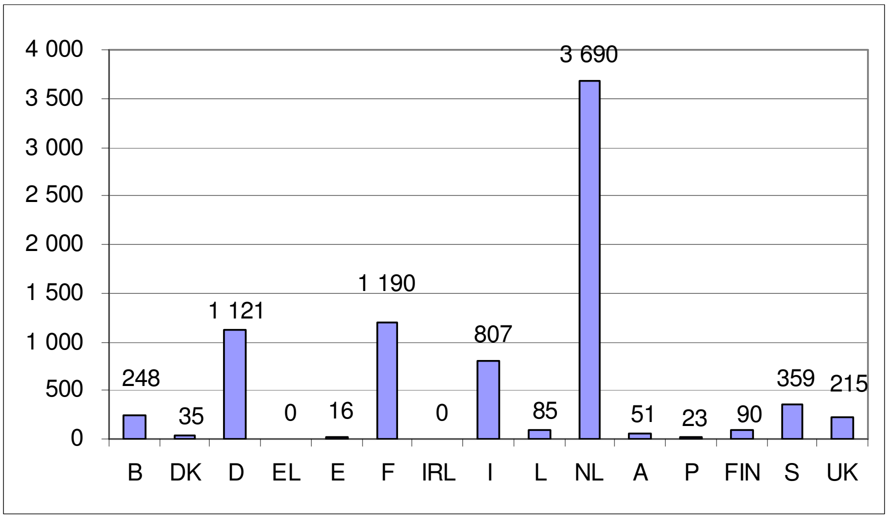


Figure 1. IWT – Number of enterprises 2000
Source: European Commission (Energy and Transport in figures 2003, Table 3.1.8)

By comparison, the figures for Germany (1121) and France (1190) seem rather small, which already indicates structural differences between these three countries. Some of these figures do not seem reasonable. For example, although there is no significant IWT activity in Italy, 850 enterprises operating in the IWT sector are recorded. This data originates from the

Eurostat enterprise statistics, which is incompatible with data from transport statistical surveys. Indeed, in the NewCronos transport statistics which has only very sketchy entries for recent years, we find for the year 1999 a number of 980 enterprises in France and 876 in Germany compared to 1191 and 1573 published in the 2002 issue of Energy and Transport in figures for the year 1999.

The following Figure 2 and 3 show the number of enterprises by number of vessels in 7 EU countries and Switzerland, this time from the NewCronos database. The data for many countries are not up to date. For this reason, datasets for different years had to be used. The comparison between the countries is therefore somewhat limited. The vast majority of enterprises only have one vessel. The share of one-vessel enterprises exceeds 70% in most countries and in Germany, Belgium and Luxembourg even amounts to 80%. In Austria, however, the share of owner-operators is less than 50%; an unusually high share of bigger enterprises (20 vessels and more) is the result.

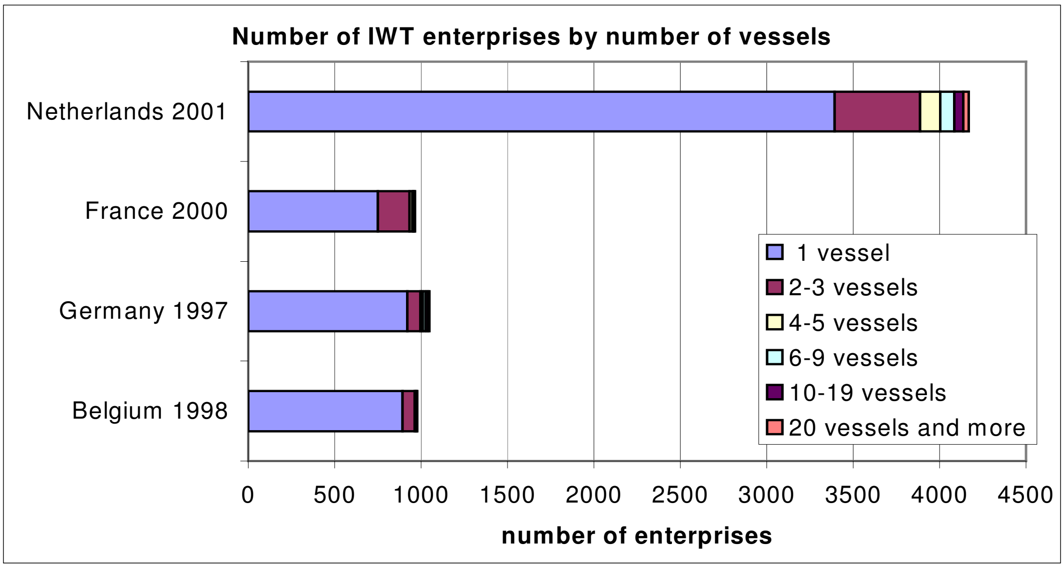


Figure 2. Countries of major importance in IWT
Source: Eurostat, (NewCronos 2003); DESTATIS data for Germany

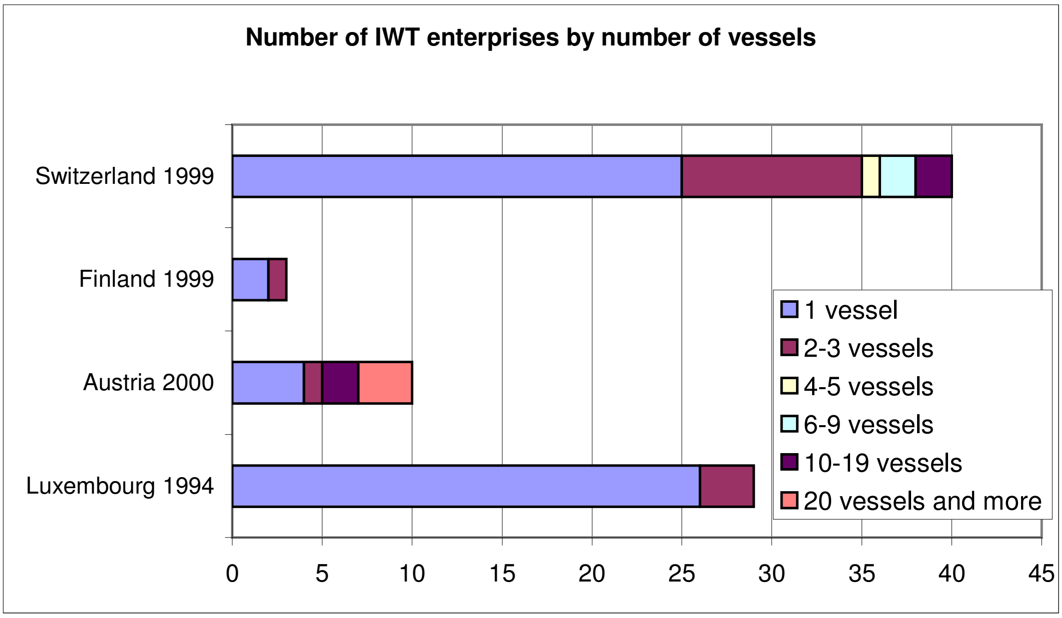


Figure 3. Countries of minor importance in IWT
Source: Eurostat, (NewCronos 2003)*

As already noted, a comparison of numbers of enterprises at EU level is difficult because of incomplete data; this applies even more so in the Accession Countries. How drastically the IWT sector has restructured over the past decade is nevertheless demonstrated by figures for three important IWT countries (table 2).

	1990	***1998***	***Change***
Belgium	1322	977	-26%
France	1828	998	-45%
Germany	1422	959	-33%

*Table 2. Changes in IWT sector (numbers of enterprises)
Source: NewCronos 2003*

During the eight-year period 1990 and 1998, the number of enterprises declined by one quarter in Belgium, by one third in Germany and by almost half in France. This change is difficult to interpret without a clear picture of the shifts that took place.

In the following we shall take a closer look at the four major IWT countries and the development of their enterprise structure. The situation in the EU accession countries will be briefly reviewed.

Germany

The NewCronos data indicated above showed a heavy decline of the total number of enterprises in the recent past. Data from another source (destatis) also record a decline in enterprise numbers since 1992, but much more gradual. (see Figure 4) While the total number of enterprises has declined, the average number of ships per enterprise was constant (2.6 vessels per enterprise in the years 1992-2000). The largest decline in the number of vessels per enterprise took place in the dry bulk sub-sector .The number of self-propelled tank vessels per enterprise has also declined. On the other hand, the fleet of dumb tanker barges per enterprise remained almost constant, while pushed and towed vessel transport developed in a non-uniform manner (see: PLANCO: Potential and Future of the German Inland Waterway Transport, Interim report N° 2, May 2003).

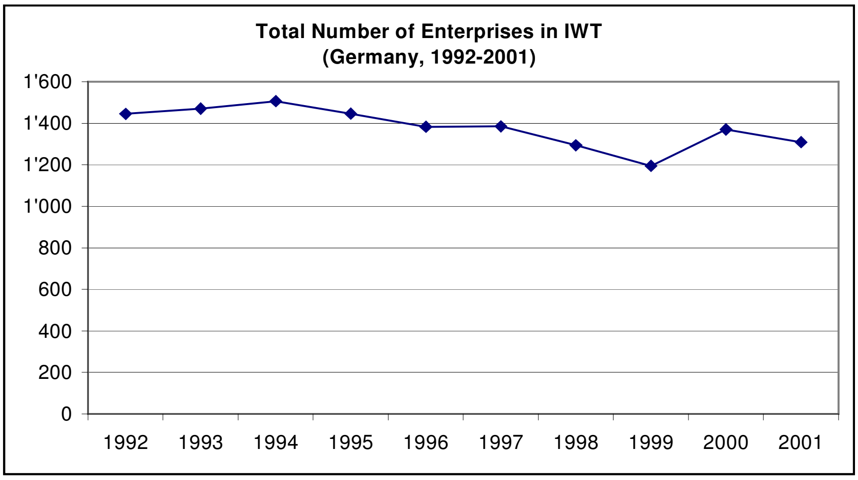


Figure 4. Development of the enterprise structure in Germany 1991-2001
Source: destatis (time series from different volumes of 'Verkehr – Binnenschifffahrt Fachserie 8 Reihe 4') Note: In the year 1998 – change of survey method

Turning from number of enterprises to fleet capacity, it should be noted that for 'owner-operators', a high number of enterprises does not result in a high number of employees or vessels, since most of these enterprises consist of only one employed person. This is the owner of the ship, generally with the help of family members. Indeed the development of capacity is not uniform – the carrying capacity of small enterprises (1 vessel) has declined, while the total carrying capacity was almost constant. This suggests that the 'new for old' scrapping/replacement system has worked in favour of larger companies rather than owner-operators who may have been less able to raise funds for new investment (see: PLANCO, 2003).

Figure 5 shows the developments with the number of vessels through time.

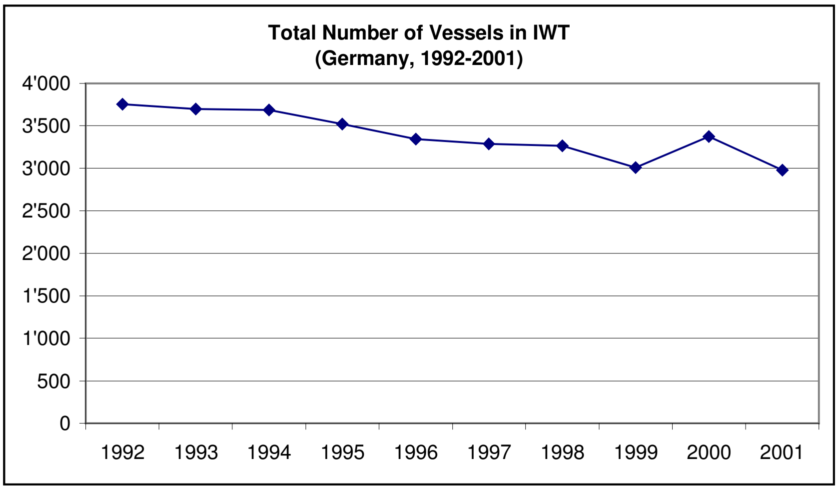


Figure 5. Development of number of vessels in German IWT enterprises 1992-2001
Source: destatis (time series form different volumes of 'Verkehr – Binnenschifffahrt Fachserie 8 Reihe 4') Note: In the year 1998 – change of survey method

The Netherlands

In the national statistics of the Netherlands, a distinction is made between the existing fleet and the active fleet. This gives additional information, as the non-active fleet may be reactivated if freight rates go up. Figure 6 shows the development of the total number of enterprises in the Netherlands. Apparently the non-active fleet is about a fifth of the total fleet. The figure for 1999 shows good consistency with the data in Figure 1, where the non-active fleet is presumably not taken into account.

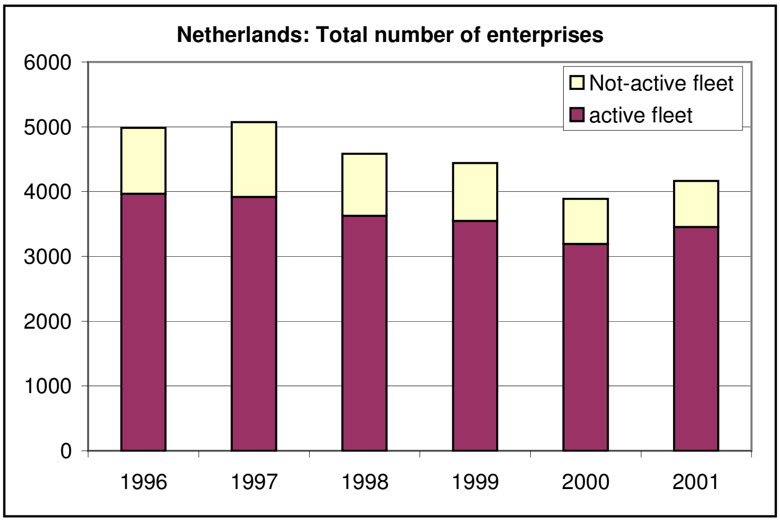


Figure 6. Development of the number of IWT enterprises 1996-2001in the Netherlands
Source: National statistics of the Netherlands (http://www.cbs.nl/)

It can be concluded from Figure 6 and Figure 7 that the IWT market in the Netherlands is dominated by a high share of ship-owners with only one vessel ('owner-operators'). The enterprises with more than one vessel often have their core activity outside the IWT market. These enterprises are part of manufacturing industry or the construction sector and use their vessels mainly for own account transport.

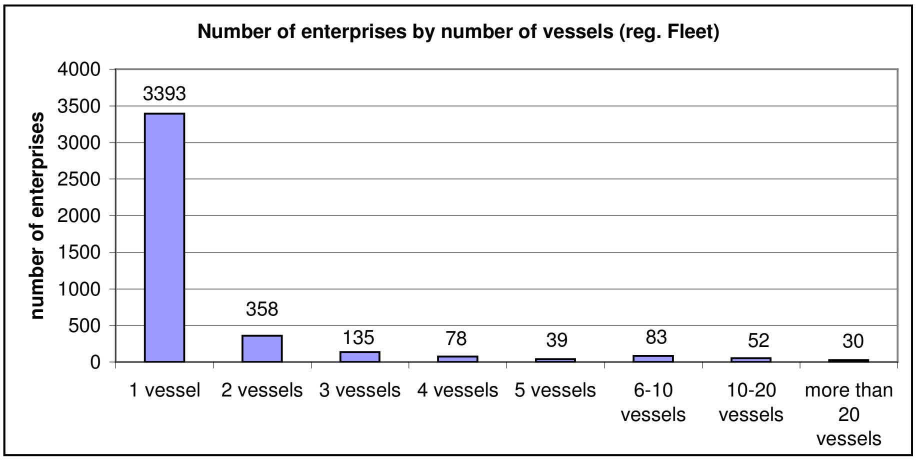


Figure 7. Enterprise structure of the Netherlands by number of vessels in 2001
Source: National statistics of the Netherlands (http://www.cbs.nl/)

One tendency in Dutch IWT is to draw up alliances of transport companies and freight-forwarders or shipping agents with high transport volume (see: PLANCO, 2003).

France

France reports for the year 2000 a total of 1121 enterprises in the IWT sector with 3410 employees, total turnover of 416 m € and investments of 20 m €[5]. As there are no time series, we show below the development of the fleet. The steady decline of recent years seems to have come to an end in 2000.

---

[5] http://www.equipement.gouv.fr/statistiques/chiffres/transpor/transpo_.htm

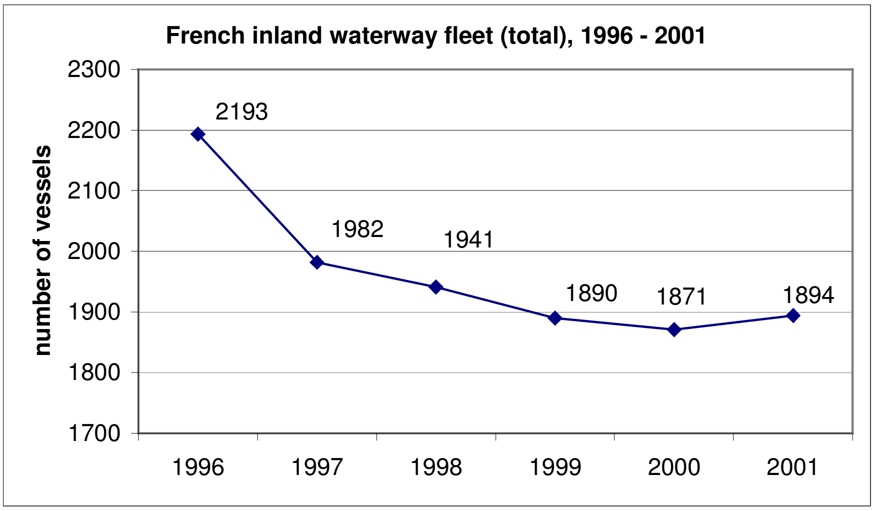


Figure 8. Development of the French IWT fleet 1996-2001
source: www.transports.equipement.gouv.fr

Like Germany and the Netherlands, the French IWT sector is also characterised by the domination of 'owner operators' – about 900 of the 1121 enterprises have less then 6 employees.

Belgium

For Belgium, not much detailed up-to-date information is available, most of the information dating back to 1999. The situation of the IWT sector is similar to other countries. For example the total number of vessels declined from 4182 in 1975 to 1639 in 1991, i.e. by 61%. This was, however, accompanied by a rise in their average carrying capacity from 555 to 894 tonnes during the process of modernisation, so that fleet capacity decreased from 2.32 mio t to 1.47 mio t or 'only' 37%. Moreover, during the slightly shorter period from 1975 to 1988, freight volume in tonnes carried on Belgian waterways actually increased from 76 to 97 mio tons. Almost all the extra traffic was in international shipments, mainly to and from the Netherlands and Germany.

The number of Belgian IWT enterprises declined further after 1992 by some 26%, though as noted above these figures are from different sources.

Austria

Statistics Austria has ceased to collect and publish data on enterprises in the transport statistics.

The formerly State-owned Danube steam ship company (DDSG = Donaudampfer-schifffahrtsgesellschaft) was privatised in 1994. Since that time, there is an organisational distinction between passenger shipping, tanker shipping and freight shipping. Most of the vessels are not under Austrian flag but that of Hungary, Slovak Republic and Germany.

Actually 90% of the self-propelled vessels are ‘flagged out’. On the other hand, the number of employees has been substantially reduced (actually halved) since the days of the national Danube steam ship company, the present employees on the vessels are mostly of Ukrainian citizenship.

DDSG reported financial figures until 1993, but current data about the economic situation of the IWT enterprises is not available. In theory, the revenues should be easy to estimate, as the freight rates per transported tonne are well known, but in practice we do not know the tonnage transported by the different associations.

In the early 90s, DDSG had received significant amounts of subsidies, while there is now virtually no financial aid for the companies. Today the enterprises employ crews mostly on short-term contracts, mainly to avoid that staff becomes eligible for social security and paid holidays.

Accession countries

Before the collapse of the Soviet system in 1989/1990, there were usually 1-3 national shipping organisations per country. Since that time, many things have changed, but only indicative information is available. Vessels have been handed over to captains, who operate similarly to western owner-operators. Their advantages are low labour costs and the possibility of around-the-clock operating hours. At the moment, the East European companies appear to be close to profitability, but their productivity is still low compared to West European standards.

East European barge operators are well-informed about western freight rates and adjust their rates when operating for example in Austria. The transport between east European countries is by comparison extremely cheap. However, since their productivity is low, East European operators do not present a direct threat for their Western counterparts, despite their lower costs.

There is a tendency to larger and larger vessels, but there are some restrictions on navigability, for example on the Upper Danube. On the lower Danube, modern high-powered vessels are operating, comparable to coastal shipping.

Many eastern European vessels have only a small drive power and can, therefore, only be used in domestic transport. The enterprise structure in the some of the CEECs is highlighted below. The main source for this is the PLANCO study, mentioned above.

Statistical data from CEECs are scarce. Many of the figures indicated below come from experts familiar with the area.

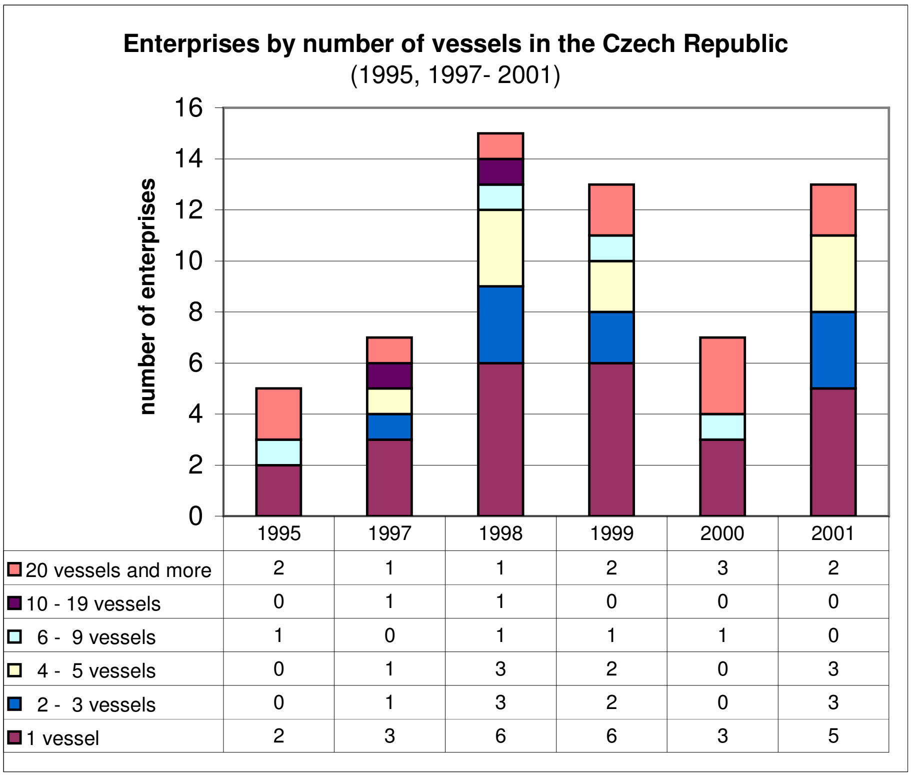
Poland

As a result of the restructuring process there are today three major IWT enterprises in Poland 27 enterprises have 3 or more vessels, and an estimated 30-60 enterprises owned one or two vessels.

The total number of vessels in 2002 was 809, of which only 20% belong to small enterprises. A special business model has developed in Poland since 1998: the captain works as a self-employed person and pays a rent to get a vessel and orders from the ship-owner. The business risk and the operating costs rest on the captain, while the owner undertakes the investments. This business model allows people to get into the IWT business easily, as they do not need much capital, and it also minimises the risk for the ship-owners.

Czech Republic

The data for the Czech Republic indicates that there are few enterprises involved in the IWT sector but that restructuring processes continue. Small one-vessel companies were merged during 1998-2000 whilst in 2001, one larger enterprise was liquidated. Therefore some smaller enterprises have been (re-) started – possibly involving the same vessels.



	1995	1997	1998	1999	2000	2001
■ 20 vessels and more	2	1	1	2	3	2
■ 10 - 19 vessels	0	1	1	0	0	0
□ 6 - 9 vessels	1	0	1	1	1	0
□ 4 - 5 vessels	0	1	3	2	0	3
■ 2 - 3 vessels	0	1	3	2	0	3
■ 1 vessel	2	3	6	6	3	5

Figure 9. *Figure 9: Development of Czech enterprises by number of vessels*
Source: MDS transport statistics (http://www.mdcr.cz/text/rocenka_01/yearbook/html/e252.htm)

Slovakia

The Slovakian IWT market is important inasmuch as IWT holds a modal share of 9%. The market has been relatively stable since 1989: one big enterprise (formerly State owned, today private) dominates. More than one quarter of its assets is held by a British transport firm – the rest belongs to private persons or local authorities. Some small enterprises do exist, but they are of minor importance.

Hungary

The latest national statistics (Oct 2003) report about the development of number of enterprises in Hungarian water transport. The number has risen from 46 in 1996 to 88 in 2000 and to 107 in 2002. However, only a small share of these enterprises is licensed to carry out international IWT, over 80% of the international performance being in the hands of the State-owned 'Mahart'. There are no statistics concerning the size of the enterprises by number of vessels.

The value performed of transport investment in current prices (billion HUF) per year is floating: 1,0 in 1996, 0,8 in 2000, 1,9 in 2001 and 1,3 in 2002. Note that this is only 2 % of the investments in rail transport as well as investments of 'other land transport'.

Romania

In Romania there exist approximately 10 bigger and 70 small IWT enterprises at the moment. Due to the war in Serbia the market has been reduced by 50%. There are hardly any infrastructure investments in the IWT sector while road and rail investments have priority.

2.4 Employment

The EU-wide deregulation and liberalisation of transport markets in the early nineties has of course affected the IWT freight markets. This has resulted in changes in the employment structure of the enterprises since staff costs are the major part of the cost structure.

With liberalisation, freight rates went down, sometimes dramatically. As a result, the shipping companies laid off employees, ships were outsourced and put under cheaper flags (i.e. Luxembourg). The owner-operators of countries with high wages (Germany, France, the Netherlands) reacted by employing 'temporary' staff from Poland, the Czech Republic or South-eastern Europe. These crewmembers were available for substantially lower wages and no social benefits needed to be paid. The contracts were usually of a short-term kind (less than 3 months), therefore the employees had no entitlement to annual leave and no work permit was necessary since tourist visa are used for these countries.

The highest number of employees in the IWT sector are found in the Netherlands (8300) and in Germany (7000). If we compare this data with those of the previous section, we may calculate the average number of employees per enterprise. While in the Netherlands there are on average less than 2 employees per enterprise in the IWT sector, this number is over 7 in Germany. In France there are about 2.6 employees per enterprise. This may indicate that German enterprises include more than the bare waterway transport, for example some land-bound activities such as logistics or planning.

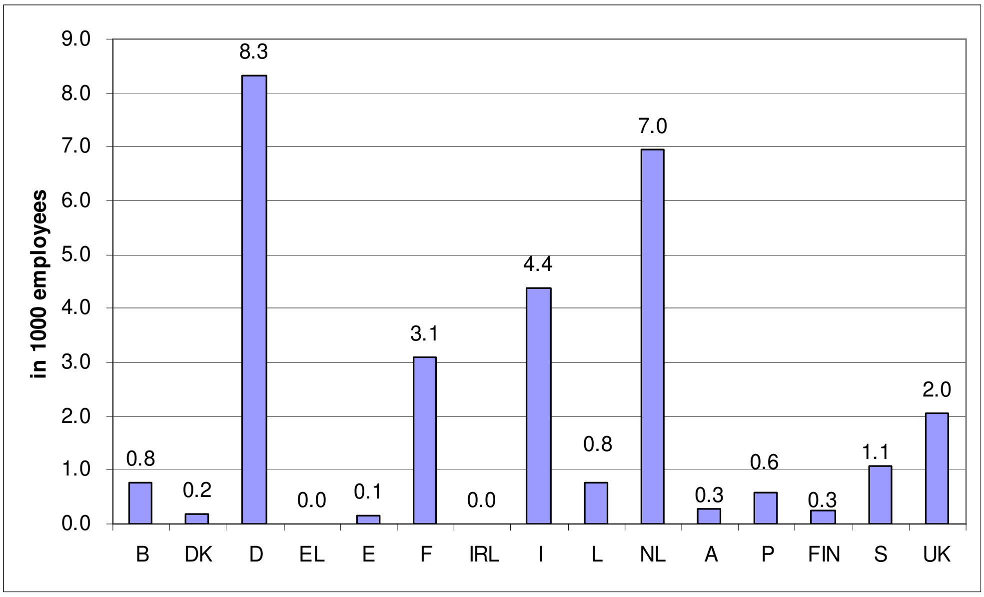


Figure 10. Inland waterway transport - Employment, 2000
Source: European Commission (Energy and Transport in Figures 2003, Table 3.1.5)

Germany

Figure 11 shows how the number of employees in Germany has declined steadily in the period 1992-2001, with only one minor intermediate rise in the year 2000.

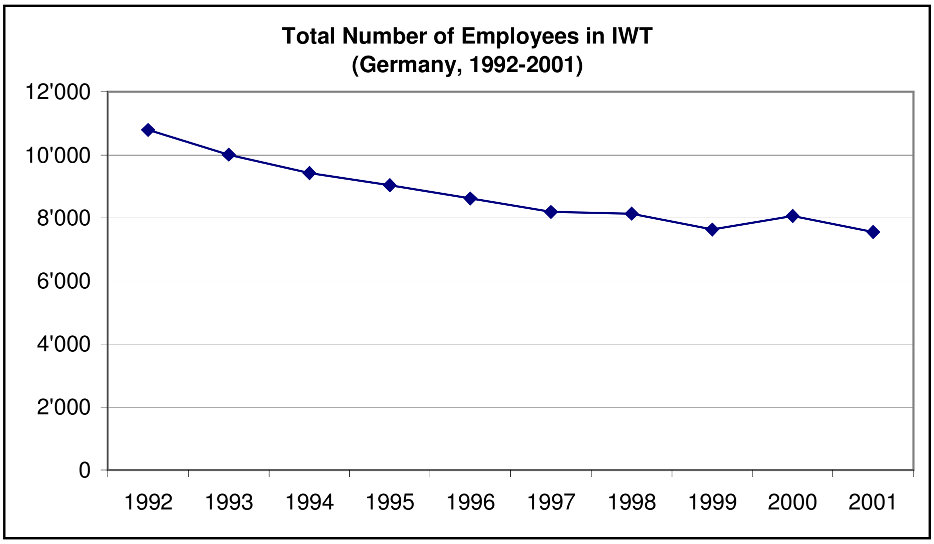


Figure 11. Development of the number of employees in German IWT enterprises
Source: destatis (time series from different volumes of 'Verkehr – Binnenschifffahrt Fachserie 8 Reihe 4')

The Netherlands

For the Netherlands, more detailed structural data is available.

The CBS states for 2000 there were 12.791 (full time equivalents) people active in IWT but older figures are lacking. 'Bureau Voorlichting Binnenvaart' estimates 15.000 jobs for 2001, which would be to the high side. In Figure 12 you can see the division of employees in different types of IWT (bulk ships, tanker, pushing barges and passenger ships). Whereas employment in the dry bulk sector has been decreased in the last years, employment in tanker shipping has risen.

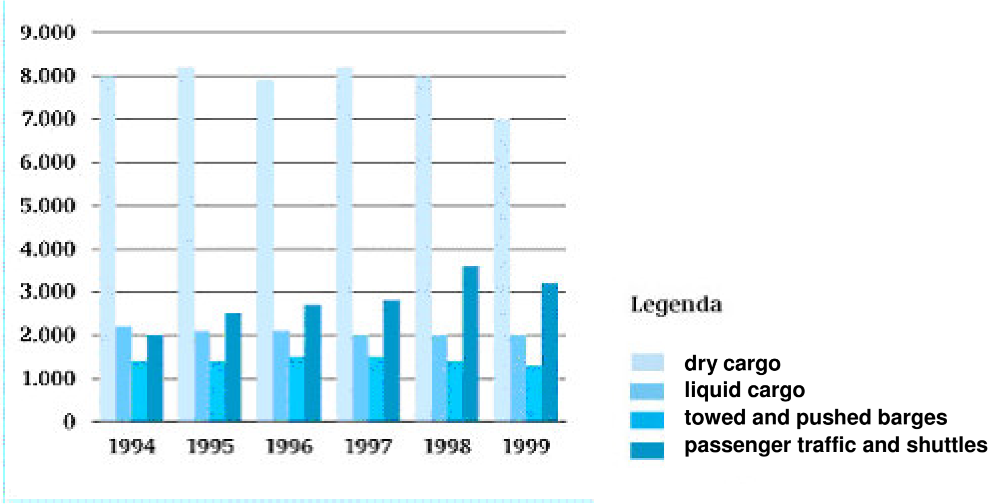


Figure 12. Development of employees in IWT (NL), Centraal Bureau voor de Statistiek 2001

Figure 13 shows the number of enterprises, broken down by the number of employees, in the years 1993 to 1998. Quite comparably to developments in Germany, a steady decline of the number of enterprises has taken place since 1993. The data also shows that whilst the number of single employee enterprises was considerably reduced, the share of enterprises with 1 to 4 employees actually grew. The proportion of enterprises with more than 4 employees is very small and remained relatively constant over the time span analysed.

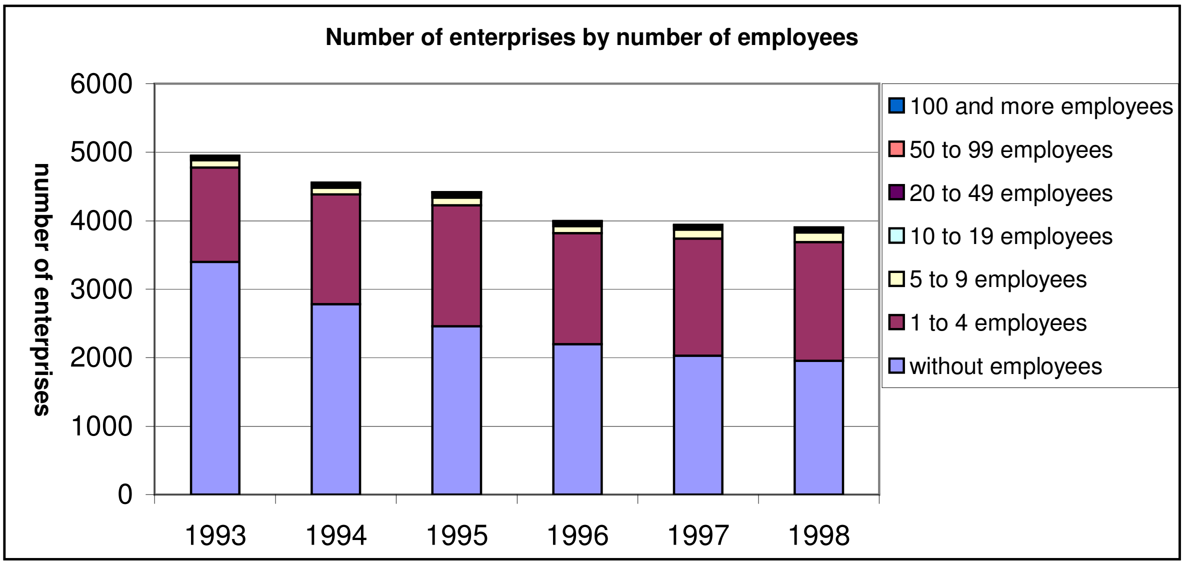


Figure 13. Development of number of enterprises by number of employees in the Netherlands
Source: National statistics of the Netherlands (http://www.cbs.nl/)

Finally, it may be of interest that in 1988 about 85% of IWT employees in Germany and 91% in the Netherlands worked on board the vessels, leaving about 1500 employees in each country to deal with land work, e.g. logistics etc.

Belgium

From the database in Belgium we can see the different shares of employees working in companies which have inland navigation for principal activity and those working in companies which have a related principal activity with inland navigation. There are much more employees and workers in IWT related jobs than employees and workers on ships. However, looking on the number of companies it is the opposite. This is because of the huge number of family sized companies not only in Belgium but in the whole West European IWT.

1. Companies with inland navigation as main activity

	workers	employees	Total	number of companies
1993	1187	200	1387	178
1994	1125	138	1263	166
1995	1105	136	1241	n.a.
1996	1060	104	1164	175
1997	975	104	1079	164
1998	886	98	984	170
1999	820	96	916	167

2. Companies with main activity related to inland navigation

	workers	employees	Total	number of companies
1993	638	3975	4613	83
1994	609	4090	4699	89
1995	592	4065	4657	93
1996	550	3761	4311	58
1997	527	3000	3527	50
1998	566	2977	3543	53
1999	581	2933	3514	57

Table 3. Employment in inland navigation in Belgium

Accession countries

The employment figures below were obtained from Eurostat. However, Eurostat declines to guarantee for the quality of this data, which indeed does not appear to be totally consistent. Nevertheless, the data indicate a continued decline in employment also in Eastern European countries.

	CZ	HU	PL	RO	SK
1993	3220	n.a.	2200	n.a.	2476
1994	2958	n.a.	n.a.	n.a.	2132
1995	826	n.a.	1665	n.a.	2099
1996	578	2287	1680	5752	1952
1997	471	2250	1494	5310	1815
1998	481	1971	974	4520	1654
1999	599	2205	672	4370	1562
2000	712	1966	768	n.a.	1406

Figure 14. Employment in inland navigation in selected Accession Countries
Source: Common Questionnaire (through Eurostat)

2.5 Economic indicators of IWT enterprises

As remarked in the introduction part of this deliverable, economic indicators for IWT enterprises are mostly not available. For this reason the information of the Common Questionnaire is of high interest. As reported in Energy and Transport in Figures (European Commission), the following annual turnovers were achieved in the IWT sector of the different countries in the year 2000 (see Figure 16).

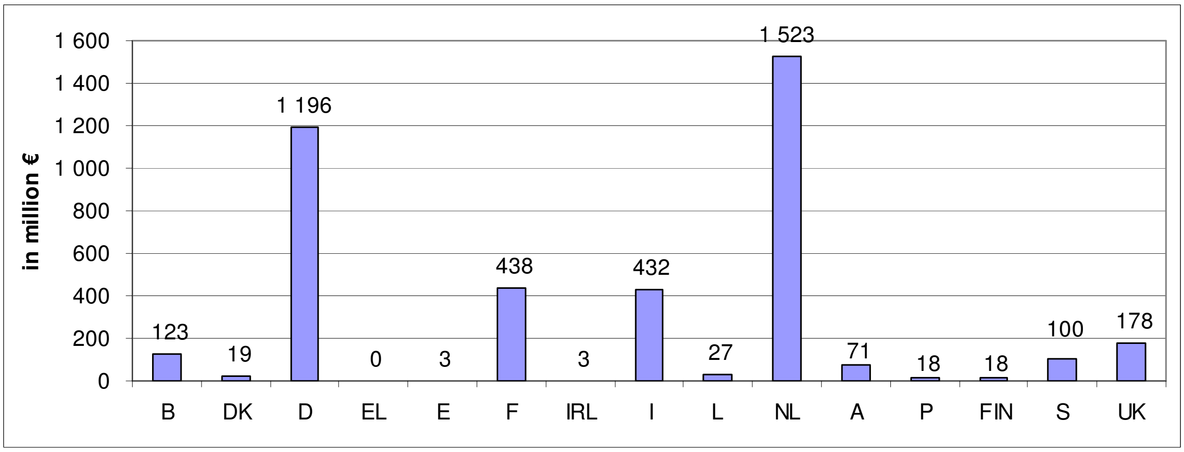


Figure 15. Inland waterway transport - Turnover 2000
Source: European Commission (Energy and Transport in Figures 2003, Table 3.1.9)

As would be expected, the highest annual turnover was recorded in Germany, the Netherlands and France. At first sight it is surprising that the annual turnover in Germany (€1.2bn) is even lower than that in the Netherlands (€1.5bn), although the transport performance in Germany is one third higher. The reason is that all enterprise related data are compiled according to the nationality of the company - regardless of whether the work has been performed domestically or abroad.- whilst transport performance data are normally produced according to the territorial principle (movements of good within a country's territory, whether carried by domestic or by foreign vessels). A major part of the performance of the Dutch fleet takes place outside the Netherlands, which explains the high turnover of the Dutch IWT sector.

The reported 432 million € of annual turnover of the Italian IWT sector is confusing. It is likely that this figure includes also coastal transport and probably even short sea shipping.

According to German data on the development of annual turnover in IWT, shown in Figure 14, the turnover reached the DM 2.5bn (€ 1.2bn) mark in 2001. A decline at the beginning of the 90s was reversed in 1996. Note that in 1994 the national system of tariffs was abolished, followed by a drop in freight rates. Turnover slowly picked up slowly at first and bounced back in 1999. Note that the German figure for the year 1999 (DM2bn; ~€1bn) differs from the annual turnover reported in the EU Energy and Transport in Figures (€ 1.365bn).

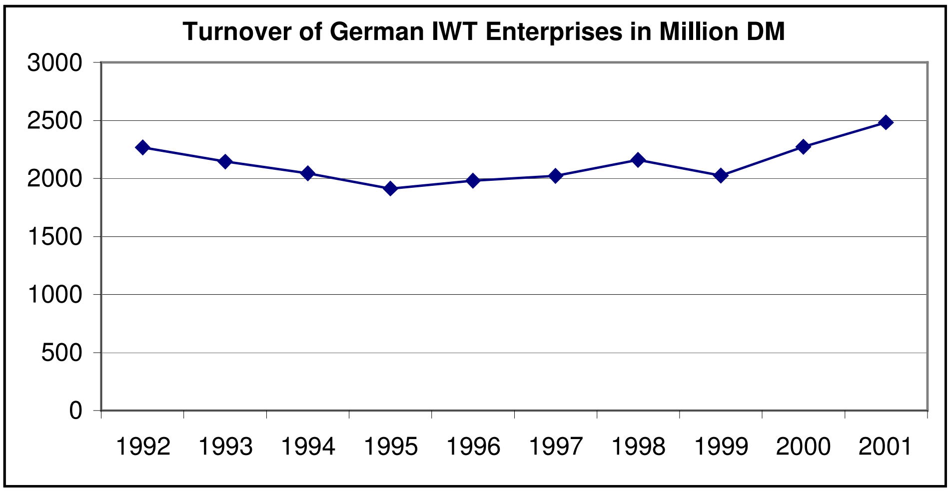


Figure 16. Development of turnover of German IWT enterprises 1992-2001
Source: destatis (time series form different volumes of 'Verkehr – Binnenschifffahrt Fachserie 8 Reihe 4'). Note: since 1999 turnover of the present year, before 1998: turnover of the previous year

As indicated by the French transport statistics service[6] the total turnover of IWT enterprises amounted to € 416 m in the year 2001. The turnover gained by transport alone was about € 384 m (2001). From our questionnaire to national authorities we got from France the following information:

turnover	€ 152,7 m
maintenance of the fleet in 2000	€ 9,5 m
benefit ('marge')	€ 3,8 m
investments	€ 20,0 m

2.6 Conclusions

The IWT industry has undergone a decade of major changes leading to a reduction in the number of enterprises, vessels and employment in virtually all countries. Mergers of smaller companies and owner-operators on the one side and split up of larger companies into smaller parts on the other side, in particular in the Accession Countries, characterise the picture with no leading trend in sight.

The employment situation is also changing. Enterprises face a serious shortage of qualified crew staff (to be treated further in the human resources chapter). Owner-operators in the present EU Member States have problems to organise and maintain a reasonable family life.

---

[6] www.transports.equipement.gouv.fr

The employment and human resources aspects are further dealt with in chapter 3, legal aspects regarding manning requirements and social standards are discussed.

Judgements on the financial situation of enterprises are hardly possible, with only data on turnover published. Freight rates indeed dropped in the course of deregulation and liberalisation, but as indicated for Germany, turnover is now growing in a market, which has progressively got rid of overcapacities.

A major effort needs to be made by the soon to be enlarged European Union to relaunch the abandoned market observation system and to extend it into the Accession Countries. This way, changes in a sector, still rather vulnerable, can effectively be made transparent and forthcoming crises can be better understood and tackled.

Chapter 3 Human resources

3.1 Introduction

The existence of sufficient and well-qualified personnel is necessary to operate and ensure a safe navigation of a ship. The development within the last years however shows that the number of 'domestic' employees tends to decline, above all within the Rhine corridor. In connection with this topic questions arise concerning e.g.:

- profile, sphere of work and attractiveness of inland navigation
- availability of qualified personnel
- transfer of personnel, e.g. to other professions
- migration of inland navigation personnel among European regions
- new generation and education or
- qualification of personnel coming from different countries

These questions and the questioning of experts that has been carried out indicate that apart from the presentation and analysis of employment figures the tasks should focus on the recording and analysing of backgrounds, structures and causes of the existing situation. That way it might be feasible to assess possible weak points and future developments to outline suitable approaches to problem solving.

3.2 Method of working

First of all, different information on employment, education and qualification within European inland navigation is analysed by making use of available European studies and statistics.

However, a higher importance will be probably attached to the interviews and discussions carried out with experts from different associations and organisation within various countries. They indeed significantly contributed to the collection of central facts as well as the assessment, structuring and weighting of individual results, which means the definition of central positions (emphases) within this chapter. Generally, the work is subdivided into the following three sections:

- Data on employment (section 3.3),
- Structures of employment (section 3.4) and
- Structures of education (section 3.5)

Section 3.3 ‘Data on employment’ mainly comprises the collection, analysis and evaluation of available statistics of different European countries as well as a questionnaire. The data basis however proved to be rather unsatisfactory. Statistics of the individual countries above all differ by non-homogenous definitions and delimitations, i.e. the existing data are often incomplete and non-comparable.

Section 3.4 ‘Structures of employment’ identifies and analysis backgrounds, structures and developments of the state of the art concerning employment within European inland navigation. Apart from the sphere of work and the work profiles within inland navigation aspects like migration, social matters as well as possible consequences of the present development are closely looked at.

Section 3.5 ‘Structures of education’ deals with the ‘nautical’ education as to inland navigation, with – topics of rising importance – the linguistic knowledge and the education covering EDP, telematics and commercial knowledge as well as the qualification of persons who are entering from other professions. Furthermore, questions regarding boatmaster’s certificates and the acceptance of patents obtained in other waterway areas are analysed.

3.3 Data on employment

Employment statistics

This section contains the results on employment figures within inland navigation based on different sources. Data are available for the listed countries only or have been gathered by the questionnaire. A significant lack of data can however be observed even for the mentioned countries making a differentiated analysis more difficult.

Problems within the national employment and fleet statistics result among others from the considerable changes within inland navigation. For instance, different measures are taken for inland navigation in Germany to lower the wage level and the social contributions, respectively or to introduce more favourable working regulations thus complicating the statistical recording:

- Some German inland navigation companies shift their main office to foreign countries (e.g. Luxembourg). Their employees, who are still working on vessels under German flag belong to a foreign company now and will no longer be considered in a German employment statistic.

- A German ship is registered in a foreign country (change of flag); if the main office of the shipping line remains in Germany the crewmembers though still being employed within German inland navigation work on a foreign vessel.

- A German ship is sold to the Netherlands or Belgium (change of owner and flag); the crewmembers of the former German owner stay on board and are now treated as employees of a foreign company.

These examples illustrate that inland navigation statistics for an individual country are severely affected by such procedures. A drop in the employment figures might be shown in the national statistics for example while it remains open how many of these employees are in fact unemployed and how many of them are just employees of companies with their main office abroad.

The general context however demonstrates that the impact on employment is less significant, since the ships, as the examples show, are still operating and the crewmembers usually remain employed. Therefore, it is sensible and necessary to shift the main emphasis of the analysis from the individual countries to a higher aggregated level. For this reason, this analysis like the total project attaches higher priority to a consideration of the corridors.

Against this background an attempt has been made to establish a table which offers a factual comparison of the figures among the individual countries. On account of the different definitions however which the country specific statistics have this aim could only be realised to a limited extent.

A comparison of the employment figures within different countries needs a coherent and consistent definition. In this connection the following aspects should be taken into consideration:

- Recording of employed and independent persons
- Inclusion of helping family members and relatives
- Harmonised decision whether
  - Only persons with permanent occupation or even with spare time occupation will be recorded
  - Only the personnel on board or also the land based personnel like service and management employees are included
  - Only cargo or even passenger transport is considered.
- Exclusion of public tasks which are not covered by the sector inland navigation e.g. waterway control authorities, waterway administration and waterway maintenance institutions.

The following table considers these aspects. It becomes evident that there are just a few figures available for several countries and moreover that it is not possible to completely illustrate the individual segments, e.g. for the nautical personnel in total or cargo or passenger transport in all. Nevertheless, the existing data are suitable to give an impression of the employment situation within inland navigation.

	Number of employees (nautical + land based) TOTAL			**Number of employees (nautical personnel only)**		
	Inland navigation TOTAL	**Cargo Transport**	**Passenger Transport**	**Inland navigation TOTAL**	**Cargo Transport**	**Passenger Transport**
Netherlands	15.023	11.389	3.634			
Germany	7.845	4.795	3.262	6.313	3.897	2.594
Belgium	2.246					
Switzerland				653	333	320
Slovakia	963			495		
Hungary	1.966					
Romania	3.300					
Poland	890	864	26	728	710	18
Czech Rep.	1.702					
France	3.420	1.843	1.577	2.912	1.591	1.321
Other Countr	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 4. Employment in the sector of Inland Navigation

Sources: Questionnaire Survey, National Statistics, Internet (www.mdcr.cz/text/rocenka_01/yearbook/index.htm; www.itb-info.be/fr/index.htm); Dr. Turek (Poland); Planco study 'Potenziale und Zukunft der deutschen Binnenschiffffahrt', 2. interim report, May 2003

Other sources deliver quite different employment figures, like for example the EU-Publication 'Energy and Transport in Figures[7]'. These discrepancies will not be evaluated here but rather emphasise the really difficult and inconsistent situation.

The above comments underline how fragmentary information on employees based on the public statistics as well as returned questionnaire are. In addition, the available information is often considerably unclear. Above all, a 'real' comparability of data among the countries is missing as a result of the different definitions.

---

[7] EU Commission: Energy and Transport in Figures, Statistical Pocketbook 2002. The figure of 4600 employees mentioned there for Italy in our opinion is clearly too high. It might be possible that this figure includes those employees within maritime navigation.

To cope with this disadvantage, a new calculation base has been developed in addition to the original workplan that deals with this problem of incomplete and inconsistent employment figures from another point of view and which will be outlined hereinafter.

Approach for approximation of employment figures

This approach indicates the nautical personnel of inland navigation (cargo transport). It starts with the national fleets and the respective (estimated) share of vessels per fleet actually being in operation and considers an average number of crewmembers per running vessel. Compared to the application of employment statistics this procedure benefits from the for all countries homogenous approach and the slightly more complete and homogeneous databases concerning the fleets. All crewmembers are recorded irrespective of their nationality.

A differentiated analysis is necessary for the quota and the input data to be taken based on the existing typical conditions for each country/fleet.

The following decisive factors should be covered by such an analysis:

- Number of the actually operating ships within a fleet
- Operating area (corridor, length of the stretches, navigation on canals and rivers)
- Ship type
- Ship size
- Owner (independent ship owner, shipping company)
- Number of days the ship is operating per year
- Daily operating time
- Manning rules (operating modus)

The above determinants are partly interdependent and decisively influence the number of crewmembers.

In order to first of all demonstrate the function the presented approach requires just simple and hardly differentiated premises. As far as information and assessments have been available they were integrated into this calculation approach, e.g. different quota as regards the share of the active fleets for east and west European countries of varying fleet structures (e.g. pushed trains versus self-propelled motor vessels). Discussions with experts confirm that it is quite reasonable to base this calculation model on this differentiation in order to be able to generate comparable results[8].

The following figure outlines the procedure the calculation model is based on.

---

[8] As far as this calculation model uses public statistics (e.g. fleet figures) its quality depends on that of the input statistics. Therefore these basic statics have to be improved, e.g. harmonized and updated.

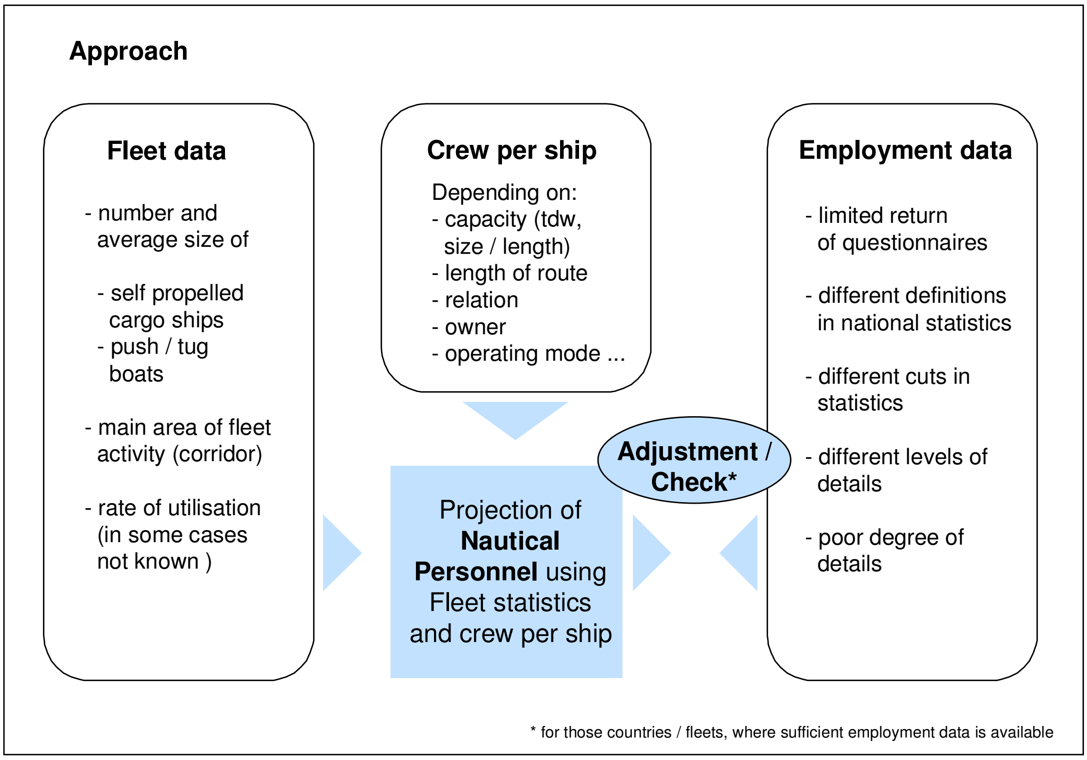


Figure 17. Projection of nautical personnel using fleet information

An exemplary calculation basing on this approach has been carried out for all countries and corridors. This model calculation assumes – country-specific – certain premises regarding:

- Share of ships actually operating in the total fleet (elimination of idle within the calculation) as well as
- Number of crew members per operating vessel.

In the course of the carried out first exemplary calculation the nautical personnel in the inland navigation of the whole investigation area has been estimated to 35,000 persons. From this about 23,000 belong to the Rhine corridor, about 5,000 to the South-East corridor, 3,000 to the East-West corridor and about 4,000 to the North-South corridor. Although these figures are not yet comprehensible data, but just a first approximation, they already can give an impression about the magnitude of the number of employment in the different corridors. As far as the input data (information about the fleets and their share of vessels being in operation as well as crews) could be provided in sufficient differentiation in the future, it can be assumed that this model is suitable in order to generate a really useful estimation for the number of nautical personnel in inland navigation. Not only in this context but also for the analysis of fleet structures (see chapter 4 on fleets), uniform and complete fleet statistics all over Europe are a vital precondition.

3.4 Structures of employment

Labour environment and - profile in inland navigation

Environment and profile of a profession is characterised by several parameters. These are, among others:

- earning possibilities (chances);
- image;
- physical workload / stress;
- leisure-time and;
- compatibility with family, friends etc.

From the view of the employees the attractiveness of a profession depends on a positive and/or optimal characteristic of the individual parameters as far as possible. In the past there was a steady growth in the variety of professions. At the same time also the frame conditions partially clearly changed, for instance in terms of shorter work times and increasing leisure requirements.

Within inland navigation different activities with different characteristics and requirements are to be found. While activities ashore, for example in shipping companies, in many criteria are comparable with those of other professions, the work of the nautical personnel is characterised by various inland navigation-specific characteristics. At first it is to differentiate between passenger and freight transport. Beyond that passenger shipping has to be divided into cruising passenger ships (hotel ships), which are predominantly supraregional in service, and excursion ships, which above all are regionally used.

The excursion ships offer relatively regulated work times due to the rather regional employment and allow in many cases the retention of a firm residence and a quite high level of compatibility of profession requirements and those of family and friends. The share of female personnel, particularly for service etc. is, accordingly, higher than in freight transports. Since this segment of inland navigation can be considered as less critical particularly with regard to crew aspects the discussion will not be deepened in this context.

Cruising passenger ships are more often supraregional and transnational used than excursion ships. The employment of the personnel can principally be realised in different forms: Either the personnel remain on board during the entire journey, or an exchange of personnel could take place during the journey. Even if these ships are usually used according to a time schedule, the compatibility of the work with the family as well as leisure-time facilities is clearly more limited due to longer absence from home than in the case of excursion shipping.

The largest restrictions however usually arise in freight transport. Apart from a relatively limited share of local or regional transportation, which allow a quite high degree of compatibility with family and social activities (for example transportation of building material), freight transport in inland navigation is predominantly supraregional and in many cases international. Besides a limited share of regular transportation, for example with containers, a large part of these transports is carried out by demand. The consequences are not only, that the crews are permanently away from home on business, but furthermore usually just have the possibility to make short term plannings with regard to their leisure time. Because of this and in the context of frequently long working times for people employed in this field of inland navigation a private life in the sense as it is possible for persons employed in other professions is not possible or only in a reduced manner.

Thus these frame conditions of course represent - in particular compared with other competing professions - substantial disadvantages of the profession of ‘able crewman’. Principally these disadvantages could be compensated with other positive boundary conditions in the sector of inland navigation, for example positive image, good earning possibilities as well as good social standards (e.g. regarding health insurance and pension schemes etc.). But, however - as demonstrated elsewhere - in inland navigation often just these conditions are not or only insufficiently fulfilled. Thus, after some time in the sector of inland navigation many employees shift to other professions, for example in connection with the establishment of a family.

Due to the already mentioned frame conditions, for several young people the interest in the profession of an able crewman is limited already at the time of the profession choice, so that the trainee numbers tend to sink in several countries. In several cases the traditional generation sequence which above all is quite popular in the families of private ship's owners in the West is interrupted. On the other hand, in Germany an increase of the trainee numbers has been observed in the past years due to a national promotion program - supported by attractive wage conditions - after years of decreasing trainee numbers. In several cases the interest was even higher than the number of training vacancies. This example shows, that chances and potentials to break the trend exist, if suitable strategies and attractive incentives are provided.

Despite a progress in productivity, e.g. due to (on the average) increasingly larger ship units and the associated possibilities of personnel reduction (in relation to the transport quantity), altogether personnel bottlenecks remain. These are typically caused by a drift to other sectors and a simultaneous (at least temporary) lack of trainees in the sector of inland navigation in several countries.

Previous Developments

Principally the problem of the lack of (domestic) personnel is similar in the different European countries. Nevertheless differences remain between the individual countries depending on the characteristics of the different parameters in the individual countries.

The lack of personnel for example in Germany is substantially stronger than in the Netherlands, where image and career profile as well as economic frame conditions in inland navigation are substantially more positive than in Germany. By example, a couple of characteristic figures are represented in the following. While in the Netherlands the number of the persons employed in the goods transport by inland navigation from 1995 (11,776 persons employed) sank only around approximately 3% until 1998 (11,389 persons employed). The number of employees in the goods transport in German inland navigation in 1995 (5,858) sank around 14% until 1998 (5,018), and from 1985 to 2000 even around approximately 46%[9].

Apart from the number of employees above all the age structure of the persons employed is of great importance. By example, the age structure is demonstrated in the following example of German inland navigation (goods transport; nautical personnel only). The youngest age groups have the smallest employment figures (caused among others by low education figures during the 1990s), while the group of employees in the age between 51 and 60 years is the largest group with almost 30%. Reaching a rate of 45% the situation is even more extreme with the captains.

Share of age group (Years)	**up to 20 (%)**	**21 – 30 (%)**	**31 – 40 (%)**	**41 – 50 (%)**	**51 – 60 (%)**	**above 60 (%)**
Nautical Personnel (totally)	9	13	19	23	29	6
of which captains (masters)	0	2	14	27	45	11
of which ‘enlisted’ crew members e.g helmsmen, boatsmen, machinists etc.	2	20	27	24	23	4

Table 1. *Age structure of nautical personnel in German companies in the sector of inland navigation (freight transport; Dec. 2002)*
Source: Arbeitgeberverband der deutschen Binnenschiffahrt e.V. (Employers' association of German inland navigation) in: ‘Potentiale und Zukunft der deutschen Binnenschiffahrt’, Planco, Essen 2003; Sample of answering enterprises without projection, base = 1.147

Due to this age structure an intensified decrease of domestic personnel has to be expected in the German inland navigation in the coming years. The above-mentioned Planco study expects this decrease to be around 120 employees p.a., of which approximately 40 captains and/or ship owners. On the other hand there will be only approximately 80 newcomers p.a., from which a part will change into sectors ashore during or after the education, so that an annual gap of at least 60 workers will remain.

---

[9] ‘Potentiale und Zukunft der deutschen Binnenschiffahrt’, Planco, 2nd Interim Report, Essen, May 2003

	1990	1991	1992	1993	1994	1995	1997	1998	1999	2000	2001
Number of apprentice-ships (total)	275	400	353	257	145	160	183	158	170	164	203
Number of newcomers per year	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	66	51	69	71	83

Table 5. Development of the number of trainees in the German inland navigaiton sector
Source: Arbeitgeberverband der deutschen Binnenschiffahrt e.V. (Employers' association of German inland navigation) in: 'Potentiale und Zukunft der deutschen Binnenschiffahrt', Planco, Essen 2003

Above all in the coming years the expected disproportionately high decrease of the number of captains is to classify as critical, since it is most difficult to replace these due to higher qualification requirements. Due to relatively small numbers of persons in the younger and 'middle' age groups a further intensification of this situation is to be expected in the future.

On the other hand it has to be taken into account that - as already mentioned - there are differences between the individual countries. In this context, the employment situation particularly in Germany cannot be classified as representative; insofar these conditions cannot be transferred in the same scale to other countries.

The situation is less difficult, for example, in the Netherlands, where the decrease in domestic employment is clearly smaller and the age structure is substantially more balanced than in Germany, as already mentioned. Therefore inland navigation in the Netherlands presently doesn't has to expect structural problems in this form and intensity as to be expected for the sector of inland navigation in Germany.

Investigations carried out within the scope of this study indicate that the employment situations of these two countries can be classified as extremes and that the situations of other inland navigation nations might be in the frame of this span. Thus only limited figures are known about structure and development of employment for the eastern countries. Discussions indicate that the structural problems of occupation in principally and in similar form, as already pointed out for the German inland navigation, apply also to at least some of the accession countries, e.g. Poland and the Czech republic. Even if in these countries the extent and temporal development of employment in inland navigation cannot be measured in detail, it has be assumed that also in these countries employment bottlenecks in the inland navigation will arise in the medium and long-term, too.

(Mechanisms of) labour related migration

In the past years the decrease of 'domestic' personnel in the inland navigation of the Rhine corridor was particularly balanced by the inflow of personnel from the accession countries, in particular Poland and the Czech Republic.

The reasons for this migration differ. The first is the decrease of importance of inland navigation in the accession countries as a consequence of political and economic upheavals to the beginning of the 90s and a release of a part of inland navigation personnel in these countries resulting from these developments. Beyond that wage differentials between the different countries and/or regions are a main reason.

Thus, the Planco study illustrates the labour costs for fictitious, three-person-crews (each of a high, middle and low qualification) in different groups of countries[10]. Therefore in West European countries like the Netherlands, Belgium and Germany labour costs for an appropriate crew lie approximately around the factor 3 to 4 over those of the corresponding values of Slovakia, Hungary or Poland. In Romania labour costs are again clearly under those in these countries and approximately around the factor 10 to 12 under the usual costs in Western Europe.

Due to the geographical location of their countries and waterways Polish and Czech inland navigators are frequently in operation in Germany and have traditionally a quite good knowledge of German language and waterways. Insofar it is obvious that a large share of the migrated personnel particularly came from these countries to Western Europe.

In the context of the accession to the European Union an inflow of further workers from the accession countries can take place into the existing EU countries due to the liberty of the job choice then occurring within the European Union[11]. On the other hand it is to expect, however, that the labour costs differences between ‘old’ and ‘new’ EU countries will continue to diminish in the future as already in the past decade. Thus in the future an important motivation for the migration from these countries might be dropped. Firstly this applies to Poland, the Czech republic, Hungary and Slovakia, whose European Union accession is intended for 2004.

Since presumably Romania and Bulgaria are to join the European Union not before 2007, labour costs differences between these two countries on the one hand and Western Europe as well as the accession countries Poland, Czech Republic, Hungary and Slovakia on the other hand, probably will attenuate much later[12]. Therefore up to then migration from Romania and Bulgaria into the aforementioned country groups might take place, while it might decrease thereafter again in the course of removing labour costs differences.

---

[10] ‘Potentiale und Zukunft der deutschen Binnenschiffahrt’, Planco, 2nd Interim Report, May 2003

[11] Concerning the free movement of workers in the sector of inland navigation see also Part C on policy and legislation, chapter 2

[12] However the question has to remain open, what time horizons are needed for an adaptation of wage levels and work conditions in the inland navigation of the accession countries of both groups (Poland, Czech Republic, Slovakia, Hungary on the one hand and Romania and Bulgaria on the other) to a western level. It can be assumed as sure that this will be no short-term process. According to an estimate of the European Transport Workers' Federation (ETF) it will take approximately a period of 25 years. This is based on the experiences from the likewise lengthy adjustment process in the context of the German reunification, which up to now did not yet lead to a complete harmonisation of wage levels and work conditions.

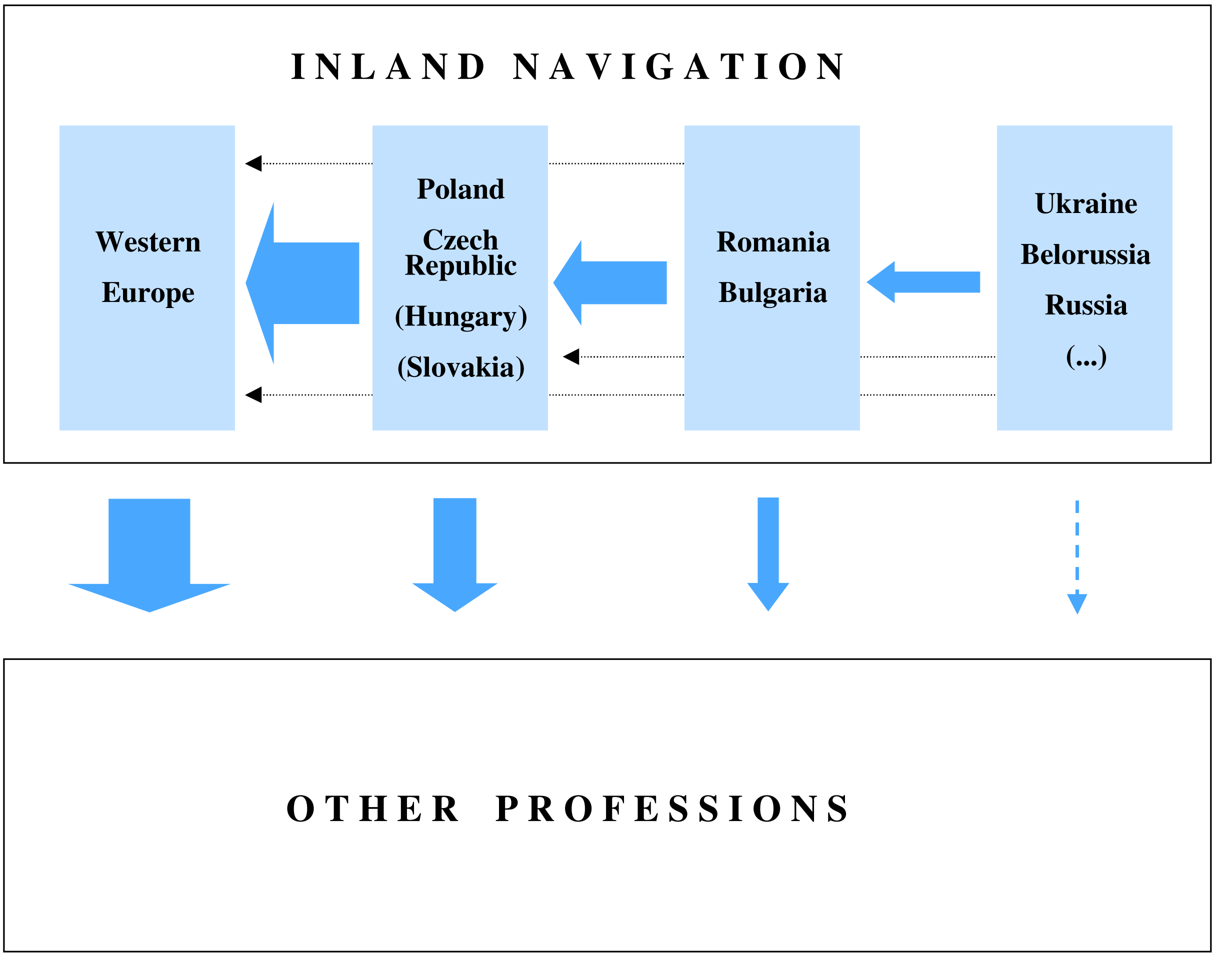


Figure 18. Structures of migration related to inland navigation

Further Developments

Apart from the migrations mentioned in many cases also a re-migration might occur in the future as a result of gradually approaching labour costs. For many employees in the inland navigation of the acceding countries lucrative employment possibilities in their native countries will arise after several years of foreign activity in the west, in many cases, however, in sectors outside of inland navigation, which offer better work conditions.

Since employees in the sector of inland navigation usually have a good qualification and frequently have good craft skills too, the potential employment spectrum for these persons is relatively wide. In this context also in the acceding countries drifts into other sectors are to be expected in the future and due to this personnel bottlenecks (related to the nautical personnel) in inland navigation. These risks are strengthened by the fact that the trainee numbers also in the acceding countries, for example in Poland and the Czech republic, are already on a very low level for years.

Therefore future migration movements from third countries (for example from the Ukraine, Belarus or Russia) into the 'old' and/or 'new' EU countries are not improbable.

Also in this case comparable mechanisms might apply like those specified before. By this a reduction of possible future personnel bottlenecks could take place. Appropriate political-legal basic conditions should have to be given, which permit employment of personnel from these countries in the (then extended) European Union. However at the moment it is still unclear whether, when and respectively to which extent such migrations might take place.

However, it cannot be excluded, that the personnel bottlenecks in the 'old' (and probably in the future also in the 'new') EU countries structurally could not be solved by migration, but mainly would be 'shifted to the east'.

Apart from the aspects specified so far further technological developments in inland navigation are to be expected in the future, which might affect the professional profile and the requirements to the personnel. These might be technical innovations, for example in connection with the controlling of the ship. Thus a further automation of the ship control, linked with an increasing utilisation of information and communication systems, is expected to become reality.

Such developments could cause, for example, that the emphasis of the crew activity more shifts toward 'monitoring'. Thus the extent of work could be reduced, while the responsibility of the individual activities could quite rise. Altogether the lack of qualified personnel could be reduced, as a smaller crew size can become possible in individual cases[13]. Therefore appropriate technical developments should be evaluated positively.

Social aspects

The above-mentioned structures and developments have various effects not least also with respect to social aspects. As already shown, the labour environment for nautical personnel in inland navigation in general cannot be widely harmonised with a regular private and/or family life, as it is natural in many other professions (among others) due to the continuous journeys. This applies to both domestic and foreign personnel as well. In addition, the social situation for foreign personnel from other countries is even more difficult.

As previously mentioned, there are linguistic shortcomings in many cases with already well-known consequences, for example communication problems and resulting from this the risk of misunderstandings and accidents. Besides, linguistic shortcomings contribute to many other problems in the social surrounding, like isolation and exclusion, which perhaps might be even worse. According to ETF in some cases the 'poor' background of foreign workers is misused as an argument for inferior labour conditions and low wages. For good and constructive working conditions, however it is quite important to create an atmosphere of mutual respect and treatment as well, irrespective of nationality, knowledge and qualification of the respective employees.

---

[13] CNR, 'Schiffe der Zukunft', Final Report to the Central Commission for Navigation on the Rhine, 2002

Regarding the question of attractiveness this profession might have for young people this of course also affects the relationship between instructor and apprentice on board.

Wages, as another crucial aspect, are handled quite differently depending on various conditions. As will be explained in more detail in chapter 4 on fleets, the payment for Czech or Polish crewmembers on board of German vessels in several cases already reaches the level of Western employees. On the other hand, it has been reported by ETF that in some cases wages of only € 1.50 per hour are paid e.g. to Ukrainian or Romanian workers[14]. Closely related to the wages is the field of labour contracts and social insurance for foreign (Eastern) employees. According to ETF often no fixed or just half-year or one-year contracts exist, causing a lot of job-hopping. Workers from Eastern Europe are sometimes only insured in case of accidents; in several cases and employers do not pay for social and pension insurance.

In general, it has to be stated that data and information in this context are quite difficult to obtain; in several cases no reliable or contradictory information exist. Even though they just offer a limited insight into this field, they demonstrate the large span of working conditions within the European inland navigation sector and their impacts on social aspects.

Connected to this field are questions of legal conditions and legislative harmonisation in the different countries, since they also influence the working conditions in practice. Further information on this aspect is provided in chapter 2 of Part C Policy and legislation.

Consequences

An exact estimation of the future development is hardly possible due to different uncertainties. As already shown there are a lot of evidences, however that there will be a lack of qualified (domestic) inland navigation personnel within both the countries of the present and the enlarged European Union in the coming years which will tend towards a further intensification. If no compensation takes place there will be the risk that the lack of qualified personnel might turn into a bottleneck factor possibly hindering the development of the European inland navigation potential.

According to CCNR[15] the increasing employment of non-domestic personnel furthermore tendentiously intensifies the danger of linguistic and communication shortcomings despite of the generally good technical qualification. This concerns both the communication of the individual crewmembers on a ship with one another and the communication among the captains of different ships.

---

[14] Irrespective of Western conditions, the equivalent of low 'Western wages' might be quite high for the Eastern employees and their families in their native countries like e.g. Romania or Ukrainia.

[15] CCNR: 'Schiffe der Zukunft', Final Report to the Central Commission for Navigation on the Rhine, Straßburg, 2002

Safety risks might appear which are expected to rise with the different enlargement steps of the European Union towards the East and the resulting increase in internationalisation of transports.

Against these background, active preventive measures should be looked for on European level[16]. This way we could prevent e.g. the transfer to other professions or even to achieve a change of the past trend as well as to improve the attractiveness of inland navigation so that e.g. the number of trainees could be increased noticeably and durably.

3.5 Structures of education

Vocational training within inland navigation

Introduction

Within the individual countries different education structures and systems exist concerning both the academic and the non-academic education. Education within inland navigation belongs to the non-academic education in almost all countries. Hungary, as an exception, requires an academic education for the master's grade see below (in former times of the socialist system more countries followed this principle).

Differences in the national vocational trainings (e.g. dual or not which means not only a theoretical (school) but also a practical (company related) education) do normally depend on the appropriate national vocational systems. Differences exist not only among the western systems with free market economy and the eastern systems (formerly socialist determined planned economy, later on transition process to free market economy) but also among the individual countries of the East and West.

Role of the River commissions

The duties of the river commission will be analysed above all in Part C on policy and legislation. Due to the considerable influence the commissions exert on matters of education though, selected aspects related to vocational training are roughly described here.

---

[16] An approach, for example, is the training initiative existing in German inland navigation for some years, due to those the trainee numbers in Germany is again rising for some years. Nevertheless only this measure cannot solve the problem by far; for that further efforts with further approaches would be necessary.

Within the 2 large waterway corridors Rhine and Danube important authorities exist, namely the Central Commission for Navigation on the Rhine (CCNR) and the Danube Commission (DC), whose range of authorisation regarding navigation on the particular waterways differs. The Central Commission for Navigation on the Rhine regulates navigational matters for the Rhine area and thus decisively contributes to a high harmonisation level for the navigation on the Rhine. This refers for instance to the granting of Master certificates, the technical safety regulations for ships or the manning rules.

In contrast with that the Danube Commission can only express recommendations which might be transferred into a binding national regulation or not. For that reason, different national solutions emerged in the Danube corridor to a larger extent than in the Rhine corridor.

The principle of mutual acceptance of national regulations is applied like for instance regarding the national vocational trainings or the relevant boatmaster´s certificates (likewise the same refers to the registration of vessels) without any need for a standardisation of these rules. That way a national patent ensures the claimed skills to navigate a vessel but different requirements might have to be met in the individual countries. For example a boatmaster´s certificate, granted on the basis of the Hungarian or Romanian regulations, is valid within all Danube countries. The fact that the requirements as far as the content is concerned may considerably differ does not play a role in this context.

A homogeneous manning rule like the Regulation for Navigation on the Rhine (RheinSchUO) is missing for the Danube area. The only exemption covers ships with other origin, e.g. from the Rhine corridor, (for those ships the national manning rules are applied within the Danube corridor).

Structure of the national vocational training within inland navigation

Several parts of the information on the structure of vocational education in the field of inland navigation are based on the studies RINAC[17] and ALSO DANUBE[18]. Further information has been provided and discussed with experts from different countries and corridors respectively. In the following at first general aspects are analysed; thereafter particular corridor related information is presented.

The duration of the vocational education usually varies between 2 and 4 years. In Belgium an education lasting up to 6 years is possible, depending on the grade of occupation. The required educational background is different as well in the individual countries. In most countries a secondary school certificate is required.

---

[17] River based Information, Navigation and Communication (RINAC), 4th Framework Programme.

[18] Advanced Logistic Solutions for the Danube Waterway (ALSO DANUBE).

Due to the different school systems this requires a school education of between 8 and 10 years, in Hungary even 12 years[19]. In several cases a minimum age is necessary as well. This mostly comes to 16 years; in Hungary however, the pre-entry condition is 18 years of age (only for the academic degree ‘ship officers in inland navigation’ as a prerequisite to obtain a master’s licence after the training of practical skills and passing appropriate examinations).

The different structures of the vocational training systems are also reflected in different ratio´s of the theoretical and the practical part (share of hours spent in service on board the ship). They vary from 15 – 20 % in Austria to practically oriented programmes as e.g. in Germany with approximately one-third theoretical education and two-thirds practical service on board (so called ‘dual system’).

The subjects of education can be subdivided into general and specific subjects. The general subjects usually comprise (in different extent) e.g. mathematics, (foreign) language, knowledge of material, basic knowledge of economics, mechanics etc.. The specific subjects in different extent refer to e.g. navigation, service on board, basics of radar and radiophone technology, electrotechnology, knowledge of waterways, vessels and ship technology, safety on board and first aid, introduction into data processing and RIS, cargo handling etc.. The examinations mostly cover both a theoretical and a practical part.

In principle, the examinations of this education level enables professionals to apply for certain further courses in the specific field of inland navigation. Examples are e.g.:

- Patents concerning the topography of certain river stretches,
- Radar,
- VHF radiophone,
- Handling of dangerous goods (ADN),
- Instructor courses or
- Management.

Besides of further practical experience, such courses are required in most of the countries in different extent and combination for higher professional qualifications as e.g. boatsman or ship´s master.

The most important result is that, despite of national differences in view of several international experts, there are no substantial quality differences within the national vocational education of inland navigation between the western (actual EU member states) and eastern states (candidates), for example regarding contents of curricula, duration of education or ratio of theory and practice. Accordingly, the required skills, which are necessary to safely operate inland vessels are provided in all cases irrespective of the country and the respective structure of education.

---

[19] Only for trainees for the master’s grade and ‘officers on inland ship’ respectively.

Furthermore, it is noticeable that vocational education in western countries (Rhine and North-South corridor) usually is quite practically orientated (‘business character’). Compared to the Danube countries theoretical training has a relatively lower importance in these countries.

In the Danube corridor educational standards in general have a high level. Partly for special qualifications it is possible to get an university degree like in Hungary; there are rather signs of overqualification than those of underqualification. To some extent the education still has a ‘military character’ with quite a high share of theory. This applies tendentious the more, the further eastern the respective country is situated. In some countries the contents of professional training are not or not completely well known on international level. In the Danube corridor no uniformly specified formal training criteria exist for the individual qualification stages. Only the boatmaster´s patent exists in all Danube states (with the respective national requirements). In that matter the principle of the mutual acknowledgement of national regulations for the respective training in the Danube corridor is applied.

The different structures in the individual countries are also reflected in the fact that (historically and politically caused) the degree of specialisation of the crews was partly quite high in the Danube corridor. Also the number of the crewmembers was tendentious higher than in the west.

In Poland and the Czech Republic (East-West corridor) good and practice-oriented training structures exist, having a similar level as ‘western standards’ have. The training standards in Poland, the Czech Republic as well as the former Eastern Germany were already early oriented to West German training standards, since ships of these countries traditionally have been operating in the west and still do so.

In the context of the transition of the former planned economies to market economies during the past years an approximation to western structures took place, even though there are still differences in these aspects in the different countries and a complete adjustment to western structures in most of the countries has not yet taken place[20].

Linguistic qualification

Already nowadays, the share of international transports within inland navigation is high but it will further rise after the EU enlargement. Against this background and the increasing use of foreign crews (migration) the knowledge of foreign languages is gaining in importance. Depending on the operating area different knowledge of foreign languages is required. The majority of the national vocational training programmes do however consider foreign languages but to a varying extent and intensity.

---

[20] However, according to the European Transport Workers´ Federation (ETF), in some cases the quality level of education tends to decline in the recent years. Also, besides the general fact of a good level of vocational education in the context of declining nautical personnel from ETF´s point of view a trend to hire lower qualified personnel comes up.

The existing linguistic deficits arising in every day practice and the resulting communication problems on the one hand among the crew members of individual vessels and on the other among the captains of different vessels need to be looked at very seriously. In many cases they are attributed to be the cause of (partly severe) accidents.

Due to Germany's geographic location and its importance within the Rhine corridor the German language is widespread as ordinary language which does not mean that it is the 'official language'. As the share of the Dutch ships is also steadily growing the Dutch language is often heard within the Rhine corridor, too.

Also on the Danube waterway there is no uniform or 'official' language. Most likely, as to standards for international transports the German language ('Danube-German') is to be found upstream and within Hungary and the Russian language downstream Hungary. Linguistic shortcomings tend to aggravate the farther the ships (crews) penetrate into 'foreign (linguistic) areas', (for example Danubian vessels / crews in the Rhine corridor or vice versa western vessels / crews on the lower Danube).

Within the East-West corridor linguistic shortcomings and the resulting effects are not that intensive than compared to the traffic between the Rhine and the Danube corridor or within the Danube corridor, respectively. The shares of cross-border transports between Germany and Poland and the Czech Republic have been comparatively high particularly for the Czech Republic and Poland since a long time. The major part of these transports are rather carried out by Czech and Polish companies and crews, respectively, than by German. For this reason, a lot of the Czech and Polish skippers traditionally have a quite good knowledge of the German language.

Within the North-South corridor linguistic shortcomings should be of minor importance due to a limited need for communication with foreign language areas. The main part of inland navigation is limited to the waterways of the corridor itself.

'Strategic' Questions

Beside the normal 'nautical' and ship-related education subjects additional 'strategic' aspects gain in importance. Experts attach high importance to them like for example indicated within the report 'Ships of the future'[21]. In the following some of those topics are listed:

- electronic data processing, telematics,
- education with regard to commercial matters, particularly for independent ship owners, etc.,
- possibilities for qualifications for persons coming from other sectors.

---

[21] 'Ships of the future', final report to the Central Commission for Navigation on the Rhine, Strasbourg, 2002.

In several countries topics like that are underrepresented within the traditional vocational trainings of inland navigation.

However, the individual aspects and countries differ. For example, the teaching programmes of the western countries but also of Poland and the Czech Republic normally already contain subjects like EDP[22] and telematics. The programmes within the Danube countries are also the subject of modernisation and improvements in recent times but complete and more detailed information are not available.

Against the background of this fast developing subject and considering the intramodal competition towards the other transport modes a deficit in know-how within inland navigation has to be avoided. Furthermore, the latest technical developments should be integrated into both the education and training programmes.

Education covering commercial subjects above all refers to the large number of independent ship owners within the western countries. It should be kept in mind however that many of the existing independent ship owners had been employed as skippers and became independent only after the liberalisation in the nineties by purchasing vessels from the shipping companies. Consequently, the major part of these independent ship owners has a lot to catch up on commercial education and knowledge. Logistic matters (integration of transports into transport chains, consideration of additional logistic components apart from the pure inland vessel transport, mainly concerning combined and intermodal transports) should be mentioned in this context too.

Taking into consideration the running restructuring process within the applicant countries a rising number of independent ship owners is to be expected also within these countries. The above mentioned statements in principle can be applied here as well. (Moreover the transition from planned to market economy should be considered for this group.)

The existing shortage in personnel within many European countries within inland navigation results in giving high importance to the education of persons who are coming in from other professions apart from the traditional vocational education. Up to now these offers are rather limited within this field.

Boatmaster´s certificates

The topic 'boatmaster's certificates' is dealt with in chapter 2 of Part C on Policy and legislation in detail. Since there is a close connection to aspects of employment and qualification selected issues are going to be roughly introduced already here.

Starting with the professional education there is the possibility to achieve further qualifications, which differ within various countries (for instance able seaman, boatsman, helmsman) up to the master´s certificate. Basic requirements have to be met during this

---

[22] Electronic Data Processing.

procedure, e.g. (for mutually accepted national boatmaster's certificate within the EU) minimum age, physical and mental suitability, professional experience and knowledge, for example as times spent on board and knowledge of waterway stretches. In case of radar supported navigation a special radar certificate needs to be proven.

Also for this kind of qualification it can be stated that the education in the West as well as in general also within the Czech Republic and in Poland is tending to a more practical orientation; compared to this education structures in the Danube corridor are more theoretical orientated.

The regulations for granting certificates and patents are stipulated by the Central Commission for Navigation on the Rhine, thus applying homogenous and binding rules for the Rhine corridor.

Within the Danube corridor the boatmaster´s certificate follows the national prerequisites. Though a vessel has to be operated by qualified personnel in terms of forms, there are however no binding standards for the requirements to be met as far as their content is concerned. Yet with regard to a boatmaster´s certificate there are dependencies in ship size and stretch related limitations which depend on the proven waterway stretch operations. The principle of mutual acceptance is valid here, too.

Against the background of the EU enlargement to the East questions as regards harmonisation of education structures and requirements as well as the mutual acceptance of boatmaster´s certificates considerably gain in importance. That applies the more as in the future an additional 'use' of crew members in 'non-domestic' waterway areas is to be expected, for example in the form of transports between the different countries and corridors, cabotage traffic within other countries and, as already discussed, concerning migration of inland navigation personnel.

Intensive efforts are to be noticed for years particularly within the two main corridors Rhine and Danube on part of the authorities (e.g. EU, CCNR, DC, etc) to adapt the present regulations to future requirements and standards. Above all, attention is focused on a mutual acceptance of patents and an alignment of education structures. In general, a skipper holding a certificate e.g. for the river Rhine can obtain the appropriate patent for the Danube section by an additional examination and proof of special waterway knowledge. Vice versa, in general this procedure is applied for a skipper with Danube certificate applying for a Rhine certificate. Thereby skippers normally benefit from the good professional (nautical) qualification.

Thus, the professional prerequisites allow many boatmasters to prove their qualification by additional tests, as long as the mutual acceptance is impossible. Nevertheless, skippers of the Danube countries are hampered by the low level of standardisation in the Danube corridor to obtain their Rhine certificate. In addition, they need to prove their 'fitness' (health certificate, for instance distinguishing of colours, etc) and their 'reliability'. According to present information there are no uniform standards existing within the Danube corridor but rather national rules, which however are not known in some cases at international level.

3.6 Conclusions

Within the scope of chapter 3 on Human Resources, various questions in relation to the personnel employed within inland navigation have been analysed. An overview on the employment situation of inland navigation within various European countries is given based on available national statistics. Due to the fragmental and non-homogenous data a separate approach for the estimation of the nautical personnel has been developed in addition to the original workplan. With this preliminary approach, a rough estimation has been carried out.

Based on several interviews with experts from different countries or corridors, respectively, backgrounds, structures and developments of the employment situation as well as education related aspects of European inland navigation were analysed.

The development in recent years (with differences in the different countries) has clearly tended towards a decline of ‘domestic’ personnel, especially within the Rhine corridor. Among the manifold causes the labour profile and the work conditions within the inland navigation sector play an important role. In several countries, also the number of trainees decreased in the past even though in Germany the number of trainees recently increased due to a national training initiative. Despite of a progress in productivity, leading to e.g. larger ship units and the chance for savings in personnel, in many cases a shortage in staff arose.

Up to now this shortage in personnel could be balanced by the entering of staff from the eastern EU accessing countries. In this context, the release of a part of the eastern personnel due to the transition process from former planned to market economy should be mentioned as well as differences in personnel costs among the western and eastern countries. Cost structures and their effects on migration considerably differ even among the eastern countries.

Since also the figures of vocational trainings dropped not only in various western countries but also in several eastern countries, e.g. Poland or the Czech Republic there is the risk that the shortage in personnel may turn out to be a bottleneck not only in western countries and hamper the development of inland navigation potentials.

Within the enlarged EU differences in wages are expected to diminish in the future so that on the one hand the previous migration stream might be reduced and on the other hand a re-migration of eastern personnel might start thereafter. Future migration movements to the ‘old’ and the ‘new’ EU countries from third countries (e.g. Russia, Belarus, Ukraine) seem to be rather probable. In this context, it should be pointed out that nowadays work conditions of foreign employees are worse in many cases compared to those of the domestic personnel. Social standards achieve an increasing relevance.

Though the ‘nautical’ education differs within the various countries e.g. concerning their share of theoretical and practical training they can however be compared in terms of ‘quality’. Therefore, no major problems should be expected from this.

Against the background of rising migration as well as an increasing share of international traffic between East and West shortcomings may occur (to a varying extent) mainly as regards linguistic skills and knowledge of foreign waterways, related to the question of mutual recognition of river patents and potentially increasing safety risks.

Additional qualification, like for instance in the field of EDP and economic education for inland navigation operators, often play a minor role up to now. But regarding the intermodal competition their significance will grow.

For the reduction of the mentioned shortcomings, different approaches are possible. Suggestions for this will be provided within the WP-s 6 (SWOT-Analysis) and 9 (Conclusions and recommendations).

3.7 References

1. Centraal Bureau voor de Rijn- en Binnenvaart, Kantor Binnenvaart: ‘Alle hens aan dek’, Onderzoek naar de personeelsproblematiek in de binnenvaart, study investigated by NEA, Rijswijk, September 2001
2. CCNR: ‘Schiffe der Zukunft’, Final Report to the Central Commission for Navigation on the Rhine, 2002
3. EU Commission: Energy and Transport in Figures, Statistical Pocketbook 2002
4. EU 4thFP Project RINAC (River based Inaformation, Navigation and Communication): Technical Report on WP9 – ‘Present training courses’ and Technical Report on WP11 – ‘Present certification’, 1997
5. EU 5thFP Project ALSO DANUBE (Advanced Logistic Solutions for Danube Waterway): Technical Report on WP5500 – ‘Impacts on workforce and training requirements’, 2003
6. European Economic and Social Committee: ‘Towards a pan-European system of inland waterway transport, Brussels, 2003
7. Interviews made with representatives of inland navigation branches, ministries, waterway authorities, labour unions, education centres etc.
8. PLANCO: ‘Potenziale und Zukunft der deutschen Binnenschiffffahrt’, 2. interim report, Essen, May 2003
9. ‘Rheinpatentverordnung’ and ‘Binnenschifferpatentverordnung’
10. www.ccnr-zkr.com

11. www.itb-info.be/fr/index.htm

12. www.mdcr.cz/text/rocenka_01/ yearbook/index.htm

Chapter 4 **Fleet**

4.1 Introduction

Inland navigation is a complex system consisting of numerous also very complex mutually dependent components. Main 'hardware' components of this system are waterways, bridges, locks, ports with their facilities and however, the fleet.

The performance abilities and competitiveness of inland navigation depend to a large extent on the fleet, which is used. In this respect, there are certain distinctive differences between particular corridors and sometimes even countries within the same corridor. To this first of all belong issues like fleet structure, capacity, state-of-the-art and equipment of the vessels.

In order to analyse and evaluate these essential issues it is not enough just to collect and show the figures dealing with the respective fleets. It is rather necessary to distinguish the fleets on the basis of technical parameters, potential performances and level of equipment influencing efficiency, competitiveness, reliability in service, traffic safety etc. In this case the interrelations of effects of different technical parameters are to be properly interpreted.

The technical and organisational parameters of the ships in operation are decisive factors concerning the competitiveness of inland navigation. They refer to both intermodal and intramodal competition. Above all, competition is determined by the costs, which are influenced by various parameters like those listed in the following:

- size and ship's capacity utilisation ratio
- draught or draught restrictions, respectively
- ship technology, equipment, age and condition of the ship
- flag, i.e. registration of the ship
- operator structure (independent ship owner or shipping line)
- operation modus, e.g. operation time of 14-, 18- or 24 hours as well as
- crew structure (number, qualification and nationality of the crewmembers)

In this chapter, also these structures and their effects on the costs of inland navigation are analysed. For this purpose the influence of fleet technology and market structures will be looked at. The cost structures are investigated with the help of selected ships. In this context it is of lower importance to reveal absolute figures than to identify the impacts which different parameters and their varying influences exert on costs (such as the wage level within different countries).

The given calculations serve as example. This means that the indicated figures may vary according to the existing circumstances and can even be altered.

4.2 Method of Working

A considerable sample of statistical data on national fleets has been collected and assessed. Comparisons were done in accordance with the ship types in different waterway corridors as well as selected elements of the fleet structure. On the basis of the available experiences as well as interviews with various experts and organisations an attempt was made to find out what kind of competition and safety related effects could result from these structural features. The mutual correlations among size, efficiency, age, equipment and safety aspects were assessed.

For the cost structure of the fleet, an analysis of relevant structures has been carried out. This comprises fleet technologies and general aspects of competition. Based on this, the reference ships as well as the relevant cost parameters were determined.

In spite of the difficult data situation, especially in this respect, several datasheets on costs and cost structures could be compiled. Experts in different countries have been contacted; in other cases data from existing investigations are identified and adopted. A questionnaire was used for data collection related to cost structures as well.

For the analysis of cost structures a two-step-approach was chosen. At first, an estimation of standby-costs and based on this, an estimation of operation costs of the respective vessels. With this approach selected examples, determined as representative as possible and representing different ships in different corridors in East and West were analysed. Thereby different parameters as mentioned in the introduction are taken into consideration. In some cases large varieties of costs appeared, e.g. concerning labour cost. In such a case several variants were calculated, in order to demonstrate the possible differences.

Interpreting the results, a first look to the effects on intermodal as well as on intramodal competition is included.

4.3 Ship types

There exist a variety of classification methods for floating objects used in inland navigation. Among others the most distinctive are:

1. According to the area of navigation:
    - River (canal) ships;
    - River-sea vessels (sea-going vessels properly equipped also for the operation in inland waterways);
    - Lakers (vessels designed and built to cope with specific conditions on the lake where they operate).
2. According to the dedicated purpose:
    - Commercial vessels including:
    - Cargo ships
    - Passenger ships for daily excursions or for cruising (equipped with cabins)
    - Technical floating objects (push boats, tugs, dredgers, floating cranes, floating docks, workboats etc.);
    - Pleasure crafts (motor or sailing yachts and boats, waterbikes, wind surfing-boards etc.);
    - Special ships (police, customs, survey, fire-fighting ships, icebreakers, military vessels, supply ships etc.).
3. According to the installed machinery (self-propelled and non-self-propelled vessels)
4. According to the kind of propulsion
5. According to the floating regime when running
6. According to the hull configuration (conventional monohulls, twin-hulls, trimarans)

However, there exist plenty of other classifications and sub-classifications based as for instance on: material of the hull, structural and hydrodynamic particulars, type of the prime-mover (engine), kind of commodity to be transported or type of service to be provided.

The classification used in PINE is adopted on the base of the purposes assigned to the vessels, and thereby the most attention was paid to river cargo vessels and barges. However, also the river-sea fleet and inland passenger vessels have been given appropriate place in the elaboration.

Ship standard sizes

The majority of inland navigation ship types are standardised in their main dimensions (however within certain tolerances). The lists and basic considerations on most typical sizes for self-propelled cargo ships and pushed barges including approximate tonnage capacities are given beneath. These vessel types/sizes have had peculiar developments within the politically and on many spots also physically divided network. Since the end of the cold war and especially after the opening of the Main-Danube Canal and the Danube confluence (South-East Corridor) joining the integrated European waterway network a number of these vessels have free access to other corridors too. More on these corridor-dependent developments and local particularities of the fleet units can be read in sections 4.4 – 'Fleet structure' and 4.5 – 'Interoperability'.

Self-propelled cargo ships

The variety of vessel sizes is caused by both the market requirements and the area of navigation. Larger shipment sizes, stable markets and favourable nautical conditions along the route – in inland navigation that practically means wide and deep rivers and canals with high bridges – set up general prerequisites for the operation of larger ships. But on the other side, larger ships cannot operate on smaller waterways if draught, width or air draft restrictions are excelled. That leaves an opportunity and need for a reasonable share of also smaller vessels in the fleet.

Vessel type	**Dimensions (L x B)**	**Tonnage capacity at a draught of**				
		1,50m	2,00m	2,50m	2,80m	3,50m
Large river motor ship	110,00 m x 11,40 m	600 t	1200 t	1800 t	2100 t	3000 t
Europe ship	85,00 m x 9,50 m	570 t	930 t	1350 t	-	-
'Johann Welker'**	80,00 m x 9,50 m	600 t	940 t	1280 t	-	-
'Gustav Koenigs' (extended)	80,00 m x 8,20 m	500 t	800 t	1100 t	-	-
'Gustav Koenigs'	67,00 m x 8,20 m	420 t	670 t	1000 t	-	-
'Kempenaar'	50,00 m x 6,60 m	400 t	600 t	650 t	-	-
Peniche	38,50 m x 5,00 m	250 t	300 t	400 t*	-	-
BM-500	56,50 m x 7,60 m	415 t	475 t	-	-	-

Table 6. Standard sizes of self-propelled river ships in Europe

**) with a maximum draught of 2.20 m*

***) names adopted in Germany, in other countries with high tradition in inland navigation similar size vessels are given other 'class notification' names*

There is another crucial aspect: the utilisation of carrying capacity of the fleet. The shipment size might not always be equal to the maximal carrying capacity of the ship at her draught allowed on the given circumstances, i.e. under actual nautical conditions along the route.

Eventually, in recent times the carrying capacity expressed in tons is not always and not the only decisive measure of ship's size class. With booming market of container transportation on the Rhine the standard size measure becomes always more and more the number of TEU (Twenty-foot Equivalent Unit) which can be stowed on board. Thus, as far as a container gross weight of one 20-feet unit might be in a range from about 2 tons (empty box) to about 24 tons (as maximally allowed for loaded 20-feet ISO-1 container) the weight capacity utilisation of a container ship could theoretically vary to a very large extent.

In recent times the sizes of some special ships exceed the values given in the above table (Table 6). More on that issue will be written in section 4.6 – 'Trends and developments'.

Pushed barges

The different barge size standards were developed in particular navigation areas matching the usual nautical conditions.

Barge type	**Dimensions (L x B)**	**Tonnage capacity at a draught of**				**Area of use**
		2,00m	2,50m	2,80m	4,00m	River or corridor
Europe Type I	70,00 m x 9,50 m	940 t	1240 t	-	-	Rhine, MLK
Europe Type II	76,50 m x 11,40 m	1250 t	1660 t	1850 t	-	Rhine, MLK, Danube
Europe Type IIa	76,50 m x 11,40 m*	1140 t	1530 t	1800 t	2800 t	Rhine
Europe Type IIb	76,50 m x 11,00 m	1100 t	1500 t			Danube
GSP-54	54,00 m x 11,00 m	900 t				Elbe, Oder
SP-65	65,00 m x 8,20 m	900 t				Elbe, Oder
SP-35	32,50 m x 8,20 m	415 t				Elbe, Oder
LASH**	18,70 m x 9,50 m	250 t	335 t	385 t		Weser, Rhine
See-Bee**	29,75 m x 10,70 m	490 t	640 t	730 t		Weser, Rhine
Interlichter**	38,25 m x 11,40 m	585 t	775 t	900 t		Danube
OBP-500	45,50 m x 9,60 m	480 t	-	-	-	Oder

Table 7. Standard sizes of pushed barges in Europe
**) increased depth*
***) various special barges for combined overseas transport aboard a sea-going mother-ship*

From Table 7 it is very obvious how nautical conditions in certain operation areas influence the size of vessels. Rhine and Danube barges are considerably larger than those designed for Elbe and Oder. Moreover, Elbe and Oder barges are constructed that way that their maximal allowed draught does not exceed 2 metres because the usual water depth on these rivers does not allow more loads.

Data sources and delimitations

The PINE work is focused on the commercial inland vessels for cargo transport. The analysis of river passenger ships is also included at a reasonable level. Numerous units of the so-called 'technical fleet' consisting of floating dredgers, cranes, vessels for supply and for waste discharge of other vessels, fire-fighting, police and survey ships as well as the fleet dedicated to recreational purposes are beyond the scope of this study.

The general data on the number of inland commercial vessels per country are based on the CCNR and DC statistics as well as on the available national statistics for those countries not covered by these two databases. In specific cases of France and Germany additional valuable sources were statistics of VNF (for France) and BDB (for Germany).

In total, it can be assessed that more than 20,000 commercial inland ships and barges are registered and allowed to navigate on the European waterways network. This number relates only to the PINE investigation area and does not include the considerable number of units in the European part of the ex-USSR (except part of the Ukrainian fleet registered on the Danube).

Additionally, a large fleet of about 2000 units of so-called river-sea ships operates in European waters and certain segments of the inland waterways network. This fleet is considered separately.

The vessels operating on isolated lakes are not included here due to several reasons. These are first of all the relatively small number of such units (likely less than 1%), and the fact that commercial cargo transports on European lakes are not usual.

4.4 Fleet structure

The pattern for the fleet presentation is based on the classification of types and data available in two main and most relevant sources – Rhine and Danube official statistics. Each of these sources covers (in more or less convenient extent, level of completion and trustworthiness) the national fleets of riparian countries. The entries for other countries within the PINE area are added so far the data were available at this stage.

Some countries are intentionally erased from the data tables due to the fact that they have no commercial inland navigation at all (Greece, Ireland, Estonia) and on the other side the countries covered by the already available Danube statistics, even though not officially integrated in PINE, are included (Croatia, Serbia, Moldova, Ukraine).

The following classification of ship types is adopted for the purpose of data presentation and analysis:

- self-propelled dry cargo vessels
- dry cargo towed barges
- dry cargo push barges
- self-propelled liquid cargo vessels (including gas and chemical tankers)
- liquid cargo towed barges
- liquid cargo push barges
- river tugs
- pusher-tugs (tugs with pushing equipment)
- river passenger vessels (daily excursion vessels and river cabin cruisers)

For each of the identified type the total number of units within the national fleets is given as well as the total and average capacity, total and average propulsion output and average age. In certain cases, the level of the available data requested an additional processing or a qualified estimation which were done on a reasonable level wherever feasible, taking care not to affect the consistency and reliability of genuine data and overall results.

The data tables for inland fleets are given in the Appendix – 'Inventory of fleets'.

Rhine fleet

Tables in Appendix contain data on all the ships and barges registered under the flags of the Rhine riparian states: Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland. In the statistical yearbook issued by the CCNR these fleets are called 'inland fleets' of the respective CCNR member states.

On the other side the customised term 'Rhine fleet' comprises the fleets of inland vessels licensed for the navigation on the Rhine in countries belonging to the 'Rhine' corridor: Belgium, parts of France, Germany, Luxembourg, the Netherlands and Switzerland. The figures from this statistic issued by the CCNR were also used in the corridor-based fleet analysis.

There exists a third interpretation of the meaning of 'Rhine fleet' (not considered in this analysis) based on the IVR statistics. This comprises all the vessels under any flag (including also nowadays numerous units from Poland, Czech Republic and Romania) which are allowed i.e. licensed, on the basis of their technical features, equipment and condition, to navigate on the Rhine River.

It has to be noted that in case of Switzerland and Luxembourg all national inland vessels are licensed for the navigation on Rhine.

In Belgium this statement is generally valid for cargo units and pushboats but not for tugs and especially not for passenger vessels. Namely just less than 10% of river passenger ships under Belgian flag are certified to operate on the Rhine. About 70% of Dutch and German national inland cargo fleets have the Rhine licence while the share of tugs, pushers and passenger vessels is for both countries at relatively low level – in rough order of magnitude between 10 and 20% for particular ship types. Finally the share of the French inland fleet on the Rhine is rather negligible – only about 6% of river cargo units possess the licence but none of tugs, pushers and passenger ships.

Size of the fleet and typical fleet units

Waterways in the Rhine corridor comply with much higher nautical standards than other waterways in Europe. These high standards, the strong economy of the region with correspondingly large transport demands and, in comparison with other corridors, generally much more favourable nautical conditions influenced the development of the appropriate fleet.

The fleet of self-propelled cargo vessels licensed to operate on the Rhine river and hence within the entire corridor is manifold bigger, both in number of units and in total carrying capacity, than all the corresponding fleets of all other corridors together, including non-integrated subsystems. Almost all sizes and types of self-propelled ships shown in Table 6 are present in the Rhine corridor. In recent years, the number of vessels exceeding 2500 tdw[23] increases, especially since the Rules of the CCNR in October 1996 left the possibility for single vessels on the Rhine to have a length of up to 135 m in operation between Rotterdam and Mannheim. This allowance has later been extended to the entire route up to Basle.

According to the available statistics[24] there are some 5500 dry cargo self-propelled ships licensed for the Rhine with an average capacity of about 1000 tdw and more than one thousand tankers with an average capacity of about 1500 tdw. Even though the barge pushing technology was mass applied on the Rhine very early (at the beginning of sixties, among the first in Europe) the size of the fleet of barges and push boats remained in moderate limits. The number of units of these types is not such superior to other corridors as for self-propelled vessels. Some 1100 pushed barges for dry cargo with an average unit capacity of about 2000 tons are nowadays certified for the service on Rhine.

---

[23] 'tdw' means 'tons-deadweight' and comprises the total carrying capacity of a ship: cargo ('payload') and effects (fuel, water, lubricants, crew, provisions). From the trader's point of view only cargo carrying capacity (payload) is relevant while from the technical and legal points of view only total carrying capacity is relevant characteristic of the ship. Namely, the loaded ship must not exceed her maximal allowed draught and if she will take more fuel and less payload or less fuel and more payload depends exclusively on the decision of skipper – any combination not exceeding the total capacity is technically and legally allowed.

---

[24] ‘Rhine fleet’ of the Rhine riparian countries, status end of 2000, figures not explicitly presented in the Appendix

The total number of tank barges and towing barges of both types (for dry and liquid cargoes) is relatively small. Eventually, about 200 push boats and 50 tugs are serving the fleet of non-motorised cargo vessels on Rhine.

Last but not least, a total of about 270 river passenger vessels including both large cabin cruisers with a length of 100 to 120 m able to accommodate up to about 200 passengers on longer cruising as well as ships dedicated and designed for daily excursions and sightseeing tours are certified for the Rhine navigation.

The most typical cargo ship on the Rhine and within the whole Rhine corridor has a length between 80 and 110 m, a beam of 9.5 to 11.4 m and a design draught that allows a loading of up to 2.8 m. There are however waterways within the corridor almost permanently allowing a 3.0 m draught or more but there are also smaller waterways with draught restrictions. The standard chamber size of the river and canal lock has a width of 12 m and usually a length to accommodate one coupling train[25] – a 110 m long cargo ship with pushing equipment on bows and accompanied pushed barge. There are also locks with larger chambers which allow a simultaneous locking of a four barges train including pusher as for instance the locks on the canalised upper Rhine.

Pushed barge trains consisting of up to six barges and having a total capacity of about 16.000 tons at favourable water depth conditions are to be seen primarily on the lower Rhine. Such six-barge trains are operated by large and powerful push boats having an output of up to about 4500 kW.

Performances

The Rhine vessels must fulfil the certain minimum of requirements strictly set up by the CCNR (Central Commission for the Navigation on the Rhine) regarding speed performances and manoeuvring abilities. These requirements relate to:

- minimum speed relative to the water in going ahead
- topping manoeuvre (ability to stop within certain distance)
- going astern (steering control when running astern
- change of course and
- turning

For instance, according to the CCNR all the vessels or pushed convoys licensed for the Rhine must be able to achieve at least 13 km/h relative to the water. Besides, the vessels should be able to stop on still water within a distance of 305 metres (ships and convoys having an overall length of less than 110 m) or within a distance of 350 metres (for vessels having more than 110 m in length). In running water and downstream navigation the prescribed distances are 480 and 550 metres, respectively. The starting speed is 13 km/h relative to the water. The maximum flow velocity is 1.5 m/s. The implementation of these

---

[25] German 'Koppelverband'.

rules for e.g. Germany and the Netherlands differs slightly as consequence of the different waterway conditions in these countries. The trial measurements in the Netherlands are carried out in deep and wide fairways with no or just a negligible current while in Germany they must be done in shallow, narrow and flowing water. Therefore, for example, the starting speed for the stop trials in the Netherlands is 18.4 km/h and extends until the backward motion with a speed of minus 1.5 m/s is achieved.

However, the Rhine corridor also comprises a lot of waterways apart from the river Rhine. Smaller ships, which do not comply with the CCNR certification are operating within this corridor. But that is rather an exception than a rule.

Age

The average age of dry-cargo self-propelled ships as the dominating vessel type on the Rhine was in the year 2000 about 46 years. Thereby German (50 years) and Dutch (47) ones were slightly older than average.

The second numerous fleet segment – self-propelled tankers – is generally much younger – 33 years on average.

The average age of push boats is about 40 years whereby the oldest are Dutch units (46 years). As far as Dutch push boats represent about 50% of the corridor’s push boat fleet their age the most influences the average statistics. German, Luxembourg and Swiss units having a total share of about 27% are on average about 30 years old. The fleet of pushed barges is in these relations pretty young with on average 26 years. French barges of the Rhine fleet (only 15 units) are with about 20 years the youngest.

Character

The fleet in the Rhine corridor is characterised by the dominating share of self-propelled vessels. Towing convoys disappeared although hundreds of towed (dumb) barges still exist in official statistics. Pushed convoys are in use mainly on the lower Rhine between the deep-sea ports of the North Sea and the industrial area of the Ruhr region.

With the exception of the recently built very large river ships having a breadth of much more than 11.45 m the self-propelled cargo vessels in the Rhine corridor are usually powered by a single conventional shaft propeller. Due to the relatively favourable fairway depths (in comparison to other three integrated corridors), the design draught of cargo vessels and barges is usually 2.8 m but it is often extended to 3.5 and even 4.0 m.

Despite of their remarkable age, the units in the corridor are generally very well maintained and pretty often modernised (e.g. new engines, nautical aids, communication and information exchange facilities, pollution avoidance measures) and thereby comply with the ever rising market, safety and environmental protection requirements.

The robust economy of the corridor with high transport demands and service quality requirements caused the development of various ship types specialised for certain cargoes. There are a number of dry cargo ships with cellular guides specialised for container transport, multi-deck Ro-Ro vessels exclusively designed and equipped for passenger car transportation (car-carrier), Ro-Ro vessels for transport of extraordinary heavy and voluminous single piece cargoes, oil tankers, chemical tankers, tankers for transport of gases etc. etc. From the point of view of versatility of the fleet the Rhine vessels outstand by far the units in any other European inland waterway corridor.

Danube fleet

There are ten Danube riparian countries and a few more not directly located on the river banks but geographically gravitating and therefore likely concerned for the Danube transport corridor and waterway potential. Out of these two countries in the upper river course – Germany[26] and Austria – are EU members, two in the middle course (Slovakia, Hungary) will join the Union in spring 2004 and further two in the lower part of the Danube (Romania, Bulgaria) are candidates likely to join in 2007. As the second biggest European river (after the Volga) and by far the biggest within the enlarged EU, the Danube together with its several large navigable tributaries and canals provides good preconditions for the development of a large, potential and peculiar river fleet.

Size

The prevailingly plain character of the Danube confluence in its middle and lower range and the economic model being applied in the most of the region till the recent political changes at the end of the eighties influenced the preference to be given to the state-owned shipping companies and not to the small private ‘one-ship’ companies like on the Rhine. With small exceptions these state companies used mostly the pushing and formerly and later occasionally the towing technology to transport bulk cargoes. Some 10 years ago, the share of cargo space on non-self-propelled units was even higher than 90% and in recent years (after 2000) seems to be reduced to about 75%.

Accounting both towed and pushed units there were more than 2650 dry cargo and some 330 tank barges at the end of 2000. A considerable number of towed barges (several hundreds) are re-equipped for pushing technology and not decommissioned yet.

---

[26] Due to the geographic location of Germany in the central Europe and the fact that three of the identified four waterway corridors lead through the country it is not possible to strictly distinguish parts of the national fleet assigned to the particular corridor. This relates to the German ‘Danube’ fleet since 1992 as well as to the fleet operating on the eastern part of the West-East Corridor since the unification of Germany (e.g. Elbe and Oder). It is especially difficult to define the German ‘Danube’ fleet since the single units operating on the Rhine and on the Danube are technically pretty similar.

Pushed barges differ in size and capacity and only after the mid of the seventies the new built pushed barges tend to comply with the recommended standard ‘Danube-Europe IIb’ type with an average capacity of between 1350 and 1500 t at a draught span between 2.3 and 2.5 m. This fleet of barges is operated by a correspondingly sized fleet of push boats, tugs and pusher-tugs. Latter were originally designed and built as tugs (to tow the barges) but later rebuilt and additionally equipped for pushing technology. In some Danube countries the large series of hybrid pusher-tugs have been even originally designed and built to operate upon the need either as pushers or as tugs.

Opposite to this, the self-propelled vessels fleet with only about 200 units, prevailingly assigned to dry cargo, is pretty modest. More than this, about 50% of the Danube corridor based self-propeller cargo ships is registered in two countries with at least very poor chances to join the EU within the predictable future – Serbia and Ukraine. With the exception of the relatively modern Ukrainian self-propelled ships, which correspond to the Rhine based GMS the average unit size of the rest of the Danube fleet is only about 900 tdw. However, this figure should not be directly compared with the average unit size in the Rhine corridor because in Belgium, Germany and especially in the Netherlands and France there are a large number of smaller waterways operated by smaller vessels and on the other side, the Danube corridor itself provides nautical conditions which generally allow the operation of large inland ships, anyway not smaller than those on the Rhine river.

Due to the relatively small sample, the large diversity of sizes, purposes and navigational areas (upper, middle and lower course of the river, as well as navigable tributaries and canals) it is not possible to define the most typical cargo vessel in the Danube corridor. On the other side, it might be said that typical push boat is a twin-screw unit totalling some 1500 to 1800 kW output which usually operates 4-6 barges in a train. There are, however, a certain number of large triple-screw push boats (in the rough order of magnitude of 15-25, it is not known how many of them are still operating as triple-screw units) corresponding to the largest units on the lower Rhine which are able to operate 9 or even more barges in a single formation but the demand for such large convoys became negligible in recent times.

Performances

Performances with regard to the minimal speed and manoeuvring abilities on the Danube are not prescribed but just recommended. For example, according to the recommendations of the Danube Commission, the ships and pushed convoys have to be able to achieve a speed of 12 km/h relative to the water and to stop within a distance of 200 metres if heading upstream or 600 metres if heading downstream. There is also a general rough rule that the ship running at full speed should be able to stop (relative to the water) at the distance equalling approximately three own lengths.

Age

The average age of the self-propelled Danube vessels varies between 18 years (Croatia, Ukraine) and 32 years (Slovakia, Moldova). With the exception of Germany, Austria, Serbia and Ukraine who had also self-propelled units in their Danube fleets before there is large deficit of this type of ships in the Corridor. Since about ten years ago the new established private ship operators on the Danube used to purchase second-hand vessels from the Rhine corridor and nowadays some 100 units aged on average about 25 years are registered in countries to become Union members in the near future (Slovakia, Hungary, Romania, Bulgaria).

The pushed barge fleet is on average less than 20 years old with the exception of Serbia and Croatia where the average age of units is more than 25 years because ex-Yugoslavia was the first country in the corridor which mass introduced pushing technology at the end of the sixties. Pushed barge fleets of Romania (735 units, on average 17 years old) and especially Ukraine (369 units, 12 years old) are by far the largest and youngest on the Danube.

Character

There are still a large number of obsolete towing barges (counting hundreds of units) still retained in operational status on the Danube. A large number of these vessels, especially in Hungary and Austria, have been reconstructed over recent decades. The deck structure on bows and stern has been altered, steering gear removed and deck devices installed (mooring winches) in order to enable the vessels to be used as pushed barges. But due to their usually weak structural elements and therefore insufficient strength, lower block coefficient and reduced cargo space due to the existence of the deckhouse for former crew accommodation, these vessels cannot match the efficiency of the modern originally designed pushed barges. But despite of all disadvantages, compared with the pushing system as e.g. higher resistance, considerably higher exploitation cost due to the presence of crew onboard, etc., towed convoys are still occasionally in operation, however, under certain circumstances. For instance, in periods of low waters on the upper and lower Danube course, when the allowed draught is less than 1.7 m on certain spots, barges (pushed or towed) can be just partially loaded, e.g. to the draught of 1.3 m but long range push boats with their draughts of 1.8 to 2.2 metres are useless. Under such conditions, the old tugboats with considerably lower draughts, very often less than 1.6 m and light loaded towed barges are still applicable. That is the main reason - however, besides the lack of funds for new buildings - why these vessel types still exists on the Danube in a large number.

The extremely low share of self-propelled vessels tends to increase in recent years. The ratio of available cargo capacity between self-propelled ships and barges changed from about 1:9 at the beginning of nineties to about 1:4 ten years later. This structural change of the fleet was realised through decommissioning of the old barges and purchase/transfer of the second-hand motor ships from the Rhine corridor. New built river cargo ships are very rare exceptions.

The typical design draught of Danube vessels is in the range from 2.3 to 2.5 meters and corresponds to the average nautical conditions in the corridor. Seasonal shallow water problems along certain stretches on all the segments of the river caused that the Danube self- propelled ships have often a twin-screw arrangement although the Rhine similar size vessels with similar output have usually just one propeller. The explanation for this difference is in average nautical conditions in two corridors. Due to economy reasons, it is quite usual under relatively deep-water conditions to prefer single-screw arrangement with a single engine. In case of a 'standard' 700 to 1000 kW ship with 11.4 m breadth and operating most of the time at a 2.5 m draught the single-screw arrangement is technically feasible (from hydrodynamic aspects) and also economically fully justified. But, if such a ship cannot be fully loaded due to the severe draught restrictions during longer periods of time, and is still expected to operate then, an economic operation might be achieved only with splitting up the propulsion power to two propellers. These propellers would be of considerably smaller diameter and therefore fully submerged also at much lower draughts of the ship. That is the main reason why a lot of Danube ships – almost all larger self-propeller units - have a twin-screw arrangement which is principally more expensive (higher capital costs, total fuel consumption, maintenance and repair) than the single-screw execution habitual on the Rhine.

Standard Danube pushed barges have a breadth of 11.0 m and not 11.4 as the corresponding Rhine barges. This discrepancy results from the different width allowance by passing the locks. The West-European standard allowance is 0.60 m (ships with 11.40 and even 11.45 m breadth are allowed to pass through the lock chamber with 12 m width) while the Danube allowance on the Iron Gates lock has been for many years 1.00 m and has officially not changed yet. As far as the Iron Gates chamber have a width of 34.0 m, convoys of three barges abreast having a breadth of 11.0 m each are allowed to pass. In practice there were a lot of passages of pushed trains (before 1992 once-twice a week) having a width of 33.4 m but the standard Danube barge breadth has remained 11.0 m.

Despite of its smaller beam, the Danube pushed barge of 'Europe II' size has practically the same cargo capacity as the 0.4 m wider Rhine barge at the same draught. To clarify this it is to know that Danube barges have a generally lower designed draught partly influencing the scantlings of the hull structural components. But the main reason is that Danube barges were mostly built during the period of planned economy in the region while in the same time Rhine barges were constructed in West-European yards where the rules of market economy are applied. These different economic systems set up different ratios between the partial value of the construction material (steel plates and profiles) and the value of work to build the barge (manpower). The use of thicker plates and stronger profiles enables a simplification of the hull structure and consequently, the realisation of savings on expensive manpower in the West. Therefore, the East-Europe built push barges with low-paid manpower and consequently irrelevant construction time appear to have an about 10-15% lower empty weight than those units constructed in Western Europe.

One of the distinctive facts about the Danube fleet nowadays is that the large number of vessels of any type, which appears in the national lists of registered units is neither in operation nor in stand-by. For some Danube countries the share of this passive fleet exceeds one third of the total. It is not always clear whether these units are just temporarily without licence to operate (a licence/certificate issued by responsible national authority on the basis of applied minimal technical and safety standards in the respective country or waterway segments) due to technical insufficiencies, or whether the ship is reported off-duty by her owner due to the lack of economic effects, or – the ship is decommissioned or scrapped but not reported as such to the corresponding authority.

Elbe/Odra Fleet

The fleet designed and built to operate on Elbe, Oder and accompanied waterway links is considerably smaller than those assigned to the Rhine and Danube corridors. The character of the fleet and main particulars of typical units is assessed on the basis of Polish and Czech statistics as well as the figures on German units registered in Elbe region, Berlin and Brandenburg.

Size of the fleet and typical fleet units

The total number of self-propelled inland cargo vessels (both tankers and dry-cargo) in Poland and Czech Republic was 172 at the end of the year 2000. The German fleet operating on Elbe, Oder and the surrounding waterways consisted of 568 cargo motor ships at the end of 1996 but in the meantime it is likely that this number is lower. The average deadweight of Polish ships is only about 450 tons. That is due to the unfavourable local navigable conditions of the Oder and the other Polish domestic waterways. Therefore, the typical design draught for Polish ships is only 1.6 m. German and Czech units are based prevailingly on the Elbe conditions and, with on average slightly more than 900 tons, are about twice as large.

The fleet of barges including both towed and pushed as well as dry and liquid cargo units totals to about 1900 vessels. Their average capacity just slightly exceeds 500 tons whereby in this segment there is no remarkable difference between the Oder and Elbe units. Considering the number and type of the distinctions of barges, tugs and push boats it seems that both towing and pushing technology are still applied.

Performances

It is not known if there are requirements or official recommendations providing the least performances of vessels assigned and licensed for the operation in this region. Anyway, it is likely to expect that good shipbuilding standards have been respected. This statement might be supported by the fact that a number of Czech, Polish and German ships registered in the confluences of Elbe and Oder have a Rhine certificate, i.e. allowance to operate on the Rhine too.

Age

The age of Czech self-propelled fleet is about 30 years. Figures for Polish vessels and segment of the German Elbe/Oder fleet are not known but it seems that these ships are considerably older than those under Czech flag.

Similar applies to the fleet of barges, tugs and pushers. Czech barges are on average only 18 years old and tugs and pushers about 23. Statistical data for likely older German and Polish units of these types are not available.

Character

The fleet is characterised by considerably smaller units than in the Rhine and Danube corridors. That is clearly understandable due to the unfavourable fairway conditions. Longer periods with extremely low waters on the Elbe and the Oder (other waterways in the West-East corridor are either canals or canalised rivers with water level fluctuations relatively under control) caused relatively small design draught of typical vessels. For the Elbe it is 2.0 to 2.3 m and for the Oder as low as only 1.5 to 1.6 m. Consequently, these ship size restrictions but also hydrodynamic effects of the navigation in extremely shallow waters influenced the average output of the units to be below those on the Danube and especially far below those on the Rhine. The average output of Polish ships, both self-propelled cargo vessels and pushers or tugs does not exceed about 250 kW. Czech cargo ships, used to operate on well constructed and maintained domestic waterways, the entire course of the Elbe river as well as along the Mittelland Canal towards the Rhine corridor, are considerably larger (on average more than 900 tdw) and correspondingly powered by about 420 kW (average output for the Czech fleet of self-propelled cargo ships).

Also German and Czech tugs and pushers operating prevailingly on the Elbe, are with about 350 kW generally more powerful than the average Polish units. In Germany, there is a fleet of smaller push boats and barges (SP-35 in Tab. 2) designed to operate on a dense network of smaller waterways between Elbe and Oder and in the area of Berlin (‘Märkische Wasserstraßen’).

The overall technical condition of the Czech fleet is assessed as good while Polish fleet does not comply with the highest West-European standards in all categories yet.

Seine-Rhône (North-South) relations fleet

The waterway network assigned to this corridor includes Seine, Rhône with Saône, rest of the French waterways (except Rhine and Mosel) and parts of the Belgian waterways. These waterways are only conditionally integrated into the common European IWW network because larger ships cannot pass over from the Rhine corridor as well as not change the operation area within the North-South Corridor itself, for instance between the Seine and Rhone. This makes the definition of Corridor specific fleet a little bit more complicated than for the other three Corridors.

In attempt to define the fleet to be assigned to the Corridor it was first of all assumed that this fleet consists prevailingly of the French and Belgian vessels not licensed for the operation on the Rhine. But as already stated before the share of Belgian cargo fleet not having the licence for the operation on Rhine is negligible. Moreover, also a number of smaller Dutch vessels might be included here but it was not done. The reason for conditional exclusion of small Dutch units is firstly that they are already assigned to the Rhine Corridor (as far as these ships operate prevailingly on small waterways within the wide area of the lower Rhine confluence in the Netherlands) and secondly, that it is not much likely that these small vessels from the Netherlands would call in considerable scope deeper into the North-South Corridor (towards French ports) due to the economy reasons (small ships on large distances). Finally, only the French national fleet is considered here as specific for the North-South Corridor. Even in the case that smaller Belgian and Dutch vessels would intensively operate in the northern part of the Corridor general character and conclusions being extracted on the basis of French fleet alone will not be false.

The first practical step towards the fleet definition was therefore to subtract the units of the Rhine fleet in France from the national inland fleet. The results are shown in Table 8. Further refinement of the classification of N-S Corridor fleet was made using the VNF[27] statistics of French national inland fleet sorted upon the specific areas of navigation. It has to be noted that VNF statistics covers the large majority but not all the waterways in France and therefore also not all the units operating on national waterways. Thus it may appear that the figures obtained from different sources (ZKR[28] and VNF) are not identical even though both sources are proven as very reliable and precise.

Size of the fleet and typical fleet units

Applying the above described calculation (source: ZKR statistics for 2000) the following figures resulted for the 'rest of French fleet':

Ship's type	N° of units	Total capacity [tdw]	Total output [kW]	Average capacity [tdw]	Average output [kW]
Dry-cargo ships	1028	476367	212266	463	206
Dry cargo towed barges	0				
Dry cargo pushed barges	596	562459		944	
Tankers (self-propelled)	68	47069	17296	692	254
Tank towed barges	0				
Tank pushed barges	64	90823		1419	

---

[27] Voies Navigables de France.

[28] Zentralkommission für die Rheinschiffahrt.

Ship's type	N° of units	Total capacity [tdw]	Total output [kW]	Average capacity [tdw]	Average output [kW]
River tugs	3		835		278
Pushboats	196		91481		467

Table 8. Units of the French inland fleet operating on waterways other than the Rhine

The total cargo capacity of this fleet is more than 1.1 million tdw, which considerably exceeds the fleet, assigned to the Elbe/Oder region. It is remarkable that the available cargo spaces on self-propelled and non-self-propelled units (pushed barges, according to statistics there are no towed barges in the French fleet) stay in the ratio about 1 to 1. Considering the average size of the units, it might be concluded that pushed convoys might operate only on the larger rivers, i.e. on Seine and Rhône/Saône. In contrary, it is likely that self-propelled vessels, due to their small average size of only about 500 tons, are in service overall on the French waterways.

It is remarkable too that French self-propelled units have on average a rather small output of only about 200 kW and that is lower compared to the appropriate ships of any of the other three integrated corridors. Eventually, due to the character of French waterways (large network with prevailingly lower ECE classes), it is likely that the standard deviation of the mean values is high. That would practically mean that there are local fleets of larger ships operating on Seine and Rhône, respectively, (eventually on Mosel too, but not entering the Rhine) and a number of pretty small vessels able to move almost everywhere through the network.

Statistics dealing with regional fleets operating on Seine and on Rhone/Saone show some peculiar characteristics. The Seine fleet consists of about 450 cargo units having in total some half million tons capacity. Thereby about 80 % of the Seine based fleet capacity are in pushed barges and about 90 % of all cargo units (including self-propelled ships) are for dry cargo. Rhone/Saone based pure inland fleet consist of 74 cargo units totalling to about 125000 tdw. About 50 % of this fleet are self-propelled cargo ships and about 85 % of the total available capacity is for dry cargo.

More selective information can be read from the VNF statistics. The following table shows the distribution of fleet cargo units in France upon the areas of navigation:

	Seine		Rhone/Saone		Other waterways in France	
Ship's type	N° of units	Total capacity [tdw]	N° of units	Total capacity [tdw]	N° of units	Total capacity [tdw]
Dry-cargo ships	87	77981	25	27785	862	324185
Dry cargo pushed barges	320	349700	35	72000	105	34185
Tankers (self-propelled)	7	11346	10	17560	33	11964
Tank pushed barges	32	60900	4	7356	3	1104

Table 9. Cargo units of the French inland fleet operating on Seine, Rhone/Saone and other (minor) national waterways

On the base of total capacities and numbers of ships it follows that the average vessel sizes on the Seine and the Rhone exceed 1000 tdw and 1600 tdw, respectively, and thereby are comparable with the large Rhine and Danube units. Dry cargo ships on Seine have an average size of about 900 tons, tankers of about 1600 tons, dry cargo barges some 1100 tons and tank barges about 1900 tons. Corresponding average figures on the Rhone/Saone waterway are about 1100 tons for dry cargo ships and 1700 tons for tankers as well as roughly about 2000 tons for barges, regardless if they are for dry or liquid cargo.

Thus in general, the average sizes of self-propelled vessels and barges on Seine and Rhone/Saone fully correspond to those on the Rhine. On the other side, the large majority of fleet units operating overall on the Corridor network comprise small self-propelled dry cargo vessels (862 ships) with an average capacity[29] of about 360 tons. Also motorised tankers, pushed dry and tank barges on these smaller waterways have in average the same average size of about 360 tons.

Performances

No explicit information on this point is available but it is likely that at least on the major waterways the ships comply with similar requirements like on the Rhine and the Danube. Having in mind these average sizes and overall average for the French fleet, it might be concluded that a large number of very small units (~200 – 300 tdw) operate within the French network.

---

[29] Arithmetic mean value.

Age

Self propelled vessels are on average over 40 years old while the average age of the barge fleet is about 35 years. The pushboat fleet has on average more than 50 years and that leads to a reasonable conclusion that the majority of these units were originally designed and built as river tugs for towing the barges and then later on requipped for pushing services.

Character

The corridor fleet has a large number of units (few hundreds) ranging in size from the relatively large ‘Europe’ ships and barges to the very small vessels suitable to operate on the numerous small waterways. There are certain units in the fleet which represent really peculiar, sophisticated and technically very advanced solutions, as for instance very short but powerful push boats designed to operate pushed convoys on the waterways with a restricted lock chamber lengths.

The fleets in other, non-integrated waterways

Within the non-integrated European waterways considerable river fleets were identified in the United Kingdom, Finland and Italy. In Sweden, Spain, Portugal, Latvia and Lithuania it can be rather spoken of the use of river/sea ships on inland waterways and not of inland navigation in its genuine form.

Size of the fleet and typical fleet units

There are 118 dry cargo river ships and 55 tankers on the inland waterways in the UK. The average capacity of dry cargo vessels is about 250 tdw while tankers are with about 750 tdw on average considerably larger. These relatively small ships match the cross sections and other typical nautical conditions of British waterways. The fleet of 69 river tugs having an average output of 350 kW is used to tow a total of 223 dry cargo barges (on average having 262 tdw each) and 24 tank barges with 722 tdw on average. These figures resulted from national statistics and relate to the year 1997 and not 2000 as for the most of other countries.

The Finish inland fleet has 13 dry cargo ships averaging 227 tdw and 239 kW as well as 28 small towing barges (on average 118 tdw) and two larger pushed barges with 900 tdw each. There are also numerous tugs (28 units with an average 289 kW output, obviously not only dedicated for towing the barges) and two dual purpose pusher-tugs with 1010 kW each.

Italy has 1 dry cargo vessel (1200 tdw, 800 kW), 1 self-propelled tanker (1000 tdw, 800 kW), 12 pushed barges for dry cargo (in average 1000 tdw each) and 20 liquid cargo pushed barges each with a capacity of 1250 tdw. These barges are operated by a fleet of 11 push boats with an average output of about 1090 kW.

There is no information on the fleet size and main particulars of inland fleet units in Portugal and Lithuania even though there are some identified waterborne inland transports in these countries. But it is known that in Portugal on the Douro River passenger cruising services are the dominant kind of operation.

Performances

There is no indicative and explicit information on typical technical performances of the ships operating in respective regions.

Age

There is no sufficient information on the age of fleets within the respective isolated subsystems. Data for the UK are completely missing. Finish motor ships are on average 44 years old, towing barges 38 and tugs even 54. The fleets of pushed barges and pusher-tugs are relatively young with 13 and 20 years, respectively. Italian motor ships were built 35 years ago and barges are on average 15 and pushers on average 25 years old.

Character

Generally the very restricted cross sections of most navigable canals and rivers in the UK (width, depth, air clearance) set up the conditions for the operation of a fleet of pretty small units for cargo transports, at least small when compared to the European standards based on the Rhine, Danube and other major waterways. Therefore, a lot of canals in the UK (much more than 50%) are used rather for recreational than for commercial navigation.

The Finish inland fleet seems to be well adjusted to the local needs (transport services) and nautical conditions. Like in Sweden too, the main use of the waterway network based on numerous lakes mutually linked with natural or human-built canals is for river/sea/shortsea shipping and during the short summer season for recreational purposes (short excursion tours, charter boating).

Italian self-propelled ships are probably overpowered for the use on local network. With 0.67 kW/tdw and 0.80 kW/tdw, respectively, are both Italian cargo vessels much above the Rhine standards for the similar ship's size (e.g. 'J. Welker' type with about 0.4 to 0.5 kW/tdw). Push boats having on average 1250 kW use to operate barge trains of about 2000 tdw because nautical condition on local network do not allow bigger trains of more than two barges. On the Danube the experience shows that the push boats of corresponding power output are quite suitable to operate trains consisting of 4 'Europe IIb' barges with a nominal load of up to 6000 tdw.

4.5 Interoperability

Specific features and equipment of river vessels in different corridors

In order to perform a safe manoeuvre on very dense traffic conditions and confined fairway widths on the Rhine, plenty of ships are equipped with additional steering devices other than conventional rudder blades usual on the Danube. Almost all self-propelled vessels on the Rhine have bow thrusters and for the units longer than 90 meters bow thrusters able to deliver appropriate side thrust (the value of the thrust depends on the ship's size) are strictly prescribed. There are also barges equipped with steering devices on bows (either rudder blade, as for instance on GSP 54 barges (usually in operation on Elbe and accompanying canals) or active bow thruster on 'Europe II' barges on the Rhine. The modern long range push boats on the Rhine, e.g. 'Veerhaven VII - Walrus' and its sister-ship 'Veerhaven V - Zeeleeuw' are also equipped with bow thrusters which proved to be the better option than flanking rudders common on the Danube push boats.

In principle, the ships on the Rhine are higher powered than those on the Danube. That is valid for both self-propelled vessels and push boats. This statement can be verified comparing the convoys of the same size (6 Europe II barges having a load of 12-18000 tons) and the typical push boats used to push such convoys on the Rhine and Danube. These maximal size convoys on the lower Rhine are operated by push boats having an about 4000 kW installed output while on the Danube, the most powerful push boats (there are only four units with more than 3000 kW, otherwise large push boats have usually between 2000 and 2500 kW) operate with convoys consisting of 9 or even more barges. Assuming the same convoy size with the load of 12000 tons, the ratio between the installed power and the transported cargo is 0.33 kW per tdw on the Rhine and only about 0.21 kW per tdw on the Danube. Differences for self-propelled vessels are not that significant, but still remarkable.

The German national inspection regulations for vessels on the Rhine ('RheinSchUO' and CCNR regulations, respectively) are stricter than the analogous regulations valid on the other national waterways including the Danube and Elbe ('BinSchUO'). For instance, according to the 'RheinSchUO', the noise level measured at the distance of 25 m aside the running ship must not exceed the value of 75 dB(A) and this requirement does not have to be fulfilled in other corridors. Furthermore, the stern anchors chains must have a length of at least 60 m (instead of 40 m prescribed by the 'BinSchUO'), the vessel having a length of more than 90 m must be equipped with a bow thruster able to deliver the precisely prescribed minimal side thrust etc. etc. The vessels which do not fulfil the 'RheinSchUO' requirements are not allowed to enter the Rhine.

Since 1995, the size limits of the vessels allowed to operate on the Rhine have been changed and nowadays the maximal allowed length of a single unit is 135 m instead of former 110 m. The first ship with extended dimensions (125 x 12 m) put into service on the Rhine was the container carrier 'Miriam'.

A number of self-propelled container ships (nowadays estimated at roughly about 50 units) having a maximal allowed length of 135 m and a beam of up to 17 m, with a capacity of about 400 TEU in four tiers are in regular operation nowadays. More about that can be found in the next Section dealing with recent trends and developments in inland vessel design.

There are also many special inland ship types on the Rhine which cannot be seen on the Danube and other corridors, like for instance various specialised chemical and LNG (liquefied natural gas) tankers, four, five and even six deck passenger cars carriers, pushed barges equipped with auxiliary propulsors enabling them a certain autonomy of movements from pier to pier within the large port basins, etc.

There are also a number of ships on the Danube, either specialised for certain cargoes like RoRo catamarans (4 units) for multimodal trailer transports or oversized pushed barges with more than 12 m beam (50-100 units in UA fleet) which due to their excessive dimensions cannot pass physically to other corridors.

In regard of corridor interoperability one remarkable example deserves to be given. In the specific case of Danube and its nautical conditions it might be found out that the direct application of large inland container vessels as very successfully proven on the Rhine could meet a lot of difficulties and eventually be rejected as economically non-viable. But that would not automatically mean the shift of future container transport shares on the Danube to land modes. Possibly very good waterborne alternative might be found in the Danube typical, mid-size, 4-barge trains, able to carry about 360 TEU in 3 tiers. In the case of low waters a quite usual 6 barge train could carry even 480 TEU in just 2 tiers. At it is already stated that at the moment the large portion of the Danube pushed fleet is out of service due to the lack of transport demand. However, the promotion of such kind of opportunities brings a number of additional components in transport scenario and a lot of new unknowns.

Corridor-specific rules and regulations

There are a series of international as well as national and regional rules, regulations, agreements and prescriptions governing behave, operation and procedures within the inland navigation activities in Europe.

These are e.g. Central Commission for the Navigation on Rhine (CCNR), Danube Commission and Mosel Commission as international organisations providing the rules within the area of their jurisdiction. In all European countries with considerable inland navigation activities and tradition there are specialised organisations and authorities responsible for particular segments within the branch. Regarding the navigation on the Rhine the rules of national authorities must fully comply with the appropriate CCNR rule. On the other side, the rules adopted by the Danube Commission have till this moment just the power of a recommendation and do not strictly oblige Danube riparian countries to apply them on the river sectors under the jurisdiction of their authorities. In the meantime, the sophisticated technical standards and the diversity of areas covered by the rules and regulations made the CCNR prescriptions the pattern to be implemented for almost all major waterways in Europe including the Danube.

The examples of areas covered by the CCNR and in many cases also national rules of other, non-riparian countries within the other European waterway corridors and isolated subsystems having considerable inland navigation activities and tradition are:

- Technical issues related to the ship abilities, features, size and equipment
- Procedures for handling, storing and transportation of hazardous goods on board the river ship
- Safety of humans on board
- Examination procedure and certification requirements for the acquisition of the shipmaster's, able seaman's, boatswain's or other certificates and licences
- Minimal number of crew on board with appropriate certificates and licences to operate respective ship types and sizes along the particular routes/network stretches
- Issues related to the environment pollution control

In recent years always more and more attention is being paid to safety and environmental aspects of transport on inland waterways. The ADNR rules prescribing technical conditions for the transportation of hazardous goods on Rhine set up a series of prescriptions especially for tankers. These rules have been upgraded several times in last couple of years. For certain categories of dangerous goods all future tanker newbuildings must be done in double hull execution (with double bottoms, sidewalls and vertical cofferdams). For certain categories of goods (e.g. aggressive chemicals) this rule is applied already since long time ago (e.g. stainless steel tanks within the hull built of usual, 'mild steel'). For the already existing single hull tankers there are restrictions regarding the kind of commodity to be transported as well as transition rules – extension of allowance to operate under certain conditions and for a certain time period. The CCNR is currently intensively working on the preparation of rules regulating the matter of double hull tankers.

Possibilities to operate in adjacent integrated corridors

Four integrated IWW corridors (this statement does not fully apply to the North-South corridor in France) have been identified within the PINE investigation area. Average and characteristic nautical conditions differ from corridor to corridor and thereby considerably influence the technical parameters of ships designed to operate within the concrete corridor or region.

Free trade and transfer of goods within the Union set up the need for a smooth passage of inland ships between two adjacent corridors. Putting aside physical barriers (missing links or nautical bottlenecks), direct inland ship operation between the Rhine and North-South corridor would not meet other hindrances. Ships and their equipment are in most cases compatible and the certification for the Rhine for vessels coming from the North-South corridor would be rather a formality than a problem.

Quite different aspects arise when passing between the Rhine and West-East and especially between the Rhine and the South-East corridor (Danube confluence). Rhine ships heading east through the West-German Canal Network and Mittelland-Kanal when they once reach the Elbe river (upstream the junction of the Elbe Lateral Canal) meet the problem of relatively poor nautical conditions, in no way aligned to the parameters of the Rhine GMS ships.

The ships of GMS size can easily reach the lower Elbe and Hamburg over the Elbe Lateral Canal or the Elbe at Magdeburg but other destinations cannot be called by the GMS except to operate along the Elbe river alone at a considerably reduced draught i.e. payload, at pretty lower speed i.e. under-utilised installed power potentials, and consequently, with very unfavourable economic effects. On the other side, coming from the east towards west and the Rhine corridor, a typical large Elbe vessel (approximately 'Europe' size with about 1300 tdw at a 2.5 m draught) generally meets no barriers at all, neither nautical, nor economic, nor administrative (the last one, however, assuming that the entire set of necessary Rhine certificates are provided for the ship and her crew). But other smaller fleet units from the East End of the West-East corridor (all waterways eastwards from the Elbe), even if they fully comply with all Rules and Regulations and possess all certificates, would likely be non-competitive on the Western waterways due to their inadequate design and technical parameters. Namely, the fleet units in the Elbe/Oder part of the West-East corridor are designed and optimised for the operation in extremely shallow water. Therefore, some of the indicators of their efficiency, e.g. payload coefficient (ratio between payload and loaded displacement) and the amount of payload per crew member are much lower than for their typical Rhine competitors. This crucial interoperability issue is elaborated in sections 4.8 to 4.10 in much more details.

An even more challenging set of questions appears on the interoperability potential between the Rhine and Danube (South-East) corridor. Main particulars of the fleet units (of standard most typical vessels and barges) do not differ to a large extent. Maximal lengths, breadth, draught, air draught, installed power, main equipment and systems are (or at least should be) pretty compatible. The most distinctive feature is the fleet composition: predominantly single motor ships on Rhine and pushed trains on Danube.

Another critical aspect of the Rhine-Danube interoperability is the certification of ships and crews. For instance, a ship longer than 90 m must be equipped with bow thruster able to produce precisely prescribed side thrust for passing Main-Danube Canal and Main. There are a lot of large/long Danube ships not having a bow thruster (it is roughly estimated that less than 10% of Danube self-propelled vessels are equipped with bow thrusters) at all and for those who have it is the question mark if their thrust complies with the prescriptions or not. Similar implies to a number of other technical requirements and prescriptions like safety rules for the transportation of hazardous goods, sewage and grey water treatment on board, minimal crew on board with appropriate qualification (assuming they possess all necessary certificates and licences), external and internal noise level etc. etc.

Regarding the level of compliance of fleets of candidate countries with the EU rules and hence the level of corridor interoperability it can be assessed that the Czech, Slovak and Hungarian fleets in general satisfy quality requirements set up by the EU standards. In these countries there was a kind of self-selection of the fleet units which are able to stay commissioned and compete on the transport market while a considerable number of units are already put out of active service. This non-active share of the fleet varies from country to country and might be assessed at between 30 and 50%.

Unfortunately, these units still appear in official statistics whereby it is not clear whether the ships are really decommissioned and statistical offices simply missed to erase them from their lists or they just temporarily lost their certificate/licence for use (due to any reason, e.g. technical deficiencies). This fact reduces the chances to derive deeper assessments from the statistics. At this point, the necessity to improve the statistical basis on an all-European level for further investigations as well as for policy information purposes could be announced.

Interoperability in river-sea operation segment

Considering the seas surrounding Europe a number of areas and routes with mutually quite different and specific nautical conditions might be identified. These are for instance:

- Routes over the North Sea (between French, Belgian, Dutch and German inland/sea ports and appropriate destinations in the United Kingdom and Scandinavia
- Routes over the Baltic Sea (towards Scandinavia, Baltic States and Russia including the Russian 'integrated deep inland waterway system')
- Routes over the Gulf of Biscay (towards the Atlantic ports on the Iberian peninsula)
- Mediterranean routes of river-sea services (form the side of the inland navigation segment comprising mostly the penetration into hinterland along the Rhone/Saone waterway and nowadays still to a negligible extent into the inland waterways of Northern Italy)
- Black Sea routes mutually linking three large rivers very suitable for the direct river/sea services: Danube, Dnepr (Ukraine) and the Don/Volga system in Russia.

River/sea ships able to operate all these areas have to cope with:

- Heavy seas of the North Sea, especially during winter
- Ice on the Baltic Sea in severe winter seasons
- Extraordinary heavy storms in the Biscayan Golf
- General draught and air draught restrictions on the river stretches (all rivers)
- Additional breadth restrictions for passing the locks (many lock chambers on fluvial stretches especially in the Rhine and North-South corridors enable the passage of just up to 11.4 m wide vessels)
- Different duration of nautical season in certain, for river-sea services especially attractive regions (practically all the year round on Rhone, Seine, Rhine, Danube but considerably shortened due to ice on e.g. Saima Canal in Finland, Trollhätte Canal in Sweden, northern entrance to the Russian deep water inland system at Neva mouth and even southern entrance to the same system over the Sea of Azov and mouth of Don).

Besides physical and technical problems to be solved (see also section 4.7 'River/sea vessels') there are also some administrative barriers for the direct operation of river-sea ships between European ports and river ports located in Russian (and Ukrainian) hinterland.

Principally, during the season the Russian ‘deep water inland waterways’ are almost ideal for navigation due to a sufficient water depth for the usual draughts of the European river-sea ships, due to wide and long lock chambers (at least enabling lockage of 130 x 16 m ships) and due to high (or elevating) bridges allowing 12 m air draught at high water level. During the recent contacts of high ranked German and Russian officials (ministers of transport) it came to preliminary agreements on the opening of certain parts of the Russian IWW system for European flags. The free navigation from Rostov on Don over Don, Volga-Don Canal to Volgograd and further downstream Volga river to Astrachan on the mouth in Caspian Sea will be realised till 2007. The northern and central sectors of the major deep inland waterway link through the European part of the Russian Federation, between St. Petersburg and Volgograd over a total length of about 3000 km is planned to be open till 2010.

4.6 Trends and developments

The European inland shipbuilding industry was relatively active in 2001 and 2002. The recent trend to built hulls in Chinese and East-European yards, first of all in Romania, Russia and Poland, continues and in the meantime it became evident that steel hull construction of standardised cargo vessels in West-European river yards is rarity.

The permanently rising container business on the Rhine sets up especially high demands for new river container ships. Since 1998 with the construction of a 135 m long and a 16.8 m broad container ship ‘Jowi’ with a capacity of 398 TEU in four tiers, a general tendency to build larger vessels continues. A considerable number of 135 m long container ships (at least 35-40 units) with various breadth accommodating 4, 5 or 6 boxes abreast have been commissioned in recent years. Thereby container vessels for 4 containers abreast have a capacity of ‘only’ 268 TEU but simultaneously the possibility to extend their operation to waterways having locks with 12 m wide chambers. In order to integrate large TEU capacity, flexibility of services and economy of operation, pushed trains consisting of cargo ship and pushed barge become always more and more an attractive alternative. These trains having a length of 185 m and a breadth of up to 11.45 m correspond to the ECE waterway class Vb whereby the self-propelled ship alone can operate also in waterway class Va. A fully loaded train with 4 tiers of containers carries 368 TEU. Some recent concepts and design improvements enable a capacity increase to about 400 TEU without exceeding the given length and breadth limits. Even though these very large and extraordinary broad ships have due to certain hydrodynamic relations in restricted waterways higher specific power requirements than conventional (large) inland vessels their economic effects are obviously fully justified.

Also some 8-10 small container or pallet transport ships (‘NeoKemp’ type, ‘River Hopper’ type), able to operate on a dense network of smaller waterways in the Netherlands and Belgium (segments of the Rhine and North-South corridors), have been designed and commissioned in recent years.

These ships having a crew of two and designed for transport of containers or pallets are able to operate on small waterways and to reach destinations impossible to be called by ships of conventional design and size.

It might be remarked that the majority of the recently built container ships are not specialised exclusively for container transport and can be used also for general cargo or dry bulk.

Following the safety and pollution control requirements all new built tankers have a double hull. The majority of new buildings are chemical tankers. At the moment the largest tanker on the Rhine and the largest Rhine self-propelled ship at all is the ‘Compromis’ with a capacity of 5710 tons but it might happen soon that even larger vessels will come into service.

There are generally no new orders for push boats, neither on the Rhine nor in the other corridors. The transport market and the ownership structure on the Rhine and in the North-South corridor give preferences to self-propelled units while the Danube (South-East) corridor has a large surplus of pushing units. Nevertheless, a number of pushed barges have been recently built and imported to Western Europe, either from the lower Danube countries or from China.

There is a increase of river passenger business in whole Europe. That relates to traditional cruising areas along the Rhine, Elbe and the integrated European waterway network as well as to the traditional markets for recreational boating in Scandinavia, France and the United Kingdom. In recent years, also the Danube along its entire course between the Main-Danube Canal and the mouth in the Black Sea becomes attractive for long range river cruising. The same abruptly rising trend might be seen on Italian waterways as well as on the Douro in Portugal. This is consequently followed by orders for new ships. New cruising vessels for the major waterways set up highest standards for comfort, safety and nautical abilities. Their dimensions usually enable them to pass the 12 m wide locks and thus to operate along the whole route between the North and the Black Sea. A small draught and a sophistically designed superstructure and deckhouses enable a smooth operation at very low water levels as well as a reliable passage under the bridges at high waters. The usually applied diesel-electric propulsion with podded propellers ensures an almost noiseless operation and attaining for shallow water relatively high speeds of up to 23 km/h. Capacities of large river cruising ships with a length of up to 125 m arise 180 to 200 passengers, usually all accommodated in 2-bed cabins. The new generations of river passenger ships are almost exclusively built (including hull) in West-European yards.

From the point of view of the number of units in particular fleets, the Rhine and North-South corridor show a just slight decreasing tendency. On the other side, it came to a dramatic drop in the number of units within the Elbe, Oder and Danube fleets. Thereby also considerable shares of fleets in these regions (mostly accessing states) are not active in service at the moment even though they still appear in the official statistics. The average unit size and the tonnage continuously grow in recent years both in the Rhine fleet as well as in the common fleet of other inland vessels licensed within the riparian Rhine countries. This growing average size tendency possibly exists also within the other integrated corridors (Danube, Elbe, Oder) but cannot be identified as significant.

The different scrapping actions, which since 1969 at first were carried out in Germany, have influenced the number of existing ships. These actions focused on a reduction of overcapacities within inland navigation in order to balance demand and supply. At the same time however, the German fleet has been modernised by newbuildings, i.e. old and smaller units were scrapped and new modern ships put into service. In addition, ship capacities abroad and especially within the Netherlands significantly increased leading to a shift of the national fleet shares. As a result, there was only a slight impact of the national action.

In 1990, this action was expanded to the EU member states and from 1992 on combined with and 'old-for-new' rule according to which old ships were to be replaced by new ones to a certain extent (at first in the ratio 1:1, later from 1994 on 1:1.5). This rule expired in spring 2003 and at present a prolongation is not planned. While the background on this action is given in Part C on policy and legislation, an attempt is made here to give a rough outline of the effects caused by this action.

It is however quite difficult to assess the results, as the mentioned actions are overlapped by other effects, for instance the fall in freight rates on account of liberalisation measures, business fluctuations within the nineties as well as the reunification of Germany with a substantial impact on the German fleet structure. Nevertheless, it becomes quite obvious that the number of units within the international Rhine fleet dropped. Due to the fact that above all old and small vessels were replaced by new and modern ships, which have been put into service, modernisation effects developed and moreover the size and the average efficiency of the ships rose. However, the total carrying capacity of the international Rhine fleet has only slightly changed within the nineties.

It remains open how this development would have gone off without scrapping action and 'old-for-new' rule. There are some indications that the modernisation effects are rather limited especially, as in the past about 100 new units per year entered the market, quite a low number in relation to the complete fleet. By cancelling this action now a further liberalisation of the market takes place, which complies with the ideas of innovative independent ship owners and shipping companies.

On the other side, a permanent modernisation of the fleet can be identified irrespectively of the scrapping action results. Ship owners themselves change propulsion engines and other components of ship's systems whenever such substitution is commercially feasible and economically justifiable for them. More than that, dynamically changing communication and information exchange applications and services imposes a permanent upgrading of the electronic equipment on the bridge. The ships are thereby modernised and aligned to the market demands but their formal, statistical age remains the age of the hull, i.e. the year of built.

4.7 River/sea vessels

The operation of river/sea ships enables the direct transport of goods from an inland port over an inland waterway and sea stretch to another river or seaport. Such direct transport eliminates the expensive, time-consuming and damage-risky transhipment in the intermediate seaport.

The main prerequisite to establish the efficient economically viable river-sea service is the existence of inland waterways with navigable conditions enabling the operation of river-sea vessels. These conditions are:

- waterway dimensions:
  -fairway width
  -fairway depth
  -fairway bending radii
- hydrographical particularities:
  -fluctuations between high and low water level
  -stream flow rate
  -ice period duration and intensity
- existing infrastructure:
  -locks and chamber dimensions
  -bridge clearances

On the other side the river-sea ships alternately operating in two different navigational areas have to satisfy a number of special technical requirements in order to cope with the nautical conditions on both inland and maritime stretches. The following table shows some indicative examples of these requirements.

Special requirements set up for the operation in inland waterways	**Special requirements set up for the operation in maritime (coastal) waters**
Restrictions of: • length • breadth • height • draught	Longitudinal strength
	Stability
	Sea-keeping abilities
	Freeboard
	Tonnage measuring
Additional equipment as for instance: • stern anchor • river radar • rate of turn indicator • blue flag and blinking light	Equipment and facilities as for instance: • life-saving equipment • nautical equipment • hospital on board • lashing equipment and fittings • spare parts stock on board
Increased manoeuvrability	
Stop ability in downstream navigation	Application of approved and certified materials
Elevating wheelhouse	
Folding masts	Application of international rules and regulations
Prescribed noise level outside	
Application of regional rules and regulations	

Table 10. Comparison between requirements and measurements of IWT and sea traffic

The most relevant requirements in the inland navigation range are size restrictions caused by the dimensions of the waterways and their infrastructure. Opposite to that, there are practically no size restrictions within the maritime range but here are safety aspects resulting from the weather and wave conditions predominantly. These conditions set up first of all the hull strength, stability and sea-keeping ability of the ship. As a consequence of the above listed requirements, it becomes obvious that neither sea-going vessels might be certified to operate on inland waterways (at least due to the absence of the special prescribed equipment for inland ships) nor inland ships would be allowed to sail the sea waters (at least due to safety reasons). Therefore, the special new class of ‘river-sea ships’ was developed - or - as some German shipbuilding experts like to call them more appropriately: ‘sea-going ships with ability to operate inland waterways’.

Actual statistics with a satisfactory level of data for the river-sea vessels (or according to some technically more precise formulation ‘sea-going ships designed and equipped to operate on inland waterways’) are not available. The most reliable and comprehensive source being available at the moment is already 7 years old. In the meantime numerous new river-sea ships have been built and according to the available information from different discrete sources it seems that the fleet of this type grows in number and tonnage.

According to the available statistics (1996) a total of 1970 river-sea vessels operate in European coastal waters and enter deeper into the bigger inland waterways flowing into the North Sea, Baltic, Mediterranean and Black Sea. Independently of the nationality of their owners, these vessels operate very often under foreign flags, usually of those countries, which provide financially most convenient conditions for registration and insurance. Simultaneously, technical requirements set up by the maritime authorities in these popularly called ‘cheap flag countries’ are relatively low and that represents in many cases an additional reason for ship owners to register there. On the other side, this fact almost fully prevents reliable evidence and statistics on the fleet.

Nevertheless, regarding the general shipbuilding design and some decisive technical parameters, two particular ‘types’ and consequently ‘fleets’ of river-sea vessels in Europe could be identified: ‘West-European’ or ‘EU’ and ‘ex-USSR’ fleet. Thereby the share of ‘EU’ fleet was in 1996 about 38% while the rest of about 62% was of the ‘Russian’ type.

These two concepts (conditionally ‘eastern’ and ‘western’) of river-sea vessels can be distinguished through the brief review of types which have been prevailingly built in Europe over the recent 30 years. One concept can be recognised in most of the river-sea vessels being built in and for the former Soviet Union (‘eastern’ types). The second concept (‘western’ types) is mirrored in the recent developments in the field very representatively presented in some river-sea ship types designed in Germany and the Netherlands and usually being built either in domestic or Polish, Slovakian, Romanian, Bulgarian or Serbian yards.

From numerous types of the former Soviet river-sea vessels some characteristic types are presented beneath:

- ‘Volga’-class as relatively modern design, however with a recognisable concept and style to match major inland waterways in Russia and the national prescriptions on the number of crew. These ships have been built in the early nineties in two versions. The last, third version with the first vessel in series delivered in October 1995 bears the type-notation ‘Rossiya’
- ‘Sormovskiy’-class is the most numerous series of river-sea ship ever built. There exist a lot of modifications but the main particulars remained almost unchanged over more than 25 years.
- ‘ST’-type being designed and built in early eighties.

Type	**'Volga 1'**	**'Volga 2'**	**'Rossiya'**	**'Sormovskiy'**	**'ST'**
Loa (m)	139.9	117.5	96.3	119.2	86.9
Bmax (m)	16.6	16.6	13.6	13.4	12.2
d (m)	4.5	4.4	5.2	3.8	2.7
DWT (tons)	5500	4480	3730	3100	1230
Output (kW)	2 x 970	2 x 970	n.a.	2 x 640	2 x 440
Speed (kn)	11.0	n.a.	n.a.	10.5	10.8
N° of TEU	140	104	122	~ 100	54

Table 11. Main particulars of some typical 'eastern' river-sea ships

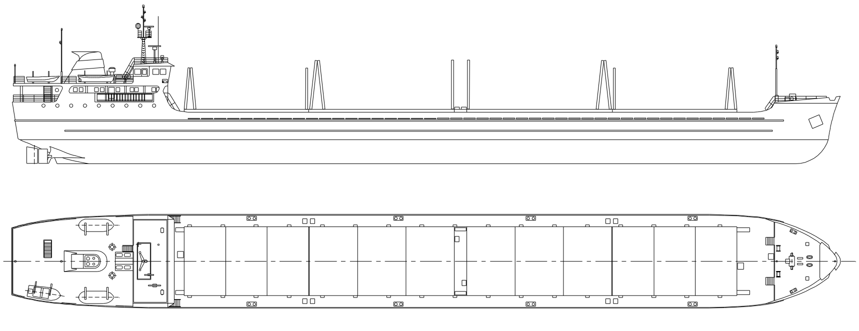


Figure 19. A general side elevation and deck layout of 'Sormovskiy' class

Several characteristic types of modern river-sea ships designed in Germany and usually built in Slovakia (types 'Rhine', 'Weser' and 'Elbe'), Germany ('Cargo-Liner') or Poland ('Eurocoaster') are listed in Table 5 below:

Type	**‘Rhein’**	**‘Weser’**	**‘Elbe’**	**‘Cargo-Liner’**	**‘Eurocoaster’**
Loa (m)	87.90	88.45	82.50	79.90	81.40
Bmax (m)	12.90	11.35	11.35	9.00	9.50
Draught (m)	5.50	4.94	4.79	2.99	3.10
Air draught (m)	12.60	12.60	9.30	4.60	4.50
DWT (tons)	3750	3000	2590	1360	1500
Output (kW)	1500	1125	1350	n.a.	700
Speed (knots)	11.7	11.5	12.8	n.a.	n.a.
TEU capacity	176	118	118	n.a.	75

Table 12. Main particulars of some typical river-sea ships designed in Germany

It became obvious in recent years that the market prevailingly demanded larger river-sea vessels due to economical reasons (lower investment, and especially operation costs per load unit). But this trend shows the possibility that within the next 5-10 years there might be no coasters available in the range of 1000 to 1500 tdw. As far as such vessels are ideally suited for smaller German, Dutch and Belgian canals, the latest trends show rising orders of these relatively small river-sea ships.

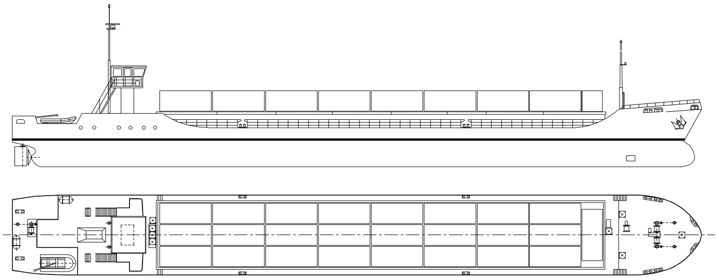


Figure 20. A general side elevation and deck layout of ‘Eurocoaster’ class

Therefore, the ‘Eurocoaster’ type has been recently designed as the modernised version of a very successful ‘Cargo-Liner’ from the seventies. Both ‘Cargo-Liner’ and ‘Eurocoaster’ types have very low air draft capabilities making them almost ideal for numerous smaller waterways within the European network.

It can be summarised that the 'eastern' design is characterised with on average larger and slightly slower vessels than 'western' ships as well as with high and voluminous superstructure (deckhouses) and fixed wheelhouse. On the other side, the 'western' design is more often equipped with an elevating wheelhouse and there is a trend in new buildings to keep the beam within the 11.45 m limits. This makes 'western' vessels more flexible and allows them to penetrate deeper into inland waterways with tighter lock chamber size and bridge clearance restrictions.

4.8 Fleet technologies

Dominant navigational conditions, local market demands and economy models in particular corridors influence in many cases the choice of technologies and technical characteristics of the fleet units. In each of the four corridors there is at least one waterway determining the fleet particularities typical for the entire corridor. These are Rhine within the Rhine Corridor, Danube in the South-East, Elbe and Oder in the West-East and eventually Seine and Rhone in the North-South corridor. Each of these waterways has characteristic fleets and technologies. Main fleet differences are identified and briefly presented beneath.

The fleet typical for the certain waterway or region might be characterised by:

- Typical unit size (length, breadth, draught, carrying capacity)
- Applied technology (self-propelled vessels, pushing or towing technology)
- Specific technical solutions (design, propulsion and steering arrangements, facilities on board, accommodation)

These distinctive particulars were already analysed in the previous sections as well as the interoperability potential (operation of a unit from one corridor in another one). However, especially on larger rivers like Rhine and Danube, numerous units of other types and sizes than those identified as 'typical' can be met. Nevertheless, a selection of units identified as typical and predominant on the most important waterways within particular corridors, including their main characteristics, can be briefly summarised as follows:

Rhine (Rhine Corridor):

- Single self-propelled ships of different sizes, e.g.
  - 'large cargo motor ship' with 110 x 11.4 m (LxB) and about 2850 tons capacity at 3.5 m draught or
  - 'Europe'-size ship with 80 (or 85) x 9.5 m (LxB) and about 1300 tons loading capacity at 2.5 m draught

- Characteristics: single-screw conventional shaft propulsion arrangement with multi-blade rudder arrangement and bow thrusters, specific propulsion power of about 0.4 kW installed output per ton of load capacity, elevating wheelhouse, comfortable accommodation per permanent residence (living)

Danube (South-East Corridor):

- Pushed trains consisting of 2, 4, 6 or even up to 9 pushed barges and pushboat of appropriate power, e.g. barge train consisting of 4 'Europe-II b' barges (2 in line, 2 abreast) with 153 x 22 m (LxB) of the train without pushboat) and having about 6000 tons cargo capacity at 2.5 m draught.
- Characteristics: Standard 'Danube-Europe II b' barges for dry cargo, no additional steering devices (bow thrusters or rudders), pushboat with twin-screw shaft propulsion, conventional main rudder blades and flanking rudders, elevating wheelhouse, large deckhouse to provide accommodation (single and double bed cabins, common living/mess and sanitary premises) for crew of 10 (or even more) necessary for long lasting voyages along the river.

Elbe (West-East Corridor):

- Both self-propelled vessels and pushing technology are applied but none can be indicated as dominant.
- Self-propelled ship of 'Europe' size (as on Rhine) or slightly smaller, usually with draught up to 2.3-2.4 m (theoretical, designed draught) due to the local nautical restrictions.
- Characteristics: General design, arrangements, facilities and equipment standards mostly cope with those of the corresponding type on the Rhine.

Seine and Rhone (North-South Corridor):

- About 80% of inland cargo units on Seine are dry-cargo pushed barges with average loading capacity exceeding 1000 tons. Larger trains consisting of 4 or more barges are possible on Seine but cannot be indicated as typical.
- The capacity ratio between self-propelled fleet and barges on Rhone is about 1 to 1. Due to the lock chamber size limits only 2-barge trains (in line) are feasible whereby the average single barge capacity exceeds 1600 tons.
- Smaller self propelled vessels on the smaller waterways.

Besides pure inland vessels, a relatively high share of river-sea ships is present both on Seine up to Paris and Rhone up to Lyon. The above listed different natures of services and units, as well as the fact that due to the missing navigable links larger units from Seine and Rhone cannot reach the adjacent Rhine corridor, prevent a clear identification of typical vessels in the North-South Corridor. Anyway, at least technical standards, facilities and equipment level are more or less the same as in other West-European countries with high IWT profile.

Therefore, for the purpose of the analysis of the cost structures to be performed in this chapter, the figures obtained for typical Rhine units might be assumed as similar to those for Seine and Rhone units in the North-South Corridor.

Eventually, considering units of the existing EU members (‘western ships’) and those from the countries to access (‘eastern’ and ‘south-eastern ships’) only from technical point of view, some very rough and general statements might be concluded:

- Two main technologies can be identified in the European inland navigation: single self propelled vessels (of different sizes) and the pushboat technology (in different sizes as well). Factors like local nautical conditions, market demands and applied economy model (market or planned economy) mainly determine the technology which is used in a certain case.
- The general characteristics of particular units of one technology (e.g. self-propelled vessels) in different corridors are comparable and relatively similar. Differences on size and installed power are rather a question of scale than a question of technology. Differences in design details and equipment level are mostly caused by local nautical conditions (water depth, transport distances etc.).
- Of probably larger importance are differences related to the owner structure and the (former) political and economical system: in many cases western ships are in the average better maintained than those from the east.
- Different levels of maintenance and condition of the fleets can also be identified between individual candidate states – some of them have the level near to the usual western standards while some are still far away from that.

By analysing and comparing the cost structures of several examples, representing different ships and corridors in east and west, these characteristics and parameters will be considered in section 4.10. Besides, further cost influencing parameters as mentioned in the introduction, whose influence might be even more important have to be analysed as well.

4.9 Circumstances of competition

Against the background of the EU enlargement to the east, traffic among the waterway areas and the operation of ships outside the local waterway network, respectively, gain in importance. Even though eastern companies are operating on western waterways already today and vice versa the assumption can be made that these traffics will further grow on account of the changes within the framework caused by the EU enlargement (see legal and political framework, WP 5). Not only the mutual traffic among the countries involved but also the possibility of cabotage traffic within other Union countries is affected. Whether or not, in which form and to what extent this might occur mainly depends on the competitive conditions among the different countries and the fleets, respectively (intramodal competition).

Due to the existing conditions like for example the geographic position of the potential operating areas or the extent to which fleets are adapted to the particular local waterway area, operating possibilities of a fleet or single vessels, respectively, within other than the local waterway areas (entry into a market) are quite different. Large self-propelled Rhine vessels, for example, are not able to run on the river Oder. Waterway conditions especially draught restrictions prevent an operation of these vessels on the river Oder. On the other hand, Polish vessels are able to sail on the river Rhine, but due to their limited cargo capacity (about 600 t Polish ship from the river Oder, draught = 1.60 m compared to about 2850 t of a large self-propelled Rhine vessel, draught 3.50 m) they are not competitive.

In addition, the geographic position in line with the existing or missing waterway links as well as possible detouring routes affects the operating possibilities within other waterway areas. The Main-Danube-Canal for example interlinks the Rhine and the Danube basin and enables the operation of vessels up to the size of a ‘large cargo motor ship’ – GMS (length x breadth = 110 x 11.40 m). Vessels of the ‘JOWI’-class as well as large pushed trains are however exempted from operation due to their size.

The existing canal network linking the Rhine corridor with the East-West-corridor (Elbe/Oder) offers the possibility for selected ships to run within the other waterway area (e.g. Czech single vessels (‘Europe’-class ship, type ‘Labe’, approx. 1190 t), within the German canal network or on the river Rhine for example up to Rotterdam).

In comparison to that, an extended waterway connection exists between the Danube basin and the East-West-Corridor via the rivers Rhine, Main and the Main-Danube-Canal. However, due to the long detours and the different characteristics of the relevant fleets ship’ operation within the other corridor does not seem to be likely.

There are no appropriate waterway links in terms of commercial purpose of inland navigation between the isolated waterways systems of the North-South-corridor (Seine and Rhône) on the one hand and the Rhine basin including the Belgium waterways of the North-South Corridor on the other. Thus, competition between the aforementioned isolated French major waterways and the other basins does not exist within the system of inland navigation (as long as there are no appropriate navigable links among these waterways). The same applies to the stretches among the other isolated systems of the area to be investigated (e.g. Great Britain or Italy).

Provided that both a physical and technical access to the market will be available enterprises are capable of running their business within the foreign corridor. Companies of the Rhine corridor are able to operate within the east (East-West-corridor and Danube corridor) and vice versa companies of the East-West and the Danube corridor within the Rhine area. Existing differences concerning wages and social payments between east and west as well as technical standards could play a decisive role. Enterprises of the east might have advantages in the west in terms of wages and western companies technical and management advantages towards the eastern owners. Furthermore, joint ventures among eastern and western companies might be founded, employing staff from the east and using ship technology, management from the west in order to combine the various common advantages. The following section deals with different approaches, which are important as regards the EU enlargement to the east and contain an analysis of the corresponding costs.

4.10 Cost structure

When analysing the cost structures a lot of influencing factors arising in different form have to be considered. The point is to realise the differences with regard to competition among the different fleets and to assess their effects on costs. For time reasons it is necessary to make a reasonable and pragmatic selection of some important cases.

In many cases the costs of the individual components are not known, since the companies do not publish them for competitive reasons. In addition, a lot of eastern companies are at present in a transition process from planned to free market economy possibly causing quick and partly lasting changes of organisation- and cost structures. The more it is important to identify the influencing parameters and their development trends.

Cost estimations have been carried out within a two-step model calculation[30]. Costs for an inland ship covering standby costs, respectively, as well as the operating costs[31] are determined. Standby costs comprise the following components (annual costs per vessel):

- wages for the crew including social payments
- maintenance and repair
- depreciation
- interests and
- insurance (hull and liability insurance)

These expenses largely incur irrespective of the ship's operation. By means of the ascertained operating days/year costs per day and hour can be found out. Operating costs have been calculated in a simplified way with the help of the average fuel consumption per hour, fuel price and a surcharge for lubricants. Standby and operating costs for the selected ships have been determined on the basis of different variants.

Besides the aforementioned ship related costs further cost positions have to be considered, if complete transport chains are analysed, e.g. in case of combined transport. Depending on the respective conditions they clearly may exceed the ship-related costs. This mainly concerns the non-distance-related costs for transhipment as well as pre- and endhaulage. This problem is already well known and has been analysed in several studies, e.g.

---

[30] Source: BMV, Handbuch Güterverkehr Binnenschiffahrt, 1998, S. 9

[31] Charges during operation (transport infrastructure costs for canals and lock fees) and port expenses (for example charge for anchoring a vessel, for berthing along public port facilities) depend on local conditions. They differ from case to case and thus distort the comparison of the ship's net costs. As this comparison particularly focuses on the differences among the ships or their operating situation, respectively, these costs equally will not be presented in all cases. However, a surcharge for shipping company management costs and provisions, respectively (in case of independent ship owners) will be added to the operation costs (see chapter 4.5).

IMPREND[32]. As this section focuses on the differences among the ships or their operating situation, respectively, these costs have not been analysed in this context. Nevertheless, it has to be kept in mind, that in case of transport chains these positions have to be considered.

In the Appendix ‘Cost structure of the fleet’, the exact method of calculation as well as the assumptions are described. Here, only main findings and conclusions are presented. In the table below, an overview is given. Total costs are distributed to the cargo volume resulting in costs per ton. Further, three different rates of capacity utilisation[33] have been considered and analysed which means 90%, 70% and 50%.

---

[32] Improvement of Pre- and ENDhaulage; Study within the Transport RTD Programme of the 4th Framework Programme of the European Commission; BCI and partners, Nijmegen, 1997

[33] The rate of capacity utilisation refers to the weight capacity, not to the TEU- or volume capacity. In practice different rates of capacity utilisation depending on the existing conditions will be met.

	Variant	**Standby costs [€]**	**Operating costs [€]**	**Total costs [€]**	**Individual costs [€/ t] at a rate of capacity utilization of**		
					90%	**70%**	**50%**
1A	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 member of family	3´273	1´838	5´111	(1152 t) 4.44	(896 t) 5.70	(640 t) 7.99
1B	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 employee	4´095	1´838	5´933	(1152 t) 5.15	(896 t) 6.62	(640 t) 9.27
2	Europe-type ship lic. f. Czech Republic; 2 teams (3 pers. each, 30 days shift)	3´193	1´027	4´220	(1071 t) 3.94	(833 t) 5.07	(595 t) 7.09
3	Europe-type ship lic. f. Danube corridor; eastern company with existing ships from the east	2´610	1´838	4´448	(1152 t) 3.86	(896 t) 4.96	(640 t) 6.95
4A	large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 1 member of family + 2 employees	7´238	2´948	10´076	(2565 t) 3.93	(1995 t) 5.05	(1425 t) 7.07
4B	large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 3 employees	7´914	2´948	10´862	(2565 t) 4.23	(1995 t) 5.44	(1425 t) 7.62
5	pushed train Danube (license in Romania)	3´850	4´167	8´017	(5400 t) 1.48	(4200 t) 1.91	(3000 t) 2.67

Table 13. Total and individual costs (related to the analysed transport example, see Appendix)

The following conclusions can be taken from this table:

Registration effect

The ‘Registration effect’ covers those consequences resulting from the registration of a ship within a corridor with its specific circumstances (e.g. level of wages). This effect will not be distorted if ships of the same type and size are compared. The registration effect mainly relates to the intramodal competition among different fleets and nations.

The comparison of the variants 1A/B and 3 shows that in case of the ‘Europe’-type ship a license for the Danube corridor (variant 3) is more favourable in terms of costs than for the Rhine corridor (variants 1A/B). Lower costs for personnel and for insurance within the Danube corridor cause this advantage. Costs for maintenance/repair and depreciation are almost the same.

Likewise, cost advantages appear in case of ship registration within the Czech Republic (variant 2) compared to a license for the Rhine corridor or the German part of the East-West-corridor, respectively, however, to a slightly lower extent than for variant 3. Costs for insurance are – like within the Danube corridor – below those existing for a ship within the Rhine corridor. Costs for maintenance/repair are slightly lower than for the aforementioned western vessel. However, cost advantages arise by the minor propulsion output, which is reflected within the moderate operating costs.

Size effect

The ‘size effect’ refers to the situation outlined that, with rising ship size, specific costs fall on the same conditions and vice versa. This statement is valid irrespective of corridors and can basically even be applied to vessels of other sizes (which are not analysed here).

The comparison of the variants 1A/B and 4A/B clarifies that on same circumstances (license for the Rhine corridor) and despite of clearly higher total costs the larger cargo motor ship (variant 4A/B) shows lower individual costs than the ‘Europe’-type vessel (variant 1A/B).

The cost advantage resulting from the size effect is – related to this example - in terms of value almost the same as the advantage by the registration effect (license ‘Europe’-type vessel for the Danube corridor, variant 3 towards license ‘Europe’-type ship for the Rhine corridor, variant 1A/B). From another point of view it is obvious that the ‘Europe’-type ship with license for the Danube corridor despite of her small size realises just as favourable costs as the ‘large cargo motor ship’ with license for the Rhine corridor.

When comparing the Danube pushed train with the ‘Europe’-type ship the size effect will be explicitly obvious. In doing so it has to be kept in mind that in this case a ‘registration effect’ will occur within the Danube corridor, as a registration of the ‘Europe’-type vessel has been assumed for Slovakia and Hungary, respectively, and regarding the pushed train within Romania.

While the size effect will remain unchanged, the registration effect might decrease on midterm horizon due to alignment tendencies in cost structures of western and eastern companies.

Rate of capacity utilisation effect

The comparison of the rates of capacity utilisation stresses, to which high extent individual costs increase with dropping capacity utilisation rates, e.g. caused by limited draught. For this example the difference in costs between the rates of capacity utilisation of 50% and 90% is clearly higher than the aforementioned size effect between the variants 1A/B and 4A/B and the registration effect; therefore the capacity utilisation effect is the dominant one in this example.

4.11 Conclusions

PINE research activities identified about 22300 registered inland navigation vessels within the concerned investigation area. Out of these about 7500 are non-propelled barges including both towed and pushed types, about 3400 are tugs and pushers and some 2600 are passenger vessels. The rest, containing about 8800 units, are self-propelled cargo vessels of all types and sizes. This review does not include objects not involved in transport duties like floating cranes, dredgers, police, customs, survey or fire-fighting vessels as well as floating objects for recreational use as yachts, boats etc.

Reviewing the statistics on the fleet structure i.e. the shares of particular ship types in corridors the following facts might be summarised and concluded:

- More than 95% of the total 22300 identified units (comprising inland fleets of all EU members with a high and medium profile in inland navigation, accessing countries and additionally the fleets of the Ukraine, Moldova, Serbia and Croatia) operate within the integrated European IWT corridors: Rhine, North-South, West-East and South-East,
- Six EU accessing countries located within the West-East (Poland, Czech Republic) and South-East Corridor (Slovakia, Hungary, Romania, Bulgaria) have a considerable share within the investigated PINE fleet. Of approximately 22000 units a total of some 4500 vessels belong to these candidates. When these countries will become Union members in 2004 and presumably 2007 their vessels will enlarge the number of units and total carrying capacity in the common fleet of inland vessels presently under the EU flag by about 20%.
- About 90% of some 21300 inland units within the four corridors are cargo ships, barges and tugs or pushers,
- There is a total of about 15500 cargo units within the corridor fleets comprising about 7000 barges and about 8500 self-propelled ships,

- Referring to the load-capacity even 84% of the entire corridor fleets of self-propelled units are assigned to the Rhine Corridor (and most of them licensed to operate on the river Rhine), about 6% each are assigned to the North-South and the Elbe-Oder area while only about 4% are ships registered in and the South-East (Danube) Corridor,
- The corridor distribution of barges (referring to load capacity as well) is less unequal: about 34% in the Rhine Corridor, 8% in North-South, 13% in the Elbe-Oder area and 44% on the Danube and tributaries,
- Vessels of non-corridor countries with remarkable inland navigation (United Kingdom, Finland) are on average smaller in size than the corresponding corridor units. Only the average unit sizes of the Italian inland fleet are similar to the average corridor sizes.

Note: Main statistical figures on ships are shown in the Appendix ('Inventory of the fleets'). Above stated shares and facts are obtained using and processing statistical figures in the Appendix.

Passenger ships of both common types (cabin cruisers and vessels for daily excursions) are represented with about 10% of the investigated sample. Thereby as principally larger, the cabin cruisers are in operation prevailingly on large and long waterways like Rhine, Main Danube, Elbe, Rhône, Seine and Mosel. In recent times such type of passenger service appears again after more then ten years cease due to the Balkan wars on the entire Danube course. River passenger ships for daily excursions are present overall and their sizes are aligned with the waterways and services they operate.

In the very special segment of river-sea vessels it is not indicative to classify units on the basis of their flags (nationality) due to frequent change of ownership and port of call (country). It might be assessed that more than 2000 units of this type operate in European and Mediterranean waters. These vessels could rather be classified according to their design into so-called 'Russia' and 'European' types.

Besides the fleet state-of-the-art two other crucial issues have been discussed in this chapter: interoperability and development trends.

Interoperability comprises here the ability of the vessels being used in one region, area or corridor to pass over to the adjacent corridor with different environment, i.e. different conditions for operation either in a physical, technical or legal sense. It was found out that a considerable level of interoperability already exists for parts of the Elbe fleet to operate in the Rhine Corridor and parts of Rhine fleet to operate in the Danube Corridor and vice versa. These statements are based exclusively on technical particulars of the fleet units.

Eventually rising demands for river passenger cruise ships can be seen in all corridors and some of the isolated systems (Portugal, Italy).

Within the Rhine corridor, different scrapping actions have been carried out first on national (German) and later on European level. These actions mainly focused on a reduction of overcapacities within inland navigation in order to balance demand and supply. From 1992 on these actions were combined with a so-called 'old-for-new' rule which expired in spring 2003. It is however quite difficult to assess the results of these different European measures, as the mentioned actions are overlapped by other effects.

Due to the fact that above all old and small vessels were replaced by new and modern ships, which have been put into service, it can be assumed, that modernisation effects developed and moreover the size and the average efficiency of the ships rose. However, the total carrying capacity of the international Rhine fleet has only slightly changed within the nineties.

It remains open how this development would have gone off without scrapping action and 'old-for-new' rule. There are some indications that the modernisation effects are rather limited especially, as in the past about 100 new units per year entered the market, quite a low number in relation to the complete fleet. By cancelling this action now a further liberalisation of the market takes place, which complies with the ideas of innovative independent ship owners and shipping companies.

On the other side, a permanent modernisation of the fleet can be identified irrespectively of the scrapping action results. Ship owners themselves change propulsion engines and other components of ship's systems whenever such substitution is commercially feasible and economically justifiable for them. More than that, dynamically changing communication and information exchange applications and services imposes a permanent upgrading of the electronic equipment on the bridge. The ships are thereby modernised and aligned to the market demands but their formal, statistical age remains the age of the hull, i.e. the year of built.

Furthermore, it might be stated that European inland fleets were developed and adjusted in considerable scope upon the corridor specific nautical conditions and in the locally ruling prescriptions and regulations. These can be summarised in peculiar unit size developments. The most advanced and from technical and operational aspects most dynamic developments take part on the river Rhine and its tributaries.

The influence of both technical and organisational parameters on the costs of inland navigation and its competitiveness have also been analysed in this chapter. Thereby, not only the competition among the different national fleets (intramodal competition) but also between the transport modes (intermodal competition) is concerned. Selected examples from the different corridors in east and west support this analysis taking into consideration the EU enlargement to the east with its resulting potential.

It becomes evident that the intramodal competition focuses on different ship types within selected corridors and on certain routes, respectively. They comprise on the one hand the Rhine corridor towards the East-West-corridor and sections within the East-West corridor (basically concerning self propelled vessels of 'Europe'-type) and on the other hand the Rhine corridor towards the Danube corridor (basically concerning self propelled vessels like 'Europe'-type ship and large river motor vessel).

The analyses carried out confirm the assumption that cost advantages will arise as to a registration of the ships within the accessing countries with their specific conditions towards a registration within western countries. By means of the example referring to the analysis on the 'Europe'-type ships (approximately the same ship size in each case) in case of a license for the Czech Republic (variant 2) compared to one for the Rhine corridor, e.g. Germany (variant 1A/B), a cost advantage (related to the individual costs, identical rate of capacity utilisation) can be identified.

With reference to the assumptions of the used examples it can be estimated to approximately 10-25%. Of about the same size is the cost advantage of the investigated 'Europe'-type ship registered within the Danube corridor (variant 3) in comparison with a 'Europe'-type ship with registration within the Rhine corridor (variant 1A/B).

Furthermore, a combination of the advantages of western and eastern structures appears to be a competitive and future promising alternative. The example 'Odralloyd' (German-Polish company with Polish crews of which cost structures had not been analysed in this context), shows the successful operation of already at present existing west-east joint ventures.

Similar results should be expected for ships of other sizes, not being analysed within this study, if vessels of the same size and rate of capacity utilisation but deriving from the aforementioned countries or corridors, respectively, were compared.

Weighting the reliability of the available data, it has to be considered that these data in some cases refer to a limited number of vessels or to single vessels. Discussions with professionals within the branch however support the supposition that the shown results appropriately reflect the proportions of cost structures. Concerning cost structures of eastern companies it has to be taken into consideration, that most of these enterprises still are in a process of transition between planned and market economy, which in some cases might change the structures within relatively short times.

Irrespective of the reliability of the examples, cost differences among the corridors caused by the registration effects become relative when taking into account the number of concerned vessels within the according corridors. Hence, the number of ships within the Danube corridor which as regards size, type and equipment approximately corresponds to the western 'Europe'-type ship amounts to only about 2% of the appropriate vessels within the international Rhine fleet. As to the Czech fleet a similar relationship can be applied.

On the other hand, a comparison between the number of Czech 'Europe'-type vessels (approximately 30-50 units) and German 'Europe'-type ships in the German part of the East-West corridor (approximately a few hundred units) points out, that in this case a stronger intramodal competition might be expected.

In addition, analyses and discussions with representatives of the branch show a process of convergence between eastern and western cost structures. Among others costs within the Rhine corridor for national personnel and personnel from Poland or the Czech Republic in several cases are nearly identical and prove this observation. However, it remains open in which form or at what speed this process of convergence will take place within the next years, above all after the eastern countries will have joined the EU.

Beside the mentioned registration effects, also size differences among the ships (size effect) and possible differences in the rate of capacity utilisation clearly influence the costs. According to the circumstances the resulting cost differences clearly might exceed those on account of the registration effects.

‘Size’- and ‘rate of capacity utilisation’ effects basically concern the ships of all fleets. They appear for instance if a certain ship (e.g. the Europe-type ship), suitable for a particular transport task, is not able to operate since the waterway infrastructure or local bottlenecks (e.g. draught limitations) prevent her operation. In such cases either a smaller vessel has to be operated or the ship has to run at a lower rate of capacity utilisation than on normal infrastructure conditions. Impacts on individual costs are substantial as shown within the model calculations. Thereby infrastructure bottlenecks influence the efficiency and the competitiveness of inland navigation in comparison to the competing transport modes; thus inland navigation is sustainably affected within intermodal competition. Due to the dominance of the capacity utilisation effect (and in several cases of the size effect as well) towards the registration effect and the large number of infrastructure bottlenecks the influence of these effects is obvious.

While the registration effect probably will decrease in line with the expected alignment tendencies of the cost structures between West and East after the accession of the new member states, the capacity utilisation effect mostly will remain unchanged as long as the infrastructure bottlenecks will not be abolished.

Note: the exact calculations of cost structures per type ship and per cost category are shown in the Appendix (‘Cost structure of the fleets’). Above stated shares and facts are obtained using statistical figures in the Appendix.

4.12 References

1. Botermann, H., ‘EU-Osterweiterung - Chancen und Gefahren für das deutsche Binnenschifffahrtsgewerbe’ in Internationales Verkehrswesen 1/2003

2. Handbuch der Donauschifffahrt, via donau – Donau Transport Entwicklungsgesellschaft mbH, Vienna 2002

3. Handbuch Güterverkehr Binnenschifffahrt, LUB Consulting GmbH / Dornier SystemConsult GmbH on behalf of the German Federal Ministry of Transport, Dresden / Friedrichshafen 1997

4. Horyna, K., Czech Republic (cost structures of Czech vessels)

5. IMprovement of PRe- and ENDhaulage (IMPREND); Study within the Transport RTD Programme of the 4th Framework Programme of the European Commission; BCI and partners, Nijmegen, 1997

6. Interviews with representatives of the branch

7. ‘Potenziale und Zukunft der deutschen Binnenschiffahrt’, 2. Interim report on behalf of the German Federal Ministry of Transport, Planco Consulting GmbH, Essen 2003

8. Schlieter, J., ‘Investitionsförderung der Partikulierunternehmen ist unumgänglich’ in DVZ, 6. September 2003

9. EUDET Project: Interim report on the Danube Waterway, ÖIR/VBD/Impetus, Duisburg-Vienna, 1997

10. IMMUNITY Project: Interim report on the state-of-the-art of inland navigation in Europe, AVV/BCI/VBD/ANAST/VNF, Rotterdam-Duisburg, 1998

11. Potenziale und Zukunft der deutschen Binnenschiffahrt, 2. Zwischenbericht, PLANCO GmbH, Essen, 2003

12. SHIFTING CARGO Project: Interim report on the European Waterway Corridors, VBD/ÖIR/ANAST, Duisburg, 1996

13. Handbuch der Donauschifffahrt, DTE GmbH, Wien, 2002

14. ‘Auswirkungen von Übergangbestimmungen in den technischen Vorschriften für Binnenschiffe’, Report on the study elaborated by VBD, Duisburg, 2001

15. Wirtschaftliche Entwicklung der Rheinschifffahrt - Statistiken 2000, ZKR, Straßburg, 2002

16. Annuaire statistique de la Commission du Danube pour 2000, DC, Budapest, 2002

17. Waterway network of the Po Valley and Veneto Region, 1998

18. ECORYS Transport and Partners: ‘Market observation for the inland waterway sector’ – Annual Report, Rotterdam, 2003

19. ‘Modern River Sea Traders’, CC&MH, Devon, 1996

20. ‘Feasibility study on river-sea lines between Po river and Mediterranean ports’, Final Report, VBD, Duisburg, 2000

21. Schiffe der Zukunft, ZKR, Straßburg, 2002

22. ‘Binnen-See-Verkehr zwischen Nordspanien/Iberische Halbinsel und Duisburg’, Study Report by EBD and Partners, Duisburg, 1997

23. Selection of titles issued in ‘Binnenschifffahrt – ZfB’ and ‘Schifffahrt und Technik’ (professional journals) in 2002 and 2003

24. Written contributions from partners and engaged local experts

Chapter 5 Infrastructure

5.1 Introduction

Quality and improvement standards of the waterway infrastructure including the land-based interfaces have a decisive influence on the efficiency of inland navigation. For example, the size of ships in operation is dependent on the usable waterway cross-sections and dimensions of the lock chambers. Thereby the local capacity bottlenecks do not only have local effects but also extend their influences usually in a wider range along the concerned transport routes, to larger network segments or even to the entire network.

Against this background the aim of this work segment is the registration of the waterway infrastructure including also smaller waterways on the basis/fundamentals of the existing classification schemes and with regard to the construction standards. Besides, the objectives are:

- the identification of the major shortcomings taking into consideration the TEN-bottlenecks and ECE-commentary on bottlenecks and missing links;
- the provision of the regional division of Europe based on the waterway network;
- the definition of regions and river basins;
- the registration of the envisaged construction works including assessment of their consequences on inland navigation.

In order to facilitate the identification of significant features and performances and to enable proper analyses and conclusions, the provided set of data presents the relevant waterways for commercial inland navigation.

5.2 Method of working

Area of investigation

Data are collected on national level. There are a number of countries initially considered to be investigated within the European area:

- 15 EU Member States
- Switzerland
- 8 accessing countries to join the EU in 2004 (out of 10, excluding Malta and Cyprus)
- and 2 candidate countries envisaged to join in 2007 (Romania and Bulgaria).

The list of concerned countries was slightly altered after the first preliminary checking of the level of national IW activities has been made. The modified list includes:

- 12 EU Member States actively participating in IW activities (because Ireland, Greece and Denmark have no inland navigation at all),
- Switzerland,
- Poland, Czech Republic, Slovakia, Hungary, Lithuania which will join the Union in May 2004 (Estonia, Latvia and Slovenia have no inland navigation),
- Romania and Bulgaria as candidates to join the EU in 2007,
- Croatia and Serbia as the countries located on a capital European waterway and central part of the South-East transport corridor (Danube as TEN Corridor N°7) and
- Ukraine (only in pretty restricted aspects) due to its presence on the lower Danube and potential fleet operating on the entire course of the Danube river.

By analysing Serbia, Croatia and (partly) Ukraine the extent as well as the value of the investigation has been enlarged, even though these countries officially are not yet included in the PINE-project.

Network subdivision

The aim of this step is to provide an overview of the waterway network within the investigation area as defined in the previous section 5.2.1. One of the waterway (WW) network characteristics of most concern is its total length. In this context several sources and statistics were used. Thereby it was always tried to define the background for the given figures even though very often the area and validity and selection criteria have not been explicitly and clearly defined by the data supplier.

The first rough assessment (the first iteration) of the total length of the waterways within the PINE investigation area was made using the AGN document[34]. The AGN has identified the so-called 'E' inland waterways in Europe. Thereby, according to the list of classified waterways in the AGN document the term 'Europe' comprises the entire European continent westwards of Ural (waterways in the Russian Federation, Ukraine and Belarus included). The least criterion for the classification under the 'E' waterway is its compliance with the ECE class IV. On the other side the ECE Resolution N°49[35] quoted this AGN document as the source and provides the following 'Classification of E waterways':

Class	Missing links	Less than **IV**	**IV**	**V**a	**V**b	**VI**a	**VI**b	**Vi**c	**VII**	Σ
Length km)	1489	4286	3969	3270	5051	667	5766	1592	1621	27711
Length (%)	5.37	15.47	14.32	11.80	18.23	2.41	20.81	5.74	5.85	100

Table 14. Main European Inland Waterways as published by the UN-ECE Resolution N°49

The problem here is that according to the AGN definition the 'E' waterways have at least an ECE class IV or above. But the ECE document provides the figures in Table 13 showing a total of 27,711 km of all classes. Subtracting the length of smaller waterways (less than class IV and 'missing links') it could be concluded that there are only about 22000 km of 'E' waterways. And then, if reasonably assessed that some 6500 km are located in the Russian Federation (its European part only[36]) and roughly about 1500 km in Ukraine and Belarus, only about 14,000 km of waterways remains which might be in this first iteration roughly considered as the total network length within the PINE investigation area. This first estimate of the PINE WW network length (about 14,000 km of higher WW classes or about 19,700 km of all waterway classes) opened up some questions and underlined the need to look for other, possibly genuine local (national) sources in order to provide realistic and reliable information on the actual WW length.

The best general overview of PINE network can be achieved looking at the corridor subdivision (Fig.22). Following the approach of 'Shifting Cargo'[37] and 'Market observation for the inland waterway sector'[38] four corridors were identified within the European IW network:

- ***Rhine Corridor*** comprising the Rhine confluence and the canals in the western part of Germany, the Netherlands, Switzerland, the eastern part of France and in Luxembourg,
- ***Danube (South-East) Corridor*** including the entire Danube confluence with all tributaries and navigable canals as well as the Main-Danube Canal,

---

[34] European Agreement on Main Inland Waterways of International Importance (AGN) -1998

[35] United Nations Economic Commission for Europe: 'Inventory of most important bottlenecks and missing links in the E waterway network – Resolution N°.49, New York and Geneva, 2003, TRANS/SC.3/159, page 4, Annex

[36] TACIS 'Strategic Study on International Freight Transport to and from the Russian Federation on the Black Sea Routes', Moscow-Hamburg-Duisburg-Athens, 1994-96

[37] Shifting Cargo to Inland Waterways, RTD project done within the 4th Framework Programme in Transport, 1996-1998

[38] Market observation for the inland waterway sector, investigation on behalf of the European Commission / DG TREN, Annual Report, January 2003

- ***East-West Corridor*** with the Mittelland Canal in northern Germany and the confluences of Elbe, Oder and Wisla as well as the
- ***North-South Corridor*** covering the major rivers, navigable tributaries and linking canals extending between the lower Rhine area and the Mediterranean, practically throughout France including the links to the Belgian network.

Besides these four corridors forming more or less the integrated European IWW system there are certain isolated national subsystems which due to their local importance and transportation records have to be listed too. These are waterways in:

- Scandinavia, i.e. in Finland and Sweden,
- the United Kingdom,
- Italy and
- the Iberian peninsula, i.e. Portugal and Spain.

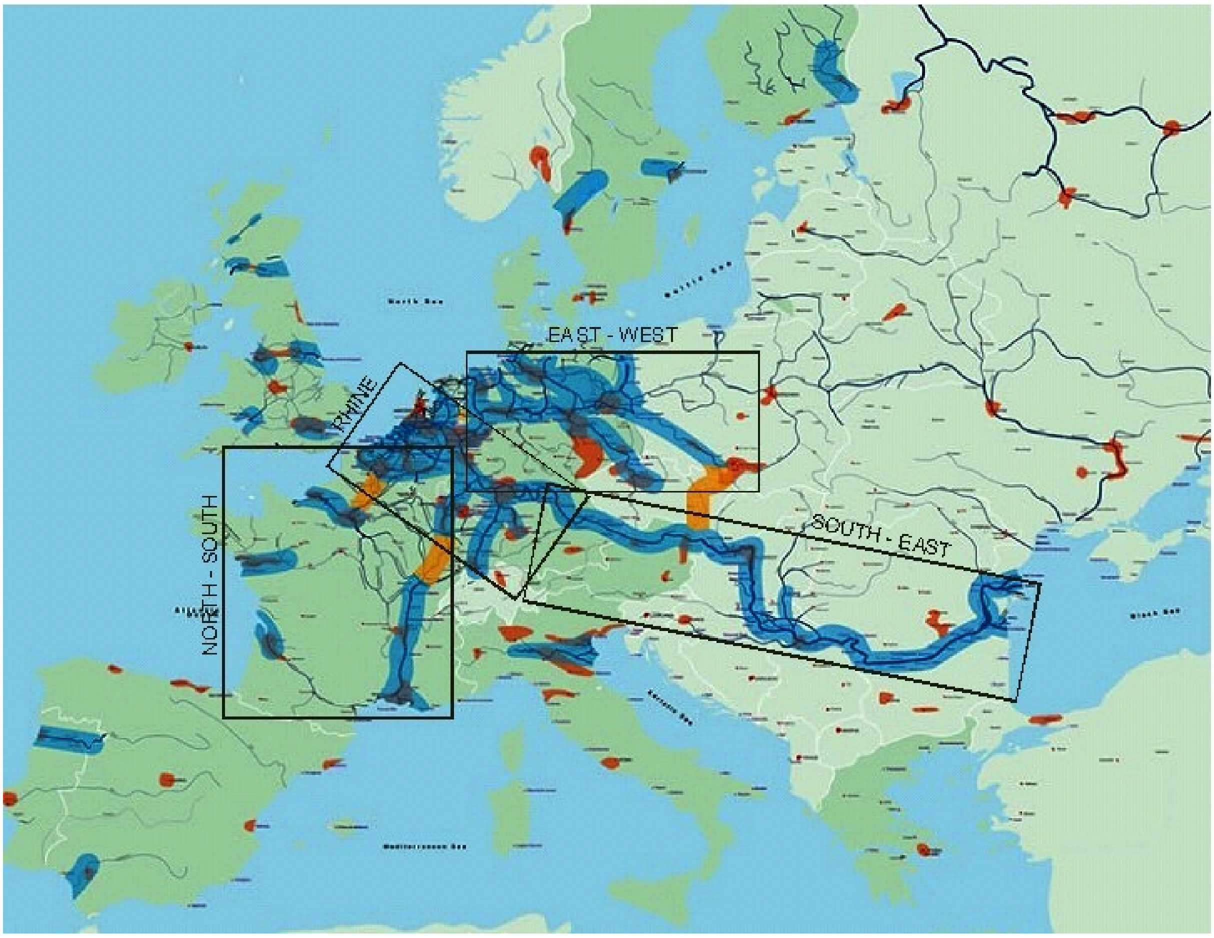


Figure 21. Inland Waterway corridors in Europe (By courtesy of INE/Via Donau)

In order to provide characterising details and a clear and comprehensive review of the major waterways, the entire investigation area is subdivided into 13 regions (Figure 22). This division was governed by a reasonable combination of the size of the area, the geographical location, the importance and capacity of the respective waterways as transport resources and the general integration level of the respective waterway group into the European network.

A selection of waterways within each of these 13 regions is presented in the ***appendix Inventory of waterways*** in tabular and schematic graphical form including further basic textual explanations.

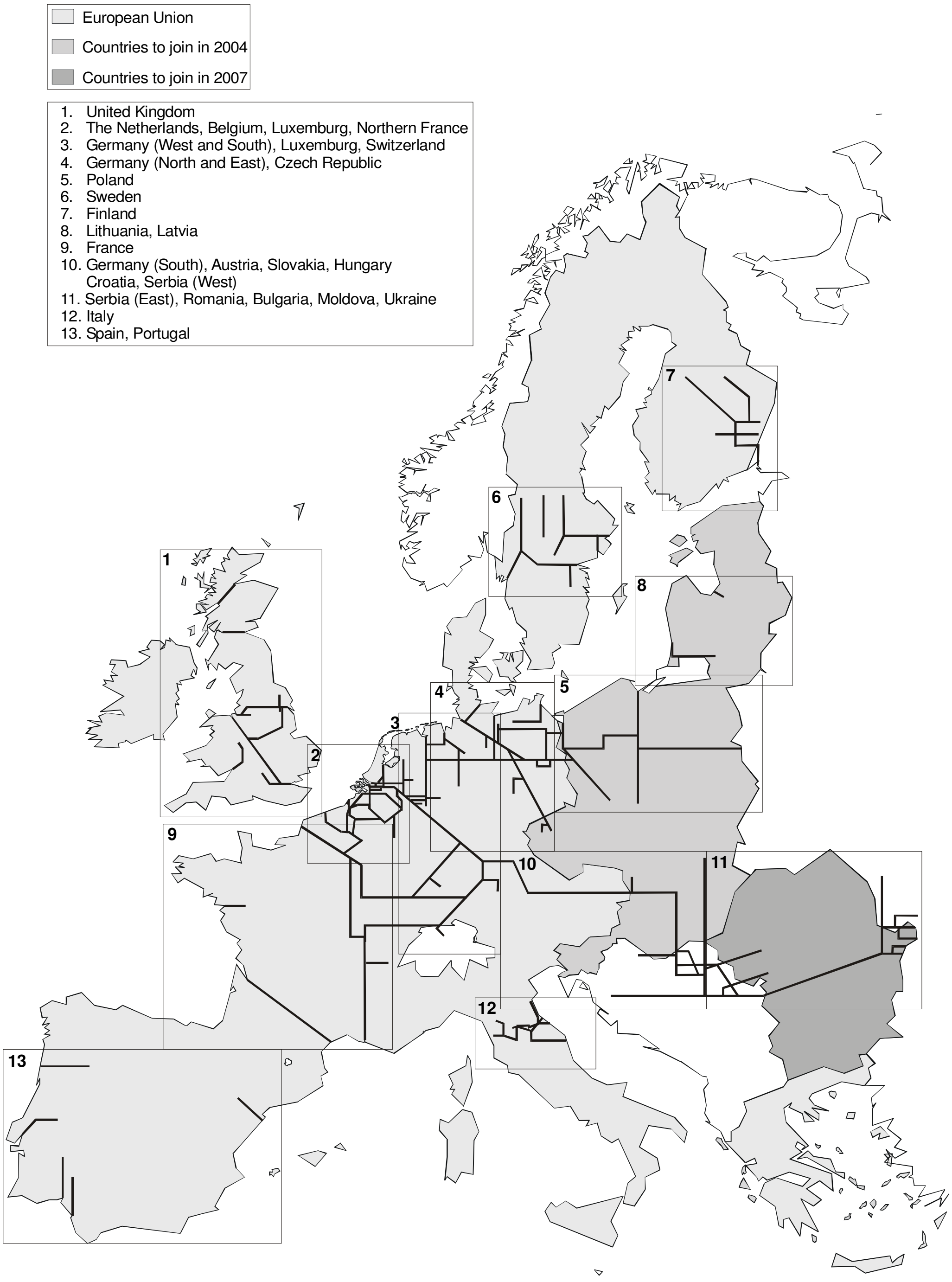


Figure 22. Subdivision of Inland waterways network in PINE

Data sets and definitions

The term ‘navigable waterway’ should include all seven waterway classes (with additional subclasses) as defined in the CEMT Resolution N°92/2.

Additionally, class ‘0’ which appears in some cases relates to those smaller waterways which are basically used just for recreational purposes.

The waterway data sets provided in ***the appendix*** comprises the following entries:

- Name of the WW
- Stretch (from-to) with uniform nautical conditions
- WW class assigned to the respective stretch according to the CEMT Resolution N°92/2.
- WW class assigned to the respective stretch according to the recommendations for the classification of fluvial-maritime waterways done by the PIANC PTC-I Working Group 16
- Navigable length of the stretch in km
- Maximal allowed breadth of a ship or pushed train in m.
- Maximal allowed draught in m (with one digit fraction) at low water level. The precise definition of low water level slightly differs from river to river (Rhine, Danube) but for the purpose of this study it has to be considered roughly as the water level which is achieved during about 90% of the year
- Maximal allowed height of a ship due to bridges or other structures above the water surface at high water level. High water level is defined here as the water level which is not excelled during more than about 5% of the year
- Total number of locks along the considered waterway or waterway segment
- Special remarks referring to the waterway or waterway segment indicating e.g. the restrictions of potential or bottleneck(s). This remark might be for instance:
    - shallow water sectors (permanent or periodical)
    - frequent, abrupt and/or considerable water level fluctuations
    - expressed flooding tendencies
    - high probability and/or considerable duration of ice periods (winter cease of navigation)
    - restrictions/hindrances for vessels sailing in opposite directions to pass-by each other (passing-by restrictions)
    - longer waiting times in front of the locks
    - commercial transport of goods not allowed (waterway dedicated only for recreational purposes, usually the waterways of CEMT classes lower than III)
    - construction works on upgrading planned or already under way

All waterways of international importance – i.e. ECE classes IV, V, VI and VII including subclasses – are analysed. Also numerous waterways of regional importance are covered in the scope of this chapter. The selection and presentation of smaller waterways of regional importance – ECE classes I, II and III - are made considering their:

- level of integration into the European waterway system (junctions to the waterways of higher ECE classes),
- general transport potential and performance,
- importance for regional economy not only for use as goods transportation resource but also for e.g. fishery, tourism, nautical recreation purposes, fresh water resource etc.

This means that it may happen that in some regions with a considerable number of smaller waterways, dedicated exclusively to the recreational use as alternative links parallel to the main waterways (as e.g. in the Netherlands), these lower classes waterways are just generally mentioned even though some of them might be of a relatively high class III. On the other side, for those regions where the main waterway network is underdeveloped, the small waterways might have a relatively high regional importance. In those cases the smallest waterways of the CEMT class I and even 0[39] are included.

It was realised at the very beginning that a complete data coverage and absolute accuracy will not be achieved. Fortunately, basic data sets for countries with considerable inland navigation activities were more easily available than for those countries having a low IWT profile. Despite of the impressive number of sources (publications and websites listed in bibliography, numerous interviews with competent persons), the density and accuracy of data from for instance Spain, Portugal and Lithuania remain relatively low. Also, data sets for Great Britain, France, Sweden and Finland as well as to a certain extent for Poland, Czech Republic and some Danube countries are not always 100% consistent and reliable. During the data collection and analyses it was found out that the best data coverage and least diversity of figures from various sources is in the countries with the strongest IWT industry and tradition – the Rhine riparian countries.

Nevertheless, with this data a clear and comprehensive picture of the waterway infrastructure in both the EU member states and the accession countries can be drawn.

---

[39] '0-class' - Non-classified waterways dedicated only for recreational use.

5.3 Corridors and main river basins

Corridors

According to the Shifting Cargo project and the Market investigation study the integrated inland waterways network in Europe can be subdivided into four main corridors. The separation which is used in this study is described below. Since three of these corridors overlap more or less in the north-western part of Europe (Belgium and the Netherlands), this area has been allocated in this study as described in order to avoid double countings.

- The Rhine corridor extending in north-south direction between the North Sea and Basle and in west-east direction between the Canal de Aire (Dunkerque-Lille) and the river Weser (Bremerhafen-Minden). The Rhine corridor includes the river Rhine as the backbone and the very dense waterway network in the Netherlands, partly Belgium, Luxembourg, western parts of Germany and the northeastern parts of France. The entire Rhine corridor is located within the existing EU member states.
-
- The Main-Danube waterway represents the major axis of the South-East corridor. Besides the rivers Main and Danube mutually linked by the Main-Danube Canal there are a number of navigable tributaries and canals merging the Danube in its middle course as well as three navigable arms and two large canals in the Danube Delta. The majority of the EU candidates to access in 2004, 2007 and those to probably join later are located along the Danube whereby some of them are countries with considerable IWT strengths and potential.
-
- The East-West corridor extending from the Weser in the west to the river Odra in the east and from the Baltic Sea in the north to Kozle in Poland in the south is concentrated around the Elbe river. The link between east and west is the Mittelland Canal. Besides these waterways, there are numerous smaller navigable tributaries of Elbe and Odra like e.g. Spree, Moldau (Vltava), Saale, Peene, Trave etc. as well as lot of canals in the eastern part of Germany. Besides Germany the corridor network is located partly in the Czech Republic and in Poland.

- Two major rivers might be considered as the backbone of the North-South corridor. These are Seine and Rhône. Despite of their physical waterborne linkage, the quality of mutual links as well as the link between Rhône and Moselle (Mosel) belonging also to this corridor does not allow the traffic of larger vessels. Practically, the entire corridor is located in France and neighbouring regions in Belgium.

The remaining waterways in Europe are isolated subsystems. These are smaller networks or individual waterways in:

- the United Kingdom
- Sweden

- Finland
- the Baltic countries (Latvia and Lithuania)
- Italy and
- the Iberian peninsula (Spain and Portugal)

Additionally, two large IWW subsystems (not directly linked by inland waterways to the major European system) are located in the European part of the former Soviet Union. These are the confluence of the Dnepr River within the Ukraine and the so-called ***'Integrated deep waterway system'*** in the Russian Federation comprising among others the rivers Volga, Kama and Don. However, these two subsystems are beyond the PINE investigation area.

Major rivers and canals

The review of the integrated part of the network identifies certain general system characteristics:

- The number of navigable waterways and the total network length is relatively high.
- The network density considerably differs from region to region.
- The quality of waterways with regard to their nautical conditions (considerably influencing transportation capacity) extends in wide range, from low navigable potentials and poor conditions to high potentials and good conditions.

Regarding their level of importance as transport infrastructure a proposal for a rough classification might be applied:

- Trans-European capital waterways
- International waterways
- National waterways
- Waterways of regional importance (may be international or national)

In the highest category of the Trans-European links the about 3500 km Rhine-Main-Danube Waterway connecting the North Sea at the northwest of the continent to the Black Sea at the southeast can be classified. The RMD Waterway extends along the entire Rhine and South-East corridor and is interlinked to the East-West corridor over the Rhine-Herne, Wesel-Datteln and Dortmund-Ems canals as well as over the Schelde-Rhine link, the river Maas and the Albert Canal to the North-South corridor.

International waterways are those bigger rivers with a considerable transport potential and (presumably, 'has to be') the level of use like for instance Mosel (Moselle) and Maas (Meuse) in the Rhine corridor, Elbe (Laba) and Oder (Odra) in the East-West corridor, Vah, Drau (Drava), Theiss (Tisza, Tisa), Save (Sava) or Prut in the South-East corridor. However, due to a better economic situation and positive political developments, despite of not always favourable nautical conditions Elbe, Mosel and Oder have a higher utilisation rate in this moment than other international rivers listed here.

There is also a number of pure national waterways of a rather high quality and transport capacity like the Seine and Rhône in France and the Schelde in Belgium (North-South), Neckar, Weser and Ems in Germany (Rhine corridor) or Vltava (Moldau) in the Czech Republic (East-West). Besides, there are also a number of national navigable canals of the highest quality, like the Amsterdam-Rijn Canal in the Netherlands (Rhine corridor) or the Albert Canal in Belgium (Rhine, North-South). More than that, the Mittelland-Kanal in Germany together with the accompanying links on its west and east ends has the highest strategic importance as the waterborne link between the West and the East of Europe. In South-Eastern Europe the Danube-Black Sea Canal belongs to the Romanian national waterways but due to its location, function, excellent nautical conditions and large transport capacity this canal has also a high international importance and especially high potential importance for the presumably positive future developments.

According to the adopted classification system, the European inland waterways dedicated to commercial use are divided into 7 main classes. Classes I to III are waterways with limited national or regional importance. Due to their navigability for larger vessels, the waterways of the class IV and higher have an international importance. An especially high potential as waterborne transport infrastructure have the highest classes Vb to VII enabling the operation of pushed trains.

According to the least values that have to be satisfied, the waterways of these highest classes should, besides the potential in transportation of traditional commodities, also enable transport of containers in four or at least in three layers (having a minimal bridge clearance at high water level of 9.10 m or, in certain excepted cases, not less than 7.00 m). The so-called 'backbone' of the European waterway system, the Rhine-Main-Danube waterway, nominally satisfies these highest standards. Particular and considerable sections of the Rhine and the Danube are assigned the highest classes VIc and even VII while the rest of the stretches, the river Main, the Main-Danube-Canal and the upper Danube satisfies at least the class Vb requirements.

Theoretically, a through-going navigation of about 3300 tdw pushed train is enabled between North and Black Sea. Unfortunately, the quality parameters for the assigned classes are not reached at a number of spots all the year round so that in reality such shipments with fully utilised capacities are quite often unfeasible. Insufficient water depth is the most restrictive factor on the Danube as e.g. on the stretches Straubing-Vilshofen, Wachau, Vienna-Bratislava, Nagymaros-Budapest, on some 10-15 spots downstream the Iron Gate II lock and finally on the main Danube stream between the Bala Arm and Giurgeni. Regarding bridge clearances the entire courses of Main, Main-Danube Canal and the upper Danube appear to be unfavourable for transport of certain commodities, especially containers.

Network density and navigability

Considering the size of the concerned area, the European waterway network has a very impressive total length and average density. This fact opens up large opportunities and potentials for utilisation, starting primarily for transportation needs but including also various other usage of water resources, for energy production, for agriculture, for fishery and last but not least for recreational purposes.

On the other side, this network is unevenly distributed and developed. This relates both to the regional network density and navigability i.e. to the waterway quality in nautical terms. Using numerous diverse sources of information and statistics, an attempt was made to provide quantitative assessments of these two network qualities. Namely, a higher density and a better navigability offer prerequisites for inland navigation as competitive, reliable and environmental friendly transport alternative and consequently provide better conditions for an overall economic wealth and growth of the concerned area.

Statistical figures on country surface, total length of waterway network[40] but also total population were collected and presented in Table 14. Total population and its density may serve as an indicator for the potential market size and thereby for potential transportation demands.

---

[40] All classes of waterways used for commercial navigation (ECE classes from I to VII), total waterway lengths based on information obtained from national sources. Diverse national and other local sources were used here because previously mentioned AGN and UN-ECE documents (see Chapter 2.2. on page 4) do not provide information suitable for the purpose of this analysis. Namely, in order to present differences in waterway density in particular countries, the total length of the national waterway network is the relevant parameter and therefore for this purpose genuine national sources have been used in this context. However, also on this ‘lower’ level (closer to genuine source) a number of inconsistencies and confusing information have been met. The first one is that almost for all countries different sources provide different figures on the total length of the national waterways. This has been especially emphasised for the countries with lower IWT profile. Such kinds of inconsistencies were solved comparing figures from several sources and selecting the most reliable one. The second problem was in obviously other standards applied for the classification of inland waterways in some countries, as for instance including routes over isolated lakes and coastal waters into the total inland waterways length. Eventually in some countries there are more than one authority responsible for the inland waterway network whereby each of these regional authorities issues the data on its part only (the case of United Kingdom). Being well aware on such circumstances an attempt was made to provide a realistic assessment of the particular national network lengths adjusting the original figures to the common standards.

Country	Area [sq. km]	Water-ways [km]	Waterway Density [km/1000 sq. km]	Corridor	Population [mill.]	Population density [pop. per sq. km]
Austria	83859	358	4	SE	8066	96
Belgium	30518	1434	47	R + NS	10263	336
Bulgaria	110910	472	4	SE	8150	73
Croatia	56414	595	11	SE	4391	78
Czech Republic	78860	303	4	WE	10267	130
Denmark	43094	-	-	-	5349	124
Estonia	43431	-	-	-	1367	31
Finland	304530	3577	12	Rest	5181	17
France	543965	5736	10	NS	58518	108
Germany	357022	7367	21	R+SE+ WE	82260	230
Greece	131626	-	-	-	10554	80
Hungary	93030	953	10	SE	10198	110
Ireland	70273	-	-	-	3834	55
Italy	301316	535	2	Rest	57844	192
Latvia	64589	12	0	-	2439	38
Lithuania	65300	277	4	Rest	3693	57
Luxembourg	2586	37	14	R	441	171
Netherlands	33882	5046	123	R	15987	472
Poland	312685	3650	12	WE	38649	124
Portugal	91906	250	3	Rest	9998	109
Romania	238390	1166	5	SE	22431	94
Serbia	88361	1561	18	SE	9500	108
Slovakia	49035	422	9	SE	5403	110
Spain	504790	69	0	Rest	40122	79
Sweden	410934	549	1	Rest	8883	22
Switzerland	41300	18	0	R	7321	177
Ukraine		174		SE		
United Kingdom	243820	5000	20	Rest	59756	245

Table 15. Waterway network and population density within the PINE area

Rhine	465308	13902	30	R	116272	250
South-East	1077021	13068	12	SE	150399	140
East-West	748567	11323	15	EW	131176	175
North-South	574483	7170	13	NS	68781	120
Rest (with IWT)	1922596	10257	5	Rest	185477	96

Table 16. Corridor summary (overlapping of corridors, just IWT countries accounted)

EU members + CH	3195421	29976	9	EU	384377	120
Candidates	1056230	7255	7	6C	102597	97
Rest	144775	2156	15	SER+HR	13891	96
Total PINE	**4396426**	**39387**[41]	**9**		**500865**	**114**

Table 17. Geopolitical summary (all countries accounted)

---

[41] Despite the 'filtering' and adjusting of each questionable figure in order to achieve unified criteria it is obvious that the sum of total lengths obtained from national statistics within the PINE area is more than twice so much as the total length assessed on the basis of the AGN figures. Regarding the total waterway length the figures given in Table 4 seem to be more realistic. However, there are also here a lot of smaller non-avoidable (methodological) errors leading to the total length somewhat higher than actual. The reasons are:

- 'filtering' and 'adjustments' of genuine figures being made too optimistic in favour to IWW (Finland, Sweden)
- for some countries with very large network (UK, Poland) the smallest waterway classes I and 0 were not mutually distinguished in available sources and most probably also 'non-commercial' class 0 is included for both countries. As far as small waterways share is by far dominating in both these countries it was not possible to provide any assessment of the shares of '0' and 'I' class waterways in total national networks.
- There are numerous waterways representing the border line between two neighbour countries (Germany-Netherlands, Germany-Poland, Germany-France, Slovakia-Hungary, Serbia-Croatia, Serbia-Romania, Bulgaria-Romania etc.) and national statistics account these common stretches as their own. That results in double counting.
- Due to the above listed reasons the sum of 39.387 km must be treated as a very rough assessment too.

For each country except for the Ukraine (just the length of the Danube stretches are included in PINE and not of other national rivers) the average network density in km waterways per 1000 square km of the area is calculated. By calculating the corridor summary waterways in Germany were accounted in three corridors – Rhine, West-East and South-East. This resulted in a higher sum of the corridor lengths than the total network length. The same approach was made for Belgium (Rhine and North-South corridors). But anyway, having in mind the nautically integrated systems in Germany and Belgium, an attempt to assign portions of national networks to respective corridors would be pretty arbitrary. Nevertheless, the assignment of the entire network at first to one and afterwards to another corridor does not affect the consistency and common sense of the resulting average density.

It might be concluded, that the Rhine corridor has about a twice higher network density than the other three corridors and even 6 times higher than the average of the non-integrated waterway subsystems. A similar proportion is in the population density, at least between the Rhine and the other integrated corridors. Considering the geopolitical classification on EU members and candidates no significant difference might be observed regarding the network density. Here only the small ‘rest group’ represented by Croatia and Serbia as the countries located on the middle course of the Danube shows a remarkably higher network density due to the existence of larger navigable tributaries and a developed navigable canal network in northern Serbia.

Another quality aspect is the navigability of waterways. It might be assessed first of all by applying the ECE classification scheme (see inventory tables in the appendix) and secondly, through the deeper analysis of the waterway conditions within a certain time span to identify seasonal deviations. Namely, the water level fluctuations on free flowing rivers might be very high, not always predictable and often with unfavourable consequences. The thorough assessment of the navigability characteristics can only be done along the segments, waterway by waterway, stretch by stretch. Therefore, an attempt was made here to provide rough general judgements on the nautical qualities in each of the four corridors using the known facts and experiences on particular waterways.

The part of the waterway network assigned to the ***Rhine*** corridor is evidently the most developed, maintained and utilised for the transportation purposes. Also the share of waterways of upper ECE classes is considerably higher than in other corridors. For instance, almost 50% of the large network of Dutch waterways are of class IV or higher. A similar situation is in Belgium and on waterways in the western part of Germany merging to the Rhine river. Except the middle and the lower Rhine course almost all the rivers in this corridor are canalised, i.e. dams with locks enable optimal and stable nautical conditions. Another quality of the Rhine corridor, especially the network segments in the Netherlands, is the existence of numerous waterways parallel to the main links which, depending on their nautical qualities, are used as alternatives or for feeder services. And last but not least, the existence of numerous smaller but well maintained waterways in Belgium and the Netherlands enables efficient feeder and even door-to-door services between industrial plants directly located on waterways and equipped with own transhipment facilities.

The ***South-East*** corridor is practically the confluence of the Danube river, with a navigable length of 2414 km the second biggest in Europe, after the Volga.

The entire course overlaps with the TEN-T corridor N°VII as the unique TEN waterborne corridor. All other TEN corridors are prevailingly assigned to the land based transport modes rail and road and only the TEN N°VII offers all three alternatives or any combination of them along its entire length. Nominally, all waterways in the ***South-East*** network are of a very high class. The Danube itself has at least class Va in its upper range and gradually increases to the highest possible class VII along the last 1500 km in front of the mouth. And almost all tributaries and navigable canals merging the Danube in its middle range belong to class IV or even Va.

The most unfavourable facts in this corridor are the existence of critical spots – bottlenecks – with considerably worse conditions than on adjacent 'average' sections as well as the large annual fluctuations of the water level. Moreover, the level of hydro-technical measures, maintenance and nautical aids are according to the experienced skippers quite different in the upper and the lower river range. Namely, maintenance and safety standards (e.g. markings as nautical aids) applied in the upper range, in Germany, Austria, Slovakia and Hungary are much higher than those in Romania and Bulgaria. From this point of view, the middle Danube range has also relatively low technical standards but due to the existence of large water reservoirs at the Iron Gates, the navigation in this sector is not much affected, at least not as regards the insufficient water depth and width.

The ***East-West*** corridor is characterised by relatively stable and favourable conditions on the main link – the Mittelland Canal – especially since the construction work on improvements took place over the recent years. But free flowing stretches of the rivers Elbe and Oder have quite unstable conditions largely affecting inland navigation. The class structure of waterways at the eastern part of the corridor in Poland with nominally more than about 3500 km of waterways shows less than a 5% share of ECE classes IV and higher and even about 60% of the lowest class I enabling only the operation of vessels with a capacity of up to about 200 tdw. Additionally, the large annual water level fluctuations and cold winters with frequent and long lasting cease of navigation due to ice do not allow at the moment comparable pre-conditions like in other corridors. Within the East-West corridor the positive exception is the relatively short but almost fully canalised network of higher ECE classes of the river Elbe (Labe) in the Czech Republic.

France has one of the biggest national networks within the PINE area. As far as the ***North-South*** corridor linking the North Sea and Mediterranean coincide mostly with French territory (about 8500 km of waterways in France[42]) its density is however beneficial. The N-S Corridor is characterised with large share (almost 75%) of minor waterways (so-called 'Freycinet' network navigable for small vessels of about 250 t capacity). These minor waterways interconnect 6 major waterways: Seine, Dunkirk-Schelde link, Rhone/Saone, Moselle (Germ. Mosel), Rhine and Garonne. The navigability of Seine and Rhone meets the highest standards of both nautical capacity (high ECE classes) and maintenance and safety standards.

---

[42] This figure relates to all waterways in France, including those for recreational purposes (ECE class 0 and above) while the sum of 5376 km in Table 2 represents only those waterways having an ECE class I or above (suitable for commercial transports).

But the unfavourable fact in the North-South corridor is that except these two major rivers almost all other waterways are of considerably lower capacity. That prevents through-going operation of larger inland vessels between corridor end points. Despite of the existence of mutual navigable links between Belgian waterways, Seine, Rhone, Mosel and Rhine the navigability of these links enable the operation of only smallest commercial vessels with perhaps questionable economic justification.

Isolated subsystems are mostly developed in the United Kingdom (the entire country is covered with a dense canal network totalling some 5000 km in length of prevailingly lowest ECE classes 0 and I - see the appendix), in Italy where the network (mostly ECE classes Va and IV) is concentrated in the Po Valley in the northern part of the country (high seasonal water level fluctuations), and in Finland and Sweden. Swedish and Finish inland waterways are propagated on numerous lakes mutually linked by navigable canals and with access to the open sea. This conducts these waterways to be used mostly for direct inland-sea services as well as for very developed recreational purposes, however, due to severe winter conditions only during a restricted period of the year.

Regarding the large differences between international common statistics (AGN, ECE – Table 13) and national sources (Tables 14 and 16) an own PINE waterway review and analysis has been made. Numerous genuine sources have been used and the figures and parameters (not only lengths of the waterway stretches) were analysed, compared, discussed with the Advisory Group members and other competent experts. Selection criteria for waterways to be included in this analysis are already defined in Section 5.2. The results of this comprehensive and voluminous task are presented in the Appendix ‘Inventory of waterways’, investigating a total of about 24´000 km of inland waterways.

River-Sea links

River-sea shipping is one of the forms of shortsea transport. The concept is very simple: one vessel sails on both coastal and inland waters avoiding cost intensive transhipment in the seaport. Direct river sea-links are those routes between two inland ports or at least one inland and one sea port which are lead partly along the inland waterway and partly over the maritime stretch and which are done by suitable vessels, able to operate in two nautically different environments: rivers/canals and maritime/coastal stretches. This definition must be interpreted very carefully and with full understanding of all circumstances and conditions. For instance, the operation of sea-going ships entering the Elbe to the Port of Hamburg must not be classified as river-sea services because the Port of Hamburg is still a typical deep-sea port, despite of its location deeply in the hinterland. Namely, the Elbe stretch between Hamburg and the estuary into the North Sea is dedicated to and used almost exclusively by sea-going ships. The same reason might be applied to some ports in the maritime range of the Danube as well as to several Scandinavian ports (Sweden, Finland) and Iberian ports (Spain, Portugal).

Furthermore, river-sea services are nowadays characterised by rather and prevailingly sporadic than regular routes. This fact does not allow the possibility to identify and list the routes in the same manner, as it is done for inland waterways.

Nevertheless, the huge potential for river-sea services is evident from the map of Europe, schematically showing the hinterland reaches of direct services along the nautically suitable and economically interesting confluences.

Nowadays, the most developed and in numerous cases regular liner services are developed between ports in the Rhine corridor (the Netherlands, Belgium, western Germany) and the British east coast, Sweden and Finland.

Examples for frequent ports of call for river-sea services are Duisburg and Cologne in Germany, Maastricht in the Netherlands, Liege and Brussels in Belgium, Goole in England, Västeras, Köping and Vänersborg in Sweden as well as Finnish ports within the range of the lake Saimaa.

Other less frequent regular and numerous sporadic services exist between the lower Rhine and the sea ports in Norway, the Baltic area (eastern parts of Germany, Poland, Estonia, Latvia, Lithuania, Russian Federation), ports on the French Atlantic coast (Seine up to Paris), the Iberian Peninsula (lower reaches of Douro and Tejo in Portugal as well as Guadalquivir up to Sevilla in Spain) and the Mediterranean Sea (in France Rhône up to Lyon) including ports in northern Africa.

Sporadic direct river-sea services exist also on the Danube, very deep in the hinterland. Danube ports downstream Budapest (in recent years temporarily only those downstream Belgrade) are linked mostly to the Black Sea and Aegean ports as well as to inland ports on Dnepr, Don and Volga rivers.

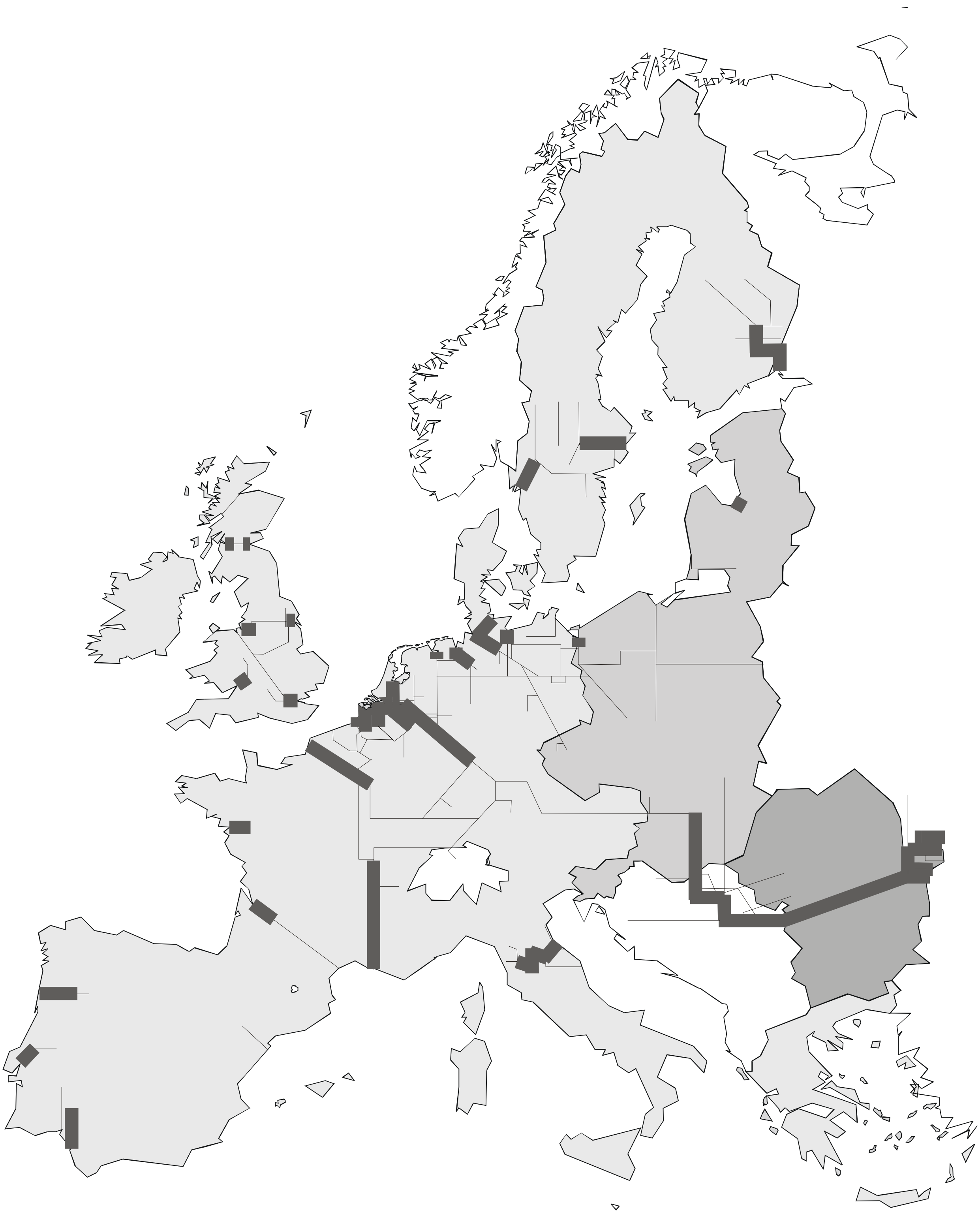


Figure 23. Destinations in hinterland within the standard range of river-sea vessels

Direct river-sea shipping has important advantages:

- hinterland destinations can be reached by maritime vessels without reloading in seaports, saving both time and money
- isolated waterway destinations in the periphery are linked to the European main IWW network (United Kingdom, Scandinavia, Baltic, Mediterranean to the Rhine corridor)
- the potential of inland waterway corridors is increased through creation of links to shortsea shipping routes
- releasing the pressure on seaports to distribute transhipped goods towards the hinterland.

The limits of river-sea shipping are determined by the nautical bottlenecks and additional technical requirements set up for the vessels to safely operate both in calm but confined inland waterways (shallow water, bridge clearances, locks) as well as in often rough maritime waters (see also Chapter 4 on Fleets).

5.4 Major shortcomings

Drafting the AGN[43] the 'UN-ECE Working Party' on Inland Water Transport stipulated the definitions of:

- missing links
- strategic bottlenecks
- basic bottlenecks.

According to the AGN definitions these are:

'Missing links are those parts of the designed IWW network which at present do not exist at all or where the quality of the link is by far below the standards of waterways which have to be mutually interlinked.'

'Strategic bottlenecks are waterway sections satisfying the basic requirements of at least ECE class IV but which, nevertheless, ought to be upgraded in order to improve the structure of the entire network or to increase the economic viability of inland navigation.'

'Basic bottlenecks are the waterway stretches whose nautical parameters at the present time are not in conformity with the requirements applicable to inland waterways of international importance (ECE class IV and above).'

---

[43] European Agreement on main inland waterways of international importance.

Accordingly, the UN-ECE Working Party identified and classified missing links and both bottleneck categories within the European network.

Additionally, INE[44] identified a selection of missing links and strategic bottlenecks in the four main corridors of the integrated European network.

The following sections provide a comparative review of these infrastructure shortcomings in particular PINE countries according to the above-mentioned categorisation.

Missing links

There are a number of missing links identified by INE and UN-ECE. They are sorted according to corridors and countries below. Since some of them connect different corridors, they might be mentioned either in the one or the other corridor.

	Country	**UN-ECE (AGN)**	**INE**
Rhine Corridor	Belgium	Liege-Köln (Meuse-Rhine)	Liege-Köln (Meuse-Rhine)
		Maldegem-Zeebrugge	
	France	Rhône-Rhine	
South-East Corridor	Austria, Poland, Czech Republic, Slovakia	Danube-Odra-Elbe	Danube-Odra-Elbe
	Slovakia	Vah-Odra	
	Romania	Danube-Bucuresti	
		Olt-Slatina	
	Croatia	Danube-Sava (Vukovar-Samac)	
West-East Corridor	Germany	Magdeburg-Berlin (MLK-EHK)[45]	
North-South Corridor	France	Seine-Moselle	

---

[44] Inland Navigation Europe – Association promoting inland navigation in Europe.

[45] The AGN classification of Magdeburg-Berlin navigable connection as a 'missing link' is false – there was a link from MLK using the section of Elbe and canals to the EHK also before the construction of waterway bridge over Elbe enabling vessels to pass directly from MLK to EHK.

	Country	UN-ECE (AGN)	INE
		Seine-Escaut (France-Benelux)	Seine-Escaut (France-Benelux)
		Saone-Moselle (Lyon-Nancy)	Saone-Moselle (Lyon-Nancy)

Table 18. Missing links in corridors

In total, four missing links are identified by both expert groups. The first between Liege and Cologne should represent a shortcut from the waterway network in Belgium and the Rhine river. The other three links connecting Seine (near Paris) with the Rhine corridor over the Belgian waterways, Marseille over Saone/Rhône with Moselle/ middle Rhine and eventually Danube over Vah with upper Odra and with Elbe might be also recognised as important.

Beside other canals listed in the above table there are also two 'missing navigable links' being considered during the last decades in the South-East corridor (Danube confluence). One would connect the Danube over Morava (Serbia) and Axios (FYROM, Greece) with the Aegean at Thessalonica and the second one the Sava River in Croatia with the Northern Adriatic. Moreover, for the Danube-Aegean link a comprehensive Greek-ex-YU study was elaborated with financial and technical support of the UN in the mid of the seventies, but due to the huge investment estimates, the realisation was never considered. Hereby, the first link might be considered as of wider regional importance while the Sava-Adriatic link would be beneficial prevailingly for the local economy.

Strategic bottlenecks

The table below provides comparative review of inland waterway bottlenecks in Europe designated as 'strategic' by the UN-ECE and by the INE experts.

South-East Corridor:

Germany	Low depth on Danube (Straubing-Vilshofen)	Upgrading Danube (Straubing-Vilshofen)
Austria	Low depth on Danube (Wachau stretch)	Low depth on Danube (Wachau stretch)
	Upgrading Danube (downstream Vienna)	Upgrading Danube (downstream Vienna)
Slovakia	Upgrading Danube (fairway depth)	
	Upgrading Danube (bridge heights)	
	Upgrading Danube (into ECE class VII)	
Hungary	Upgrading Danube (fairway depth)	Upgrading Danube (fairway depth)
	Upgrading Danube (bridge heights)	
Serbia	Upgrading Danube (fairway depth on spots)	
Bulgaria	Upgrading Danube (fairway depth on spots)	
Romania	Upgrading Danube (fairway depth on spots)	

West-East Corridor:

Germany	Upgrading Elbe	Upgrading Elbe
		Upgrading MLK (bridge clearance)
Poland	Upgrading Odra	
Czech Republic	Upgrading Elbe	Upgrading Elbe

North-South Corridor:

France	Upgrading Oise (bridge clearance)	
	Upgrading Moselle (fairway depth)	Upgrading Moselle
	Upgrading Moselle (bridge clearance)	
	Nord Pas-de-Calais (bridge clearance)	Upgrading link Seine-Benelux
	Upgrading Oise (fairway depth)	
		Upgrading Rhone (lock capacity)

Table 19. Bottlenecks in corridors

Unfortunately the above lists with missing links and strategic bottlenecks do not provide priorities.

At the end of June in 2003 a high-level EU group of experts chaired by the former EU Commissioner Karel van Miert proposed a list of priority projects on European transport infrastructure (all modes) which have to be carried out till 2020. The Group examined over 100 projects put forward by the various states. After examining their technical and economic aspects it assessed, how these projects fit in with the European transport policy proposed in the White Paper, their European added value and the realistic nature of their timetable and funding prospects. On this basis the Group gave the highest priority to the ***upgrading of the Danube*** (main strategic bottleneck in the South-East Corridor, to start work before 2010) and, for the longer-term time horizon, the ***construction of the Seine-Scheldt*** (Escaut) waterway (linking the Seine and the Belgian waterways with a high class navigable canal, nowadays crucial missing link in the North-South Corridor).

It might be concluded that identified strategic bottlenecks have different importance levels from the point of view of the overall European IWT dimension.

Basic (local) bottlenecks

These lowest level shortcomings are not considered in detail within the PINE study. There are, however, a lot of existing links which deserve the right to be upgraded reasonably expecting very beneficial consequences for the inland navigation at local and regional and indirectly perhaps also at international level but such actions can not be given the highest European dimension.

Some examples for this category of 'basic' bottlenecks (extracted from the AGN documents) are:

- Upgrading of the Meuse in France between Givet and the Belgian border into ECE class IV
- Upgrading of the MLK in Germany over the entire length into ECE Vb class (remaining sections only)
- Upgrading of the Saar in Germany into class Vb
- Upgrading of the Havel-Oder-Waterway in Germany into class Va
- Upgrading of sections of Odra and Wisla in Poland into higher ECE classes
- Upgrading of the Odra-Visla connection in Poland from the existing class II into class Vb
- Upgrading of Bug in Poland up to the state border with Belarus into class Vb
- Upgrading of Prut (Danube tributary in Romania) in its lower range
- Upgrading of Vah (Danube tributary) in Slovakia
- Upgrading of Sava in Croatia from existing class III into Vb etc. etc.

In certain cases these improvements might be fully justified not only on national but also on international level. An example for this is the upgrading of the remaining sections of the MLK in Germany as part of the key structure for the waterborne connection between Western Europe as the core of the EU and the candidate countries Poland and Czech.

Bottlenecks identified by other bodies

The UECC (Union of European Chambers of Commerce and Industry) provided its list of missing links and bottlenecks in the European traffic network. Two waterway links have been given strategic importance:

- Construction of a high class waterway link in accordance with modern European standards between the Rhine and Rhone confluences
- Raising the Saone bridges

Similar activities in the eastern part of the West-East corridor are leaded by the Elbe-Oder Chamber Union.

5.5 Construction works

This section provides a brief review of capital current construction works on infrastructure improvements within the PINE area[46], those that were recently accomplished as well as those planned to be realised in the near future. The cost equivalents are given wherever available.

Rhine Corridor

The Netherlands

Selected projects on infrastructure improvements, that are of national importance, are the following:

- Increasing capacity of the fairway Lemmer – Delfzijl (provinces of Friesland and Groningen, in the north of the Netherlands). Start of the project in 2001, costs amount to € 115 million.
- 'Rhine valley' improvements concern the increase of the capacity of several side channels and a new vision on the main artery, the Waal river. Costs are scheduled to be € 197m or more and planning starts in 2005.
- Amsterdam – Rhine Canal: this is the connection between the port of Amsterdam and the Rhine river to Germany. Several locks have to be removed or improved to provide capacity for larger vessels. Costs are estimated at € 89 million and planning is to start in 2006. A specific project concerns the Sea entrance near IJmuiden, for which a budget of € 592 million has been scheduled. This also benefits sea transport.
- In the south of the Netherlands, projects on the Maas and its side canals concern the extension of canals towards the industrial zones in Tilburg and the extension of capacity. Costs are budgeted at € 734 million for several projects. A start in 2004 is planned.

Belgium

In Belgium, several larger projects can be identified:

- Canal du Centre (near La Louvière) was recently (in August 2002) upgraded with the inauguration of the world biggest ship hoisting facility at Strépy-Thieu. The new facility has a lifting capacity of 2000 t (instead of 300 t of the old one). This enables the navigation of inland ships with 1350 tonnes deadweight between Dunkerque and Liege.

---

[46] for Italy based on national sources, for the remaining countries according to Ecorys Transport and Partners: 'Market observation for the inland waterway sector' – Annual report, Rotterdam, 2003.

- The lock at Wijnegem (Albert Canal eastwards of Antwerp) will be renovated and the bridge heights will be elevated. Container transport of three layers will be possible from 2005 on.
- The lock of Lanaye (between Liege and Maastricht) will be upgraded, enabling an improvement of the connection between the Walloon waterway basin (Meuse and Sambre) and the Dutch waterways (Maas and Julianakanaal). The works are to be completed by the end of the 2010.
- Several works have recently been carried out on the Sea canal 'Brussels to the Scheldt'. For example, after the inauguration of new lock at Wintham – Willebroek (halfway) the canal is now attainable for shortsea shipping vessels and the overall throughput capacity of this waterway stretch is currently assessed at approximately 16 million tonnes a year.

Germany

Within the course of the new federal traffic infrastructure plan (Bundesverkehrswegeplan drafted in 2003) several upgrading and construction measures for waterway infrastructure are envisaged. In 2001 about 373 million Euro have been spent for inland waterway infrastructure (not only Rhine corridor but whole Germany). For 2003 an amount of 434 million Euro is planned.

The envisaged measures in the Rhine corridor comprise among others the following waterways:

- Rhein-Herne-Kanal, Dortmund Ems-Kanal, Datteln-Hamm-Kanal (deepening measures)
- Rhine (improvements of the river-bed stability in the lower and middle course)
- Mosel (construction of secondary lock chambers)
- Other smaller projects including measures remained from the previous federal plans for traffic infrastructure

Switzerland

The construction of five locks on the Rhine river upstream Rheinfelden will enable a navigation further upstream for about 35 km up to the mouth of the Aare river.

South-East Corridor

Germany

Improvement projects envisaged in the new federal traffic infrastructure plan comprise the deepening of the upper and lower Main course, the consolidation of the Danube on the Straubing-Vilshofen section (but only in accordance with the proposed alternative A which is often strongly criticised by leading transport experts as absolutely insufficient and ineffective).

Austria

The Austrian General Traffic Plan foresees the investments of approximately € 80 million for the upgrading of the Danube downstream from Vienna (section between the lock Freudenau at Vienna and the Slovak border) over the next ten years. Until 2021, approximately € 0.2 billion will be spent. Measures are also planned in the ports along the Danube, namely the upgrading of the terminals in Vienna- Freudenau and Enns as well as port related infrastructure in Vienna, Enns, Krems and Linz.

Slovakia

Upon the Slovakian sources, the finishing of the Nagymaros step of the Gabčikovo – Nagymaros dam and a lock system is planned within the scope of the original international agreement between Hungary and Slovakia till the year 2005. The question is if this plan is still realistic or not. The Gabcikovo lock is nearly 10 years in operation, with highly positive influence on navigation and on operations of the port of Bratislava. Furthermore, the construction of the Sered dam and the lock on the river Vah and the beginning of the second stage of making the river Vah navigable are envisaged. Regarding port developments, the start of the construction of a transport centre in the port of Bratislava is foreseen.

During the next phase, up to 2010, the finishing of the second stage of making the river Vah navigable on the section Sered-Puchov is scheduled. The third stage comprises the section Puchov – Žilina. Furthermore, the construction of the port of Komarno (eastern part) is planned.

Hungary

Measures are envisaged to ensure the navigability of the Danube according to the European standard ECE class VIb[47] on the Slovakian-Hungarian section. Furthermore, the navigational conditions of other Hungarian rivers (Tisza, Körös, Bodrog) shall be improved.

The above mentioned infrastructure development plans are well defined till 2005, but further developments depend on financial possibilities. These developments can be considered as necessary to meet the transport requirements of the Hungarian economy.

Croatia

In recent years the construction of the ECE class Vb Danube-Sava Canal between the ports of Vukovar (Danube) and Samac (Sava) in a length of 61.4 km with two locks and 17 bridges becomes always more probable.

---

[47] CEMT category VIb indicates a capacity of 6,400-12,000 for push convoys (2*2).

Besides evident benefits for inland navigation in shortening the nautical distance between Croatian ports on the Sava river upstream Samac and ports in western Europe (actually all Danube ports upstream Vukovar) by more than 400 km and destinations in eastern Europe (actually all Danube ports downstream Belgrade) by 85 km the canal would be used for watering of the large agricultural area in the region. The beginning of the construction depends on the funding availability and the completion of Master plan which is under way. The envisaged duration of works is estimated at 10 years.

Serbia

Major works are concentrated on the rehabilitation of Danube fairway at Novi Sad. During the air strikes in April 1999 all three bridges at Novi Sad have been destroyed or severally damaged and the navigation was completely ceased. In the year 2000 three new bridges were built:

- steel road bridge as the permanent solution elevated for about 2 metres above the lowest point of the bridge previously stayed on that place and representing the main air draught barrier at the middle Danube before 1999
- temporary railroad bridge at the place of former road and railway bridge
- temporary road pontoon bridge (built on tank barges)

After political changes in Serbia in autumn 2000 the works on the fairway stretch at Novi Sad were intensified:

- International community funded the Danube Commission's clearance project with €25.7m, whereby the EU contributed €22m or 85%. The works comprising unexploded ordnance clearance, debris clearance of three bridges and the rehabilitation of the riverbed are mostly accomplished before spring 2003. A navigable channel was already open since autumn 2001.
- Works on the reconstruction of the six-lane road 'Sloboda' ('Liberty') bridge are under way. The envisaged costs of €41m are partly covered by the EU contribution amounting €34m. However, full navigation will be restored with the removal of the last obstacle - temporary pontoon bridge - at the latest when the reconstructed 'Sloboda' bridge will be reopened for use (scheduled autumn 2004). At present, the pontoon bridge opens three times a week to allow transiting navigation.

Additionally, an international tender for the elaboration of the Inland Navigation Master Plan till 2025 is opened in April 2003. Envisaged budget for the elaboration of the Master Plan which would include development guidelines for the waterway infrastructure, interfaces (ports) and fleet amounts €2m. The money will be funded by EAR - European Agency for Reconstruction.

Romania

Infrastructure developments concern shore protection measures on the Sulina Canal as well as a topohydrographical measurement and signalling system on the Danube. Improvement works for a better navigation on the Danube between Calarasi (km 375) and Braila (km 175) are foreseen. An upgrading of the port infrastructure of the Port of Galati is also envisaged. A new bridge over the Danube between Romanian Calafat and Bulgarian Vidin is under construction.

Bulgaria

The bridge over Danube at Vidin to Romanian city of Calafat is under construction under financial support of the EU.

West-East Corridor

Germany

The measures from the aforementioned investment programme concerning this corridor comprise the upgrading of the following waterways:

- Middle Weser
- Küstenkanal (the rest of improvement works)
- Elbe-Lübeck-Kanal (preservation of current conditions)
- Oder-Havel-Waterway (consolidation)
- VDE 17 (Verkehrsprojekt 'Deutsche Einheit' Nr. 17) connection Hannover – Berlin (Mittelland Canal / Elbe-Havel-Kanal / Untere Havel-Wasserstraße / Berliner Wasserstraßen), improvements and consolidation works
- Construction measures on the river Saale are under discussion
- On the river Elbe maintenance works are under political discussion and presently stopped. Formerly planned construction measures are not covered by the present infrastructure plan.

Czech Republic

Infrastructure developments are planned to improve navigation on the river Elbe along the section between Střekov and the Czech-German border. The improvement of navigation on this section of waterway is a key intent for the promotion of navigation in the Czech Republic and to ensure effective operation of ships. Navigation depth of 1.6 m should be ensured for at least 345 days a year.

The upgrading of the Elbe up to Pardubice is envisaged to prolong the navigability of the river Elbe. After the construction of the port of Pardubice, cargo flows of about 800.000 tonnes per year on international relations are expected. Further to this, measures will be taken to upgrade the Vltava-Elbe waterway.

Poland

In Poland, development of inland water transport system will be based on improvements of the existing infrastructure. Relevant plans are described in the 'Programme for Odra River 2006'. Modernisation plans include full compliance with anti flooding requirements and environmental protection, especially in river valleys. Development of water tourism is also included in development planning. Commercial companies identify possibilities of extending their existing services and introducing new services and routes. Unfortunately, due to the budget constrains, only emergency repair and maintenance works take place at present, apart from some investments in the Szczecin-Swinoujscie Sea Port area. A total amount of about 200 million EUR has been foreseen for the investment projects in the port's development strategy plan for the nearest years; the undertakings planned are intended to facilitate the outgrowth of port infrastructure that in turn would provide the external entities and investors with an opportunity to make their economic and financial investments within the port areas.

In other regions of Poland, the construction of stage of fall in Malczyce on the Odra river is nearly completed. In Wroclaw, the construction of the 'Millennium Bridge' is planned.

North-South Corridor

France

Developments of the French waterways are described per river or canal:

- Canal Dunkerque – Escaut: The available height under bridges on this canal is only 4.50 m. The projected investment will improve this to 5.25 m, in order to allow standard conditions for container operations and bigger vessels. The project will also improve the characteristics of the whole waterway to the European gauge Va[48]. The cost of this investment is estimated at € 119 million.
- Meuse and port of Givet: The aim of this project is to set up a better water regulation of the river Meuse and to improve the available draught. As a result, the French part of the river will offer the 'Belgian gauge', i.e. allowing the use of 1,350 tonne fully loaded vessels.

---

[48] CEMT category Va indicates a capacity of 1,500-3,000 tonnes for motor ships or 1,600-3,000 tonnes for push convoys (1*2 push barges)

- Oise: The present gauge of the river Oise is lower than the European gauge, limited to 3,000 tonne vessels from Conflans to Creil and to 2,000 tonne vessels between Creil and Compiègne. The aim of the investment is to remove these constraints. The first phase (modernisation of dams and locks) is estimated at € 98 million.
- Yonne: In the present conditions, small 'Freycinet' vessels with a 300 tonne load can use the river. The project is to deepen the river (future draught 2.20m) and to enlarge locks in order to give access to bigger vessels with a 1,000 tonne load. The cost of the project is estimated at € 10 millions.

Non-integrated networks (isolated subsystems)

Italy

At present the following works have recently been accomplished, planned or under way in a total investment value of about €105m (this amount includes investments in port facilities, maintenance fleet and monitoring systems not listed here):

Ferrara Waterway:

- Reconstruction of the lock of Pontelagoscuro. The existing facility is not in line with modern navigation standards
- Substitution of two old opening bridges of Valle Lepri and San Pietro
- Substitution of the railway bridge of Migliarano which has insufficient span and air clearance

Po river:

- Regulation of the riverbed
- Adopting of the Po-Brondolo Waterway
- Regulation of the mouth of Po di Levante

Also further construction of the Fissero-Tartaro-Canalbianco Waterway can be mentioned.

Finland

The following works are recently accomplished or currently under way:

- Study on the possibilities for year-round navigation on Saimaa Canal (presently approx. 9.5 months a year due to ice).
- Deepening of the entrance channel to the Saimaa Canal to ensure more reliable navigation during wind induced low water periods at the Gulf of Finland.
- Construction of a new waterway – 'Tahko waterway' – along the lakes north-east of the City of Kuopio. The Tahko waterway has 2 locks on about 1.5 km long land canal linking two lakes and about 80 km traced and marked along the natural lakes. Lock chambers'

size is 35 x 8 x 1.8 m. This waterway opened for traffic in June 2002 is designed and dedicated to passenger and recreational purposes.

It might be seen that the above listed construction and consolidation works and projects are considered on the national level. Each government has own improvement plans based on the own priority list. Due to changes of governments and political aims respectively and limited budgets as well, in some cases national influences prevent the completion of construction and/or upgrading measures which had been envisaged before. This refers for instance to the rivers Elbe and Danube. A lack of general European co-ordination of the inland waterways improvement works can be noticed.

5.6 Conclusions

In total, about 24.000 km of inland waterways of all classes from lowest ‘0’ (only for recreational use) to highest ‘VII’ have been identified, investigated and sorted by the working team within the PINE area. Detailed information on these waterways are to be seen in the Appendix. Within these about 24.000 km an effort was made to include all the waterways of ECE classes IV and above as well as those waterways of the lower classes which – according to the expert opinion of the working team – irrespectively of their lower navigability qualities represent the selection of important waterborne links. Out of all in the report presented waterways more than 80% belong to the integrated network. The remaining about 20% (about 4350 km) are single (isolated) waterways or smaller systems in the UK, Finland, Sweden, the Iberian Peninsula and Italy.

Available statistics and other sources do not provide standardised contents and levels of information on inland waterways in all investigated corridors and regions. Therefore, the tables with basic data sets are not always fully completed or in certain cases some inputs were estimated on the basis of indirect information and knowledge. Nevertheless, this data provides a clear and comprehensive picture of the waterway infrastructure in both the EU member states and the accession countries.

Regarding the integrated network four inland waterborne corridors are identified: Rhine, Danube (South-East), West-East, and North-South. These corridors are formed on transport flows and major inland waterway links. Besides, the confluences of three large European rivers form the base of the European network: Rhine, Danube and Elbe (including the almost parallel river Odra). The fourth – North-South Corridor mostly coincides with two large rivers in France, with Seine and Rhone. Unfortunately, although physically linked to the Rhine Corridor, the nautical quality of waterborne links between these major waterways in France does not allow direct navigation of larger units.

From a nautical point of view the river Rhine with the major tributaries and canals is, thanks to the good maintenance standards, generally in a better condition than the other confluences. The Danube confluence bears a huge potential as waterborne transport resource, but there exist large deviations of the fairway qualities on certain sectors. It might be concluded that the Danube is an excellent waterway with a series of local bottlenecks.

These local bottlenecks drastically reduce the efficiency not only on a particular sector but also along the much longer part of the concerned route. The Eastern segment of the integrated network comprising Elbe and Odra as well as the West-East connection via navigable canals are of a lower nautical potential than Rhine and Danube. The conditionally named North-South Corridor consists of numerous smaller waterways and two large rivers – Seine and Rhone/Saone. Unfortunately these capable waterways of high ECE classes are not mutually linked with waterways enabling direct navigation of larger vessels.

In regard of nautically not integrated parts of the existing EU a considerable potential can be seen in the United Kingdom and Italy. Inland navigable networks in Sweden and Finland are used more for direct river-sea services and recreational shipping/boating than for inland waterborne cargo transport. Besides, severe climatic conditions with long lasting winter cease of navigation strongly affect (reduce) transport potential of the Scandinavian waterways. The waterways on the Iberian Peninsula are rather used for river/sea than for commercial inland navigation services.

The existence of numerous rivers navigable for smaller sea-going ships in their estuaries and sometimes also relatively deep into the hinterland provides an excellent infrastructure for intensive use of direct river-sea services. Especially high potential for river-sea services exists between the North and Baltic Sea coasts in the central part of the continent and the British Isles, Scandinavia and the Iberian Peninsula. Further two regions with a high river/sea affinity are the Mediterranean (mouth of Rhone in France, Po in Italy) and the Black Sea region (Danube delta, mouths of Dnepr and Don, link to the Eastern Mediterranean over Bosphorus and Dardanelli Straits).

Parts of the waterway network, beside other countries especially in the Netherlands, Belgium and France (North-South and Rhine corridor), are characterised by smaller waterways. Due to infrastructure limits, only smaller vessels can operate on these waterways. On the other hand, several parts of these networks of smaller waterways are characterised by a high network density.

In the light of the ***accession of the new member states*** some waterway connections hold an integral importance. This firstly refers to the river Danube, which connects 4 of the 5 accession countries located on the Balkan (Slovakia, Hungary, Bulgaria and Romania) to the central European waterway network, extending the present EU waterway network for almost 2000 km towards south-eastern Europe; additional navigable tributaries and canals not yet counted. Beyond south-eastern Europe, further direct waterborne transport alternatives between the EU and Russia, Ukraine, Turkey and Near East are related to this important European river.

The East-West corridor also connects important accession countries (Poland and the Czech Republic) to the EU-core. The most important connecting waterways are the Mittellandkanal (MLK, almost completely upgraded and well maintained), the river Elbe/Labe, which forms the connection to the Czech Republic as well as the further east German waterways which are located eastwards of the river Elbe/Labe, connecting the river Oder/Odra and Poland, respectively, to MLK.

The upper section of the Elbe/Labe on the Czech territory already has good construction standards (partially canalised by construction of numerous dams with locks); for the Polish section of the upper Oder/Odra comprehensive construction and upgrading measures are envisaged (`Program Odra 2006´). In contrast to this, for the above mentioned German waterway sections (except MLK) construction (and maintenance) deficits exist, which heavily limit the benefits of the construction standards and envisaged measures in the Czech Republic and Poland as well as the quality of the network connection of both acceding countries.

Network ***shortcomings*** are presented in three levels: missing links, strategic and local bottlenecks. There are different weighting criteria within each particular level.

Current ***construction works*** on waterway improvements are only in rare cases interlinked with identified shortcomings showing that an internationally concerted concept is missing.

5.7 References

1. ‘Die Binnenwasserstraßen der Bundesrepublik Deutschland – Sammlung von Daten und Fakten’, VBW, Duisburg, 1995
2. ‘Westeuropäischer Schiffahrts- und Hafenkalender’, VBW, Duisburg, 1992, 1994, 1996, 1997
3. INBAT Project: VBD Report ‘Schifffahrtsrelevante Parameter der Elbe’, Duisburg, 2001
4. ‘EUROPEAN AGREEMENT ON MAIN INLAND WATERWAYS OF INTERNATIONAL IMPORTANCE (AGN)’, UN/ECE, Geneva, 1996
5. ‘Modern River Sea Traders’, CC&MH, Devon, 1996
6. EUDET Project: Interim report on the Danube Waterway, ÖIR/VBD/Impetus, Duisburg-Vienna, 1997
7. SHIFTING CARGO Project: Interim report on the European Waterway Corridors, VBD/ÖIR/ANAST, Duisburg, 1996
8. INBAT Project: PWR Report ‘Statistical analysis of waterway depth variation in time on the Oder River’, Duisburg, 2001

9. INLATRANS Project: ‘Integrating inland waterway transport systems in the Baltic Sea region’, Final Report, 2001

10. http://www.mariterm.se/inlatrans/

11. Pomorska Enciklopedija, Bands I-VIII, JLZ, Zagreb, 1975-1989

12. ‘Dal Po al Mare del Nord – Le vie e i porti della navigazione interna in Europa’, Reggio Emilia, 1995

13. ‘Evropska plovna magistrala Severno More – Crno More’, SF, Beograd, 1995

14. ‘Feasibility study on river-sea lines between Po river and Mediterranean ports’, Final Report, VBD, Duisburg, 2000

15. ‘Danube – Synopsis of facts regarding navigation through Yugoslavia, Bulgaria and Romania (from km 1433 to the mouth)’, EBD, Duisburg, 1992

16. White Paper on trends in and development of Inland Navigation and its Infrastructure – Economic Commission for Europe, Geneva, 1996

17. http://www.british-waterways.co.uk/

18. Handbuch der Donau Schifffahrt, DTE GmbH, Wien, 2002

19. Trans-European Waterways, INE prospect material, Brussels, 2002

20. Navigazione interna, N.3/4, Cremona, Dec. 1998

21. Waterway network of the Po Valley and Veneto Region, 1998

22. http://www1.oecd.org/cem/resol/waterway/wat922e.pdf

23. UN-ECE, Inventory of most important bottlenecks and missing links in the E waterway network – Resolution N°49, New York-Geneva, 2003

24. http://www.mdcr.cz/english/index23.htm

25. ECORYS Transport and Partners: ‘Market observation for the inland waterway sector – Annual Report, Rotterdam, 2003

26. http://europa.eu.int/comm/external_relations/see/news/ip02_1123.htm

27. Draft of the Bundesverkehrswegeplan 2003, German BMVBW, 2003

28. ‘BDB fordert Nachbesserung im Entwurf des Bundesverkehrswegeplanes 2003: Ausbaugesetz fehlt – Investitionen unklar’, Binnenschiffahrts Report No.2, 2003

29. ‘Transeuropäische Netze – der Weg nach vorn’, Introductory word of Ms. Loyola de Palacio, Vice-president of the Commission and Commission Member for Energy and Transport

30. ‘The importance of Inland Waterways in ECMT Statistics’, Document No.2 of the ECMT Seminar ‘The inland waterways of tomorrow on the European continent’ held in Paris on January 30, 2002

31. Written contributions from partners and engaged local experts

32. http://www.euromapping.fr/Anglais/contents.html
33. ‘Statistisches Jahrbuch 2002 für das Ausland’, Statistisches Bundesamt, Wiesbaden, 2002

34. Annual Bulletin of Transport Statistics for Europe and North America, ECE, Geneva, Vol. XLVI, 1996

35. http://www.aina.org.uk/

36. ‘Visenamjenski kanal Dunav-Sava’, Croatian Ministry of Maritime Affairs, Transport and Communication, Zagreb, 2002

37. ‘Bassin du Nord/Pas-de-Calais’ – ‘Carte du Transport Fluvial’, VNF, 2001

38. « Annual Report», INE, 2002-2003

39. « Lücken und Engpässe im Europäeischen Verkehrsnetz – Situation 2003 », UECC, 2003

Chapter 6 Interfaces: ports and transhipment sites

6.1 Introduction

Particular objectives of the Study segment dealing with access to the waterways – ***interfaces*** - are:

- Registration of the structure and quality of accesses to the waterway network
- Definition of different types of interfaces
- Selection of representative ports and presentation of relevant information including e.g. figures on their annual volumes, structure of transhipped goods, available facilities, development trends etc.
- Identification of potential national supporting programmes for construction/upgrading of ports, terminals etc.
- Assessment of structure and quality of access to the inland waterway network
- Identification and evaluation of possible shortcomings.

6.2 Method of working

Considering the very large number of inland ports on European waterways, wide spans of their importance, size, role and specific activities and simultaneously to keep the number of ports to be analysed at a reasonable level it was necessary to apply the following sequence of steps:

- To establish a set of criteria for the selection of representative sample of ports
- To collect relevant information on the selected ports
- To perform quantitative and qualitative analysis of collected figures and information
- To identify corridor specific particularities of ports and to assess their structure, general quality, development perspectives and shortcomings

The basic conditions to be fulfilled were:

- To cover all 4 identified waterway corridors as well as some sites in non-integrated network
- To present different types of inland ports in regard with size and services
- That selected port reflects as much as possible the general situation in the corridor/region/waterway
- To present at least one port of all the countries with high and medium profile in inland navigation in Europe

Besides these general criteria and conditions the additional set of criteria for port selection were formed on the base of:

- Strategic importance as an intermodal traffic node (regarding land based infrastructural network on the pan-European level).
- Regional importance (state of the industrial development, population density).
- Estimated development opportunities .

This approach has been discussed and approved by addressed Members of the Advisory Group dealing especially with the inland port problematic. Final selection of port sample was made though an active co-operation and with kind assistance of the European Federation of Inland Ports - EFIP.

Basic information on selected ports are given in section 6.3 'Port selection and statistics' and classified upon the type of port. General assessment of ports in section 6.4 is performed per corridor.

6.3 Port selection and statistics

According to the AGN - 'European Agreement on main inland waterways of international importance' of 1998, a total of 374 of so-called 'E-Ports' are identified on European Waterways. Out of them 334 are 'E-Ports' located within the PINE investigation area.

Besides these 'E-ports' there are also countless ports of regional importance not satisfying one or more of the above-listed criteria as well as numerous industrial ports (private ports and wet transhipment sites). For the purpose of PINE Study four different types of inland ports have been determined with regard to their specific role, activities and special services they provide:

- ***Conventional inland ports*** providing their ship-to-shore transhipment services almost exclusively to inland vessels (no calls of river-sea ships), using prevailingly traditional Lo-Lo (vertical) transhipment technologies of various kinds of dry cargoes including containers (ports not specialised for some 'unconventional' commodity or technology).

- ***River-Sea ports*** as inland ports (located deeply in hinterland) on major waterways of higher ECE classes providing water transhipment services both to inland and river-sea vessels running directly to the port of call located overseas (sea port or another river-sea port on other waterway).
- ***Deep-sea ports*** with considerable role in inland navigation services, interface of all inland modes (inland navigation, road and rail, eventually pipeline too) and maritime shipping (deep-sea, short-sea, coastal).
- ***Inland ports*** providing only special services or using prevailingly unconventional technologies in transhipment and/or other activities.

The list of selected ports of all above identified types, including corridor they are assigned to as well as country is given in Table 17. Industrial (private) ports and transhipment sites are assessed in general form within the appropriate corridor sections.

This list just slightly deviates from the original selection agreed with EFIP. The reasons are in difficulties to obtain relevant set of information for some ports from the original selection as well as the intention to provide as much as possible figures to be used for an impartial quantitative assessment. A total of 32 ports within the PINE area have been selected. Their approximate locations are schematically presented in the next figure.

Corridor	***Conventional***		***River-sea***		***Deep-sea***		***Specialised***	
Rhine	Basle	CH	Duisburg	D	Rotterdam	NL		
	Meppel	NL	Liege	B				
	Mertert	L						
	Nijmegen	NL						
	Stuttgart	D						
South-East	Bratislava	SK	Galati	RO	Constanta	RO	Passau-Sch.	D
	Budapest-Cs.	H	Rousse	BG			Vidin	BG
	Enns-Ennsdorf	A						
	Lom	BG						
	Orsova	RO						
	Pancevo	SER						
	Vukovar	CRO						
West-East	Aken	D	Szczecin	PL				
	Decin	CZ						
	Magdeburg	D						
	Wroclaw MP	PL						
North-South	Charleroi	B	Lyon	F				
			Paris	F				
Isolated sub-systems	Cremona	I	Joensuu	FIN				
			Goole	UK				
			Vaesteras	S				
Total:	18		10		2		2	

Table 20. Review of selected ports

Besides the above listed types of ports it is necessary to explain the meaning of terms ‘terminal’ and ‘transhipment site’ which will be frequently mentioned in the subsequent parts of this chapter.

Terminal (‘end station’ for a certain mean of transport) is a part of a port or a separate transhipment/temporary storage entity dealing with special kind of commodity, as e.g. ‘oil terminal’, ‘grain terminal’, ‘container terminal’ or ‘Ro-Ro terminal’. Terminal is in no case the final destination of shipment but just the place where goods change the mean of transport from one mode to another. A port can contain more specialised terminals.

Transhipment site is an appropriately arranged and fitted location on the waterway bank (‘wet transhipment site’) used by industrial company or service operator appointed by the company for transhipment of cargoes transported to and from the site by inland vessel.

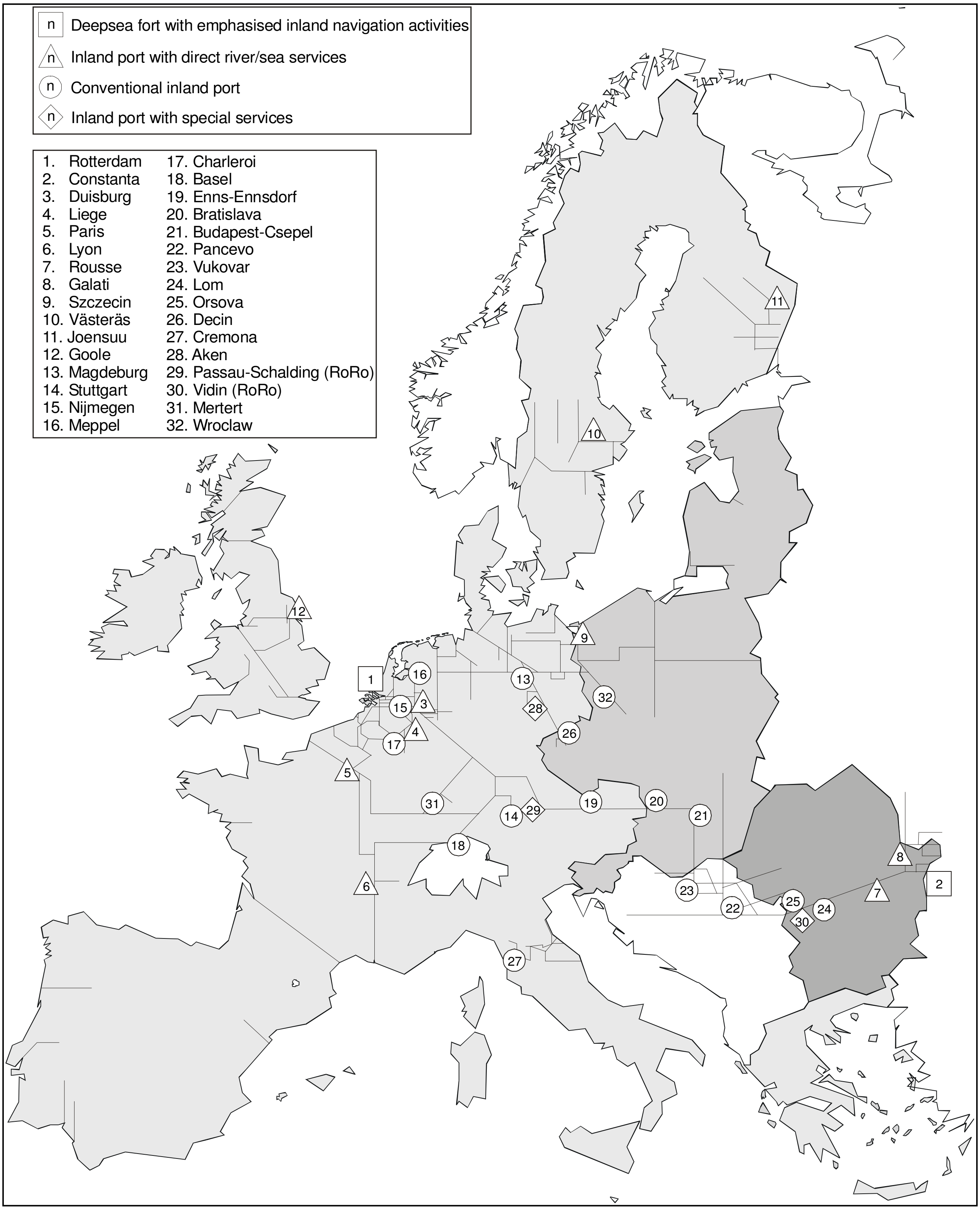


Figure 24. Location of selected ports

6.4 General assessment

Basic considerations

Inland port is a complex, dynamic system determined by its basic dimensions: ***objectives, functions, components*** and ***links***. Consequently the general assessment of a port quality and potentials might be performed by partial assessments of each of the above listed dimensions and integrating them into a common result. Some of these dimensions do not allow any quantification and for others, even if quantifiable, a non-selective approach might result in a false conclusion.

With regard to their ***objectives*** each port, irrelevant of its size, type and geographical location, primarily serves as an interface between waterborne and land-based means of transportation. Following-up the development of the market, especially regional transport market, additional 'complementary' objectives and functions can arise and grow so that under certain circumstances they even considerably exceed the primary goal – i.e. efficient transhipment from ship to shore and from shore to ship. For instance, a port may be established as a global or regional hub, as a logistic centre or as a freeport or, however, as all of these simultaneously.

The additional objectives determine and initiate development of new ***functions***. Besides traditional port functions as acceptance of goods over the waterfront, transfer to a land based mode (railway, road, also pipeline) and forwarding to the next destination (or the same in inverse sequence), there are also complementary as well as auxiliary functions of a port. Complementary functions are for instance storage, distribution and processing of goods (e.g. stuffing/stripping of intermodal transport units), inspection, checking and reporting of shipments (follow-up documentation) while auxiliary functions comprise variety of services like supply of vessels with fuel, water and provisions, repairs and maintenance of vessels, containers etc., discharging of waste, sewage and bilge water from ships etc.

Condition to perform these functions is the existence of particular technical, technological and organisational ***components***. Technical components comprise facilities and their arrangement within the port area. These components are mostly quantifiable, like e.g. number of berths and their total length, depth at the waterfront, number of cranes, size of the open and covered storage areas, capacity of silos and tanks etc. Technological components deal with purpose and specialisation of harbour, for instance those with dominant orientation towards general cargo, or dry bulk, or liquid bulk or containers because each group of commodity impose the application of corresponding transhipment technology (crane, conveyor, pump). Eventually organisational components relate to the form of operation, i.e. is it public or private port, and the presence of one or other form is influenced by the kind and intensity of cargo flows, available physical, technical and manpower resources and price relations in the local environment.

Finally, ***links*** are operations and activities between certain components (internal transfer of goods between piers, storage, sorting and reloading platforms etc.) performed by internal transport means (e.g. fork lift trucks, straddle carriers, reach stackers etc.).

Port capacity and quantitative indicators

A reliable and impartial assessment and evaluation of a general port quality is a very complex and difficult task. Some clarifications for this statement follows beneath.

One of the most indicative measures for 'the overall quality' of port operation might be likewise for ships the capacity utilisation ratio. This is defined as the ratio between realised throughput and theoretical capacity within the same time span (e.g. mill. of tons per year). The problem is that there exists no strict and generally accepted definition of a port capacity. The most common interpretation is 'the maximal cargo amount able to flow from the entrance to the exit within the certain time interval'. As far as a port is an assemblage of components and links, it is obvious that each individual component and link has its own capacity limit. So it could be 'berth capacity', 'transfer capacity', 'storage capacity' as well as 'traffic intensity' and 'service rate' which determine the weakest individual component and thus the overall port capacity.

Traditionally used definition for the port capacity is the volume of cargo which can be transhipped in port over the length unit of pier during one year. Even in this simplified definition the large unknown is the 'volume which ***can be*** transhipped'. Although this volume can be roughly estimated through the step-by-step analysis of each influencing factor and under assumption that all conditions are fixed as they are (no additional cranes, no additional manpower, no extended operating hours etc.) such task would go far beyond the PINE objectives.

Therefore, on the basis of usually available figures of the port annual throughput and available facilities an attempt was made to calculate some numeric values which could provide certain indications on port ability, effectiveness and potentials. All of these numeric indicators must be considered with care and in relative terms. Proper interpretation of them, their mutual comparison in different corridors as well as consideration and interpretation of some qualitative indicators was found as a reasonable methodology applicable for this task.

Numeric data on selected ports as well as quantitative indicators are given in the Appendix. The following parameters and indicators are assessed and analysed:

- Total annual throughput in tons (by waterway, rail and road)
- Trend in throughput in the last decade (rising, stagnating or falling)
- Multimodality abilities (access to road and rail networks)
- Total length of berths in metres
- Total number of portal cranes (cranes moving along the waterfront)
- Total open storage area in square metres
- Total covered storage area in square metres

- ‘Structure of goods’ indicator as the ratio between covered and open storage area. Higher value could mean higher share of high value commodities as well as higher level of secondary and auxiliary services.
- ‘Storage load’ indicator as the ratio between total annual throughput and total storage area (open + covered). Higher value likely means a better utilisation of storage but on the other side (presumably unlikely) it might indicate the shortage of storage area.
- ‘Berth load’ indicator as the ratio between total annual throughput and total length of berths (piers). As far as the aforementioned commonly used definition of port capacity takes theoretical annual volume that can be transhipped over the pier length unit it is obvious that the highest ‘berth load’ value simultaneously means the best port capacity utilisation.
- ‘Crane load’ indicator defined as the ratio of total annual throughput and number of cranes. Higher values mean higher productivity i.e. better utilisation of cranes.
- ‘Crane density’ indicator as the ratio between the number of cranes and total pier length. It has to be noted that this indicator is derived from previous two, namely it is the ratio between ‘berth load’ and ‘crane load’. A ‘crane density’ indicator must be considered just in very relative terms due to the unknown lifting capacities of cranes. Higher ‘density’ of cranes enables only a higher number of possible movements per time unit.
- ‘Versatility of services’ (or variety of services) as a qualitatively estimated indicator (high, moderate or low) based on the number of different functions and provided services (secondary and auxiliary) in the port. The note ‘high’ means higher potential and better chances on the market.
- ‘Numerousness of commodity categories’ (high, moderate, low) judged on the base of terminal numbers, existence of various special storages and transhipment facilities etc. Note ‘high’ most likely means good equipment level and probably considerable share of high value, usually containerised, commodities.

Further qualitative assessments, brief general information and comparative analyses follow beneath for each particular waterway corridor.

6.5 Assessment per corridor

Rhine Corridor

There are almost 150 so-called ‘E-ports’ of a total of 334 within the PINE area identified in the Rhine Corridor[49]. That represents a share of about 45% or approximately the same share as of all three remaining corridors together (in non-integrated subsystems there are 41 E-ports in the list or more than 12% of the PINE area).

---

[49] Extracted from the AGN -1998 List of inland navigation ports of international importance (E-ports)

Comparing this number of ‘E-Ports’ with the length of major waterways assigned to the Corridor it results in an average distance between two ports of only about 20 km[50]. It can be assumed that in the Corridor there are additionally a number of public ports not classified as ‘E-ports’ as well as several hundreds of private (industrial) ports and wet transhipment sites. These assumptions are based on the fact that only in the Netherlands there are 341 identified wet transhipment sites and among this number more than 70 have access to the railway network.

Conventional inland ports in the Rhine Corridor

The sample consists of 5 ports ranging in annual throughput roughly between 1 and 9 million tons of goods. General trend in volume development in the last decade is stagnating to slightly increasing. All ports have 3-modal capacities. Average berth load and crane load indicators are considerably higher than those in other corridors showing hereby the higher productivity of the major port facilities. On the other side ‘goods structure’ and ‘crane density’ do not show so significant differences when compared with appropriate indicators in the Danube and Elbe-Oder areas. Remarkable differences are identified in versatility of port services (secondary and auxiliary) and reloaded commodity categories. Both indicators in the Rhine Corridor tend to the ‘high’ mark in contrary to the average notes for the Danube ports (‘moderate’ to ‘low’). Unfortunately, available information on the Elbe and Oder ports were not sufficient to enable this kind of assessment.

There is an encouraging trend in structure of goods development. Traditional bulk cargoes are reduced but that is compensated by permanently growing containerised commodities (usually two-digit annual growing rate in recent years on the Rhine) and thus especially the share of containers in total volumes.

River-Sea Ports

Two very large river-sea ports were chosen as examples for the Corridor: Duisburg as simultaneously the biggest inland port in Europe and Liege. However, a number of other inland ports on Rhine, Maas and Albert Canal might be also classified as river-sea ports as far as they are called by river/sea vessels. The two selected ports have the ‘berth load’ indicator of the same order of magnitude as conventional inland ports on the Rhine and accompanying major waterways. But storage load indicators are considerably higher (about 3 times) than for conventional inland ports and that could mean a better utilisation of available storage spaces in these ports.

---

[50] Due to the possible errors in the calculation of the total length of higher class waterways in the Corridor this figure must be regarded only as the rough order of magnitude. As far as the intention is only to provide relative comparison of E-Port density in different corridors such rough assessment can be justified.

The fact that this kind of ports is relatively frequently called by river-sea vessels does not minimise the main role of them as prevailingly inland ports. The decisive quality here is that these ports located deeply in the hinterland (e.g. the Port of Duisburg about 250 km from the North Sea coast) are intensively called also by sea-going vessels (more precisely river-sea vessels, more on this issue is provided in Chapter 4 on fleets).

According to the official information from the 'Duisport' (Management of the Port of Duisburg) there are annually about 2000 calls of river-sea ships in the Port of Duisburg in recent years. Simultaneously pure inland vessels make some 30000 calls per year. This results in a rough share of about 7% of call by sea-going ships. The share of volume in tons is not available but could be roughly assessed. A river-sea vessel has a carrying capacity between 1500 and 4500 tdw. Assuming mean capacity of 2400 tons and moderate weight capacity utilisation of 50% the average load might be assessed to 1200 tons per ship. On the other side river vessels vary in capacity from relatively small 800 tdw ships to pushed trains having up to 16000 tons capacity. Assuming prevailing number of self-propelled vessels with average load of about 600 tons (based on the Duisport's ship-to-shore transhipments and waterborne shares in recent years) it seems quite realistic that the share of cargo transhipped from river-sea vessels might be as high as about 10%. This relates however only to 'wet' transhipment (over the waterfront).

Port of Rotterdam and its role in the inland navigation

The Port of Rotterdam together with two other deep-sea ports on the North Sea coast – Antwerp and Amsterdam, so-called 'ARA Ports' – influences the nature of the inland navigation in the Rhine Corridor in considerable extent. Rotterdam is the largest European container port (more than 6 mill. TEU per year) and the biggest deep-sea port in the World (about 320 mill. tons). Each year around 30.000 sea-going ships and more than 100.000 inland vessels are reloaded along the berths. However, this leading position is on the other side enabled and supported by the outstanding transport potentials and realisation of inland navigation on the river Rhine. According to the German statistics for 2002 the 16% growth of container transhipment over the waterside in German inland ports is recorded in comparison to the year before. Thereby a large majority of about 1.2 mill TEU coming to or from the Port of Rotterdam by inland vessels have their origins/destinations in Germany – mostly in inland ports along the Rhine river.

Wet transhipment sites

It has been referred to that the limited number of interfaces is one of the weak points of Inland Waterway Transport. As for rail transport, it is inherent to IWT that the interfaces have a crucial function with creating access to the modality and in many cases, improving IWT will always include improving the access points: both in quantitative and in qualitative terms.

The Netherlands and Belgium, having the densest IWW networks, will clearly always need an equal dense network of terminals. Because of the fact that the network of municipal ports and seaports facilitating IWT would be insufficient to make good use of the fine network, policies have come up in these countries fostering the bottom-up establishments of small-scale transhipment points. These can be meant for bulk goods (the majority) as well as containers. In the Netherlands, for example, logistics service providers are increasingly offering multimodal container forwarding services as an attractive enlargement of their portfolio. Figure 26 shows the transhipment points for Belgium (Flanders part), and Figure 27 for the Netherlands.

Figure 26 *Transhipment points in Belgium (situation 2001)*
Source: INE

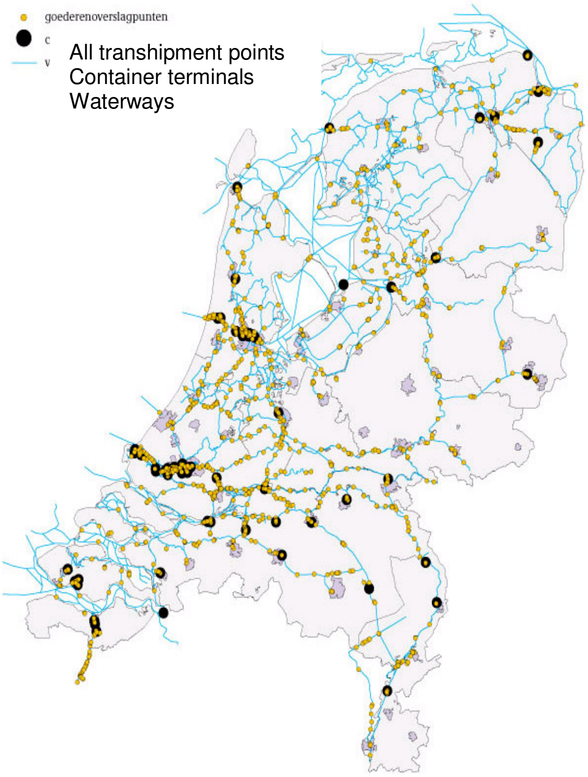


Figure 27 *Inland Waterways and Transhipment points in the Netherlands*
Source: AVV, 2003

These rather to call them ‘private industrial ports’ are present in considerable scale in Germany too. A number of industries that make intensive use of raw materials and solid fuels like steel plants and electric power plants are located directly on waterways and very often have their own transhipment facilities. It is also remarkable the presence of specialised Ro-Ro terminals in a number of ports in the corridor. They are either planned as transhipment sites for extraordinary heavy and voluminous single-piece cargoes, or as mutlimodal Ro-Ro terminals (for trucks and/or semi-trailers) or for horizontal transhipment of new manufactured vehicles. One of the unique examples with excellent results is the Ro-Ro terminal in Cologne-Niehl. A total of 260.000 passenger cars are transhipped there annually and forwarded on board specially built inland ships to other destinations.

South-East (Danube) Corridor

With 45 ‘E-ports’ the South-East Corridor has only 13.5% of major inland ports within the PINE area. Considering the fact that the Corridor is rather a single line then a surface network partly explains this relatively small share of larger ports.

As far as the total length of the major waterways assigned to the S-E Corridor is about 4000 km[51] it results that average mutual distance between two E-ports is about 90 km which can be assessed as pretty large.

Industrial ports and transhipment sites are not present in a remarkable scale. There are however some large private ports like for instance the port of Voest-Alpine steel plant in Linz (A) and a few thermo-electric power plants and cement factories having their own transhipment sites but that is not typical for the Corridor.

After the abrupt decrease of throughputs in a number of Danube ports since the end of eighties with political and economic changes in the Eastern and South-Eastern Europe, and especially after the break out of Balkan conflicts, the recent developments show stagnation or even a light recovery. Opening of the Main-Danube Canal in autumn 1992 enabled excellent perspectives but due to the continuous Balkan crises real benefits enjoyed only the ports upstream the ex-YU-Hungarian border. These ports were able to compensate losses in eastbound traffic shifting their main activities towards West. But Romanian and Bulgarian ports were strongly affected by Balkan wars and blockade of the passage through the ex-YU sector of the Danube (now in Croatia and Serbia). The culmination of these unfavourable circumstances arised in 1999 after the demolition of three Danube bridges at Novi Sad (actually located at the middle of the Danube length) which resulted in almost two years lasting total physical blockade of any traffic between the upper and lower river course. At the moment the situation is partly improved, debris and damaged structures are removed and the temporarily erected pontoon bridge opens 3 times a week to leave the passage of oncoming vessels from both upstream and downstream direction. By the end of 2004 it is expected to accomplish repair works on the last of three damaged bridges, final disassembling of temporary pontoon bridge and re-establishing of regular free navigation along the entire Danube course.

Conventional inland ports

The sample of 7 Danube ports was analysed. Their average throughput (figures relate to the year 2000) is more than twice lower than for the corresponding group in the Rhine Corridor but slightly higher than for the Elbe/Oder group. All the ports but one have access to the major road and rail networks in their vicinity. Average order of magnitude for the size of open storages correspond to those in the Rhine Corridor but certain differences can be seen in average ‘goods structure’ indicator. It is about 40% lower than that on the Rhine indicating either the low share of high value goods (usually to be weather protected by storing them in warehouses) or the shortage of covered storages. Average ‘storage load’ indicator is just slightly lower than on the Rhine but some 50% lower ‘berth load’ indicates considerably lower efficiency. That especially relates to the crane efficiency, which is about 2.5 times lower than on the Rhine even though the crane density is slightly higher.

---

[51] sum of the lengths of waterways in the Corridor having an ECE class IV and higher, as listed in the Appendix 1, the entire length of the Main-Danube Canal is assigned to the Corridor.

The above comparison with the Rhine together with prevailingly low notes for versatility of available services and numerousness of different commodities show that several of the Danube ports have still to look for their way towards efficient operation. One of the peculiar features of this 'linear' corridor is the existence of ports in 'old Member States' (Germany and Austria in the western part), next to them towards East there are ports within the 'new Members 2004' (Slovakia and Hungary), then follow ports in the now so-called 'Western Balkan' (Croatia and Serbia, with at the moment unpredictable status regarding the year of their accession to the Union), further eastwards there are ports in the 'Accession Countries' probably to join the EU in 2007 (Romania and Bulgaria) and at the utmost eastern part Moldova and Ukraine with an absolutely unclear situation whether they will join the EU one day or not.

It might be interesting to analyse possible differences among these groups, especially those downstream Austria, but the investigated sample within the PINE Study is too small to provide indicative distinctions. It might be generalised very roughly and with several exemptions that there is a certain tendency of degrading service qualities in ports heading from West towards East. But in the recent years exceptional efforts have been made to improve the services in a number of Danube ports.

River-sea ports

The rather sporadic than regular nature of Danube river-sea services disables the identification of ports located in hinterland and having remarkably higher frequency of calls by river-sea ships than other larger ports along the lower and middle river course. Up to river kilometre 170 measured from the branch mouth at Sulina Danube is a maritime waterway stretch which means that genuine sea-going ships are able to operate following the maritime navigation rules. These ships calling frequently ports like Reni (km 127), Braila (km 170) and Galati (km 150) are in no-case river-sea vessels (because they are not equipped for inland navigation) and hence not allowed to operate further upstream. On the other side, till 1991 river-sea ships of both western and eastern origin (design) and flags called the ports located as deeply upstream as Belgrade (km 1170) and even Budapest (km 1650). Since that time the calls in the middle river course became rarity. Therefore the choice are Galati in Romania and Rousse in Bulgaria (km 495) as both ports are relatively large and easy accessible for river-sea ships all the year round. However, despite of favourable nautical conditions and potentials of ports the share of volume transhipped from river-sea ships is much lower than 2% as recorded in the Rhine Corridor and hence can be considered as negligible.

On the other hand the lower and middle course of the Danube provides excellent opportunities for direct sea-river and river-sea river services between the Central and South-East European Countries on the one side and the Black Sea Region, Russian and Ukrainian ‘deep water inland navigation system’[52] and eventually Eastern Mediterranean on the other. Hence the potential is really huge to open the high-quality waterborne alternatives between the enlarged EU and the neighbouring regions on the East.

Average cargo throughput of these Danube ports is manifold lower than the average of Duisburg and Liege. The volume records in recent years show stagnation. Good structure indicator, especially for Galati, is very low. Simultaneously the berth load indicator for Galati is very high which could be explained with intensive reloading of raw materials in the port. The same indicator for Rousse (with twice better ratio of covered vs. open storage areas than Galati) is on the other side manifold lower than that on the Rhine. Numerous available cranes with much higher density per pier length are in average twice lesser utilised than in the Rhine Corridor.

Deep-sea Port of Constanta

With its location on the east end of the unrivalled Trans-European Rhine-Main-Danube Waterway the deep-sea port of Constanta might be assigned the similar role for the Danube as the ARA ports have for the river Rhine. There are however large differences in regard to geographical location (Constanta is pretty far away from the main global deep-sea routes), general economic development level of the surrounding regions and eventually in the population density.

But nevertheless, positive developments have already begun promoting Constanta as the main deep-sea hub for the wide region and underlining potentials for the whole hinterland along the Danube. These potentials are supported by the existence of several Danube capitals like Vienna, Bratislava, Budapest, Belgrade as well as other larger cities and industrial sites which are located either directly or close to the Danube river. Further economic development and growing traffic potentials respectively have to be expected against the background of the oncoming EU-accession of several Danube riparian countries. This occasion might play a decisive role for the further development of the Danube shipping. Having in mind the weak land-based infrastructure for the hinterland transport, the Danube shipping will have the chance to acquire a considerable share in modal-split.

Putting aside the current role of Constanta from the deep sea side (certain figures and indicators shown in Appendix differ from those of Rotterdam even in the order of magnitude) it is more interesting to consider briefly the role and potentials from the inland side. The southern zone of the Port is under intensive construction.

---

[52] comprising waterborne access to the European part of Russia through the Don river, Volga-Don Canal, Volga, Kama and Oka thousands of kilometres deep into the hinterland, even to places like Nizhny Novgorod and Moscow or Kiev in Ukraine over the Dnepr river.

This zone consists mainly of container and Ro-Ro terminals equipped with modern facilities. Within the same zone, well sheltered by breakwaters and directly at the entrance lock of the Danube-Black Sea Canal is also the inland port (terminals and berths for inland ships). At the moment almost 25% of the total throughput belongs to the volume transported by inland navigation.

Voluminous construction works currently under way will enlarge the current handling capacity of containers form about 100.000 boxes to about 400.000 in short terms and in medium terms up to 800.000.

Inland ports with special function

As a consequence of a weak road and rail infrastructure and services in the region it began since the beginning of eighties a very successful implementation of multimode Ro-Ro services on the Danube (transport of semi-trailers aboard a river vessel). A number of purpose-built or rebuilt ships and barges were introduced in services along the various river stretches. Simultaneously a number of Ro-Ro terminals have been erected along the entire course. Most of them are located within the existing port areas like for instance in Linz, Vienna, Bratislava, Budapest, Vidin, Rousse and Reni. A quite new terminal on separate location and exclusively for Ro-Ro purposes was established in Passau-Schalding (km 2233). The longest Ro-Ro service line was between this terminal and Ro-Ro terminal within the Port of Vidin (km 793). Since the beginning of blockade on the middle Danube in 1992 this service runs irregularly, manifold lower intensity than in the first 10 years of exploitation and with shorter or longer breaks influenced by the sanctions, blockade or war consequences. Other services organised only along the upper or on lower segments of the river are still running. Since the gradual stabilisation of situation in the Balkan regions there is a rising interest for this kind of multimodal services in many Danube ports, at least as a low investment middle term logistic solution and intensification of container logistics.

West-East Corridor

More than 20% of ‘E-ports’ within the PINE area are located within the West-East corridor, along the Mittelland Canal and waterways within the Elbe and Oder confluences. The average mutual distance of E-ports is about 40 km[53]. Within the dense network of smaller waterways between Elbe and Oder and densely populated area of Berlin and surrounding there is also a considerable number of small ports and transhipment sites.

---

[53] The same method of calculation is applied as for Rhine and Danube corridors.

Conventional inland ports

The sample of 4 ports on Elbe and Oder has been investigated. Additionally, 10 ports located along the Mittelland Canal in 'old' German federal states were considered very roughly in order to get more realistic conclusions over the entire West-East Corridor.

It is symptomatic here that like in the Danube Corridor the average ratio between covered and open storage areas is pretty low. Namely, this Corridor average ratio for ports located in former Eastern Europe (Czech Republic, Poland and former Eastern Germany) is almost equal to the Danube average value if only Danube ports downstream Austria would be accounted. Due to the pretty higher ratio along the Mittelland Canal the Corridor 'mean of the means' is improved and becomes more or less equal to that calculated for the entire Danube Corridor. However, in both cases - in West-East as well as in the Danube Corridor - the values are despite the average based on a 'mixture' of 'old' EU ports and those to become the EU ports in short term horizon, still far behind the average on the Rhine. Further indicators for the entire West-East Corridor show prevailingly stagnation tendency of volumes in the last decade. Values indicating 'crane density' are considerably lower than those on the Rhine and Danube. Thereby, 'western' segment of the West-East Corridor (Mittelland Canal) has alone exactly the same value as average in the Rhine Corridor (slightly lower than on the Danube) but 'eastern' segment alone (Elbe, Oder) has even twice lower 'crane density' indicator than the West. Consequently, the 'berth load' indicator is in the eastern part of the Corridor twice lower than on the Danube and about three times lower than in the European West (Rhine and North-South Corridors).

Ports in the western part of the West-East Corridor are often characterised with strong presence of specialised storage equipment of high capacities, mostly reservoirs for liquid commodities and silos for cereals.

It has to be underlined that relatively severe weather conditions during winter, with pretty usual and long lasting ice on rivers and canals especially in the eastern part, mean additional difficulties for navigation and thus handicap for ports.

River-sea port of Szczecin

The Port of Szczecin is very large and stays side-by-side to all largest river-sea ports in the western corridors. The overall throughput is of the same order of magnitude like Liege, Paris, Lyon and Duisburg. But remarkably lower storage-, pier- and crane-load indicators than respective averages in all other corridors including the Danube (except the crane load which is in Szczecin slightly higher than in the ports on the lower Danube) indicate low productivity of available facilities. Considering the waterborne link to the hinterland, lower course of the Oder is of a good quality and capacity but reaches are too short. Namely, the middle course of Oder along the German-Polish border has relatively poor condition and represents the bottleneck for the entire eastern part of the Corridor disabling a navigation of larger ships either towards well regulated upper Oder course or towards Berlin, Elbe and western parts of the network.

Deep-sea port of Hamburg

The Port of Hamburg is located on Elbe, pretty deep upstream of the mouth into the North Sea. It is second biggest deep-sea port in Europe, after Rotterdam. A hinterland with large consuming centres like Berlin, Dresden, and Prague is also present. The overall economic situation in this part of Europe has considerably improved in recent years. At the first glance basic preconditions for Hamburg to play the same role on Elbe like Rotterdam plays on the Rhine are fulfilled. But one obviously very important condition is missing: the average nautical conditions on the river Elbe upstream the junction point of the Elbe Lateral Canal are manifold worse than those on the Rhine. Long lasting periods of extremely low water level on the free-flowing middle and upper Elbe which appear almost regularly each year affect the fleet efficiency (very often just partly loaded vessels), and indirectly restrict business of inland ports and their developments in the entire corridor. Therefore the share of inland navigation in the hinterland transports to and from the Port of Hamburg remains clear behind ist potentials.

Assuming the realisation of long planned construction works on improvements of the nautical conditions and their reliability on the Elbe waterway a significant growth of waterborne traffic between the Port of Hamburg and its hinterland could be expected.

6.5.4 North-South Corridor

The available figures and information were, despite of all efforts and after contacting numerous possible sources, not sufficient enough concerning scope and format to enable the same level of numerical analysis as for the other three corridors. Nevertheless, some general remarks and information provide the information on the ports in the corridor, at least the most potential ones. There are 32 ‘E-ports’ or 9.6% of the total number in the area conditionally assigned to the North-South Corridor (entire France except the river Moselle and the parts of Belgian network). Applying very rough method of assessment the average mutual distance (or ‘port density’) is about 35 km (35 km of major waterways per one ‘E-Port’ in the Corridor). As far as the total length of French waterways (according to official statistics 8501 km) comprises more than 75% of waterways with ECE class III and lower and the national fleet consists of a large number of smaller units (Peniche, Freycinet, Campinois types) it is to assume also a large number of small ports and transhipment sites in the Corridor. From that point of view the situation in some regions of France might be comparable to that already described in the Rhine Corridor for Flanders and the Netherlands.

Of bigger ports Paris, Lyon and Charleroi have been investigated. Paris and Lyon have an emphasised image of river-sea ports with growing share tendency of maritime calls even though the particular share of goods transhipped directly from fluvial-maritime vessels does not exceed 2% (in case of Paris during the nineties).

Main origins/destinations for river-sea ships calling the port of Paris-Genneviliers are in the United Kingdom (about 50% of all calls) and Iberian Peninsula (about 25%).

In several cases large ports in the corridor have operating zones and terminals dispersed over wide area. For instance, the Port of Paris has three large zones wide apart from each other.

6.5.5 Non-integrated waterway subsystems

Out of four ports being analysed three are typical river-sea ports and only the Port of Cremona in Italy can be considered as a conventional inland port. In regard to the basic port productivity criteria (berth- and crane-load) is the Port of Cremona at the same level as the similar size ports in integrated corridors. Having in mind relatively short transport distances within the isolated system in Italy such values for Cremona (and similar for Mantova as the second biggest really inland port in Italy) can be assessed as very good.

River-sea ports considered in isolated subsystems are located in Finland, Sweden and Great Britain. Except partly Joensuu in Finland the other two ports have rather short-sea than inland character. Goole at the mouth of river Ouse in Great Britain is the origin and destination of numerous river-sea services from and to the continent and has considerable annual volumes. One part of volumes transhipped from river-sea and short-sea ships is transported to and from the hinterland by river vessels, along the Ouse towards Yorkshire and Aire & Calder Canal towards Leeds. Scandinavian river-sea ports located on fresh water lakes and canals deeply inland are often disabled to perform waterside transhipment in winter due to the cease of navigation during ice period.

6.6 Conclusions

Brief review of the general situation now

According to the AGN statistics (table 17) there are about 22´000 km of inland waterways with ECE class IV or higher in the entire Europe including Ukraine and the Russian Federation (European part). The same source identifies 374 so-called ‘E’-ports on this network. That means the average density or mutual distance between two ‘E’ ports of about 60 km. It is reasonable to estimate that within the PINE area, i.e. without Ukraine and the Russian Federation, this average mutual distance is slightly smaller, 50-55 km. A very rough comparative assessment shows that an average capital ports density in the Rhine Corridor is almost twice higher than in the North-South and West-East Corridors and even four times higher than in the South-East (Danube) Corridor.

Adding the numerous private ports/'wet transhipment sites' mostly concentrated also within the Rhine and North-South corridors it follows that the average density of waterway interfaces within these corridors is by far unrivalled. Especially the wet transhipment sites provide a direct access to the waterways for several enterprises resulting in increased competitiveness of inland navigation due to avoiding or reduction of cost-intensive pre- and endhaulage, respectively

The comparison of annual throughputs and some conditional quality indicators for the selected sample of ports shows that almost in any category (type) the interfaces within the Rhine corridor are ranked much higher than those in other corridors. This is however the result of numerous factors as e.g. the level of economic development, population density, quality and density of waterway network, potentials and qualities of fleet units and their performances etc. Only some individual ports in other corridors achieve the same level of quality parameters/efficiencies like average in the Rhine corridor. The ports located in the eastern parts of the South-East and West-East corridors show according to the investigated samples generally low productivity indicators.

Inland ports in isolated subsystems have very often a 'river-sea character'. This is quite reasonable due to relatively short inland length and distances within these smaller systems/waterways, which probably could not justify internal inland navigation services with larger units even if waterway conditions allow that. Here is Italy in certain extent the only exception.

Expectations for the near future

Future developments of waterway interfaces among others will depend on cargo flows. Ports which are located well and which are able to quickly adopt their services to the dynamically changed market demands will have good chances to increase their turnover even in the case of unfavourable modal split developments in regard to inland navigation. First of all '***good location***' must be considered in relative and broad terms. This means:

- Within the area of a large 'source' or 'abyss' of cargo flow (production or consumption of goods or simultaneously both)
- In the 'main stream' of considerable cargo flow
- On the crossway of two or more cargo flows
- In close vicinity to the main railway and road directions having simultaneously direct and efficient links to these networks

Assuming 'good location' as necessary predisposition and besides that also well balanced equipment, storages and flexible management being able to redirect available resources and employ them optimally at each change of the transportation market the ports should have an advantage of providing services for three main land-based modes – inland waterway, rail and road. Respecting this it seems very reasonable that a large number of ports will tend to further develop themselves into trimodal transport centres and will promote their role as intermodal nodal points rather than to rely on traditional, prevailingly waterborne transhipment.

Comparison EU15 vs. EU25

Six future EU-member states with medium to high IWT profile are concentrated in the eastern part of the West-East Corridor (PL and CZ) and on the middle and lower course of the South-East (Danube) Corridor. Regardless of current level of equipment and utilisation of their inland ports the access of these countries with their interfaces will be beneficial to overall EU IWT system. The benefits will be enabled for transport branches in both 'old' and 'new' EU community. The network of interfaces will become considerably larger and it will extend towards new markets. One important aspect might be very positively assessed. Within the recent period of transition in Central, Eastern and South-Eastern European countries the share of road transport increased non-proportionally steeper than in 'old' member states. Inclusion of inland ports and waterways will push forwarding agents to consider waterborne alternatives and opportunities – at least on longer legs – much more seriously than nowadays. This expectation is based upon the shortage of road and rail capacities and the lack of larger 'dry' bimodal (road-rail) freight centres in the accession states and the fact that inland ports already have equipment and facilities which are usually under-utilised. In that regard the funding (by public means) of bi-modal terminals (road-rail) in vicinity of tri-modal inland ports might be counterproductive.

However, this positive forecast in volume developments might be affected by appearance of shortcomings not visible at the moment due to the lower rate of utilisation of port capacities.

What kind of shortcomings might arise?

On the basis of recent interviews, published information and own experiences of consortium experts gained on spot there are a number of ports in accessing states already refitted, modernised and adopted to provide services at a similar level as they are in some successful inland ports in the well developed Rhine and North-South corridors. However, there are also several others where certain shortcomings cannot be excluded. These peculiar shortcomings might be:

- Shortage of storage capacities for high-value goods (warehouses) and special storage facilities like silos (for grain or other granulate- or powder-form goods), tanks (liquids of any kind) or refrigerated storages (perishable goods);
- Obsolete and worn out facilities, equipment and small mechanisation;
- Weak infrastructure links to major rail and road routes (quality of access to other networks) and/or harbour area/zone surrounded by urban structures restricting further expansion of facilities/services;
- Inflexible management with insufficient organisational know-how and non-motivated manpower.

These insufficiencies might especially affect waterborne transhipment efficiency and thus result in a modal split unfavourable to the inland navigation at all. Namely, in modern logistic chains, particularly in the transport segment of containerised high-value commodities, the value of time becomes always higher.

This relates especially to deviations from JIT schedule but also to a total elapsed time for transport. Inland ship in her segment of transport is on the one hand handicapped by slow speed of motion (slower than train or truck) but on the other hand able to perform just-in-time arrivals in general with manifold higher reliability than the other two modes, especially more reliable than the truck. The handicap of low speed and voyage duration could be partly compensated by efficient (quick) transhipment but also additionally deepened due to technical and organisational shortages.

What potentials will be opened up?

Enlarging the network and number of nodes (ports) and simplifying customs and other procedures within the common EU market the following opportunities will be opened up:

- More waterborne links (transport services by inland ship) will be possible
- Higher probability for longer average transport distance by inland ship and thus higher commercial attractiveness of the mode in intermodal competition
- A number of EU inland, short- and deep-sea ports in the Baltic Sea, Black Sea and Eastern Mediterranean (Cyprus, Malta) regions enabling further development of the 'motorway of the sea' concepts (projects, services) and further trade facilitation with neighbouring countries outside the Union (RF, Ukraine, Near East, North Africa)
- Establishing additional major multimodal transport nodes (IWT, rail, road) on intersections of the capital routes (TEN-T)
- Expansion of business activities in complementary and auxiliary services within the 'free zones' in strategically important ports of the future Member states as an impetus for the faster economic developments in the neighbouring regions

Eventually, as the consequence of faster economic developments in the regions around strategically important inland ports it might be expected stronger concentration of production activities and population growth along the waterway routes in the respective countries.

As conclusions can be resumed:

- In public ports, both in the old and the new Member States, it might come to a problem of dispersed responsibilities: on the one side for port facilities (private entrepreneurs) and on the other for local (micro) infrastructure as quays and access links to the main road and rail network (municipality) and on the third side state responsibility for the waterway network (as well as for the main land-based network). This share of responsibilities within the system bears the risk of non-synchronised and non-well-balanced actions utmostly needed for the system effectiveness,
- There are generally matured structures at all levels in the old member states caused by the long term continuity of business relations governed by the market economy rules,
- There are possible risks and unknowns due to still non-visible shortcomings in development directions in a number of ports in the candidate countries (former East). This statement is based on the break of former activities governed by the plan economy (followed by the abrupt drop down of volumes in the first half of the nineties) and still not

fully completed transition into the market economy rules and requirements. In that context, assuming the scenario of rising volumes, it is of increasing importance that:

- The ports in the former East are ready to respond to the rising and changing demands in quantitative and qualitative terms (e.g. micro-infrastructure, links to other modes, facilities, management, manpower…)
- These ports are properly located concerning the production and consumption centres nowadays and in the future
- These ports are properly linked to the land-related main transport infrastructure in the vicinity of the ports
- No capacity limits hinder the development of these ports, for instance in regard of port area extension due to urban structures
- A successful accomplishment of transition towards market economy is possible. Otherwise, the necessity of policy measures to assist this process might be checked.

At the end, it has to be underlined that ports must in no case appear as weak points for the development potentials of the inland navigation system because the integration of inland navigation can only be accomplished through efficient services of inland ports as interfaces to other systems and modes. In that context dispersed responsibilities for particular port components and links have to be paid special attention.

Based on positive frame conditions inland navigation can contribute to achieve the necessary transport prerequisites, which are requested for the market developments and the expected successful integration of the candidate states into the Union.

Chapter 7 Information and communication systems

7.1 Introduction

Modern logistics management requires extensive information exchange between the supply chain partners. The integration of information and communication technology (ICT) within the operational processes of the inland waterway sector has not developed to the same level. However, as a consequence of the possibilities and opportunities that are connected to ICT – increased efficiency of logistics operations, increased safety, improved environmental protection – so-called River Information Services (RIS) have emerged within Europe. These services have to be seen as a major step forward, turning inland navigation into a transparent, reliable, flexible and easy-to-access transport mode. Together with its cost-effective and environmentally friendly logistics operations, the development of RIS makes inland navigation attractive to modern supply chain management. In addition to the meaning of RIS for commercial logistics actors, RIS have proven to be invaluable for waterway authorities (e.g. supporting traffic management tasks, dangerous goods monitoring, etc).

RIS are defined as a concept for harmonised information services to support traffic and transport management in inland navigation, including interfaces to other transport modes [PIANC, 2002]. RIS are principally not dealing with internal commercial activities between companies, but RIS are open for interfacing with commercial processes [PIANC, 2001].

Stand-alone telematics services have been integrated into cohesive applications since the late 1980s, but still the inland navigation sector is faced with the challenge of integrating various services and systems into a common operational concept. On the one hand, a common architecture has been developed in the form of official guidelines, for instance in the PIANC Guidelines (2002), adopted by the Central Commission for Navigation of the Rhine in May 2003.

On the other hand, numerous ***research and development*** projects have worked on the development of RIS in Europe. A major impetus for the development of RIS concepts was provided by the INDRIS project. The name INDRIS stands for Inland Navigation Demonstrator for River Information Services.

This project – funded within the 4th Framework Programme (FP4) for Research, Technical Development and Demonstration of the European Union – described the functions of RIS for all potential users, specified relevant information processes and developed open standards for information content and communication between public and private parties [INDRIS, 2001]. The project was a joint venture between national public authorities, the transport industry, the ICT-industry and research institutes from Austria, Germany, Belgium, France, Italy and the Netherlands. The project started in January 1998 and was formally completed in June 2000.

Presently, the follow-up project COMPRIS (FP5) aims to develop a technical, organisational and functional architecture for River Information Services on a pan-European level, as well as to prepare the steps for the implementation of RIS on the most important European waterways. The COMPRIS project (Consortium Operational Management Platform River Information Services) is led by the Adviesdienst Verkeer en Vervoer (AVV). The project started in September 2002 and runs until the end of 2005. COMPRIS should mark the final phase of RIS development before large-scale implementation, having close relations to national RIS projects and initiatives. The development and enhancement of standards on information exchange (e.g. Inland ECDIS, electronic ship reporting, AIS) is one of the core elements of COMPRIS.

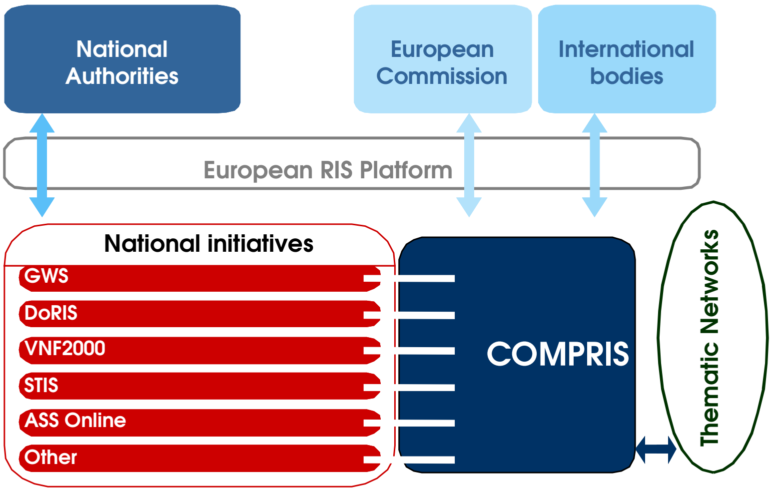


Figure 28 General approach of the COMPRIS project

The various functionality's of RIS – which will be discussed in more detail in 7.3 – jointly produce services that potentially make inland navigation more reliable, safer and more efficient.

In other words, RIS can contribute to the improved integration of inland navigation in intermodal supply chains in Europe, which is a prerequisite for a higher modal share for inland navigation. This coincides with policy objectives of the European Transport Policy as presented in the White Paper 'European Transport Policy for 2010' (Commission of the European Communities, 2001).

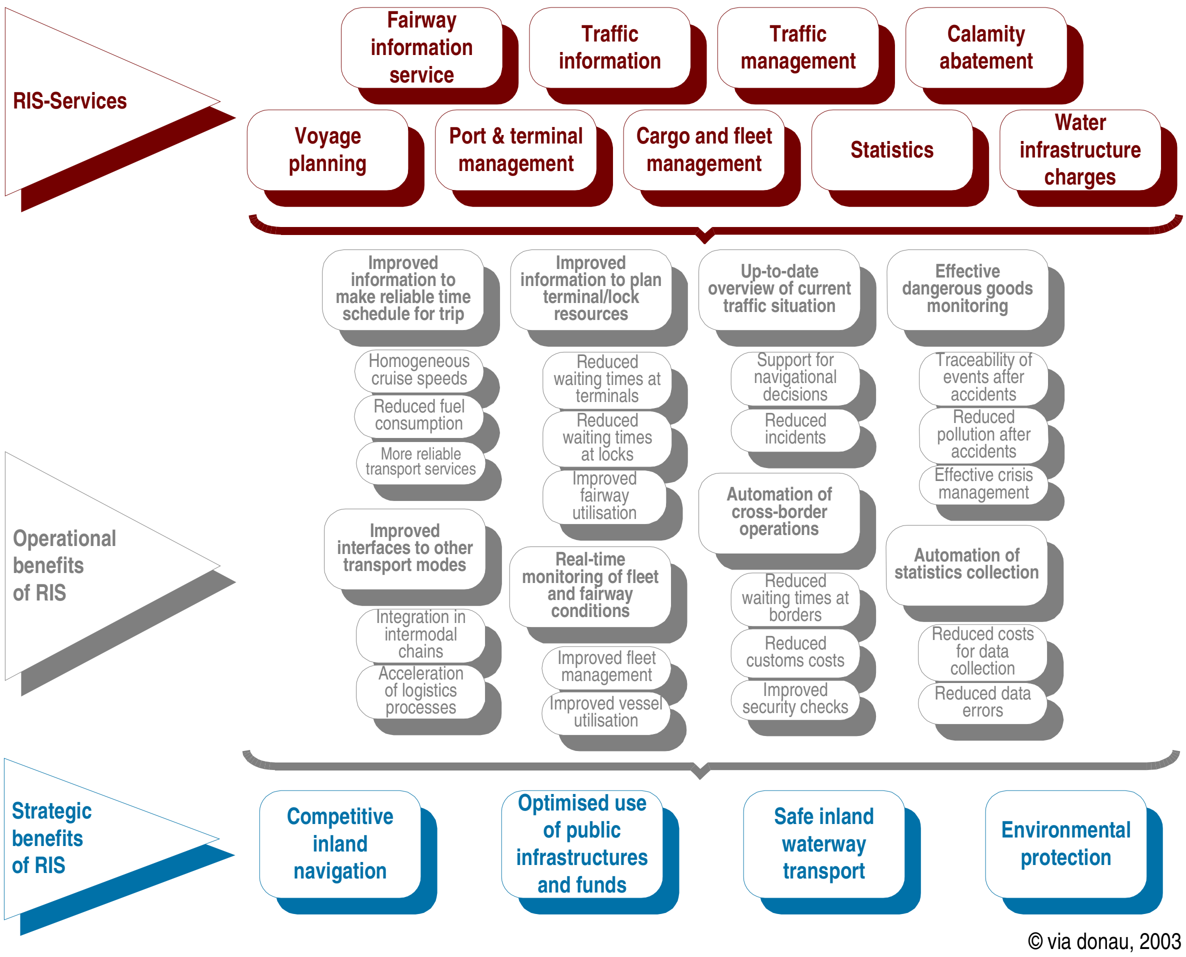
Given the positive contribution of inland navigation to the achievement of transport policy objectives – sustainable and competitive transport – the development of RIS is strongly supported by numerous international bodies and institutions. One of the most important political statements supporting the further development of RIS is the Declaration of European Ministers of Transport signed in Rotterdam in September 2001. This declaration states that Member and Accession States are recommended to implement pan-European River Information Services by the year 2005, on the basis of recommendations of the European Commission. Several activities have been undertaken in order to stimulate the implementation of RIS on a European scale. The European RIS Platform was established by the responsible national authorities (including candidate countries) in order to co-ordinate the creation of internationally interoperable RIS.

RIS is important for the entire European inland waterway sector. By means of RIS, inland waterway can literally join up with the latest logistics developments, which are all about reliable and predictable logistics supply chains. The revitalisation of inland navigation through the implementation of RIS is of special interest to the Danube corridor. The upcoming enlargement of the European Union towards Central and Eastern European countries brings about massive increases of freight transport by road. Therefore, it is necessary to modernise Danube navigation and make inland waterway transport more attractive in the competition and co-operation with road transport. This creates a window of opportunity: RIS applications can be realised on short-term and can therefore support the modal share of inland navigation in the Danube corridor during a period of general traffic increases.

RIS are expected to produce four types of strategic benefits (see Figure 29):

- Increased competitiveness of inland navigation
- Optimised use of public infrastructures and funds
- Improved safety
- Increased environmental protection.

The basic services of RIS are also shown in Figure 29; these will be discussed in more detail in 7.3.



© via donau, 2003

Figure 29 Benefits of River Information Services

RIS enable the establishment of ***competitive inland navigation transport services***. First, RIS provide up-to-date information that can be used to plan voyages and calculate more reliable time schedules. Based on the current and expected positioning data of the various vessels that are under way in the network, lock/bridge/terminal operators can calculate and communicate the Required Times of Arrival to the individual skippers. While approaching the lock/terminal the skipper can decide to adjust his cruising speed (more homogeneous travel speeds), which in the end results in a reduction of waiting times at locks and terminals. In this sense, RIS comply with the information needs of modern supply chain management, since it allows optimised use and monitoring of resources and possibilities for flexible reactions in case of any deviation from the original planning. Secondly, RIS principally enable information interfaces with all supply chain members as well as with other transport modes.

Due to these interfaces – that eliminate fractures in the information chain – the integration of inland navigation into intermodal supply chains is supported. Third, RIS enable real-time monitoring of inland navigation fleet and the changing fairway conditions en route.

This allows improved fleet management (optimised deployment of personnel and fleet based on up-to-date information) as well as more detailed trip planning and draught management based on up-to-date information on fairway conditions. Real-time information is provided that can be used to load ships according to the current navigational conditions.

Terminal and lock operators are capable of producing better planning of terminal resources through receipt of Estimated Times of Arrival (ETA) and additional information (e.g. stowage plans, vessel dimensions) of approaching vessels. These pre-announcement data allow a pro-active approach towards terminal or lock scheduling: before the vessel enters the port or lock, the operator can prepare and schedule the handling activities. For skippers this means a reduction of waiting times and a optimised chain of processes for the entire voyage. Public infrastructures cash in on the pre-announcement data through better utilisation rates. Additionally, RIS enable the automated collection of statistical and customs data. Traditionally, this is connected with paper work, which is time-consuming and prone to data errors. RIS makes the automatic collection of required data possible in an efficient way, which ultimately results in ***lower public expenditure***.

With the introduction of RIS, skippers are offered up-to-date and complete overviews of traffic situations. This allows skippers to take well-informed navigational decisions, which will consequently lead to a reduction of incidents and injuries/fatalities. Traditionally, ship masters had for instance to rely on information shown on the radar and verbal information provided by vessel traffic service (VTS) centres in order to take navigational decisions. The application of RIS has dramatically improved this picture: skippers use electronic charts, which are necessarily up-to-date, receive precise positioning data on approaching vessels, and are informed about current fairway and weather conditions electronically. Moreover, RIS enable detailed monitoring of dangerous goods transports, which helps prevent shipping accidents. These and other data allow safe navigation. Additionally, automated and more efficient customs procedures and security checks – supported by RIS – also contribute to ***increased safety and security in inland navigation***.

RIS lead to a reduction of fuel consumption as a consequence of better voyage planning and more reliable time scheduling. In addition, RIS contribute to a modal shift of cargo from road to waterway, leading to a reduction of exhausts such as CO_2 and NO_x but also of noise nuisance. RIS therefore supports the ***reduction of emissions*** caused by transport activities in a direct and indirect way.

Finally, RIS provide the possibility to monitor the transport of dangerous goods. This allows timely responses in the event of accidents and potential environmental calamities. Since data on all traffic movements can be stored in a database, reconstruction of incidents can be helpful in the analysis of causes for the accident. All in all, this contributes to environmental protection in relation to inland navigation.

7.2 Method of working

This chapter on information and communication services in inland navigation concentrates on three elements: functions, technologies and applications. First, RIS services are defined by specifying the different functions that are encountered in the literature and practice (see 7.3). Second an overview of the technologies required for effective RIS services is provided. Thirdly, the status of existing RIS applications across Europe is discussed. On the basis of an analysis of these three elements, a synthesis is made in which the core issues – which hamper the further implementation of RIS in Europe – are analysed. Recommendations for policy actions are summarised towards the end of this deliverable.

Various sources were used to describe and analyse the current status of RIS within Europe. Literature sources such as the CCNR RIS Guidelines as well as documentation of national initiatives were used to identify the characteristic features of RIS in Europe. Background information on the bottlenecks and recommendations for further actions – was mainly deduced from interviews and consultations with national experts from Germany, The Netherlands and Austria.

7.3 Functions of River Information Services

A recent survey initiated by AVV [Bureau Telematica Binnenvaart, 2002] revealed the specific information needs of skippers navigating on the river Rhine. This survey among 554 shipping companies showed that (potential) users of River Information Services – when asked about their priorities – mainly expect to receive information on obstructions of the fairway (in the form of Notices to Skippers), weather reports, water levels, current fairway depths, information on operational hours of locks/bridges and electronic maps.

Modern River Information Services provide an even wider range of services (see Figure 30). The services of RIS can be divided into information services that are primarily traffic-related (the upper boxes in Figure 30) and mainly transport-related (the lower boxes in Figure 30).

Figure 30. RIS – main services
Source: PIANC, 2001

The following section consist of a detailed de-composition of the above RIS-services into RIS-functions, as these have been adopted by the Central Commission for the Navigation on the Rhine [ZKR, 2002].

Fairway information services (FIS)

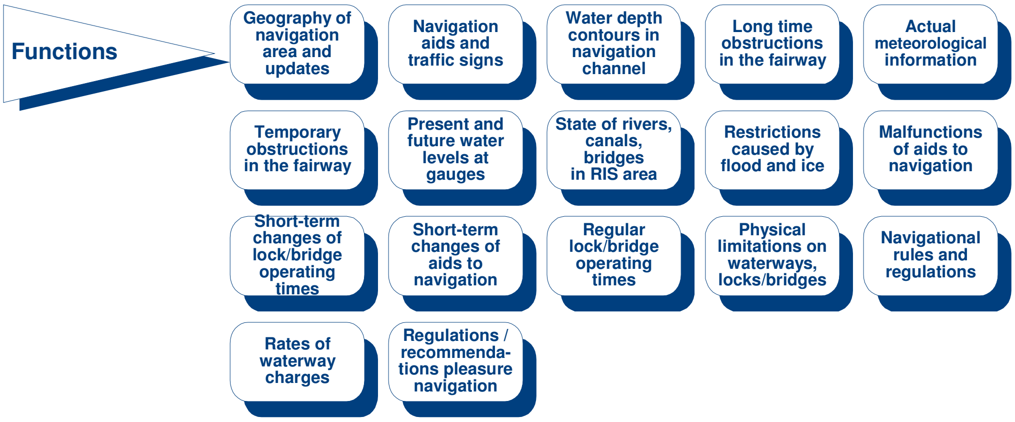


Figure 31. Functions of Fairway Information Services [Source: ZKR, 2002]

Fairway information services (FIS) contain geographical, hydrological and administrative data that are used by skippers and fleet managers to plan, execute and monitor a trip. FIS provide dynamic information (e.g. water levels) as well as static information (e.g. traffic signs, opening hours of locks) regarding the use and status of the inland waterway infrastructure, and thereby support tactical and strategic navigation decisions (draught and route planning). FIS basically contain data on the waterway infrastructure only – excluding data on vessel movements – and therefore consists of one-way information - shore to ship/office. Traditionally, these services are provided through published Notices to Skippers, TV and radio broadcasts, internet, VHF nautical information radio, e-mail subscription services and fixed telephones on locks (see figure below for a brief summary of the FIS-related technologies). Tailor-made FIS can be supplied by [PIANC, 2001]:

- Radiotelephone for urgent information such as changes of lock times, temporary obstructions in the fairway, navigation restrictions caused by floods and ice.
- Internet services for information that needs to be communicated not more than on a daily basis – e.g. current and predicted water levels, ice and flood predictions. Additionally, notices to skippers could be transmitted by E-mail or SMS subscription.
- Inland ECDIS maps as a means to display the fairway information. The electronic format guarantees that the latest map version is used. The radar and AIS information can be integrated as overlays.

Developments in the field of FIS include the integration of fairway information in electronic maps – or rather graphical databases. AIS could be used for broadcasting urgent messages from shore (Notices to Skippers) as well as small ECDIS updates. Generally all safety-related information can be transmitted via AIS, though with limitations of the data amount. Recently, a proposal for an International Standard for Notices to Skippers has been submitted to the CCNR, Danube Commission and the UNECE [AVV, 2003]. This standard should harmonise the structure of data sets in all participating countries and make available automatic translations of the most important contents.

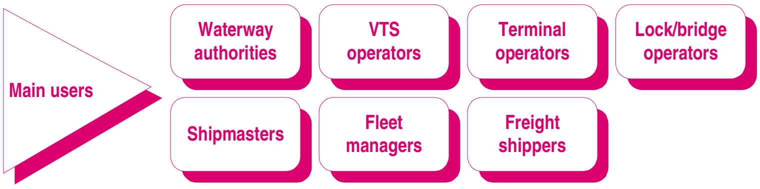


Figure 32. Main users of Fairway Information Services

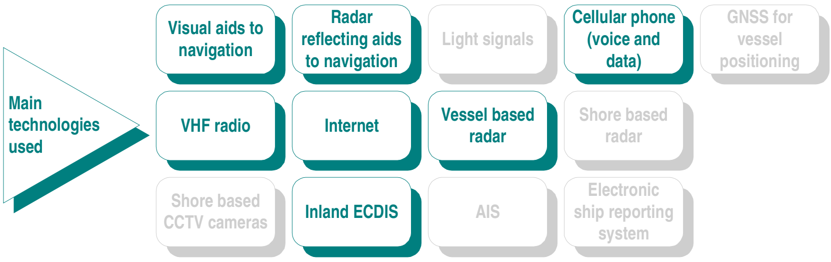


Figure 33. Main technologies required for Fairway Information Services

Traffic Information

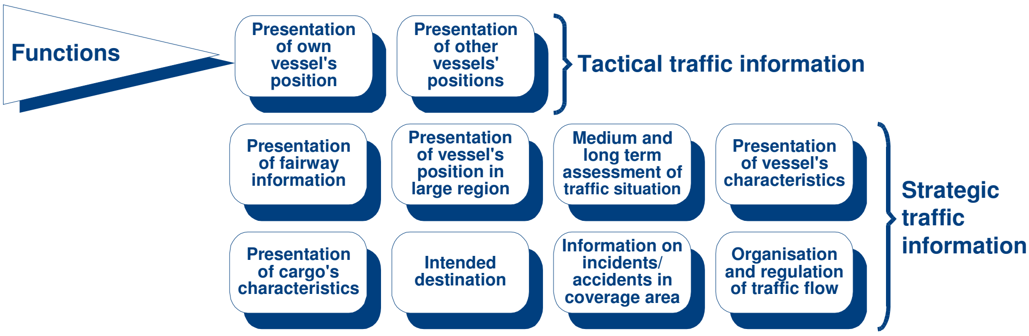


Figure 34. Functions of Traffic Information [Source: ZKR, 2002]

Traffic information services basically consist of tactical traffic information (display of the present vessel characteristics and movements on a limited part of the waterway) and strategic traffic information (display of vessels and their characteristics over a larger geographical area, including forecasts and analyses of future traffic situations).

Tactical Traffic Image (TTI)

Tactical Traffic Images contain information on vessels' positions, time, speed, direction and specific vessel information of all targets identified by radar and – if available – Automatic Identification Systems (AIS). The TTI is produced by collecting radar data and vessel-based AIS signals and displaying the signals on an Inland ECDIS. The TTI provides information that is directly related to the position, speed and orientation/tracks of the ships.

TTIs display the vessel's own position as well as the positions of other vessels in the same section of the waterway. The information on the TTI therefore supports the shipmaster in his/her immediate navigation decisions in the current traffic situation. The TTI allows skippers to make navigational arrangements with other vessels (e.g. turning, overtaking, passing). A TTI provides all the information needed to take over responsibility for navigational decisions.

A TTI can be installed on board for skippers, whereas the traffic operator on shore can concentrate with TTI on safety information tasks. When AIS transponders are installed on-board, information on the ships' identity and the cargo carried is available to the traffic operator as well. This allows fast and well-founded responses from rescue forces in the event of accidents.

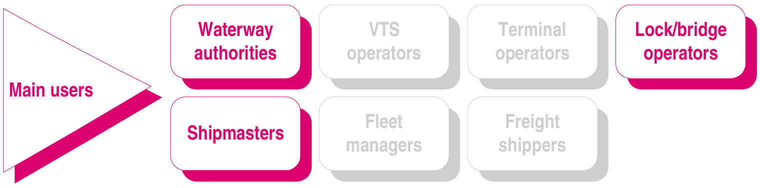


Figure 35. Main users of Tactical Traffic Image

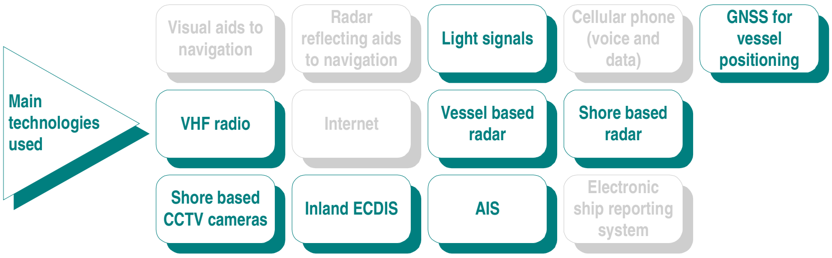


Figure 36. Main technologies required for Tactical Traffic Image

Strategic Traffic Image (STI)

The STI is a general overview of the traffic situation in a relative large area. STI will mainly be used for planning and monitoring purposes. The STI model will provide the user with information about intended voyages of vessels, (dangerous) cargo RTAs on defined points, and additional information of the vessels.

STI also allows a prognosis of the short-term development of traffic within a certain region (e.g. one kilometre); future traffic situations and locations – encounters between upcoming vessels and overtaking by passing ships – can be calculated and planned in advance.

The STI provides data for numerous user groups. It supports commercial users in their mid- and long-term traffic and fleet management decisions. Fleet managers and logistics service providers can use the STI to track and trace their fleet. It helps identify availability and position of all connected vessels. This potentially results in optimised utilisation of transport capacities. Additionally. STI allows waterway authorities to monitor navigational behaviour (law enforcement) – which minimises accidents – and to improve throughput of the waterway infrastructure. STI allows calculation of ETAs and RTAs for lock and terminal operators: the lock and transhipment cycles can be planned with higher accuracy.

In sum, a STI provides information to a broad range of users and allows a safe and efficient planning of trips along an entire corridor.

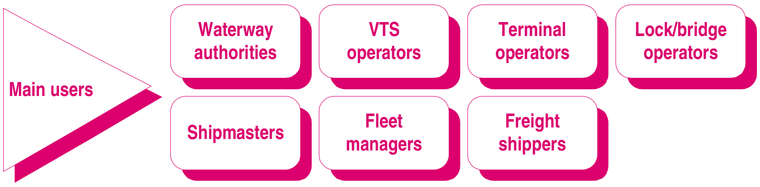


Figure 37. Main users of Strategic Traffic Image

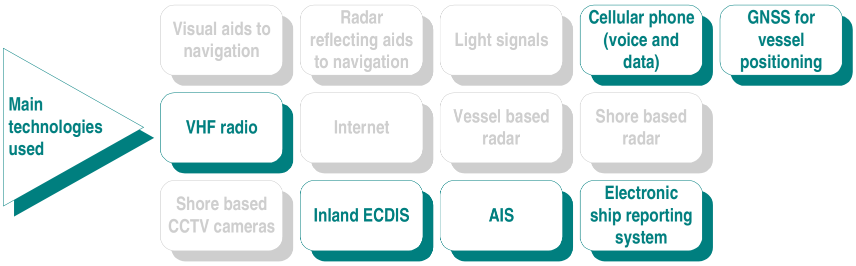


Figure 38. Main technologies required for Strategic Traffic Image

Traffic management

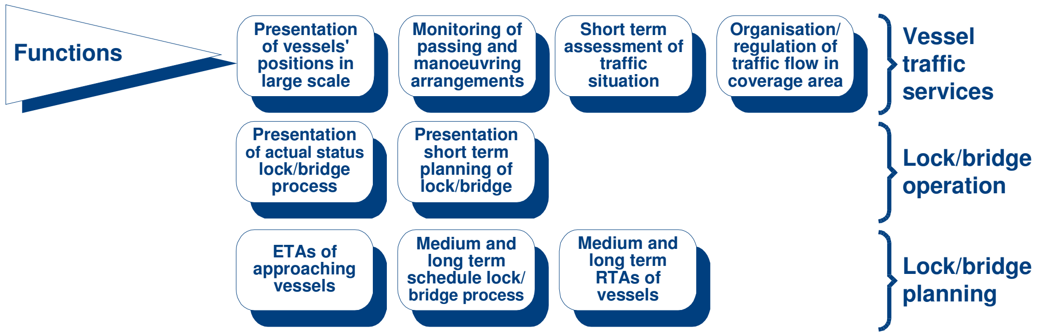


Figure 39. Functions of Traffic Management [Source: ZKR, 2002]

The role of waterway authorities is to optimise the use of the infrastructure they are controlling as well as facilitate safe navigation. At present so-called Vessel Traffic Services (VTS) centres are installed at some critical points along the European waterway network in the Netherlands and Germany where large amounts of traffic have to be managed. The VTS centres provide vessels with traffic information on 'blind spots' in the fairway network. Vessel Traffic Services are services implemented by a Competent Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area.

Another traffic management concept is based on the AIS technology (see section 0). This concept does not foresee a central VTS management function, but rather decentralised decisions support for navigational decisions. The AIS technology provides individual skippers with the information needed to take navigational decisions.

The information required by VTS centres is basically gathered by means of permanent shore-based radar stations. AIS could in the future provide additional information such as data about dangerous cargo shipped and the vessel's identity with much cheaper shore-side infrastructure. Likewise, verbal reports from skippers (by VHF radio) to the VTS centre can be replaced by electronic data exchange.

A second part of traffic management is formed by lock operation and planning. RIS support lock/bridge operators in their medium-term decisions by data exchange with neighbouring locks/bridges. RIS thereby assists in the calculation of ETAs/RTAs (Estimated/Requested Time of Arrival) for a chain of locks. ETA information of approaching vessels supports the overall lock planning and allows smooth passage of vessels through the locks and bridges. A through-going lock planning can reduce waiting times significantly. In turn, lock operators can inform the individual skipper of his RTA, who can thereby adapt his speed and possibly save on fuel consumption.

Figure 40. Main users of Traffic Management

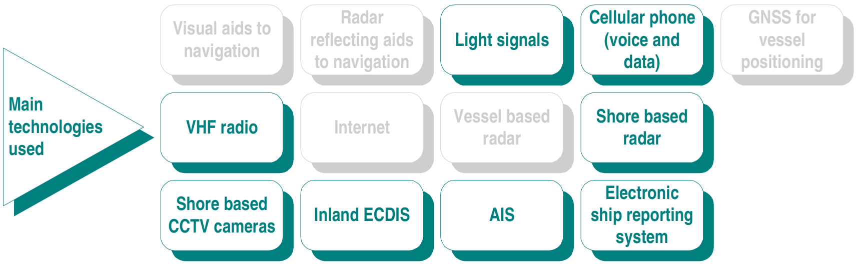


Figure 41. Main technologies required for Traffic Management

Calamity abatement

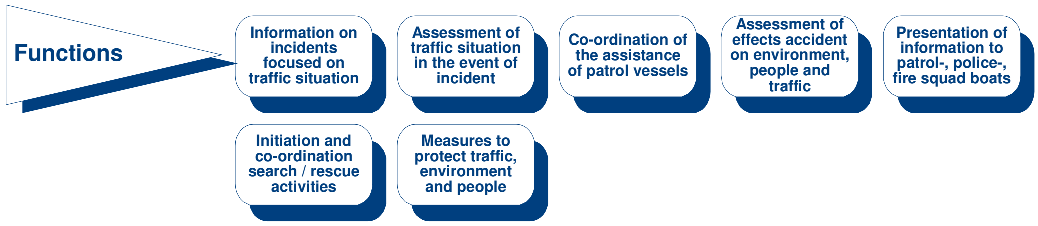


Figure 42. Functions of Calamity Abatement [Source: ZKR, 2002]

Calamity abatement services – as part of RIS – register vessels and their transport data at the beginning of a trip and update the data during the voyage. In case of an accident, the responsible authorities are capable of providing the data immediately to the rescue and emergency teams.

A ship reporting system is a tool to document all safety-related information on board and put these data at the disposal of the waterway authority. Ship reporting systems have been introduced for Rhine navigation since the mid-1990s in order to allow calamity abatement (e.g. IVS90, MIB, MOVES). The data are mainly received by VHF voice communication (e.g. on the Rhine) or by fax (on the Danube) depending on national legislation. Electronic data entry and reporting is also enabled by the Dutch BICS application, which can be used by skippers sailing in the Netherlands, Germany, France, Switzerland and Austria to report the cargo they are carrying.

Figure 43. Main users of Calamity Abatement

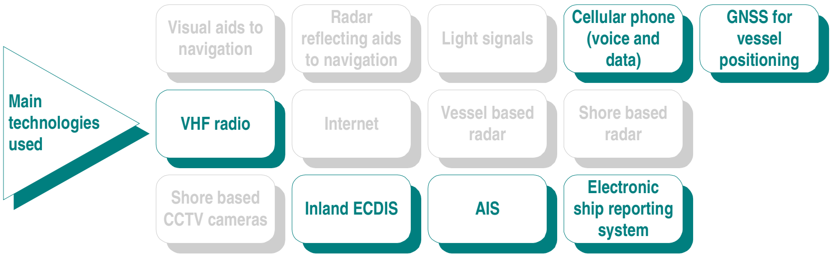


Figure 44. Main technologies required for Calamity Abatement

Voyage planning

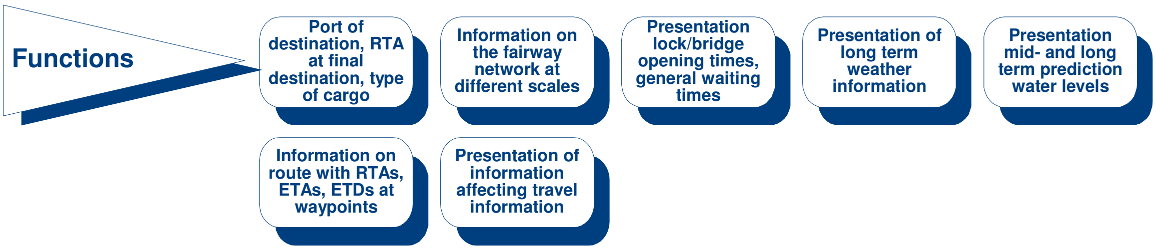


Figure 45. Functions of Voyage Planning [Source: ZKR, 2002]

A voyage is a movement of a ship between the port of departure and the port of destination. Planning of a voyage includes the planning of the draught and the ETA of the vessel. Skippers and fleet managers need fairway information for these planning activities. Traditionally this information is made available by means of so-called Notices to Skippers, which provide information on the availability of the waterway infrastructure (e.g. constraints due to construction works). Additionally, information on water levels and currents before and during the trip are needed. However, reliable water level forecasts for the entire route – especially for international voyages between Rhine and Danube – are currently not available. Therefore, when navigation conditions change during the trip, this information should be made available to the skipper, in order to allow him/her to undertake re-scheduling when necessary.

Decisions concerning the actual navigation and the manoeuvring of the vessel remain within the responsibility of the shipmaster. Any information provided by the RIS cannot replace any of these decisions [PIANC, 2001].

Figure 46. Main users of Voyage Planning

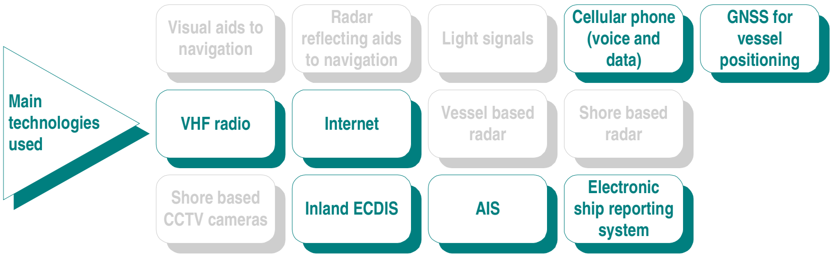


Figure 47. Main technologies required for Voyage Planning

Port and terminal planning

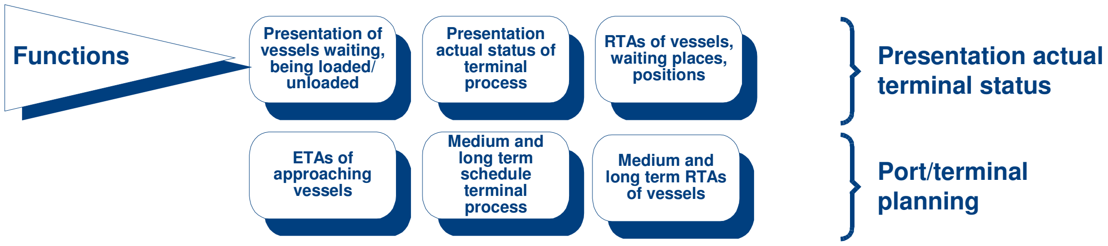


Figure 48. Functions of Port and Terminal Planning [Source: ZKR, 2002]

Terminal and port operators need Estimated Time of Arrival (ETA) information in order to be able to plan resources for terminal processes. ETA information of approaching vessels supports the overall terminal utilisation and allows smooth passage of vessels through the terminal facilities. As a result, transhipment processes – and especially waiting times – can be compressed. In case of insufficient terminal capacities, the terminal operator can inform the individual skipper of his Requested Time of Arrival (RTA). All in all a better slot management is possible as a result of the exchange of ETA and RTA data. In general, improved terminal planning results in faster and more reliable transit times, which normally constitute a disproportional part of the door-to-door order cycle time.

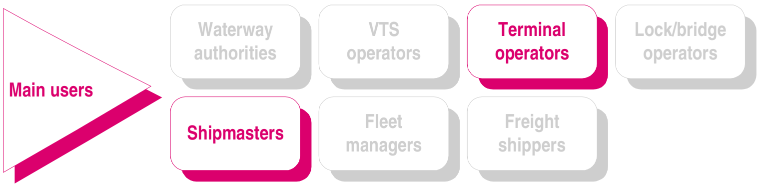


Figure 49. Main users of Port and Terminal Planning

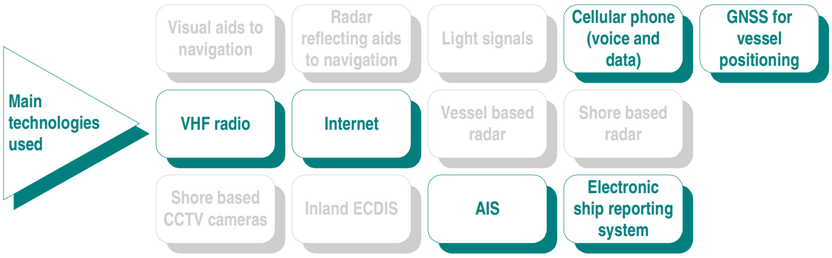


Figure 50. Main technologies required for Port and Terminal Planning

Cargo and fleet management

Figure 51. Functions of Cargo and Fleet Management

Cargo and fleet management basically comprises two types of information:

- Information on the vessels and the fleet
- Detailed information on the cargo transported

RIS allow logistics applications such as fleet planning support, ETA/RTA negotiations between vessels and terminals, tracking and tracing, and electronic marketplaces. Fleet managers and logistics service providers can for instance use the STI to track and trace their fleet. It helps identify availability and position of all connected vessels. This potentially results in optimised utilisation of transport capacities within an existing fleet.

This fleet planning capability can even be extended towards a logistics data pool among different companies. For instance, the ALSO Danube project – a project of the European Commission within the 5th Framework Programme GROWTH – developed and tested the concept of a Common Source Logistics Database (CSL.DB). The CSL.DB is among others fed by traffic data registered by the traffic information services. The CSL.DB links logistical information with the tactical traffic information of the vessels.

These data are collected in the database and used for logistical and transport planning by shippers and logistics service providers. Obviously, an important issue in the field of transport management is the confidentiality and security of commercial data.

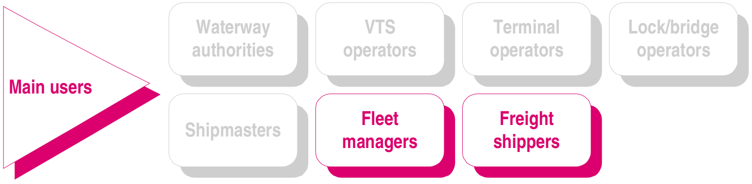


Figure 52. Main users of Cargo and Fleet Management

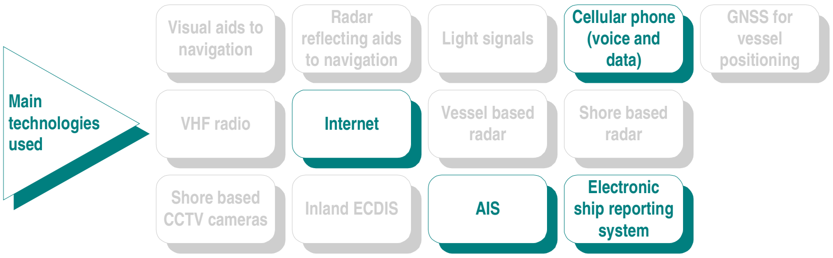


Figure 53. Main technologies required for Cargo and Fleet Management

Statistics

RIS can be used to collect relevant inland waterway freight statistics. These are mainly of interest to the waterway authorities for strategic planning and monitoring purposes. Statistics can be made available in different formats:

- General traffic data
- Cargo statistics
- Vessel statistics
- Lock statistics
- Accident statistics
- Port/transhipment statistics

The emergence of electronic ship reporting systems would strongly simplify the collection of statistical data. Nowadays, statistical data are mainly gathered through surveys in writing. The reliability and completeness of these data can be questioned. Electronic data collection would reduce these errors, and moreover reduce the costs of data gathering.

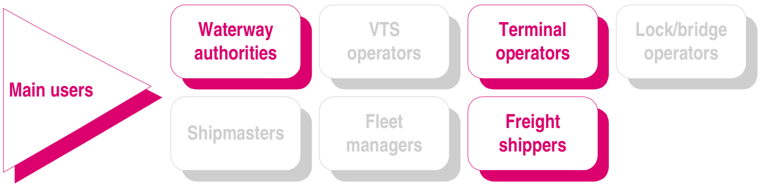


Figure 54. Main users of Statistics

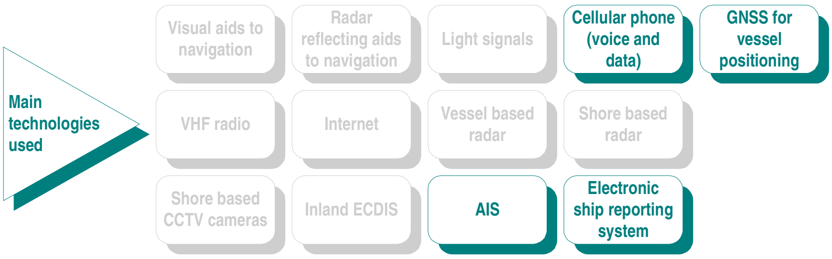


Figure 55. Main technologies required for Statistics

Figure 56. Main users of Water Infrastructure Charges

Water infrastructure charges

Finally, RIS can assist in levying charges for the use of infrastructure tolls. The travel data of the ship can be used to automatically calculate the charge and initiate the invoicing procedure.

Systems such as the German ASS-Online system has been developed to allow skippers to electronically send their declaration notification. The system can then send electronical invoices to the skipper. The infrastructure charges services mainly work through conventional technologies such as the internet and mobile phone.

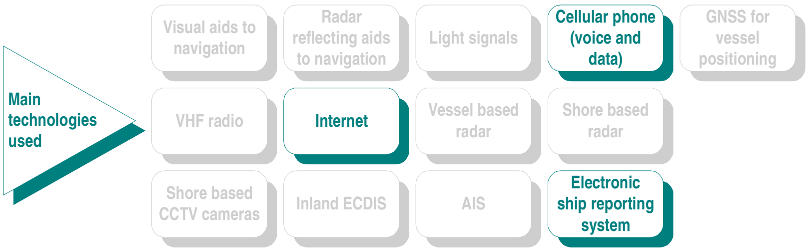


Figure 57. Main technologies required for Water Infrastructure Charges

7.4 RIS Technologies

PIANC [2001] identified a series of main RIS-related technological innovations that have been introduced in the inland waterway sector during the last decade:

- Electronic Navigation Charts (ENC) for visualisation of fairway and ship position information.
- Internet applications and Inland ECDIS for Notices to Skippers.
- Electronic ship reporting systems for information collection on voyage-related data (ship and cargo).
- Automatic Identification System AIS (transponders) for automatic reporting on the position of ships.

The purpose and status of these and other RIS technologies are briefly discussed in this section.

Radio-telephone/VHF equipment

Radiotelephone is suited for the simultaneous reception of inland navigation radio on two VHF channels (ship/ship and shore/ship). VHF stands for Very High Frequency, which represents frequencies between 30 – 300 MHz. For Rhine navigation vessels are required to be equipped with two VHF receivers. For instance, in Germany the first on-board radio device must be activated on the channel 10 (for ship-ship communication) and the second radio is used to communicate with VTS centres (traffic and lock management information).

On stretches with high traffic densities VTS operators monitor the progress and adherence to the original sailing plan of the vessels passing through. The VTS centre provides information to the vessel by VHF radio, which might influence navigational decisions (e.g. information on opposing traffic, fairway conditions, weather reports). With the emergence of AIS, parts of this information exchange may be automated. On stretches where no VTS centre exists, which is the major part of the European waterway network, AIS is a valuable addition to verbal VHF ship-ship communication, especially on stretches where upcoming traffic is not visible far in advance.

GPS and dGPS

The Global Positioning System (NAVSTAR GPS) is the main source for positioning data. However, for GPS data to be suitable for safe navigation decisions, the positioning data need to be more accurate than the relatively rough GPS data. Differential GPS (dGPS) uses a so-called reference receiver station, which is situated at a known location. The co-ordinates of the reference station are compared with the co-ordinates that have been obtained by the GPS. The differential value is sent as a correction factor to the GPS receiver on board. This largely improves the positioning accuracy of the measurements.

The correction data can be transmitted according to the IALA standard in the medium wave band, which is a maritime solution. Correcting stations would then need to meet the requirements of IMO Resolution A-915(22) and IALA requirements to Land-based Radio Navigation System of Satellite Positioning. Alternatives are EGNOS (European Geostationary Navigation Overlay System) or DGPS via AIS base stations. EGNOS is based on GPS receivers communicating with the EGNOS satellite system. EGNOS produces position data with 3 -5 metre accuracy. EGNOS is under development but already broadcasts correcting signals from two satellites for the GPS system. EGNOS will be operational by 2004.

Mobile communication networks

A personal computer with modem and mobile communication facilities (GSM – Global System for Mobile Communication) is required to receive e-mail and gain access to the internet. Many RIS applications are based on web-technology, e.g. internet is needed for electronic reporting and for the display of Electronic Navigable Charts (ENC). GSM/GPRS (General Packet Radio Service) is already available on a large scale, whereas Wireless LAN (WLAN) and UMTS (Universal Mobile Telecommunication System) are seen as promising technologies for the future. UMTS is a future system with wideband multimedia capabilities.

Transmission of data and internet communication by inland skippers via GSM is limited because of the high costs and the relatively low transmission speeds incurred. GPRS is a worldwide standard for mobile data transmission that is potentially cheaper. The user of GPRS does not pay per time unit but per amount of sent and received information.

Radar

An on-board radar is suited for the presentation of traffic in the vicinity of the vessel. Radar data are generated at a constant rate as defined by the antennal rotation speed (typical update rate 2 seconds).

Radar images may be deteriorated in cases of heavy precipitation and interference of obstacles (such as buildings, mountains). Radar will however remain the main sensor for detecting vessels now and in the future.

Automatic Identification System (AIS)

AIS is an additional source of navigational information, which supports radar systems. An AIS uses dynamic digital broadcast radios carried on vessels. AIS automatically broadcasts relevant information about the vessel at regular intervals (typically every two seconds). These data are received and integrated by other AIS devices (ships or shore stations), which can be displayed as real-time navigation data on a radar or Inland ECDIS. The use of AIS could reduce language barriers, as a major part of the information is exchanged electronically.

Many verbal reports from skippers to the VTS centre could be replaced by electronic information. Vessels that may not be visible by on-board radar systems can be identified by AIS (e.g. in cases of river bends, dikes).

An AIS system consists among others of following components [IALA, 2001]:

- One multi-channel VHF transmitter
- Two multi-channel VHF receivers
- An internal GNSS receiver for timing purposes and position redundancy
- Interfaces to radar, ECDIS and integrated navigation systems, sensors
- AIS can also provide other information in addition to the ships' position. AIS is a shipborne radio data system, which allows the exchange of following types of data between AIS-equipped vessels and between vessels and shore stations:
- Static information: official ship number, call sign of ship, name of vessel, type of vessel, length and beam.
- Dynamic information: position, position time stamp, navigational status
- Trip-related information: length and beam of convoy, draught of vessel, destination (UNECE location code), ETA.
- Basic safety-related information: summarised cargo data according can be sent by AIS.

AIS allows information exchange among many vessels at the same time. AIS data of vessels are received by other AIS-equipped ships, and by base or repeater stations on shore. A standard for AIS base stations for use in inland navigation needs to be finalised. AIS aims to achieve positional accuracy better than 5 metres when associated with DGNSS correction signals.

Despite the advantages of AIS mentioned, various issues need to be resolved before widescale implementation can be thought of. Among the potential carriers of the AIS transponders – the individual skippers – some resistance is noted, which is basically caused by the costs of installation and the ‘big brother’ argument. Moreover, AIS is a question of all-or-nothing: all traffic participants need to be equipped with it (including recreational boats), otherwise the traffic information is incomplete.

Electronic Navigable Chart (ENC)

Inland ECDIS (Electronic Chart Display and Information System for Inland Navigation) is the European standard for Electronic Navigational Charts, adopted by the Central Commission for the Navigation on the Rhine (in May 2001) and the Danube Commission. Inland ECDIS maps are based on and are compatible with maritime ECDIS (promoted by IMO and IHO), and are expected to be available for the Rhine and the Danube within a short period of time. Through the usage of the same standard, maps can be produced for estuaries of rivers, where both maritime and inland vessels navigate. Inland ECDIS can be used in two modes – the navigation and information mode – with and without traffic information by radar or AIS overlay respectively. In the information mode the Inland ECDIS chart is ‘just’ an electronic map without traffic information, the navigation mode additionally offers up-to-date information on nearby traffic. Since a skipper cannot be expected to use different equipment in different countries, a harmonised Inland ECDIS standard has been developed.

Technical standards

In addition to 'hardware'-technologies, standards play an important role in the development of RIS in Europe.

Standardisation of RIS is required because of [PIANC, 2001]:

- The international character of inland navigation.
- The need to integrate inland navigation in intermodal transport chains, with their own IT systems.
- The need for critical mass for suppliers of hard- and software.

The appendix contains an overview of RIS-related technical standards that was drawn from the PIANC Technical Brief [2002], with a few recent additions.

The INDRIS project delivered basic standards for data content and transmission. The remaining of this section is limited to a summary of the status of data and communication standards.

Data standards

Standards are indispensable in order prevent several systems to be developed in parallel, requiring (relatively expensive) interfaces afterwards. Standards are therefore cost-effective for the system as a whole. Inland ECDIS is an example of a European-wide standard to describe and display objects along the inland waterway (e.g. locks) in a harmonised way. The IHO S57 standard is a widely accepted standard for electronic navigable charts.

Data formats for water levels or weather reports have not been standardised yet, but will be in short term.

Standards for transport and logistics data are developed along the lines of Electronic Data Interchange, whereby specific EDIFACT messages have been specified for inland navigation.

Communication standards

The communication standards used for fairway information systems are based on TCP/IP protocols and GSM communications. Wireless technologies (e.g. UMTS) are expected to replace these standards in the future [Willems, 2001].

Tactical and strategic traffic images are based on the AIS standards that have been developed originally in maritime shipping by the IMO. The IMO standards have been adapted according to the needs for inland navigation.

7.5 Selected RIS Applications now and in the future

In this section some examples of recent RIS projects are given to provide an impression of their main services and the status of RIS in Europe. Where data are available the numerous RIS applications are analysed according to the same criteria:

- Services
- Main technologies
- (Potential) users
- Status of service
- Geographic coverage

The data presented in this section are mainly based on expert interviews, website information for the various RIS applications, the state-of-the-art overview developed within the framework of COMPRIS, as well as on PIANC [2002].

ARGO

ARGO (Advanced River Navigation) is a German navigation system for inland waterway skippers. It provides data on the fairway conditions and actual water levels in real time. A method was developed to display current water depths on Inland ECDIS charts. ARGO consists of three components: an electronic navigation chart (ENC), a radar image and water depth information for critical stretches (e.g. Straubing-Vilshofen) displayed on the chart [Steinhuber, 2002]. Through a GPS receiver it is possible to display the position of the own vessel on the image very accurately.

- Services: fairway information, voyage planning
- Main technologies: cellular phone, GNSS, Internet, Inland ECDIS
- (Potential) users: waterway authorities, shipmasters
- Status of service: testing phase, operation planned for late 2003
- Geographic coverage: southern Germany

ASS-Online

ASS-Online is a German web-based IT system, which offers an information system for waterway infrastructure charges, data exchange between waterway authorities (in different jurisdictions), electronic transport notification by skippers, and electronic invoices to skippers. The technologies used include a PC with internet connection, as well as an account for digital signatures. ASS-Online is mainly aimed at electronic waterway infrastructure charging and generation of statistics. Additionally, the data stored can be used for calamity abatement purposes. ASS-Online is planned to be finalised in 2004:

- Services: waterway infrastructure charges, calamity abatement, statistics
- Main technologies: internet (PC with internet connection), digital signature
- (Potential) users: waterway authorities, VTS operators, shipmasters
- Status of service: started 2002, finalisation scheduled for 2004.
- Geographic coverage: Germany

Bargelink

Bargelink is an electronic marketplace for inland navigation. Some 1,000 skippers are offering their services and fleet on this website, cargo shippers can offer their cargo to be transported. Bargelink is a marketplace for inland shipping agents, barge owners, forwarders, shippers and shipping companies. The offering party decides to whom he offers his cargo or barge and what contract he will close at what conditions.

The contact between the potential partners will be established outside Bargelink by phone, fax, SMS and/or e-mail. Carriers are able to give their quotes on detailed requests. The shipper decides who will participate in the auction and who will get the deal. Successful auctions are charged with 1.25% of the transport volume. Participating in an auction and getting a deal is free of charge for carriers. Up to March 2002 more than 300.000 tons had already been shipped via this marketplace.

- Services: cargo and fleet management
- Main technologies: internet (PC with internet connection), cellular phone
- (Potential) users: shipmasters, fleet managers, freight shippers
- Status of service: online since 2001
- Geographic coverage: Europe

BICS

BICS (Barge Information and Communication System) has been primarily developed for reporting the transport of dangerous goods. Such EDI-messages from skippers to the authorities can be received in the Dutch IVS90 system and the German MIB/MOVES systems. BICS enables detailed information exchange about the cargo (e.g. precise name of the cargo and indication of risks) and planned loading and unloading points during the voyage. These data are transmitted by PC and mobile telephone to the various waterway and port authorities. The standards used include EDIFACT as well as TCP/IP protocols. Until now this information is usually exchanged verbally by marine phone, and/or by fax. BICS makes the supply of information faster, more reliable and more confidential. The usage of BICS reduces the need for verbal communication and reduces errors in data entry. Data only have to be declared once, on departure of the vessel. Data are also stored for statistical purposes.

- Services: calamity abatement, voyage planning, cargo/fleet management, statistics
- Main technologies: internet, cellular phone, electronic ship reporting
- (Potential) users: all user groups
- Status of service: operational since 1996

- Geographic coverage: Austria, France, Germany, Luxembourg, Switzerland, The Netherlands

BIVAS

BIVAS (Binnenvaart Intelligent Vraag en Aanbod Systeem – Inland Navigation Intelligent Demand and Supply System) creates a virtual marketplace of demand and supply. The system works via wireless communication and internet technology.

BIVAS was part of the Flemish INDRIS demonstrator, which is an interactive internet site where supply and demand for freight can be matched. BIVAS presents the demand for transport as well as the supply of vessel capacity, and thereby only establishes the contact between skipper and shipper. When changes are made to the cargo offered, the skipper becomes a SMS notification message. The actual negotiations are left to the market parties themselves, BIVAS does not support the commercial process itself. The BIVAS software runs on common PCs and communicates through an internet connection.

- Services: cargo and fleet management
- Main technologies: internet, cellular phone
- (Potential) users: shipmasters, fleet managers, freight shippers
- Status of service: started 1996 as a pilot project, stopped in 2002
- Geographic coverage: Belgium

BintraS

BintraS (BINnenschiff-TRAnsport System) is an information site about mainly German waterways, ports and transport companies. As such, BintraS points to the possibilities of inland waterway transport, and provides an inland waterway market place for active freight mediation. It contains a bulletin board where cargo and available ship capacity can be published. An eBusinet study claimed that in 2002 some 27 private shipowners participated in BintraS [eBusinet and BDS Binnenschifffahrt, 2002].

- Services: port and terminal management, cargo / fleet management
- Main technologies: internet
- (Potential) users: shipmasters, fleet managers
- Status of service: operational since 2001
- Geographic coverage: Germany, The Netherlands

Container98

Container98 is a container stowage computer platform available since 1998, which is able to process digital load lists of different operators. A connection to the BICS system is possible. A comparable system is the Container-Planner, which is also a container stowage programme that can be used by inland skippers to receive loading lists from container operators. The software allows the production of loading plans before containers are actually loaded. The location of containers with dangerous goods can easily be identified (calamity abatement). The communication standard is based on EDIFACT.

- Services: calamity abatement, port/terminal management,
- cargo/fleet management
- Main technologies: EDI messages
- (Potential) users: terminal operators, shipmasters, fleet managers
- Status of service: operational since 1998
- Geographic coverage: not limited

COPIT

COPIT is a German positioning and information system to enable co-operation among private ship owners, to optimise vessel utilisation and minimisation of empty returns. The technologies used include on-board GPS receivers, a personal computer and the COPIT software. The COPIT software on-board transmits the position that is provided by the GPS-receiver. The data of individual vessels (name, position, status, telephone number, etcetera) are transmitted by GSM (SMS messages) to the COPIT-Internet server. COPIT therefore enables tracking and tracing of shipments. For incoming transport demand, the COPIT transport management tool determines the vessel that is best suited to carry out the tasks (in terms of cargo type, time, geographical proximity).

- Services: fairway information, traffic management,
- cargo/fleet management
- Main technologies: cellular phone, internet, GPS
- (Potential) users: shipmasters, fleet managers, freight shippers
- Status of service: operational since 2000
- Geographic coverage: Germany, The Netherlands

Desk Water

Desk Water is a Dutch website, which provides up-to-date Notices to Skippers, reporting on fairway conditions of the European waterway network (fairway obstructions, maximum draught at specific locations, construction works at locks). Additionally, the Water Desk website contains a small bulletin board where cargo offers can be posted, as well a limited ship and address list of subscribed ship owners. Skippers can use the online calculator to calculate profit margins for specific shipments. The website can also be accessed by GSM easily.

- Services: fairway information services, cargo/fleet management
- Main technologies: internet, cellular phone
- (Potential) users: shipmasters, fleet managers
- Status of service: operational since 2001
- Geographic coverage: The Netherlands

DoRIS

DoRIS (Danube River Information Services) automatically generates traffic information by means of AIS transponders. The tactical traffic image is currently being tested for use by waterway authorities and skippers. Additionally, DoRIS offers opportunities for transport management, lock management (provision of ETA data to plan lock schedules), navigation (supporting the skipper in his nautical decisions by providing positioning data on an electronic chart) and calamity abatement (by monitoring vessels carrying dangerous goods). For the needs of commercial users a web interface as well as an XML-interface for direct connection of authorised external logistics servers are provided. XML means eXtensible Markup Language, which is a data format for structured document interchange on the web.

The DoRIS system comprises following main technological components: AIS transponders onboard and on shore, tactical traffic image on board and on shore, and Inland ECDIS of the Danube. The geographic information system for instance provides a user-friendly interface to the commercial RADARpilot 720º. The DoRIS application allows calamity abatement since all traffic data are stored in a central database. in case of accidents, these data can be retrieved for risks analysis purposes. The data can also be used for statistical analyses.

- Services: traffic information services, traffic management, calamity abatement, port and terminal management, statistics
- Main technologies: AIS, GPS, internet, Inland ECDIS, cellular phone
- (Potential) users: all user groups
- Status of service: test centre operational since 2002
- Geographic coverage: 33km within Austria, with planned connections to remaining Danube

ELWIS

ELWIS is the German Electronic Waterway Information System, which provides a series of (fairway) information services that are relevant to the inland waterway sector. This website contains notices to skippers, actual and forecast water levels and draughts, information on ice, addresses of authorities, traffic statistics.

- Services: fairway information services, voyage planning, statistics
- Main technologies: cellular phone (SMS), internet
- (Potential) users: waterway authorities, shipmasters, fleet managers
- Status of service: operational, new version 2003
- Geographic coverage: mainly Germany

IBIS and GINA

IBIS (Informatisering Binnenscheepvaart) was developed in Flanders as part of the INDRIS project. With IBIS, AWZ (Waterways and Maritime Affairs Administration) is able to deliver navigation licences, locate ships within their territory and collect data on inland navigation.

IBIS can calculate the ETA of ship at a certain point (e.g. lock), so that lock operators can already arrange the lock chambers in advance.

The application uses an internet browser to communicate with the central database in Brussels. In the future a system of electronic notification will be established. Then the skipper will be able to send his data (identity of the skipper, weight and type of cargo) by means of an EDIFACT message to the waterway authorities.

GINA (Gestion Informatisée de la Navigation) is a reporting application for Wallonia dedicated to the invoicing of navigation fees and the generation of statistics. Lock pre-announcement is also part of GINA.

- Services: traffic management (lock/bridge management), statistics, waterway infrastructure charges
- Main technologies: EDI, internet
- (Potential) users: waterway authorities, lock/terminal operators, shipmasters
- Status of service: IBIS operational since 1999, GINA first version 1986
- Geographic coverage: IBIS/Flanders, GINA/Wallonia

IVS90

IVS90 is a ship reporting system used by Dutch waterway authorities supporting lock planning, vessel traffic services (VTS), calamity abatement and statistics. The data registered in IVS90 include the vessel data (name, registry number (Europa number), dead-weight, length and width dimension, owner) and specific trip data (draught, height of cargo, number of personnel on board, port of departure and destination, planned route, cargo specific data). These data are automatically transmitted between locks and/or regional VTS centres. Data only need to be entered once by the skipper at the beginning of the voyage, by means of marine VHF radio, mobile phone, fax or EDI. Data flows are much more streamlined, since repetitive data enquiries between VTS and lock operators are eliminated. The BICS system can be used for electronic data transmission.

Based on the reported ship information, VTS operators are capable of monitoring and regulating ship movements better and can react faster in the event of an accident. Moreover, statistical data are acquired without any additional efforts.

The German MIB and MOVES services are comparable with IVS90. The MIB (Melde- und Informationssystem Binnenschifffahrt) registers dangerous goods transport, as well as long push units and tug tows combinations. The MOVES (Mobiles Verkehrserfassungsystem) – tested since 2003 – registers electronically the data of ships passing the locks in the Main region.

- Services: traffic management, calamity abatement, voyage planning, statistics
- Main technologies: VHF radio, cellular phone, EDI
- (Potential) users: waterway authorities, VTS operators, lock/terminal operators, shipmasters
- Status of service: operational since 1994
- Geographic coverage: The Netherlands

MIB

The German Melde- und Informationssystem Binnenschifffahrt (MIB) is used to register and monitor transports of dangerous goods, pushing and towing combinations longer than 140 metres as well as exceptional transports. The VTS centre at the start of the trip registers all safety-related data, which are transmitted to all competent authorities along the journey. In case of accidents, the data are sent to the rescue forces and the police. Skippers use the BICS programme (see section 0) to transmit the data to the MIB database.

- Services: calamity abatement, voyage planning, cargo/fleet management, statistics
- Main technologies: VHF radio, cellular phone, internet, EDI
- (Potential) users: all user groups
- Status of service: operational
- Geographic coverage: Germany

NIF

NIF stands for Nautischer Informations-Funk. This German service is used to transmit messages related to water levels, high-water notifications, water level predictions, ice and mist messages, police messages. Additionally, NIF can be used to receive or broadcast information in cases of emergency.

- Services: fairway information services, traffic management, calamity abatement, voyage planning
- Main technologies: VHF radio
- (Potential) users: waterway authorities, shipmasters
- Status of service: operational
- Geographic coverage: Germany

PC Navigo

PC Navigo is a voyage and route planner for the inland waterways network of Europe. The application contains a database on nodes and links in the waterway network (e.g. maximum speeds, water levels, lock dimensions, operating hours, phone numbers, and other relevant data needed for navigation). The software is capable of generating reliable route plans and time schedules (ETA calculator). All major European waterways are covered.

- Services: fairway information, traffic management, voyage planning

- Main technologies: cellular phone, GPS, Internet, Inland ECDIS
- (Potential) users: shipmasters, fleet managers
- Status of service: operational since 1992
- Geographic coverage: European waterway network

RADARpilot 720º

RADARpilot 720º is an Inland ECDIS-based navigation system mainly for on-board use, which combines GPS data with electronic charts. It displays the river bank, the fairway, radar buoys, bridges, power lines and traffic signs. The RADARpilot 720º can be connected to all common radars for inland navigation. The chart is underlaid under the radar image. Actual water levels and forecasts can be downloaded (e.g. from the ELWIS website), usable draughts can be computed and displayed. AIS transponder data can be integrated to exchange actual vessel information between traffic participants. Due to the combination of GPS and a chart drawing engine the navigator has direct and up-to-date access to all necessary information for navigation. RADARpilot 720º can allow navigation even under the most difficult conditions (e.g. fog, heavy rainfall or darkness).

- Services: fairway information, traffic information services and traffic management (in combination with COPIT interface), voyage planning
- Main technologies: GPS, radar, ECDIS, AIS, cellular phone
- (Potential) users: shipmasters, VTS operators
- Status of service: commercial product available since 2000
- Geographic coverage: central Europe

RSOE/DISR

DISR is the Hungarian Danube Information and Emergency Call System, which is operated by the National Association of Radio Distress-Signalling and Infocommunications (RSOE). The main service currently offered by the application is aimed at calamity abatement. DISR covers the entire Hungarian section of the Danube, records vessels transporting dangerous goods and provides nautical information for skippers. The service – which is mainly aimed at waterway authorities /VTS operators and shipmasters – used to be based on VHF radio exclusively, but the DISR application is currently being developed further within the context of the COMPRIS project. The extension goes in the direction of applying AIS technology.

- Services: calamity abatement
- Main technologies: VHF (AIS)
- (Potential) users: waterway authorities, shipmasters, VTS operators
- Status of service: operational, new tests with AIS underway
- Geographic coverage: Hungarian Danube

Saimaa waterways information system

The RIS applications used on the Lake Saimaa (Finland) comprise a complete package of RIS services, from fairway information services to waterway infrastructure charges. The 814 km long waterway network is equipped with eight VHF radio stations as well as eight AIS stations.

These are linked to the VTS traffic centre, which provides information services to vessels in the network. Vessel traffic movements can be monitored in real-time.

The traffic centre can also operate (remote control) all eight locks and seven bridges along the canal (PIANC, 2002).

- Services: all RIS services
- Main technologies: VHF, AIS, GPS, Inland ECDIS
- (Potential) users: all user groups
- Status of service: operational
- Geographic coverage: Lake Saimaa (Finland)

Ship@Sight

Ship@Sight is a remote tracking and tracing system that runs via the internet. Fleet and ship details can be displayed on an electronic chart (e.g. vessels ID, position, heading, latitude and longitude). Shipowners and authorised users can log in on the internet site and retrieve the status information they need.

- Services: traffic information services and traffic management
- Main technologies: internet, GPS, Inland ECDIS
- (Potential) users: shipmasters, fleet managers
- Status of service: operational
- Geographic coverage: Europe

STIS

Shipping and Transport Information Services (STIS) is meant as an overall architecture which should be used by various RIS applications for various stakeholders. It intends to make compatible the numerous stand-alone applications that are available now and in the future. Until the end of 2003 following system components are planned to be finalised: a business plan; standards and protocols for data exchange and communication; a system architecture; and a prototype for a nautical-geographical database (Inland ECDIS).

- Services: traffic management, voyage planning, cargo and fleet management, port and terminal management, calamity abatement, statistics
- Main technologies: cellular phone, GNSS

(Potential) users:	waterway authorities, shipmasters, fleet managers, terminal operators
Status of service:	explorative phase finished December 2002
Geographic coverage:	The Netherlands

VNF2000

VNF2000 is a French information network used to invoice navigation tolls and to produce traffic statistics. VNF2000+ will allow companies and ship owners to declare their transports by EDI messages and no more by paper. VNF uses the Dutch BICS for transmission. Planned finalisation date of VNF2000+ is March 2005.

- Services: traffic information, statistics, infrastructure charges
- Main technologies: internet, GPS, Inland ECDIS
- (Potential) users: waterway authorities, shipmasters, fleet managers
- Status of service: operational since 2000, VNF2000+ planned for 2005
- Geographic coverage: France

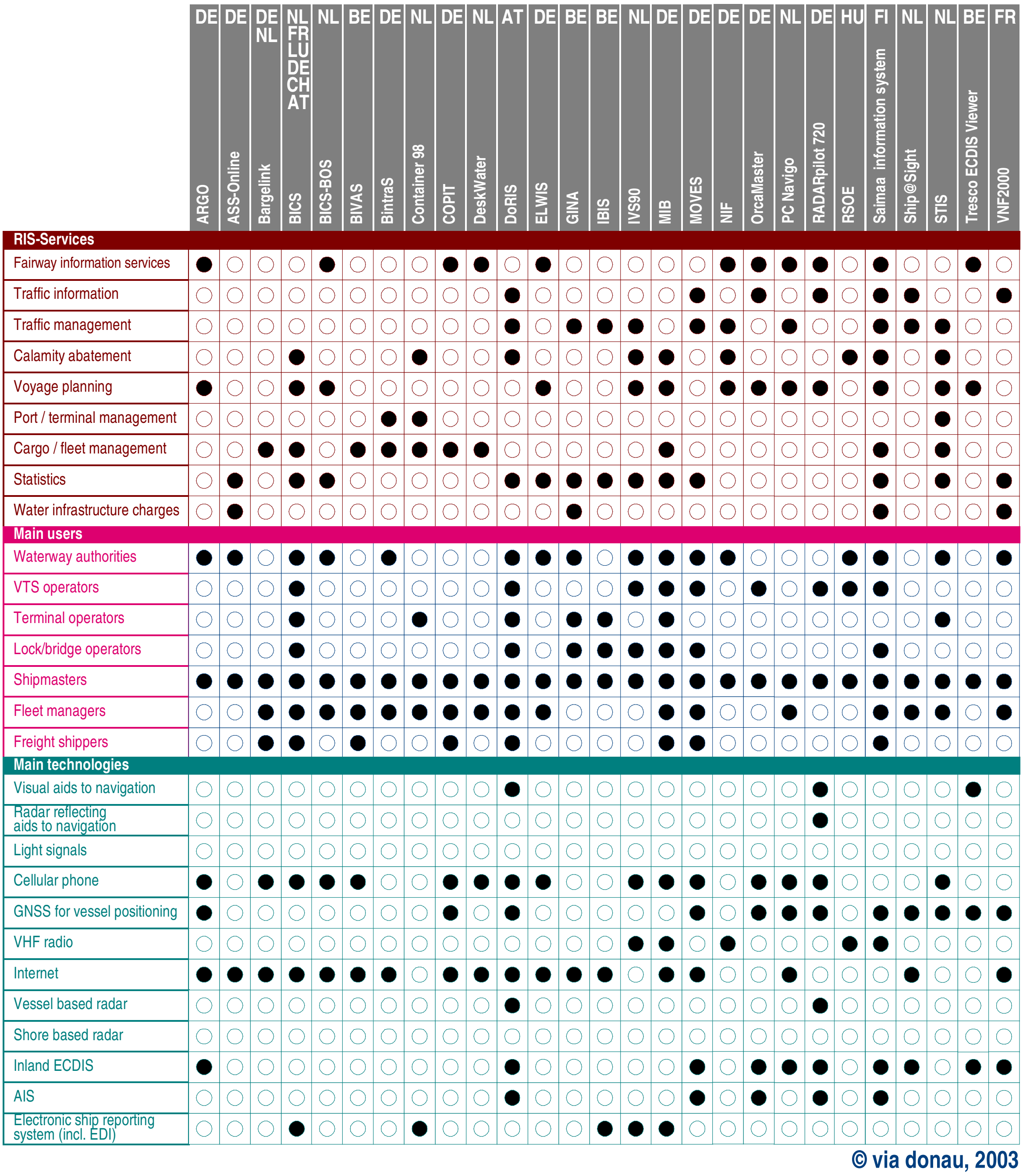
7.6 Conclusions

Figure 58 shows the mentioned RIS applications together with the service levels offered. The main characteristics are displayed: services offered, user groups and technologies used. Some observations can be made on the basis of this overview.

First, among the selected RIS applications, the most common *services* offered include fairway information services, voyage planning tools and the gathering of inland waterway statistics. Only a limited number of applications deal with port/terminal management and water infrastructure charges. The services offered should be constantly monitored from the perspective of the various user needs.

Secondly, as regards the *users groups*, shipmasters are obviously the most targeted user group. Almost every application involves information exchange between some actor in the logistics chain and the shipmaster. Other user groups addressed relatively often are fleet managers and waterway authorities. The relative neglect of lack of applications and river information services that are aimed at shippers and logistics service providers could prove to be a limiting factor in trying to stimulate the further growth potential of inland waterway navigation. RIS applications for these user groups need to be developed further in order to support logistics decisionmakers in their modal choices in favour of inland navigation.

Finally, considering the *technologies* used for the various RIS applications, it can be stated that the majority of applications use the cellular phone and the internet as their basic technologies, followed by GNSS and Inland ECDIS. The use of other promising technologies such electronic ship reporting and AIS should be analysed and promoted when appropriate.



	DE	DE	DE NL	NL FR LU DE CH AT	NL	BE	DE	NL	DE	NL	AT	DE	BE	BE	NL	DE	DE	DE	DE	NL	DE	HU	FI	NL	NL	BE	FR
	ARGO	ASS-Online	Bargelink	BICS	BICS-BOS	BIVAS	BintraS	Container 98	COPIT	DeskWater	DoRIS	ELWIS	GINA	IBIS	IVS90	MIB	MOVES	NIF	OrcaMaster	PC Navigo	RADARpilot 720	RSOE	Saimaa information system	Ship@Sight	STIS	Tresco ECDIS Viewer	VNF2000
RIS-Services																											
Fairway information services	●	○	○	○	●	○	○	○	●	●	○	●	○	○	○	○	○	●	●	●	●	○	●	○	○	●	○
Traffic information	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	●	○	●	○	●	○	●	●	○	○	●
Traffic management	○	○	○	○	○	○	○	○	○	○	●	○	●	●	●	○	●	●	○	●	○	○	●	●	●	○	○
Calamity abatement	○	○	○	●	○	○	○	●	○	○	●	○	○	○	●	●	○	●	○	○	○	●	●	○	●	○	○
Voyage planning	●	○	○	●	●	○	○	○	○	○	○	●	○	○	●	●	○	●	●	●	●	○	●	○	●	●	○
Port / terminal management	○	○	○	○	○	○	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○
Cargo / fleet management	○	○	●	●	○	●	●	●	●	●	○	○	○	○	○	●	○	○	○	○	○	○	●	○	●	○	○
Statistics	○	●	○	●	●	○	○	○	○	○	●	●	●	●	●	●	●	○	○	○	○	○	●	○	●	○	●
Water infrastructure charges	○	●	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	●	○	○	○	●
Main users																											
Waterway authorities	●	●	○	●	●	○	●	○	○	○	●	●	●	○	●	●	●	●	○	○	○	●	●	○	●	○	●
VTS operators	○	○	○	●	○	○	○	○	○	○	●	○	○	○	●	●	●	○	●	○	●	●	●	○	○	○	○
Terminal operators	○	○	○	●	○	○	○	●	○	○	●	○	●	●	○	●	○	○	○	○	○	○	○	○	●	○	○
Lock/bridge operators	○	○	○	●	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○	○	●	○	○	○	○
Shipmasters	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Fleet managers	○	○	●	●	●	●	●	●	●	●	●	●	○	○	○	●	●	○	○	●	○	○	●	●	●	○	●
Freight shippers	○	○	●	●	○	●	○	○	●	○	●	○	○	○	○	●	●	○	○	○	○	○	●	○	○	○	○
Main technologies																											
Visual aids to navigation	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	●	○	○	○	○	●	○
Radar reflecting aids to navigation	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○
Light signals	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cellular phone	●	○	●	●	●	●	○	○	●	●	●	●	○	○	●	●	●	○	●	●	●	○	○	○	●	○	○
GNSS for vessel positioning	●	○	○	○	○	○	○	○	●	○	●	○	○	○	○	○	●	○	●	●	●	○	●	●	●	●	●
VHF radio	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○	●	○	○	○	●	●	○	○	○	○
Internet	●	●	●	●	●	●	●	○	●	●	●	●	●	●	○	●	●	○	○	●	○	○	○	●	○	○	●
Vessel based radar	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○
Shore based radar	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Inland ECDIS	●	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	●	○	●	●	●	○	●	●	○	●	●
AIS	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	●	○	●	○	●	○	●	○	○	○	○
Electronic ship reporting system (incl. EDI)	○	○	○	●	○	○	○	●	○	○	○	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○

© via donau, 2003

Figure 58. Overview of RIS-services, users and technologies

Expert interviews and desk research revealed a number of core problems related to the future development of RIS on a European level. Five themes were identified as the most important barriers to the further implementation of RIS:

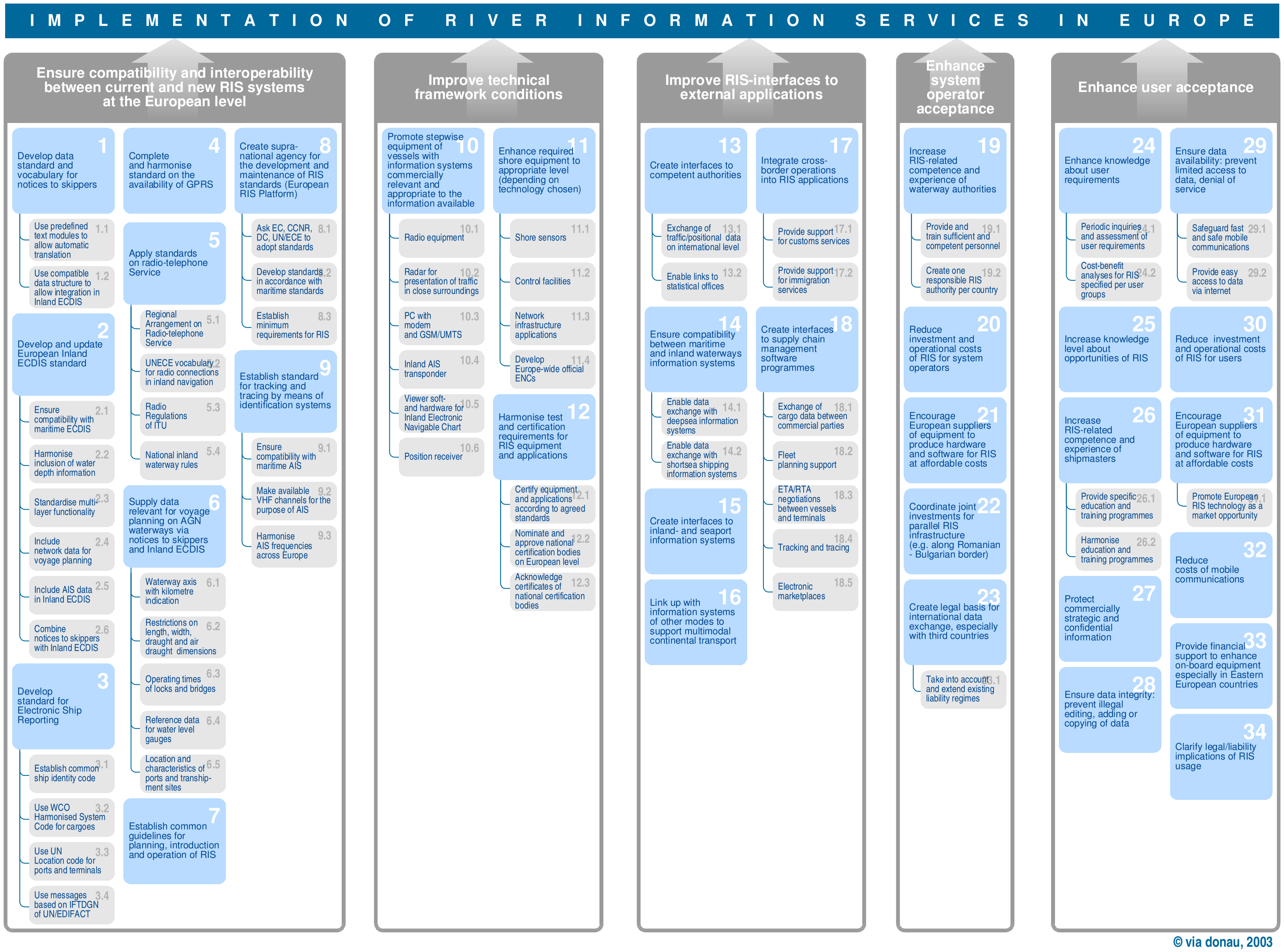
- Compatibility and interoperability among RIS applications;
- Realisation of technical framework conditions;
- Interfaces between RIS- and external applications;
- Acceptance among (potential) system operators;
- User acceptance.

Each of these factors and possible actions will be discussed in the following subsections.

Compatibility and interoperability

As Figure 58 showed, despite some interconnections between the applications, many of the existing river information services have been developed independently of each other. There is therefore a possible danger of an emerging patchwork of various RIS applications. This danger is also mentioned in the Draft PIANC/INE Declaration of 29th May 2002. Lacking standardisation and interoperability of applications will hamper common use of the systems. This is certainly not desirable from the perspective of the European policy to create pan-European RIS. Standardisation of RIS is for instance needed because of inland navigation's international character and because of the need for critical mass (required for hardware and software manufacturers) [Zentralkommission für die Rheinschifffahrt, 2002]. The development of a European RIS architecture is highly important from this perspective.

The first column in Figure 59 displays the necessary measures to guarantee more compatibility and interoperability between current and future RIS system at the European level. Some measures to relieve existing problems include the following instruments (ideas for measures are based on an is of existing policy documents, statements, declarations and guidelines, as well as expert interviews. Some of the measures proposed will be discussed briefly.



© via donau, 2003

Figure 59. Catalogue of measures to increase implementation of RIS in Europe

Standards need to be developed for notices to skippers (item 1 in Figure 59). As has been shown, information on water levels, weather reports, restrictions on navigation, etc. reflect some of the main information needs among shipmasters. This information is typically provided in the form of Notices to Skippers. In the current situation, these notices are available in free and varying text formats. Standardisation of vocabulary and compatible data structures can support automatic translation and integration in Inland ECDIS applications.

European Inland ECDIS standards (item 2) need to be further developed and updated in order to ensure compatibility with maritime ECDIS and to include water depth information and network data for voyage planning. Currently, harmonised and complete availability of Inland ECDIS maps in Europe is lacking, as well as regular and organised update cycles.

Standards for Electronic Ship Reporting (item 3) need to be developed on the basis of common ship identity codes, harmonised systems for cargo codes, uniform location codes and EDIFACT standards. The identification of a vessel is the cornerstone of state-of-the-art RIS services. Nowadays it remains possible that a vessel (and its owner) is unknown to a waterway authority or terminal operator because the ship identification number is not recognised in the databases of the authorities [Merckx and Notteboom, 2003].

The creation of a supra-national agency for the development of RIS standards in the form of the European RIS Platform (item 8) is another measure to co-ordinate the involvement of international organisations (ISO, UNECE, EC, CCNR, DC) in the ratification of standards. This organisation should also determine a certain minimum required level of RIS application throughout Europe.

As regards the standardisation of tracking and tracing equipment (item 9) it would be important to ensure compatibility of AIS with maritime standards, to make available VHF channels for AIS data exchange and to harmonise AIS frequencies across Europe.

Technical framework conditions

Merckx and Notteboom [2003] discussed the fear that the majority of private ship owners and skippers will lag behind, as there is a general lack of knowledge with respect to information and communication technology. They support this argument by presenting results of a survey held in 2001 among Belgian skippers, stating that only 60 per cent of inland barge operators have a personal computer on board and 28 per cent have access to the internet (via WAP or GPRS). A comparable study among 310 German private ship owners in 2002 showed that 29 per cent of the German ship owners are equipped with an internet connection onboard [eBusinet and BDS Binnenschifffahrt, 2002]. On the basis of a sample of 554 Dutch private ship owners, it was estimated that about 60 per cent of all skippers possessed a personal computer onboard [Bureau Telematica Binnenvaart, 2002]. 89 per cent of these PC users also had an internet connection in 2002, whereas this used to be only 23 per cent in 1999. This shows the rapid dissemination of internet communication and enervates the common perception of a traditional and conservative sector.

Other equipment – or technical framework conditions – than the PC needed onboard depend on the RIS services implemented (item 10). Depending on the commercial viability of services, following on-board equipment would be needed:

- Radio equipment
- Radar
- Inland AIS transponder
- Viewer soft- and hardware for Inland ECDIS
- Position receiver.

Also depending on the RIS offered following shore-side equipment would be required (item 11):

- Shore sensors
- Control facilities
- Network infrastructure applications
- Europe-wide official electronic maps.

Finally, item 12 in Figure 59 requires the harmonisation of test and certification requirements for equipment across Europe, so that equipment is certified according to agreed standards and that equipment certificates are acknowledged on a European level.

Interfaces between RIS- and external applications

Inland navigation does operate in isolation, but is part of a supply chain with various actors and partners. Therefore RIS applications cannot be developed as stand-alone applications, but have to be linked to ‘the outside world’. Therefore interfaces should easily be achievable to following external applications:

- Waterway authorities (item 13): to enable the exchange of traffic data on an international level and to enable automatic links to statistical offices.
- Maritime information systems (item 14): because of the interrelations between inland navigation and the deepsea/shortsea systems, interfaces have to be created to enable a seamless information chain.
- Seaport and inland port information systems (item 15): interfaces with information systems of ports are equally important in order to enable efficient port operations.
- Intermodal information systems (item 16): too often information is reaching the business partners too late to ensure an efficient intermodal operation. Just as the physical flow of goods, information chains need to be unbroken. This appears to be a major problem in the establishment of intermodal transport chains.
- Cross-border operations (item 17): improved interfaces between RIS and cross-border operations would provide for customs services and immigration services in terms of reduced processing times and costs of procedures.

- Supply chain management software (item 18): modern manufacturing companies apply supply chain management software to control their logistics processes. RIS applications should be able to link up and communicate with these systems in order to facilitate the integration of inland navigation in logistics chains. Failure of doing so would cancel out opportunities for inland navigation in many markets.

Acceptance among (potential) system operators

The advantages of RIS are clear to all competent waterway authorities. Nevertheless, there are various factors that hinder the further dissemination of RIS applications among (potential) system operators. First, the know-how and experiences among these actors could be increased by means of dedicated training programmes and the nomination of a specialised responsible RIS authority per country. Second, the investment costs of RIS should be reduced (which can also be reached through harmonisation of technical standards and the development of common accepted guidelines for the planning, introduction and operation of RIS). Additionally, European manufacturers of soft- and hardware are to be encouraged to produce equipment at affordable prices. Where possible trans-national investments are to be co-ordinated.

User acceptance

In addition to the technical possibilities for RIS services, the success of these innovations also strongly depends on their commercial benefits for potential users. In fact, RIS will only be successful if they create additional benefits and an added value to their current business. Increasing user acceptance will therefore be one of the major issues to be solved in order to increase the implementation of RIS across Europe.

First, the knowledge on the user requirements needs to be increased (item 24). A survey by eBusinet and BDS Binnenschifffahrt [2002] showed that the most important electronic information required by skippers are data on the weather, water levels, navigations blocks, and contacts with commercial partners. This is confirmed by findings of the Bureau Telematica Binnenvaart [2002]. User requirements are however dynamic and subject to change. Therefore, it is proposed to constantly monitor user requirements through periodic inquiries. Additionally, the need for RIS should be carefully assessed, based on a benefit/cost analysis and a consultation of the user groups [Zentralkommission für die Rheinschifffahrt, 2002].

Second, opportunities of RIS are to be communicated to the potential users in good quality (item 25). To date, there are for instance no special training programmes that support the inland waterway skippers in getting to know the possibilities of personal computers onboard. Training and education should therefore be made available – though this should not lead to ignoring the user friendliness of RIS applications. Preferably, one should not be concentrating on user manuals and training programmes, but principally on user-friendliness of applications.

Third, a series of current issues are connected to the safe, cost-effective and reliable exchange of data. Confidentiality of data exchange in a RIS needs to be ensured. Additionally, high costs of mobile communications and the unreliable/slow internet connections were identified in an eBusinet study [2002] as some of the main issues as regards the relatively limited market penetration of PCs and internet. What is needed are affordable, reliable and fast mobile applications and equipment (items 27 to 32).

Some skippers in the eBusinet survey saw the danger of cut-throat price competition stimulated by the emergence of electronic marketplaces. The traditional linkages between individual skippers and the shipping companies form another factor that limited the further distribution of electronic market places in the inland navigation sector. Nowadays the transport contract is negotiated between the individual skipper and the dispatcher of the shipping company. This individual contract takes into account criteria such as price, shipment size, possibility of return load, time of delivery, etcetera). Additionally, in case of problems this direct bilateral relation usually enables fast trouble shooting [eBusinet and BDS Binnenschifffahrt, 2002]. These kinds of long-term relations and the added-value of this co-ordination function between skippers and shipping companies can hardly be equalled by electronic market places. Almost 70 per cent of the German private ship owners have binding agreements and relationships with shipping companies, which will not be abandoned because of the emergence of electronic marketplaces. Some of the examples mentioned (see for instance BIVAS in section 0) therefore also limit themselves to establishing the first contact. The negotiation process is left to the bilateral contacts. An alternative solution is provided by the example of Bargelink: some of the parties behind this marketplace originate from existing shipping companies, and could therefore enable the preservation of traditional relations, while at the same time using the advantages of the new media.

7.7 References

1. Adviesdienst Verkeer en Vervoer (2003), COMPRIS: The last step to the Pan-European implementation of RIS, European Inland Waterway Conference, 11-13 June 2003, Györ.

2. Bureau Telematica Binnenvaart (2002), Rapportage vaartonline ICT-peiling, commissioned by the Adviesdienst Verkeer en Vervoer, Rotterdam.

3. Commission of the European Communities (2001), European transport policy for 2010: time to decide, Brussels.

4. EBusinet and BDS Binnenschifffahrt (2002), Elektronische Marktplätze in de Binnenschifffahrt: Bestandaufnahme und Bewertung.

5. IALA (2001), Guidelines on AIS as a VTS tool, St. Germain en Laye, December 2001.

6. INDRIS (2001), INDRIS: Policy Summary January 2001, Fourth Framework Programme, Contract WA-97-SC.2211, Rotterdam.

7. Merckx, F. abd Th. Notteboom (2003), ICT in inland navigation: the missing link!?, European Inland Waterway Conference, 11-13 June 2003, Györ.

8. PIANC (2001), RIS Guidelines 4.3, October 2001.

9. PIANC (2002), River Information Services: PIANC's Technical Brief, PIANC Working Group 24.

10. PIANC & INE (2002), Deployment of River Information Services in Europe: Draft 29 May 2002.

11. Steinhuber, L. (2002), Workshop GIS Forum: Nationaler Status der Arbeiten in Deutschland, WSD Süd Würzburg.

12. Willems, C.P.M. (2001), From INDRIS to COMPRIS, Rotterdam.

13. Zentralkommission für die Rheinschifffahrt (2002), Richtlinien und Empfehlungen für Informationsdienste auf Binnenschifffahrtsstraßen, 22nd July 2002, Polizeiausschuss Ständiger Technischer Ausschuss, Arbeitsgruppe RIS.

List of abbreviations

AIS	–	Automatic Identification System
CCTV	–	Closed Circuit Television
DGPS	–	Differential Global Positioning System
DoRIS	–	Danube River Information Services
ECDIS	–	Electronic Chart Display and Information System
EGNOS	–	European Geostationary Navigation Overlay System
ENC	–	Electronic Navigational Chart
ETA	–	Estimated Time of Arrival
FIS	–	Fairway Information Services
GPS	–	Global Positioning System
GPRS	–	General Packet Radio Service
GSM	–	Global System for Mobile Communication
GNSS	–	Global Navigation Satellite System
IALA	–	International Organisation of Marine Aids to Navigation and Lighthouse Authorities
ICT	–	Information and Communication Technology
IHO	–	International Hydrographic Organisation
IMO	–	International Maritime Organisation
RIS	–	River Information Services
RTA	–	Required Time of Arrival
STI	–	Strategic Traffic Image
TTI	–	Tactical Traffic Image
UMTS	–	Universal Mobile Telecommunication System
VHF	–	Very High Frequency
VTS	–	Vessel Traffic Services
WLAN	–	Wireless Local Area Network

PINE

Prospects of Inland Navigation within the enlarged Europe

Part B Demand side

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

Chapter 1 Present transport volumes

1.1 The role of Inland Waterway Transport in Europe

1.1.1 Overview

Amongst the inland modes of transport – road, rail, inland waterway – IWT plays a small but significant role in the present EU Member States and a minor role in the accession countries.

Table 1 gives an overview of transport volumes by rail, road and inland waterway in the year 2000 by country of loading and unloading. The total volume of IWT in the year 2000 was 438 million tonnes, of which 215 million were domestic and 223 million international intra-EU-15 freight. These volumes represent modal shares of 3.5% of total freight volumes, a mere 1.8% of total domestic freight of all EU-15 countries (12.5 billion tonnes), but 26% of all freight that crosses intra-EU-15 borders.

In Candidate countries (Turkey excluded), the share of IWT is a mere 0.26% in domestic freight, in international trade between 2.5 and 4.7% (see part B Demand, chapter 3, Table 26).

The big international flows are between Germany and the Netherlands (108 million tonnes per year), between Belgium and the Netherlands (56 million tonnes), between Belgium and Germany (26 million tonnes), between France and Germany and France and the Netherlands (10 million tonnes each) as well as between Belgium and France (8 million). The trade between these four countries represent 97% of all international IWT. We note also from Table 1 that international transport volumes can be quite asymmetrical in the two directions. For example, 82 million tonnes are shipped from the Netherlands to Germany but only 26 million tonnes move in the opposite direction.

🟨 Railways (1)
🟦 Road (2)
🟩 IWW (3)

Country of unloading	Country of loading															
	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK	International intra-EU-15
Belgium	23902	1	3060	-	237	5366	-	2144	764	2296	269	0	-	204	189	14530
	315829	298	18512	3	948	25876	34	1452	1639	22963	493	93	16	201	1590	74118
	25451	5 *	13195	-	-	3577	-	1*	33	36112	18	-	1*	-	2*	52944
Denmark	32	1646	612	-	3	132	202	3	7	77	:	10	664	0	-	1742
	568	206907	5371	2	292	690	30	461	10	1139	112	19	190	2149	130	11163
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Germany	3656	421	193626	1	1107	4558	-	9660	1604	1806	7732	3	8	1111	50	31717
	19912	5796	2898779	142	4450	21359	85	11171	2292	32365	10920	613	84	1296	2214	112699
	12679	51*	60860	-	182*	8339	13*	5*	307	81898	589	2*	7*	27*	433*	104532
Greece	-	-	0	386	-	0	-	-	-	-	136	-	-	0	-	136
	7	5	155	203179	21	102	4	88	-	43	53	9	4	55	40	586
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	370	-	841	-	20734	608	-	65	50	2	17	202	-	5	169	2329
	1378	282	3926	2	907729	14470	49	2923	48	1675	268	4146	49	110	1236	30562
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
France	5641	53	4651	-	0	91111	-	1761	1060	1535	247	:	2	424	479	15853
	35470	698	20926	3	11473	1843560	115	9979	1605	8831	749	502	58	246	4740	95395
	4782	-	2392	-	-	26706	-	-	9	5398	34	-	-	-	2*	12617
Ireland	-	-	-	-	-	-	2680	-	-	-	-	-	-	-	-	-
	51	38	111	-	62	165	175414	47	-	67	3	3	-	-	9150	9697
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Italy	3237	457	11123	-	82	6311	-	31546	238	1341	3721	0	:	816	703	28029
	1801	445	10827	81	2994	10747	42	1176437	164	1962	6448	463	23	102	1313	37412
	-	-	-	-	-	-	-	482	-	-	-	-	-	-	-	-
Luxembourg	4457	0	1220	0	0	287	7	:	2709	0	:	-	0	5	:	5976
	2681	30	2142	0	24	2175	2	93	19449	510	47	30	1	14	72	7821
	209	-	615	-	-	26	-	-	12	325	-	-	-	-	-	1175
Netherlands	2862	3	2401	-	24	450	-	943	121	5219	247	-	-	117	0	7168
	24645	759	32685	6	1322	6260	60	1295	346	464660	562	70	52	680	1475	70217
	19433	1*	25704	-	-	4275	-	-	85	100680	155	-	-	-	-	49653
Austria	517	36	8605	-	10	441	-	725	27	490	20239	-	0	242	2	11095
	475	111	14845	25	295	888	8	4239	53	846	241237	36	9	117	244	22191
	73	-	439	-	-	18	-	-	-	1254	1146	-	-	-	-	1784
Portugal	1	-	3	-	690	18	-	2	3	-	-	8069	-	-	0	717
	129	25	605	-	6710	847	-	653	11	134	75	103897	8	37	190	9424
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Finland	6	15	147	0	0	16	0	45	16	6	10	-	24071	117	0	378
	4	151	65	-	78	49	-	32	-	82	1	3	415611	1509	-	1974
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	156	:	1111	-	:	:	-	202	-	75	99	-	116	19367	-	1759
	220	2002	1439	52	172	233	3	137	21	788	108	35	1860	322716	20	7090
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
United Kingdom	28	-	102	-	-	439	313	6	52	114	39	-	7	:	95379	1100
	2296	172	2968	12	2059	6176	4087	1936	135	2366	305	238	1	23	1628099	22774
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
International intra-EU-15	20963	986	33876	1	2153	18626	522	15556	3942	7742	12517	215	797	3041	1592	122529
	89637	10812	114577	328	30900	90037	4519	34506	6324	73771	20144	6260	2355	6539	22414	513123
	37176	57	42345	0	182	16235	13	6	434	124987	796	2	8	27	437	222705

(1) On the basis of receipts (except for Sweden, where mirror declarations of dispatches to Sweden were taken). For international transport: DK, LU: 1992 ; UK: 1994 ; FR: 1997 ; EL, ES, PT: 1999.
For national transport: UK: 1994 ; IE: 1998

(2) Figures represent transport performed by vehicles registered in the individual Member States in 2000. Performance by Greek hauliers are excluded. International transport includes cross-trade.
National transport (Greece: 1997) excludes cabotage.

(3) On the basis of receipts. For national transport: IT: 1992.

* Fluvio-maritime transport, consisting of transport operations partly on inland waterways and partly on the sea, without transhipment.

Source: Eurostat.

Table 1. Intra-EU goods transport by relation and transport mode 2000, 1000 tonnes

The role of the inland waterway sector is best presented by its transport performance in terms of tonne-kilometres (tkm) moved in a defined territory during a given period of time. Table 2 records the transport performance by country in the years 1995 and 2000 from the ProgTrans data base, showing modal shares as well as annual growth rates. Five of the 10 new Member States are included in this data base. The content of Table 2 will be analysed below in more detail.

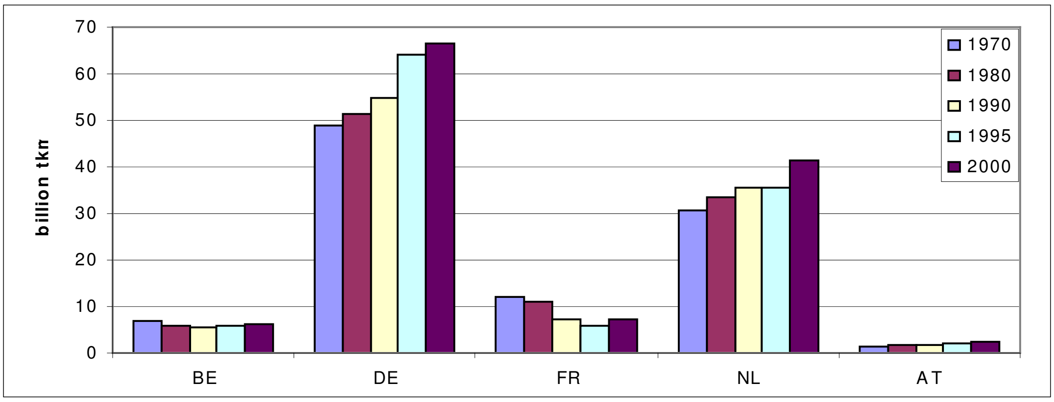
Country	1995				2000				Share 2000 (%)			Growth 1995 - 2000 (%			
	Total	Road	Rail	**IWT**	Total	Road	Rail	**IWT**	Road	Rail	**IWT**	Total	Road	Rail	**IWT**
Austria (A)	36'200	20'927	13'227	2'046	45'594	25'804	17'346	2'444	57	38	5	4.7	4.3	5.6	3.6
Belgium (B)	47'665	34'551	7'307	5'807	53'676	39'610	7'674	6'392	74	14	12	2.4	2.8	1.0	1.9
Denmark (DK)	16'711	14'713	1'998	-	18'665	16'640	2'025	-	89	11	-	2.2	2.5	0.3	-
Finland (FIN)	33'188	23'200	9'559	429	42'111	31'475	10'107	529	75	24	1	4.9	6.3	1.1	4.3
France (F)	281'100	227'100	48'140	5'860	334'220	271'472	55'448	7'300	81	17	2	3.5	3.6	2.9	4.5
Germany (D)	414'415	282'387	68'046	63'982	488'790	346'293	76'032	66'466	71	16	14	3.4	4.2	2.2	0.8
Greece (GR)	15'090	14'798	292	-	19'103	18'777	326	-	98	2	-	4.8	4.9	2.2	-
Ireland (IRL)	6'173	5'571	602	-	7'938	7'447	491	-	94	6	-	5.2	6.0	-4.0	-
Italy (I)	217'182	195'300	21'747	135	267'025	243'982	22'834	210	91	9	0	4.2	4.6	1.0	9.1
Luxembourg (L)	2'769	1'873	566	330	3'473	2'478	683	312	71	20	9	4.6	5.8	3.8	-1.1
Netherlands (NL)	80'745	42'182	3'097	35'466	94'905	50'629	3'819	40'457	53	4	43	3.3	3.7	4.3	2.7
Norway (N)	13'589	10'874	2'715	-	17'474	14'985	2'489	-	86	14	-	5.2	6.6	-1.7	-
Portugal (P)	13'570	11'551	2'019	-	15'201	13'018	2'183	-	86	14	-	2.3	2.4	1.6	-
Spain (E)	210'646	200'227	10'419	-	268'536	256'494	12'042	-	96	4	-	5.0	5.1	2.9	-
Sweden (S)	48'715	29'324	19'391	-	51'376	31'479	19'897	-	61	39	-	1.1	1.4	0.5	-
United Kingdom (UK)	163'500	150'000	13'300	200	176'500	158'000	18'300	200	90	10	0	1.5	1.0	6.6	0.0
Switzerland (CH)	23'802	14'956	8'686	160	33'265	21'949	11'189	127	66	34	0	6.9	8.0	5.2	-4.5
Czech Republic (CZ)	56'450	32'500	22'630	1'320	57'305	39'036	17'496	773	68	31	1	0.3	3.7	-5.0	-10.1
Estonia (EE)	5'346	1'500	3'846	-	11'478	3'690	7'788	-	32	68	-	16.5	19.7	15.2	-
Hungary (HU)	20'195	10'535	8'400	1'260	22'315	13'329	8'095	891	60	36	4	2.0	4.8	-0.7	-6.7
Poland (PL)	120'286	51'200	68'206	880	128'158	72'842	54'015	1'301	57	42	1	1.3	7.3	-4.6	8.1

Table 2. Inland Transport Performance in Europe 1995 and 2000, billion tkm
Source: ProgTrans 2003

1.1.2 EU-15 Countries

Transport Performance

During the year 2000, close to 125 billion IWT-tonne-kilometres of goods moved within the territory of the EU-15 Countries representing some 7% of the total transport performance of the so-called surface transport modes, i.e. road (80%), rail (13%), and inland waterways (not counting pipeline transport, short sea-shipping and air transport).



	BE	DE	FR	IT	LU	NL	AT	FI	CH	EU15+CH
1970	6.7	48.8	12.2	0.4	0.3	30.6	1.3	1.6	0.14	102.1
1980	5.9	51.4	10.9	0.2	0.3	33.5	1.6	1.9	0.13	105.7
1990	5.4	54.8	7.2	0.1	0.3	35.7	1.7	1.2	0.20	106.6
1995	5.8	64.0	5.9	0.1	0.3	35.5	2.0	0.6	0.16	114.4
2000	7.3	66.5	7.3	0.2	0.4	40.5	2.4	0.5	0.13	125.1
2001	7.6	64.8	6.7	0.2	0.4	41.9	2.6	0.5	-	124.7

Figure 1. Development of Inland Waterway Transport in Western Europe 1970 – 2000, billion tkm
Source: European Commission (Energy and Transport in Figures 2003, Table 3.4.8)

Over the past 30 years, IWT has slowly increased from 102 billion tonne-kilometres in 1970 to 106 billion in 1980 and 107 billion in 1990. However, the share of IWT in total surface transport has continuously decreased from 12% in 1970 to the 7% in 2000 mentioned above. While the overall growth of IWT in the past decade was 17% the development of tonne-kilometres in the individual countries varied substantially. The countries that are closely connected to the Rhine had growth rates between 16 % (the Netherlands and Belgium) and 21% (Germany), mainly based on increases in the hinterland transport of containerised goods and bulk material from the ARA seaports. On the other hand, France and Luxembourg have remained stable in their performance since 1990. Austria saw an increase of 41% (from a low level) due to the opening of the Main-Danube-Canal in 1992, which enables continuous transports from the north seaports to the south east of the EU. Figure 24 shows the performance and modal shares for individual EU countries featuring IWT. Note that over 85% of the EU tonne-kilometres in IWT take place in Germany and in the Netherlands combined (75% in terms of tonnage). Hence, the most important traffic flows at present occur in the Rhine corridor.

The diagram on the next page shows the modal shares of IWT, based on the Prognos European Transport Report for the year 2000. This is in line with the data of Energy and Transport in Figures 2002 (see above) because the latter were also produced by Prognos.

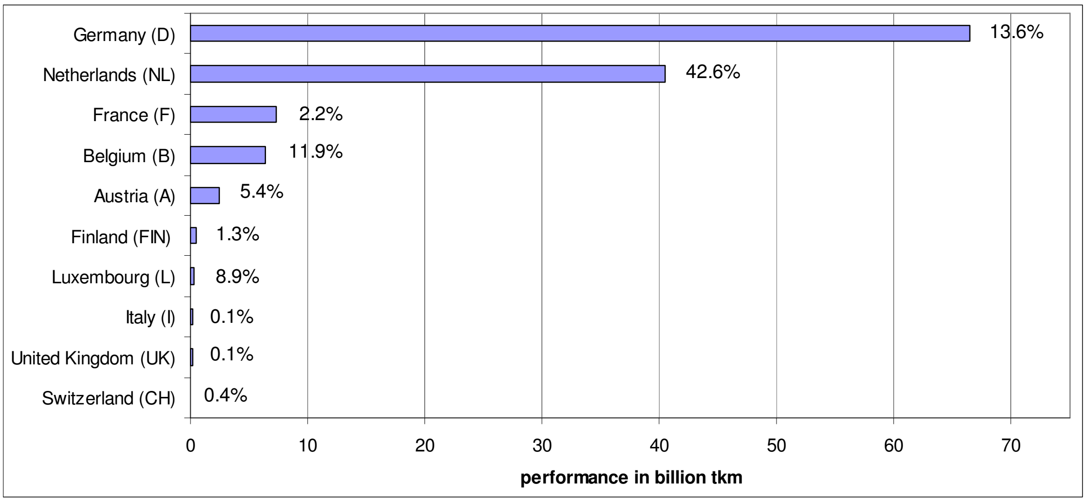


Figure 2. Performance of Goods Transport by IWW in Western Europe 2000, bn tkm (share of IWT performance in percent figures)
Source: PROGNOS European Transport Report 2002

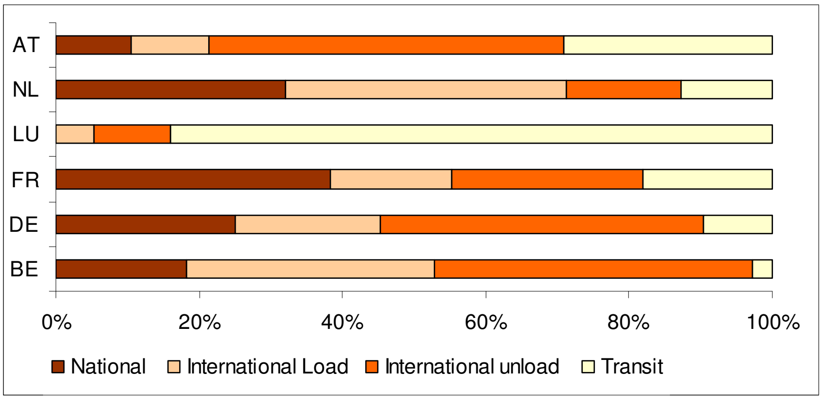
IWT exists in only 9 of the 15 EU member states, IWT performance exceeds 1 billion tonne-kilometres p.a. in only 5 countries and this has not changed over the past decade. The league of EU member states is led by Germany with 66.5 billion tonne-kilometres in 2002 representing over half of total EU performance (53%). The Netherlands follow with 40.5 billion tonne-kilometres or close to 1/3 of the EU total (32.5%), France with 7.3 billion tonne-kilometres (5.9%), Belgium with 6.4 billion tonne-kilometres (5.1%), and Austria with 2.4 billion tonne-kilometres (2%).

In the Netherlands, IWT accounts for 43% of total goods transport performance. This is the highest modal share in the Union and in all of Europe. The 66.5 billion tonne-kilometres moved in Germany represent 14% of total goods movements. The share in Belgium is 12%, and in Luxembourg 9%, followed by Austria (5%), France 2%, Finland 1%.

In early 2002, Prognos had made provisional forecasts indicating a drop of IWT performance in the EU in 2001 and a slight recovery in 2002. The most recent statistical digest from Eurostat (Statistics in Focus, theme 7, August 2003) indicates for 2001 (Belgium not included) an increase in the order of 1.1% in volume and a decline of 1.5% in performance. The driving factor was a decline in volume in Germany, France and Luxemburg, offset by an increase in the Netherlands of almost 5%. But the increase in the Netherlands in terms of tonne-kilometres was not sufficient to offset the drop in France by 9% and in Germany by 2.5%.

The German Federal Statistical office has just released IWT statistics for 2002 which indicate a further decline of 1.8% in volume and 1% in performance, undoubtedly due to the sluggish German economy.

Transport volumes



	BE*	DE	FR*	LU*	NL	AT
National	19	61	24	0	101	1
International load	36	49	11	1	123	1
International unload	46	109	17	1	50	5
Transit	3	23	11	9	40	3
Total	104	242	62	11	314	11

Figure 3. Split by transport type of total goods based on million tonnes transported in 2000 (: 1998)*
Source: Eurostat, Statistics in focus 8/2002: IW freight transport in 1995-2000 in the EU

Three quarters of the overall tonnage of IWT in the EU is international transport including transit, so that domestic transport accounts for approximately 26%.

Another important factor in IWT is domestic transport in the Netherlands also coming from the seaports. Partly it does not end in the Netherlands itself but is transhipped to other modes. The other part, however, is direct transport to Dutch industry in the hinterland. The Netherlands profits from its vast waterway system, which connects the industrial centres with the seaports, and with each other. Moreover, the rail system, as the competing mode number 1 in conventional bulk transport, is underrepresented in the Dutch transport system compared to the rail systems of its neighbours.

In France IWT has the highest domestic share. On the one hand this is caused by the isolated infrastructure system which is not well linked with neighbouring waterways. On the other hand we notice a trend towards strengthening domestic transport, especially of raw materials, oil products, building materials and agricultural products. Finally, Belgium also plays an important role in IWT if one looks at total volumes, but the transport is mainly of international importance. Note that when adding up the volumes of these three transport types for all EU Countries, the sum will be inflated by double counting. Moreover, any differences in volumes between Figure 3 and Table 1 may be caused by different reporting years as well as by incoherence in national reporting figures.

Distance

As regards domestic IWT there are substantial differences in volumes (tonnes) and performance (tkm) between the EU reporting countries. This becomes obvious when looking at ***average distances***, which depend on the size of the country and the extent of its waterway system. The average distance in domestic transport is 206 km in Germany, 145 km in France, 93 km in the Netherlands and 79 km in Austria.

Comparing the three most important IWW countries (see Table 1), the Dutch volumes of domestic transport (101 m t) substantially outweigh the German (over 61 m t) and French volumes (nearly 27 m t). On the other hand the performance in Germany (11.6 bn tkm) is higher than in the Netherlands (9.3 bn tkm) and much higher than in France (3.6 bn tkm).

Within the territory of the present 15 EU member states, the average distance of both domestic *and* international IWT at approximately 280 kilometres is only slightly higher than for rail (250 kilometres), but 2.5 times the average distance of road trucking (110 kilometres). This is not surprising as one of road transport's greatest advantages lies in the distribution of goods within relatively short distances. The ***split by distance classes*** (again only domestic transport) shows a well-balanced mix for IWT (0-49 km: 28%, 50-149 km: 39%, 150-499 km: 30%, ≥ 500 km: 3%).

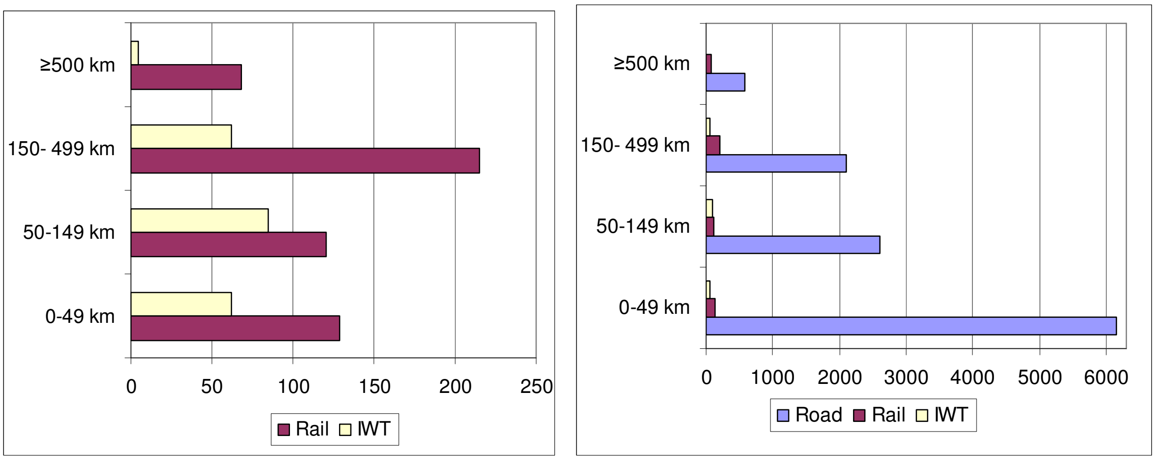


Figure 4. Distribution of transport volumes by distance classes and modes in tonnes for 2001 (domestic transport in EU countries only); (Note the difference in scale when road transport is added)
Source: European Commission (Energy and Transport in Figures 2003, Table 3.4.4)

This means a higher concentration on shorter distances as compared to rail, which has a quarter of its transport volumes in the two lower distance classes each. The two pictures in Figure 4 demonstrate the modal shares of the surface transport modes in each distance class.

Transport volume by commodity type

In Figure 5, inland waterway goods transport demand in terms of loaded volumes (tonnes) is broken down by type of commodity according to the standard NST/R classification, with the following NST/R chapters:

0	*agricultural products and live animals*
1	*food stuffs and animal fodders*
2	*solid mineral fuels*
3	*petroleum products*
4	*ores and metal wastes*
5	*metal products*
6	*crude and manufactured minerals, building materials*
7	*fertilisers*
8	*chemicals*
9	*machinery, transport equipment, manufactured articles, others*

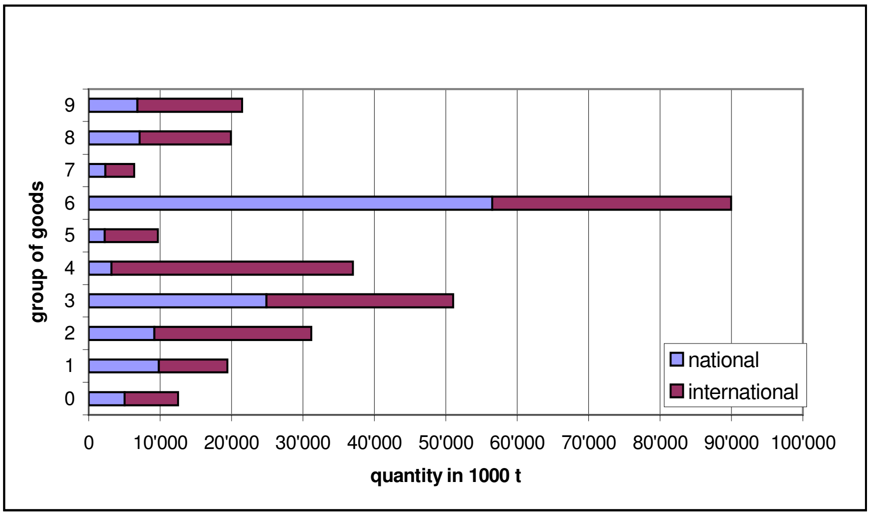


Figure 5. Inland waterway transport by group of goods 2001 (reporting countries: NL, DE, FR, BE, AT, LU)
Source: NewCronos, Eurostat 2003

The main commodity types shipped by IWT are minerals and building materials with 90 million tonnes loaded in the 6 EU reporting countries, of which over one third (56 m t or 38%) are international shipments. All other commodity types have a much higher share of international shipments, mostly above 50%. Indeed, in metal products, ores and metal wastes international shipments account for over 90%.

Variations in average distances for different commodity types (see Figure 6) are relatively limited. They range between 150 and 250 km except ores (110 km) and fertilisers (310 km). Investment goods and consumer goods show a relatively low average distance of 150 km, with over 40% in the 50 – 150 km bracket and over 50% in the 150 – 500 km range. This is important for future IWT potentials as this goods category is both of high value, with interesting freight rates, and one of the quickest growing transport sectors. These containerised consumer goods transports are to a significant extent generated in the seaports.

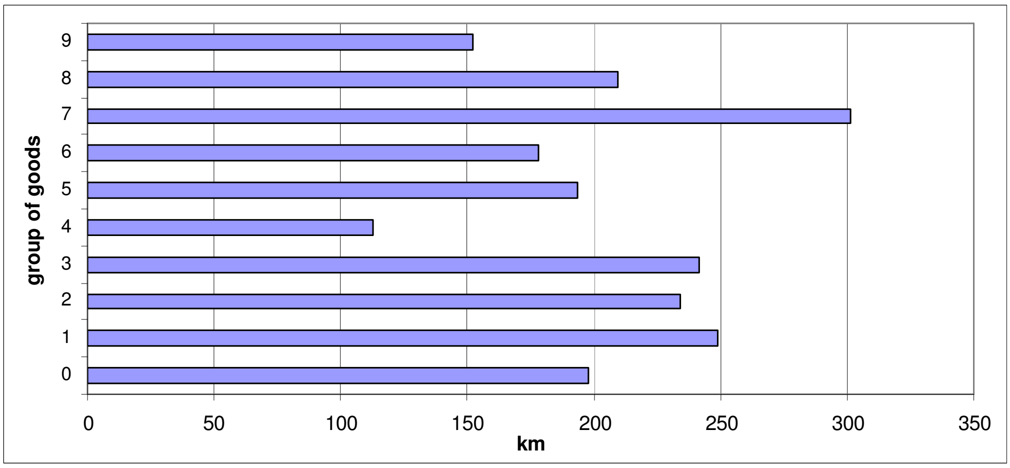


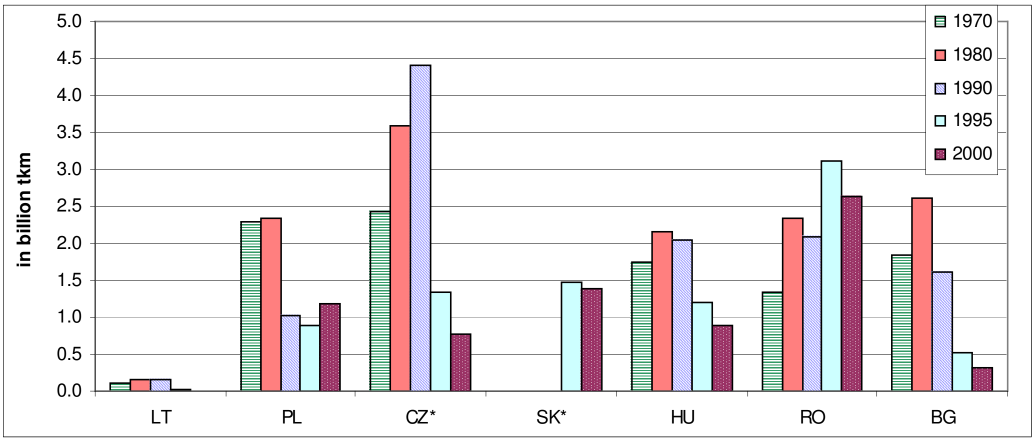
Figure 6. Averaged transport distance by group of goods 2001 (Loading countries: EEA countries)
Source: NewCronos, Eurostat 2003

This would explain the high proportion in the 50 – 150 km IWT distance class. In the hinterland transport from and to seaports transhipment costs play a comparatively minor role as the facilities for transhipment to inland vessels are excellent and there is no need to pre haul. Competitive conditions are therefore quite good.

1.1.3 EU Accession Countries

Transport performance

In the EU Accession Countries, a total of 8.5 billion tonne-kilometres were transported in 1999. Romania ranks first with 2.8 billion tonne-kilometres, followed by Slovakia and Hungary who had 1.6 billion tonne-kilometres each. The Czech Republic, Poland and Bulgaria remain below the 1 billion tonne-kilometre bracket. The Baltic states do not have any IWT worth mentioning. Of all the Accession Countries the former Czechoslovakia had the highest transport volumes in inland navigation in 1990 with nearly 4.5 billion tonne-kilometres, but this has substantially declined since that time to 2.5 billion tonne-kilometres for CZ and SK together. Similar developments took place in Poland and Bulgaria. After the disappearance of the Iron Curtain and the beginning of an increase in the transport of high value products and other containerised goods, road transport showed a remarkable growth, especially in the foreign trade of these countries. Another argument in favour of fast growing lorry traffic is the low market access barriers for private entrepreneurs who have seen their chance to profit from the transformation process. This development was running at the expense of rail and inland navigation.



	EE	LV	LT	PL	CZ*	SK*	HU	RO	BG	Total
1970	0.01	0.05	0.12	2.30	2.43	CZ	1.76	1.35	1.83	9.85
1980	0.01	0.09	0.15	2.33	3.59	CZ	2.15	2.35	2.61	13.28
1990	0.00	0.29	0.16	1.03	4.42	CZ	2.04	2.09	1.61	11.65
1995	0.00	0.00	0.02	0.88	1.35	1.47	1.21	3.11	0.53	8.57
2000	0.00	0.00	0.00	1.17	0.77	1.38	0.89	2.63	0.31	7.17

**Note: CZ represents till 1990 the figures for Czechoslovakia (on Jan. 1993, Czechoslovakia ceased to exist and the Czech Republic and the Slovak Republic became independent states)*

Figure 7. Development of Inland Waterway Transport in Accession Countries 1970-2000, in billion tkm
Source: European Commission (Energy and Transport in Figures 2003, Table 3.4.24)

Remarkable is the relatively low modal share of the IWT sector in the Danubian Countries (see Figure 8). Whilst in Romania and Slovakia it has just 7.9 and 7% respectively, it manages only 3.1% in Hungary and 3% in Bulgaria. Even lower is the share in the Czech Republic (1.3%) and Poland (0.9%). In the next chapter we will give a more detailed insight into the development of these figures, based on river corridor analyses.

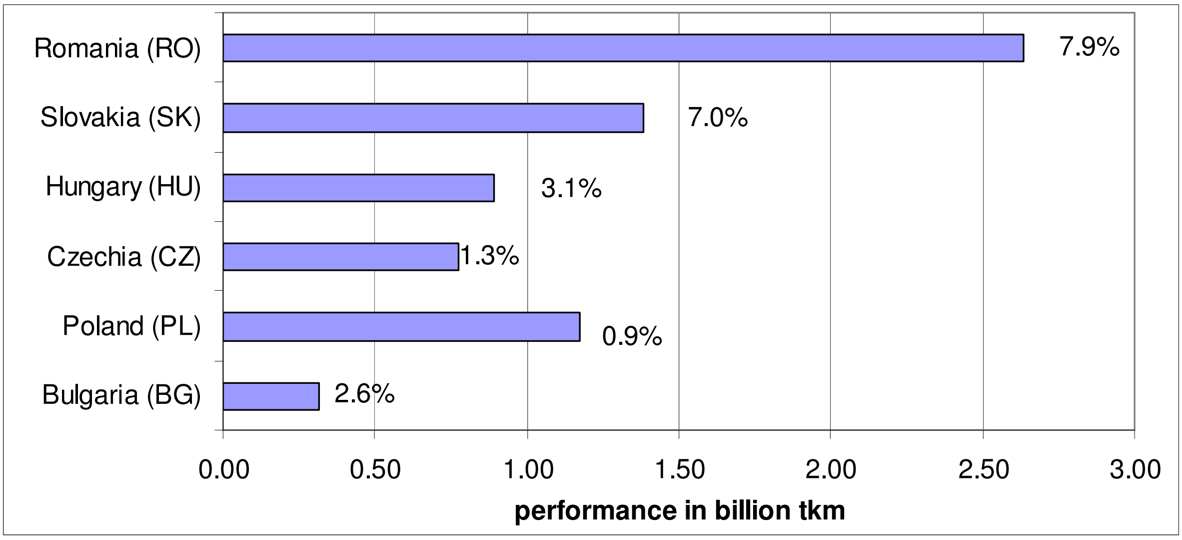


Figure 8. Performance of goods transport by IWW in the Accession Countries 2000, billion tkm (share of IWT performance in percent figures)
Source: European Commission (Energy and Transport in Figures 2003, Table 3.4.21)

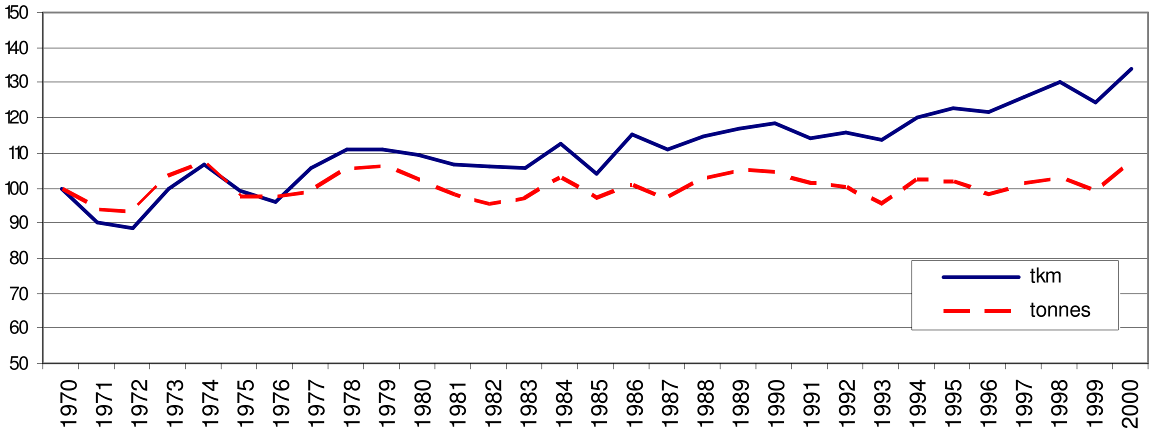
Most CEECs do not yet apply the system of IWT data collection of the European Union. Therefore, data on important IWT indicators such as distances, transport volumes, break down by commodity are missing.

1.2 Inland waterway transport per corridor: present situation

Statistical data collected by the Rhine Commission and the Danube Commission are important sources for IWT activities in defined areas. Other corridors of the European inland waterway system are proposed in the policy context, i.e. the East-West corridor linking the Netherlands with Northern Germany and Poland or the North-South corridor linking again the Netherlands with Belgium and France. Differing definitions exist for these two corridors and no organisation is engaged to promote them, collecting statistical data which to report on in this chapter.

1.2.1 Rhine corridor

The statistical data for the Rhine are divided into 3 sections; what is called the traditional Rhine is the navigable section between Rheinfelden on the Swiss-German frontier (Upper Rhine) and Emmerich close to the German-Netherlands frontier (Lower Rhine). The Netherlands section is statistically divided into international and domestic Dutch transport. Figure 9 shows a clear trend: whereas the transport volumes in tonnes were constant from 1970 to 1999, with a maximum variation of ± 10 %, the performance in tkm has increased continuously, being 34 % up in 2000, despite similar up and down movements over time. In 1999 IWT was temporarily interrupted on the Upper Rhine, but the decrease in transport was compensated by a substantial increase in 2000 when volume rose by 8 % and performance by even 10 %. Freight transport demand continues to grow faster than the economy in general; most of the growth in performance was due to longer distances.



	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
tkm	100,00	99,39	109,48	104,16	118,64	114,05	116,02	113,50	120,20	122,58	121,72	125,76	130,33	124,07	134,11
tonnes	100,00	97,44	102,52	97,12	104,42	101,33	100,51	95,70	102,21	101,89	98,26	101,33	102,71	99,27	107,09

Figure 9. Long-term trends of transport volume and performance on the Rhine 1970 – 2000 (Index: 1970 = 100)
Source: Central Commission of the Rhine 2003

Figure 10 shows that since 1989 transport volumes have reached a total of nearly 300 m t of which 200 m t were moved on the traditional Rhine (which was already the case since 1978). Adding international transport on the Dutch section and transport on the traditional Rhine may lead to double counting. The year 2000 has seen a record-breaking 207 m t moved, but this is only a marginally higher than the previous record in 1974. Nevertheless in the same period there has been a considerable growth of 26% in tonne-kilometres performed of 35.4 bn tkm in 1974 to 44.5 bn tkm in 2000.

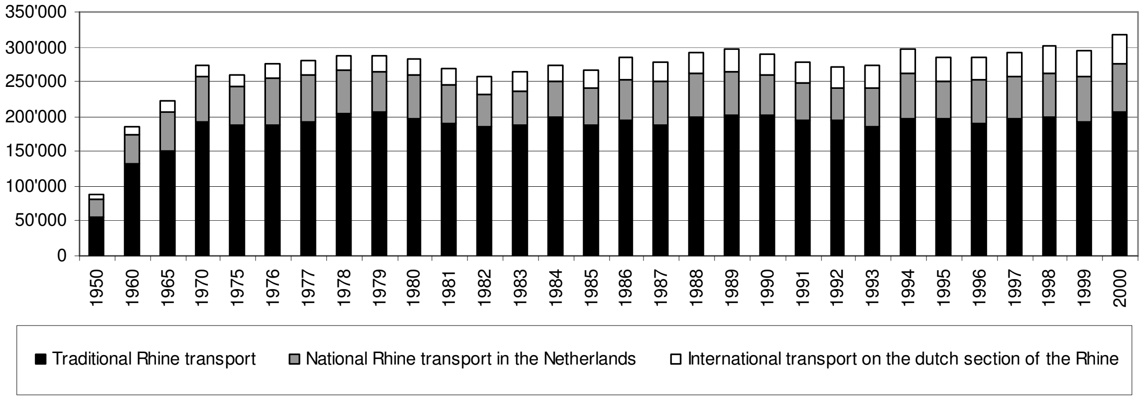
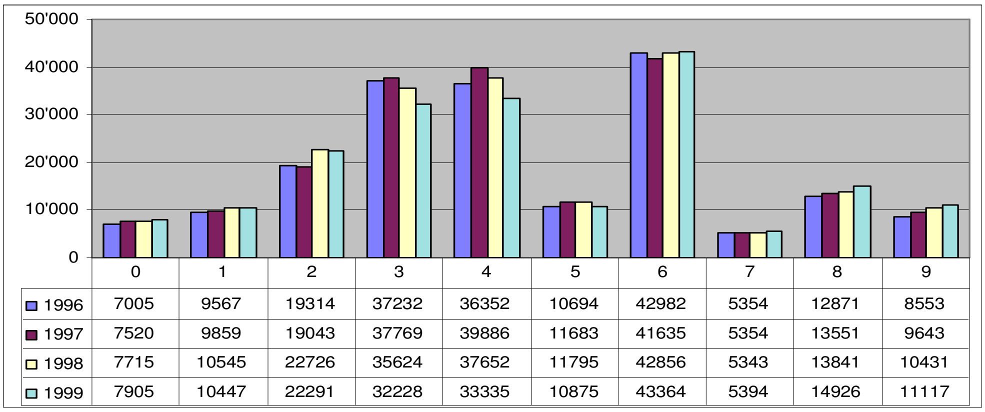


Figure 10. Transport on the Rhine in 1000 t
Source: Central Commission of the Rhine 2003

As regards commodities (Figure 11) petroleum products, ores and minerals dominate Rhine transport, but it should be noted that petroleum products and ores declined in 1998 and 1999. Since no more up to date figures are available it is not clear whether the decline has stopped or not.

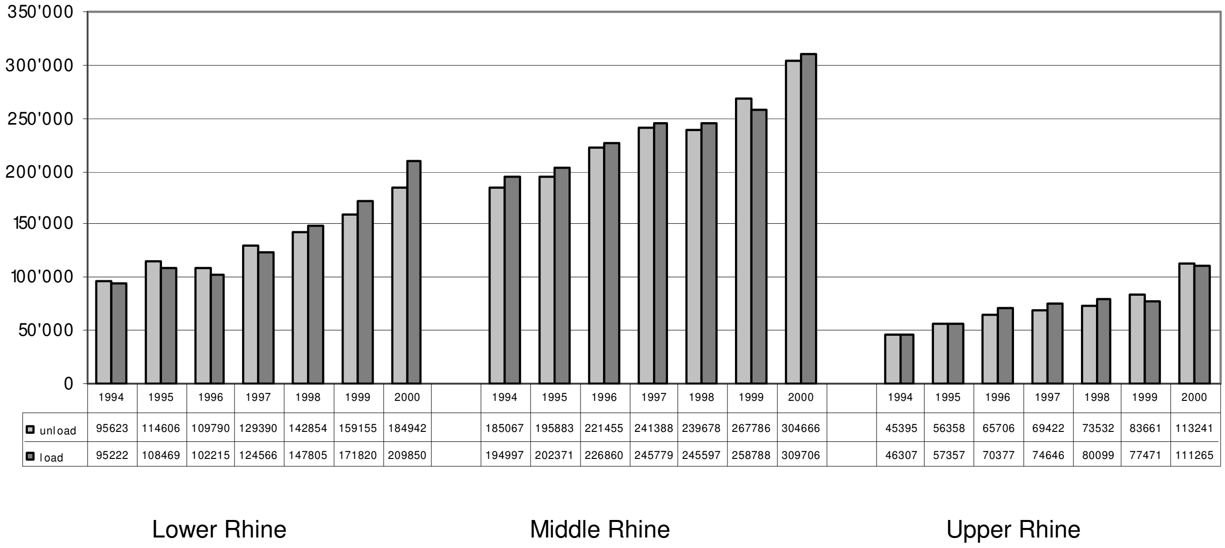
This probably depends on the development of the petrol market where consumer prices have been quite unstable. In the commodity range, minerals led with 43,4 m t in 1999, followed by ores (33,3 m t), petroleum (32,2 m t) and solid mineral fuels (22,3 m t). The high value products of NST/R chapter 9 (manufactured articles etc.) only account for 11,1 m t and a share of just 6 %. Foodstuffs and animal fodders, metal products and chemicals are just as insignificant, whilst fertilisers and agricultural products have the smallest tonnage.



	0	1	2	3	4	5	6	7	8	9
🟦 1996	7005	9567	19314	37232	36352	10694	42982	5354	12871	8553
🟪 1997	7520	9859	19043	37769	39886	11683	41635	5354	13551	9643
🟨 1998	7715	10545	22726	35624	37652	11795	42856	5343	13841	10431
▢ 1999	7905	10447	22291	32228	33335	10875	43364	5394	14926	11117

Figure 11. Evolution of transport on the traditional Rhine by goods categories in 1000 tonnes
Source: Central Commission of the Rhine 2003

Container transport is one of the sectors with the biggest growth rates (see Figure 12). Most of the containers were loaded and unloaded on the Middle Rhine (more than 300 000 TEU each). The Lower Rhine follows with approx. two-thirds of those volumes (185 000 TEU unload, 200 000 load) and the Upper Rhine with only one third of the Middle Rhine (113 000 TEU unload, 111 000 load). Upstream 40 foot-containers dominate in consumer goods, downstream mainly 20 feet-containers are filled with half-finished products moving to the seaports. A problem in this sector is the high share of empty containers: in the Dutch Rhine section 36% of the containers moving downstream are empty. This is caused by unbalanced trade flows as the import of containerised goods transhipped in the ARA seaports is much bigger than the containerised export volumes.



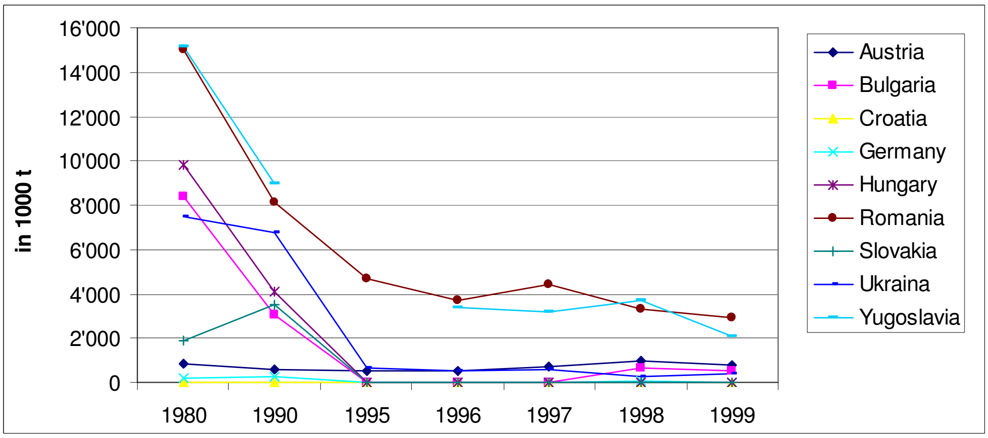
	1994	1995	1996	1997	1998	1999	2000		1994	1995	1996	1997	1998	1999	2000		1994	1995	1996	1997	1998	1999	2000
▢ unload	95623	114606	109790	129390	142854	159155	184942		185067	195883	221455	241388	239678	267786	304666		45395	56358	65706	69422	73532	83661	113241
■ load	95222	108469	102215	124566	147805	171820	209850		194997	202371	226860	245779	245597	258788	309706		46307	57357	70377	74646	80099	77471	111265

Figure 12. Evolution of container transhipment in the Rhine ports by sections in TEU 1994-2000
Source: Central Commission of the Rhine 2003

1.2.2 Danube corridor

Data for the year 2000 on Danubian shipping comes from Statistics Austria. Time series data prior to 1999 have been taken from the United Nations.

The time series data from the UN Bulletin of Transport Statistics differentiates between internal and international loaded transport (see Figure 13 and Figure 14). These give a first overview on the development of freight transport on the Danube.

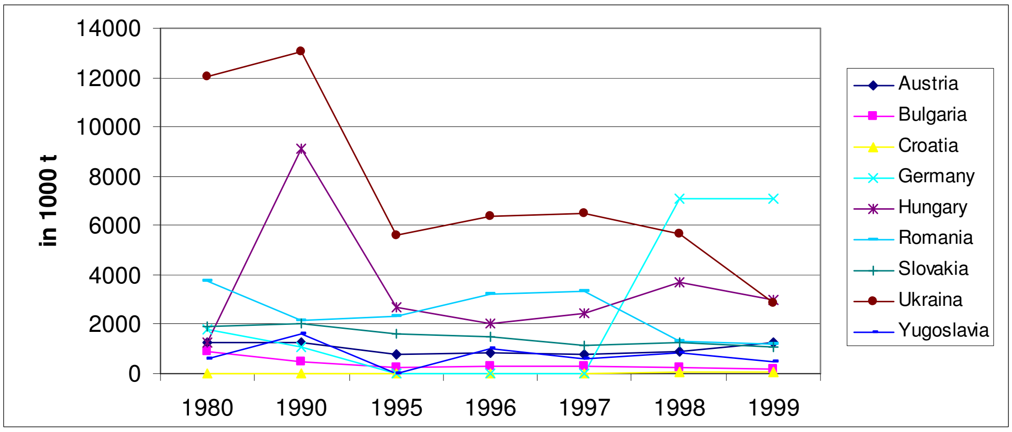


Country	**1980**	**1990**	**1995**	**1996**	**1997**	**1998**	**1999**
Austria	830	607	522	539	698	964	774
Bulgaria	8.389	3.060	n.a.	14	11	664	498
Croatia	n.a.	n.a.	n.a.	n.a.	n.a.	12	14
Germany	192	289	n.a.	n.a.	n.a.	55	17
Hungary	9.819	4.109	n.a.	n.a.	n.a.	n.a.	n.a.
Romania	15.003	8.144	4.715	3.686	4.423	3.304	2.934
Slovakia	1.865	3.490	n.a.	11	9	9	11
Ukraina	7.478	6.776	675	498	561	273	409
Yugoslavia	15.156	8.994	n.a.	3.405	3.203	3.705	2.102
Total	58.732	35.469	5.912	8.153	8.905	8.986	6.759
Goods entered by sea	8.080	3.345	2.688	2.350	519	572	452
Index (1980 = 100)	100	77	24	28	27	34	27

Figure 13. Danube - Internal transport; goods carried between the ports of a country, in 1000 tonnes Source: United Nations 2001, Annual Bulletin of Transport Statistics for Europe and North America

The statistics of the UN show the development of freight transport on the Danube between 1980 and 1999. The figures have to be explained in order to obtain a correct impression of the actual development of freight transport on the Danube. The diagrams (figures 15 and 16) show a clear trend towards a decline in transport volumes between 1980 and 1995. The development can be explained by several reasons:

- Rearrangement of statistical collection method: Since 1990 the heavy decline in internal transport volumes (figure 14) can be partly explained due to the fact that the statistical countings before 1990 included transports of gravel over distance of no more than 2 km.
- Change of economic system: The transition of the Eastern European countries from planned economy to free market economy in 1989 led to a dramatic change of transport relations and consequently to a reduction of freight transport volumes on the Danube.
- First crisis in Yugoslavia between 1992 and 1995: The crisis led to a temporary UN trade embargo and herewith to a drastic decline of transport volumes on the Danube.
- Second crisis in Yugoslavia between 1999 and 2002: The destruction of the bridge in Novi Sad blocked inland navigation in this area and led to a drastic decline of transport volumes on the Danube.
- Opening of the Main-Danube-canal in 1992: led to a certain compensation of transport volumes in the area of the Upper Danube.



Country	**1980**	**1990**	**1995**	**1996**	**1997**	**1998**	**1999**
Austria	1246	1236	789	812	780	922	1263
Bulgaria	903	477	222	310	286	241	204
Croatia	n.a.	n.a.	n.a.	n.a.	n.a.	51	51
Germany	1808	1085	n.a.	n.a.	n.a.	7075	7088
Hungary	1279	9114	2674	2017	2414	3706	2968
Romania	3769	2120	2320	3200	3353	1298	1176
Slovakia	1885	2020	1583	1495	1142	1270	1087
Ukraina	12029	13071	5617	6360	6519	5632	2881
Yugoslavia	612	1634	n.a.	1028	586	814	494
Total	23531	30757	13205	15222	15080	21009	17212

Figure 14. International transport; goods which have been loaded in the reporting country and have left with a destination, whether Danubian or not, in 1000 tonnes
Source: United Nations 2001, Annual Bulletin of Transport Statistics for Europe and North America

For the year 2000 data for Danube navigation transport have been analysed on the basis of the Austrian national statistics, which can be regarded as a reliable source for transport figures. In this statistics all inland waterway transports related to Austria are included (origin- destination-, transit transports). Given Austria's interface function, these shipments can be considered representative of the domestic and international traffic on the Danube. Following table shows Danube navigation transport volumes from, to and via Austria including the average transport distances:

Country of unloading

Country of loading	**Netherlands**	**Belgium**	**Luxembourg**	**France**	**Switzerland**	**Germany**	**Austria**	**Slovakia**	**Hungary**	**Bulgaria**	**Romania**	**Serbia-Mont.**	**Croatia**	**Ukraine**	**Total**
Netherlands							**1.256.251** *1.382*	**124.486** *1.666*	**342.605** *1.816*	**463** *2.525*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**1.723.805**
Belgium							**74.006** *1.544*	**5.312** *1.664*	**56.527** *1.895*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**135.845**
Luxembourg							**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0**
France							**17.916** *1.261*	**6.303** *1.404*	**18.589** *1.525*	**274** *2.527*	**0** *0*	**1.500** *1.771*	**0** *0*	**0** *0*	**44.582**
Switzerland							**4.896** *1.206*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**4.896**
Germany							**439.772** *651*	**68.969** *613*	**319.423** *879*	**10.443** *1.584*	**0** *0*	**67.502** *1.130*	**16.222** *975*	**877** *2.156*	**923.208**
Austria	**229.644** *1.463*	**109.571** *1.452*	**0** *0*	**25.472** *1.145*	**3.950** *1.175*	**544.002** *602*		**81.387** *159*	**143.598** *424*	**142** *1.556*	**34** *1.000*	**39.424** *842*	**884** *799*	**13.759** *2.047*	**1.191.867**
Slovakia	**116.163** *1.621*	**62.671** *1.660*	**0** *0*	**27.434** *1.318*	**0** *0*	**650.823** *593*	**2.008.289** *229*								**2.865.380**
Hungary	**147.504** *1.872*	**196.119** *1.935*	**0** *0*	**6.665** *1.580*	**4.608** *1.795*	**770.138** *1.044*	**1.503.436** *434*								**2.628.470**
Bulgaria	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**21.276** *1.608*	**39.781** *1.385*								**61.057**
Romania	**463** *2.525*	**650** *2.569*	**0** *0*	**0** *0*	**0** *0*	**9.374** *1.823*	**6.747** *1.627*								**17.234**
Serbia-Montenegr	**923** *2.281*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**123.947** *1.242*	**70.665** *682*								**195.535**
Croatia	**1.229** *2.447*	**1.708** *2.190*	**0** *0*	**0** *0*	**0** *0*	**3.146** *1.838*	**0** *0*								**6.083**
Ukraine	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**0** *0*	**9.034** *2.299*	**28.137** *2.033*								**37.171**
Total	**495.926**	**370.719**	**0**	**59.571**	**8.558**	**2.131.740**	**5.449.896**	**286.457**	**880.742**	**11.322**	**34**	**108.426**	**17.106**	**14.636**	**9.835.133**

Table 3. Danube navigation from, to and via Austria in 2000 (in tons) and average transport distances

Table 3 shows transport volumes on the Danube which are related to Austria. Noticeable are the long transport distances, above all between Western European countries and Danube riparian countries (linked over the Main-Danube canal), but also within the Danubian area (e.g. average transport distance between Austria and Romania was 1.627 km).

An analysis of transport volumes by goods categories (on the basis of NST/R chapters) is given in following overview. The goods exchange between Western European countries and Danube riparian countries has been examined:

Transport volumes from Western European countries (N, B, F, CH, D) to Danube countries (A, SK, H, BG, RO)

Goods category (NST/R)

Country of loading

	0	1	2	3	4	5	6	7	8	9	Total
Netherlands	96.967	490.703	6.566	55.422	841.125	40.427	89.087	72.197	23.662	7.186	1,723.342
Belgium	5.294	35.087	22.469	15.783	2.581	3.914	10.318	28.775	8.983	2.639	135.843
France	25.393	2.500	-	-	-	474	-	8.878	3.853	3.433	44.531
Switzerland	4.896	-	-	-	-	-	-	-	-	-	4.896
Germany	262.955	307.353	43.026	61.992	474	53.448	37.413	46.643	18.172	18.572	850.677
Total	395.505	835.644	72.061	133.197	844.808	98.263	136.818	156.493	54.670	31.830	2,759.289

Transport volumes from Danube countries (A, SK, H, BG, RO) to Western European countries (N, B, F, CH, D)

Goods category (NST/R)

Country of unloading

	0	1	2	3	4	5	6	7	8	9	Total
Netherlands	191.912	82.523	-	48.020	12.920	51.568	3.980	13.855	16.534	85.383	506.695
Belgium	37.216	103.520	-	10.331	10.310	174.651	15.038	3.912	395	12.638	368.011
France	1.000	-	-	-	430	46.400	-	10.252	-	1.488	59.570
Switzerland	3.694	914	-	-	-	-	-	3.950	-	-	8.558
Germany	52.196	230.940	48.486	265.638	39.987	535.139	176.466	583.692	6.934	27.893	1,967.371
Total	286.018	417.897	48.486	323.989	63.647	807.758	195.484	615.661	23.863	127.402	2,910.205

Table 4. Transport volumes between Danube and Western European countries by goods categories in 2000 (in tons)

Table 4 shows the different goods structure concerning the goods exchange via inland navigation between Western European countries and Danube riparian countries. Whereas the transport volumes are in both directions about the same size, the dominant goods categories are different: From Western European countries the goods categories 1 and 4 (food stuffs and animal fodders, ores and metal) are dominating, whereas from Danubian countries above all the goods categories 5 and 7 (metal products and fertilisers) are transported towards the West. Following figure compares the transport volumes between the Danube and Western European countries by goods categories (NST/R chapters):

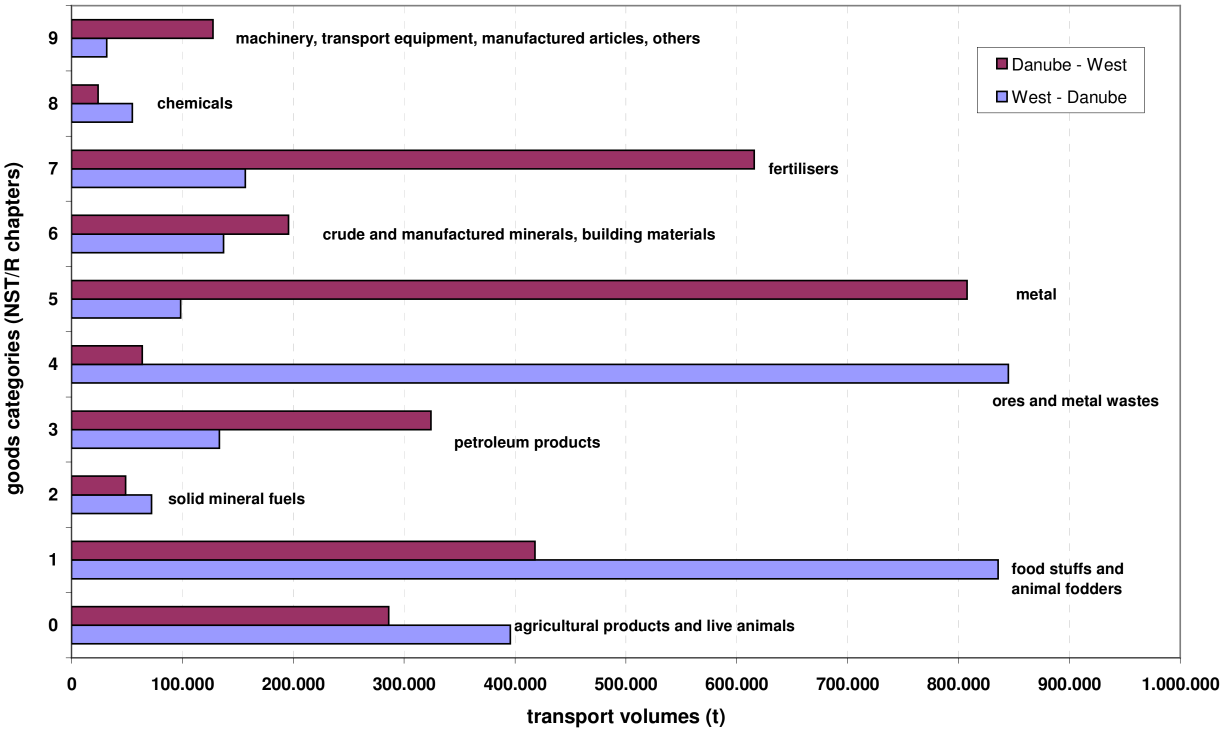


Figure 15. Transport volumes between Danube countries (A,SK,H,BG,RO) and Western European countries (N,B,F,CG,D) by goods categories (NST/R chapters)

The dominating goods categories (metal products and fertilisers) for the relation Danube countries – Western European countries are so called ´just in time´ products, whereas the goods coming from the West (above all metal products and food stuffs and animal fodders) are not time critical and can be handled with corresponding stock-keeping facilities. Furthermore the consignee of such goods transports is often located directly on the waterway (e.g. steel mill Voest in Austria).

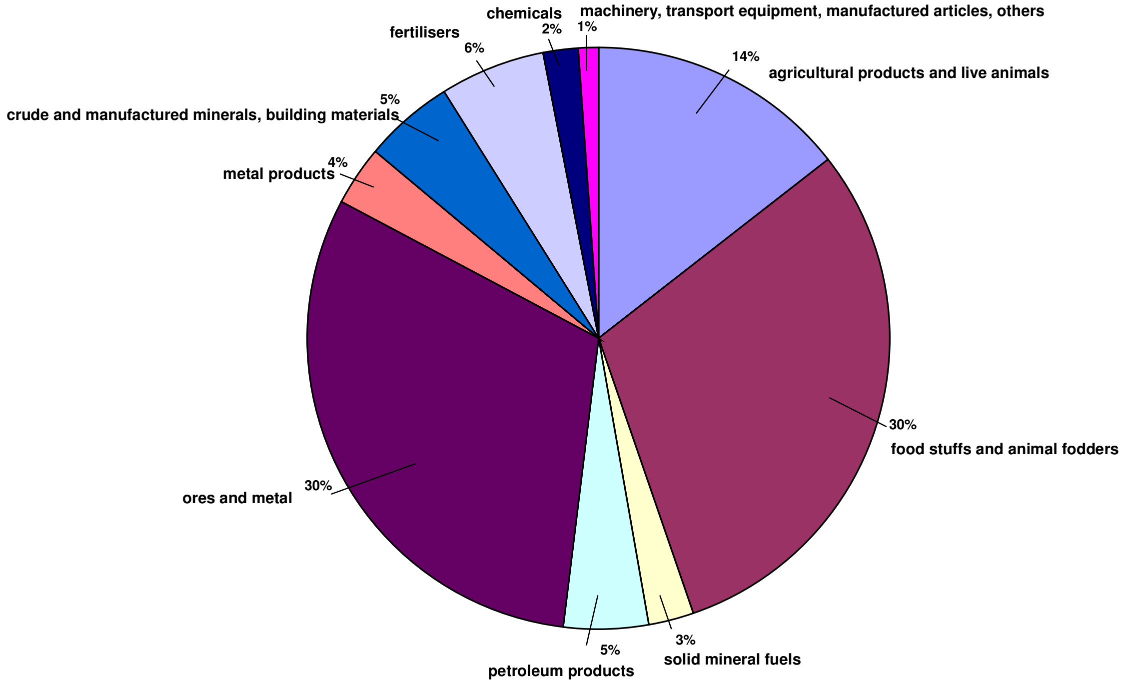


Figure 16. Transport volumes from Western European countries (N,B,F,CG,D) to Danube countries (A,SK,H,BG,RO) by goods categories (NST/R chapters)

Figure 16 is another illustration of the transport volumes from Western European countries to Danube countries. Three goods categories are dominating (0,1,4 corresponding to agricultural products and live animals, foods stuffs and animal fodders and ores and metal). The next figure shows the same illustration for the relation Danube countries – Western European countries:

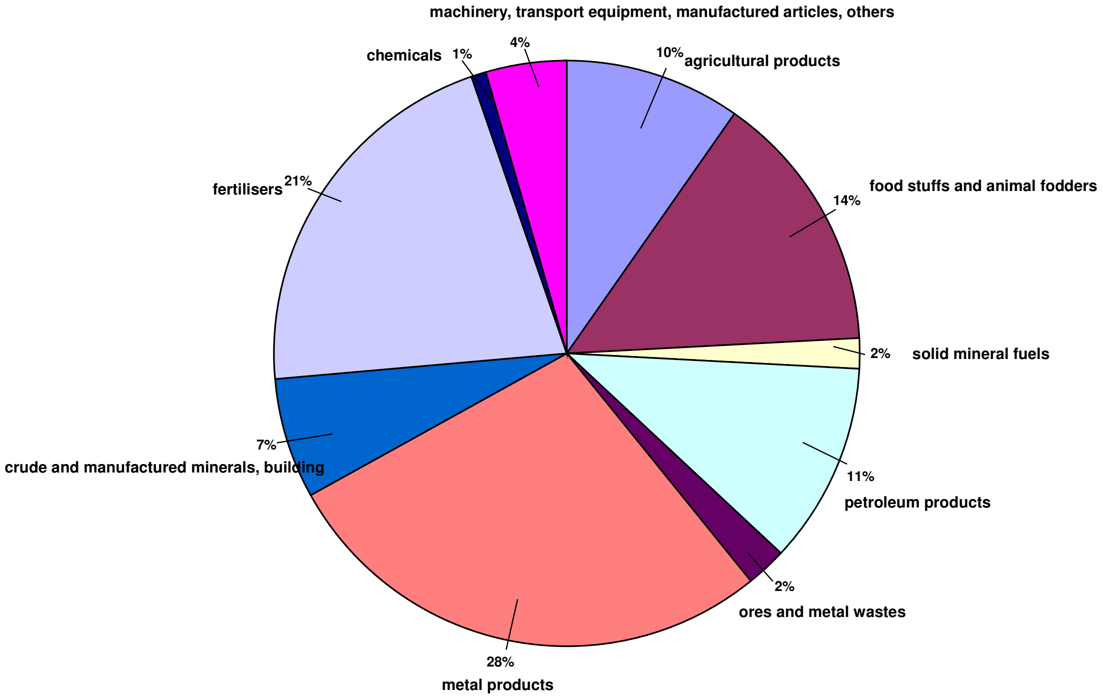


Figure 17. Transport volumes from Danube countries (A,SK,H,BG,RO) to Western European countries (N,B,F,CG,D) by goods categories (NST/R chapters)

Besides the goods categories also the utilisation degrees of vessels differ between the two relations Western European countries and Danube countries:

Utilization degree for transports from Western European countries (N, B, F, CH, D) to Danube countries (A, SK, H, BG, RO)

	tdW (loading capacity of utilized vessels in tons)	transported goods (in tons)	average utilization degree
import to Austria	2,728.394	1,792.841	65,7%
transit via Austria [1]	1,850.111	1,038.980	56,2%
Total from West	4,578.505	2,831.821	61,9%

Utilization degree for transports from Danube countries (A, SK, H, BG, RO) to Western European countries (N, B, F, CH, D)

	tdW (loading capacity of utilized vessels in tons)	transported goods (in tons)	average utilization degree
export from Austria	1,658.730	911.641	55,0%
transit via Austria [1]	3,703.522	2,153.874	58,0%
Total to West	5,362.252	3,065.515	57,2%

1) figures inclusive Ucraine, Croatia,Serbia/Montenegro

Table 5. Utilization degrees of transport relations between Western European countries (N,B,F,CG,D) and Danube countries (A,SK,H,BG,RO) in 2000

Table 5 shows the average utilization degrees of loaded vessels operating between Western European countries and Danube countries. The average utilization rates are with 61,9% (transports Western European countries – Danube countries) respectively 57,2% (transports Danube countries - Western European countries) significantly below the ones in the rest of Europe (e.g. the average utilization rate on the river Moselle amounts about 86%). The reasons for this are not lacking transport volumes but above all infrastructure bottlenecks on the Upper Danube: Long average transport distances (see Table 3) lead to the problem of unpredictable water level prognoses and herewith to a higher risk for the vessel operators. Additional safety margins are calculated by the captains when determining the possible draught of their vessels in order to be able to pass the infrastructure bottlenecks on the Upper Danube without the necessity to lighten the vessels. The infrastructure bottlenecks on the Upper Danube in Germany, Austria and Hungary have insufficient waterway depths and additionally heavily fluctuating water levels which leads to drastically reduced utilization rates of vessels operating between Western European countries and Danube countries.

The pairing of transports (the balance between incoming and outgoing traffic) is another interesting criterion for the competitiveness of inland navigation, which is shown in following table:

	transports from Western European countries	transports from Danube countries
total transport volume (in tons)	2,759.289	2,910.205
petroleum products (NST/R goods category 3)	133.197	323.989
dry goods (all other NST/R goods categories)	2,626.092	2,586.216
transports from German Danube ports (Danube internal transport)	452.978	857.260
transport volume (in tons)	2,173.114	1,728.956
Pairing	100	80

Table 6. Pairing of transports between Western European countries (N, B, F, CH, D) and Danube countries (A, SK, H, BG, RO)

Table 6 shows that the pairing of transports between Western European countries and Danube countries is 100:80 and herewith represents a very favourable situation for IWT transports.

1.2.3 North-South corridor

The North-South corridor comprises navigable inland waterways of the Netherlands, Belgium and France. No proper corridor data is available. The role of this corridor is best derived from the following origin-destination statistics of France; only the Belgium-Netherlands relation is missing.

Tonnage	Pays de destination						
Bassin d'origine	Allemagne	Autres pays	Belgique	Luxembourg	Pays-bas	Suisse	Total
Rhin	5'385'665	14'282	689'473	58'345	2'422'609	712'299	9'282'673
Rhône et basse-saône	3'155		6'675		1'382	202'191	213'403
Seine et canaux annexes	12'480		169'850		104'505		286'835
Voies de liaison de Paris avec le Nord et l'Est	50'198		808'412		589'070	2'750	1'450'430
Voies du Centre	7'138		91'446		56'969		155'553
Voies du Nord et du Pas de calais	90'268		624'115		305'083		1'019'466
Voies navigables de l'Est	1'525'036	29'343	926'069	10'000	1'679'489	9'070	4'179'007
Total	7'073'940	43'625	3'316'040	68'345	5'159'107	926'310	16'587'367

Tonnage	Pays d'origine						
Bassin de destination	Allemagne	Autres pays	Belgique	Luxembourg	Pays-bas	Suisse	Total
Rhin	867'838	35'371	843'911	1'915	1'496'147	56'020	3'301'202
Rhône et basse-saône	28'377		13'040		14'909		56'326
Seine et canaux annexes	69'013	3043	170'041	1'147	53'488		296'732
Voies de liaison de Paris avec le Nord et l'Est	116'697		696'643	404	92'668		906'412
Voies du Centre	1'220		3'025	629	4'431		9'305
Voies du Nord et du Pas de calais	476'920		1'129'274		871'400		2'477'594
Voies navigables de l'Est	527'364	16'537	1'080'698	354	3'334'744	6'322	4'966'019
Total	2'087'429	54'951	3'936'632	4'449	5'867'787	62'342	12'013'590

Table 7. France: Volume of Inland Waterway Transport by Region (domestic) and Country (international) of origin or destination – 1999, tonnes
Source: VNF

The table does not permit to identify the flows according to the waterway actually used. It is, however, safe to assume that all traffic with origin from and destination to the two regions of Northern France (Nord – Pas-de-Calais and the Seine system) will be channelled on the North-South corridor. These are 1.3 million tonnes out of France and 2.8 million tonnes into France.

1.2.4 East-West Corridor

Here again, no comprehensive data base exists for this corridor and we have to rely on statistical information from national sources. The main part of this corridor being the river and canal network in Northern Germany, German data may be taken to be indicative. PLANCO (2003) reports that in the year 2000, total port throughputs in the area[1] (loading and unloading) amounted to 90 million tonnes, down from over 100 million tonnes in 1995.

---

[1] Comprising the areas of Elbe, Weser, Mittellandkanal, West German canal network as well as the regions of Berlin, Brandenburg and Mecklenburg-Vorpommern.

In addition, PLANCO quotes transport volumes crossing the borders with Germany's Eastern neighbours Poland (5.3 -5.4 million tonnes) and Czech Republic (1.5 million tonnes) but does not give corresponding figures for earlier years.

1.3 Conclusions

The main conclusion from the foregoing analysis is the trend of modest growth of IWT across the Union, represented by the five countries with a significant IWT market (Austria, Belgium, France, Germany and the Netherlands). There was a very modest growth in the 70s, stagnation in the 80s and acceleration in the 90s. This trend has lead to an EU wide stabilisation of the market share of IWT and its competing modes of inland transport.

97% of international intra-EU-15 IWT is between Belgium, France, Germany and the Netherlands.

Because of its natural conditions, the Netherlands can move over 40% of cargo in terms of tonne-kilometres on its domestic rivers and canals. In Germany and Belgium, IWT modal share is 14 and 12 % respectively. In all other EU countries including Austria and France, the share is 5% or below. As the case of the Netherlands shows, IWT is not a negligible mode of transport if physical supply conditions are favourable. The problem is less on the demand side: most goods except perishables are suitable for IWT with improving ship technology; it is more on the supply side. Usage is already made of natural rivers and many canals have been upgraded; building additional infrastructure, to allow navigation even under severe meteorological conditions, is very costly with limited feasibility in economic and financial terms.

The IWT sector is nevertheless a fragile one: demand in terms of volume (tonnes) is rather stable, while with growing transport distances, the sector's performance (tonne-kilometres) is improving.

In accession countries, IWT is of importance in Romania, Slovakia and Hungary. These countries are still in a transformation process where the modal share of road transport is increasing fast and those of rail and IWW are declining. It is unlikely that this process can be stopped in order to maintain high shares of rail and inland water transport.

The Rhine corridor as the main European IWT artery is performing well. In particular, container traffic has increased year by year at a high growth rate and the limit of growth has not yet been reached.

The Danube corridor has suffered much from the troubled recent history of the Balkans with traffic being cut off in Serbia during the war. Meanwhile the debris from bridge bombing has been cleared and navigation can return to normal.

The analysis of transport volumes by goods categories shows a significant development potential of transport flows between Western European countries and Danube countries. The main current handicap for a stronger increase of transport volumes are infrastructure bottlenecks – insufficient and highly fluctuating water levels in the free flowing sections - on the Upper Danube.

Chapter 2 Socio-economic developments

2.1 Introduction

Main driver of freight transport demand is the socio-economic development. Therefore, forecasts of population, economic growth (GDP) and foreign trade (exports and imports) are described in this separate chapter. Based on these trends, in the next chapter the forecasts of transport volumes will be presented.

2.2 Method of working

The socio-economic forecasts (population, GDP, foreign trade) in this chapter are taken from the Prognos European Transport Report 2002 and are consistent with the Prognos forecast of transport performance in the next chapter.

The PINE study was not expected to produce a new, consistent and authoritative set of demand forecasts for the freight transport sector including inland navigation. To obtain relevant information, data and forecasts, a variety of sources were investigated.

2.3 Developments in the EU and accession countries

2.3.1 Demography

The population in the EU-15 has almost been stagnant in the 1990s, increasing from 366 million inhabitants in 1991 to just 376 million in 2000, with an estimated annual growth of 0.3%. Countries exceeding average growth were Luxembourg (+1.4% p.a.), The Netherlands (+0.7% p.a.), Austria (+0.6% p.a.), France and the U.K. (+0.4% p.a.).

Several of the accession countries including Bulgaria, Czech Republic and Hungary have known a marginal to significant drop in population. Poland had a very strong growth during the 1980s falling to a moderate position in the 1990s.

Population growth is expected to come to a standstill Europe wide after enlargement of the Union in 2004, which will add some 75 m inhabitants in 2004 and some further 30 m (Romania and Bulgaria) after 2007. The future Union will thus have some 455 m inhabitants, Turkey not included.

2.3.2 Gross Domestic Product

Notwithstanding the present stagnation of GDP in the European Union Member States, an average growth of slightly over 2% annually is expected in the coming decade.

Country	1995 - 2000	2000 - 2005	2005 - 2010
Austria	2.6	1.9	2.2
Belgium	2.8	2.0	2.1
Denmark	2.7	2.1	2.3
Finland	5.1	2.1	2.4
France	2.5	2.1	2.1
Germany	1.8	1.9	2.1
Greece	3.3	3.3	2.5
Ireland	9.6	4.7	3.4
Italy	1.9	2.0	1.9
Luxemburg	6.2	3.7	2.7
Netherlands	3.7	2.2	2.2
Portugal	3.6	2.1	2.4
Spain	3.8	2.6	2.5
Sweden	2.9	2.1	2.2
United Kingdom	2.8	2.2	2.2
EU-15	2.6	2.1	2.2

© prognos 2002

Table 8. Forecast of GDP Growth in EU Member States (constant prices; in % p.a.)
Source: Prognos World Reports 2002 – Industrial countries 2000 – 2010

Economic growth in the main IWT countries (Austria, Belgium, France, Germany, Luxembourg, and Netherlands) is somewhat below average. However, these countries have today a per capita GDP (in 1995 prices) between 23.000 and 25.000 € p.a. which is above the average of 20.000 € in the EU-15 area. The foreign trade intensity is also above average as they account for 55% of external trade but only have 45% of the population in the whole EU area. Growth prospects in the EU accession countries are anticipated to be close to 4% p.a.

GDP growth assumptions in the PRIMES forecasts are somewhat more optimistic for the EU-15 countries (2.4% p.a. for the present decade), but slightly more cautious for the accession countries (3.8% p.a.).

Country	**1995 - 2000**	**2000 - 2005**	**2005 - 2010**
Bulgaria	-3.0	3.8	3.2
Croatia	*3.7*	*3.2*	*3.1*
Czech Republic	0.2	3.8	4.4
Estonia	4.4	5.1	4.0
Hungary	3.8	4.8	4.5
Latvia	4.2	4.7	3.9
Lithuania	3.1	3.4	3.8
Poland	5.4	4.2	4.3
Romania	-2.8	2.0	2.7
Slovakia	4.6	3.2	3.6
Slovenia	4.2	4.7	4.2
Yugoslavia	*-1.0*	*3.7*	*3.2*
EU Accession Countries	3.1	4.0	4.1

© prognos 2001

Table 9. Forecast of GDP Growth in CEECs (constant prices; in % p.a.)
Source: Prognos World Reports 2001 – Central and Eastern European Countries 1999 – 2010

In this table, we have added Yugoslavia and Croatia which are not candidates for EU membership but are riverains of the Danube corridor and therefore of importance regarding IWT demand.

2.3.3 Foreign Trade

In addition to GDP, external trade is an important driving force for international transport demand. Export and import figures are expressed in monetary terms and do not reflect quantities or volumes of physical trade. They include, of course, exports and imports of services which are not relevant for freight transport demand. Also, in developing economies, we observe the trend towards higher value goods. This means that trade volumes are growing more slowly than values.

The last decade of the past century was characterised by a strong growth of international trade in most EU countries: between 1995 and 2000, exports grew by 7.5% p.a., imports by 8% p.a.. Modest trade expansion was recorded in Italy, Belgium and Denmark while Ireland, Spain, Finland and Greece topped the list.

Country	Exports			Imports		
	1995 – 2000	2000 – 2005	2005 - 2010	1995 - 2000	2000 - 2005	2005 - 2010
Austria	8.5	5.2	4.3	7.8	4.9	4.2
Belgium	5.8	4.0	4.1	5.7	4.0	4.1
Denmark	6.0	4.6	4.0	6.6	4.2	3.9
Finland	10.2	2.7	4.8	8.6	2.9	4.8
France	8.0	4.3	4.1	7.7	4.2	4.1
Germany	8.4	4.5	4.4	7.7	4.1	4.2
Greece	9.5	5.5	4.8	9.3	5.5	4.8
Ireland	16.2	6.3	5.5	15.9	6.3	5.7
Italy	4.1	4.6	4.2	6.3	4.7	4.2
Luxemburg	9.3	5.6	4.6	8.6	5.5	4.6
Netherlands	7.1	4.2	4.0	7.6	4.1	4.0
Portugal	6.4	4.6	5.1	8.5	4.0	5.1
Spain	10.2	4.9	5.2	11.4	5.0	5.2
Sweden	8.2	3.4	4.4	8.1	3.2	4.4
United Kingdom	6.2	4.2	4.1	9.0	4.5	4.1
EU-15	7.5	4.4	4.3	8.0	4.4	4.3

© prognos 2002

Table 10. Forecast of Foreign Trade in EU Member States (constant prices; in % p.a.)
Source: Prognos World Reports 2002 – Industrial countries 2000 – 2010

Current forecasts for the present decade anticipate a slow expansion of both exports and imports not only during the first half characterised by a severe slowdown of economic growth in all parts of the industrialised world. Nevertheless, growth rates in the order of 4.4% p.a. are more than twice the anticipated GDP growth. The big countries such as Germany, France, UK and Italy are close to average; groth remains strongest in peripherial countries such as Ireland, Spain, Portugal, Greece and Finland.

Trade expansion in the 1990ies was in part due to the transformation process in the CEECs with high import needs but also strong export growth. Hungary lead the league with 16% growth p.a. of both exports and imports between 1995 and 2000. All accession countries together registered annual growth of exports of 8.5 % p.a. and of inputs over 11% p.a.

Country	**Exports**			**Imports**		
	1995 - 2000	**2000 - 2005**	**2005 - 2010**	**1995 - 2000**	**2000 - 2005**	**2005 - 2010**
Bulgaria	-3.1	7.9	5.3	-0.6	7.0	5.3
Croatia	*5.4*	*6.6*	*6.2*	*5.4*	*5.2*	*5.8*
Czech Rep.	8.2	10.2	7.5	8.3	9.9	7.3
Estonia	10.0	12.9	8.0	10.2	11.8	7.7
Hungary	16.0	11.6	7.5	16.2	11.0	7.4
Latvia	7.7	8.0	7.3	11.3	5.9	6.9
Lithuania	3.9	9.8	7.5	8.2	7.4	6.5
Poland	8.8	9.6	7.6	16.8	7.9	7.1
Romania	4.2	7.8	4.9	4.0	7.0	4.5
Slovakia	8.3	8.1	6.3	10.5	7.5	6.3
Slovenia	5.8	7.8	6.8	8.0	6.8	6.5
Yugoslavia	*-2.8*	*2.6*	*5.1*	*6.1*	*5.9*	*5.7*
EU Accession Countries	8.5	9.7	7.2	11.1	8.7	6.9

Table 11. Forecast of Foreign Trade in CEECs (constant prices; in % p.a.)
Source: Prognos World Reports 2001 – Central and Eastern European Countries 1999 – 2010

Foreign trade of the accession countries will stay strong until 2010 albeit slowing down gradually to 7% annually in the second half of the current decade.

Chapter 3 Future transport volumes

3.1 Introduction

The objective of this chapter is to highlight the prospects of future evolution of goods transport demand in pan-European inland waterway transport. These will be as far as possible trends of total transport volumes and performances, as well as in the form of modal shifts. The forecasts will cover the inland waterway countries of the present EU-15 as well as those of the candidate countries.

3.2 Method of working

Europe wide transport demand forecasts (origin-destination) are being produced under the TEN-T – STAC study, commissioned by DG TREN to develop the quantitative framework for the revision of the Union’s TEN-T priorities. These forecasts that cover IWT will be available to DG TREN once the STAC study will be completed. Forecasts for individual corridors or river systems can be retrieved from the STAC database.

The transport forecasts presented here build up on past trends and the actual situation presented in the previous chapter.

The socio-economic forecasts (population, GDP, foreign trade) in section 2.3 are taken from the Prognos European Transport Report 2002 and are consistent with the Prognos forecast of transport performance in section 2.4.

The PINE study was not expected to produce a new, consistent and authoritative set of demand forecasts for the freight transport sector including inland navigation. To obtain relevant information, data and forecasts, a variety of sources were investigated.

The main sources have been the Prognos European Transport Report 2002 (horizon 2015) and forecasts carried out within the above mentioned STAC study (horizon 2020) that were obtained by request, courtesy of NEA, the team leader of the STAC consortium.

DG TREN's PRIMES forecasts (horizon 2030) could not be used since the definition of inland navigation does not match with that used in the PINE study[2].

Forecast data on trends of shipping types and on geographical markets were taken from the ECORYS reports on "Market observation for the inland waterway sector" (horizon 2010).

An expected set of new forecast data using the SCENES model that had been developed under the European Commissions 5th Framework research programme were not available on time to be included.

There remains a problem of consistency of the different forecasts that could not be resolved in the course of the PINE study.

3.3 Transport performance

On the basis of the macro-economic growth prospects highlighted above, goods transport demand has been forecast by Prognos to grow in the EU-15 area by 2.6% p.a. in the decade from 2000 to 2010 and by 2% p.a. between 2010 and 2015. In total, a growth of 42% (2.4% p.a.) in terms of tonne-kilometres is forecast for the period between 2000 and 2015.

---

[2] In the PRIMES study, inland navigation includes domestic short sea shipping that is of major importance in the Greece, Italy, Spain and the United Kingdom.

Country	2000				2015				Share 2015 (%)			Growth 2000-2015 (% p.a.)			
	Total	Road	Rail	**IWT**	Total	Road	Rail	**IWT**	Road	Rail	**IWT**	Total	Road	Rail	**IWT**
Austria (AT)	45'594	25'804	17'346	2'444	64'699	33'902	27'174	3'623	52	42	6	2.4	1.8	3.0	2.7
Belgium (BE)	53'676	39'610	7'674	6'392	73'584	55'777	9'566	8'241	76	13	11	2.1	2.3	1.5	1.7
Denmark (DK)	18'665	16'640	2'025	-	23'692	21'112	2'580	-	89	11	-	1.6	1.6	1.6	-
Finland (FI)	42'111	31'475	10'107	529	51'384	37'767	12'918	699	74	25	1	1.3	1.2	1.6	1.9
France (FR)	334'220	271'472	55'448	7'300	469'158	375'936	82'009	11'213	80	17	2	2.3	2.2	2.6	2.9
Germany (DE)	488'790	346'293	76'032	66'466	690'764	500'113	106'032	84'619	72	15	12	2.3	2.5	2.2	1.6
Greece (GR)	19'103	18'777	326	-	35'053	34'282	771	-	98	2	-	4.1	4.1	5.9	-
Ireland (IE)	7'938	7'447	491	-	11'510	10'831	679	-	94	6	-	2.5	2.5	2.2	-
Italy (IT)	267'025	243'982	22'834	210	376'449	338'541	37'645	264	90	10	0	2.3	2.2	3.4	1.5
Luxembourg (LU)	3'473	2'478	683	312	5'017	3'612	1'003	401	72	20	8	2.5	2.5	2.6	1.7
Netherlands (NL)	94'905	50'629	3'819	40'457	134'161	69'093	8'050	57'018	52	6	43	2.3	2.1	5.1	2.3
Portugal (PT)	15'201	13'018	2'183	-	20'518	17'153	3'365	-	84	16	-	2.0	1.9	2.9	-
Spain (ES)	268'536	256'494	12'042	-	420'266	397'572	22'694	-	95	5	-	3.0	3.0	4.3	-
Sweden (SE)	51'376	31'479	19'897	-	66'046	39'892	26'154	-	60	40	-	1.7	1.6	1.8	-
United Kingdom (UK)	176'500	158'000	18'300	200	234'264	201'936	32'071	258	86	14	0	1.9	1.6	3.8	1.7
Norway (NO)	17'474	14'985	2'489	-	25'623	22'420	3'203	-	88	13	-	2.6	2.7	1.7	-
Switzerland (CH)	33'265	21'949	11'189	127	54'031	33'175	20'640	216	61	38	0	3.3	2.8	4.2	3.6
Czech Republic (CZ)	57'305	39'036	17'496	773	76'567	58'543	16'845	1'179	76	22	2	2.0	2.7	-0.3	2.9
Estonia (EE)	11'478	3'690	7'788	-	20'489	6'925	13'564	-	34	66	-	3.9	4.3	3.8	-
Hungary (HU)	22'315	13'329	8'095	891	32'042	21'180	9'549	1'314	66	30	4	2.4	3.1	1.1	2.6
Poland (PL)	128'158	72'842	54'015	1'301	175'004	116'028	56'666	2'310	66	32	1	2.1	3.2	0.3	3.9
Slovenia (SI)	4'947	2'090	2'857	-	7'627	4'195	3'432	-	55	45	-	2.9	4.8	1.2	-
EU15	1'887'113	1'513'597	249'207	124'308	2'676'565	2'137'518	372'711	166'336	80	14	6	2.4	2.3	2.7	2.0
EU15 + 2	1'937'851	1'550'531	262'885	124'435	2'756'219	2'193'113	396'554	166'552	80	14	6	2.4	2.3	2.8	2.0
CEEC5	224'203	130'987	90'251	2'965	311'729	206'871	100'055	4'803	66	32	2	2.2	3.1	0.7	3.3

Table 12. Goods transport performance by country and mode, 2000 and 2015, billion tonne-kilometres
Source: Prognos European Transport Report 2002

Demand for inland waterway transport is currently expected to grow in the same period by 35% (2% p.a.), compared to 41% (2.3% p.a.) growth in goods transport by road and 51% (2.7%) by rail. The railway sector will benefit from measures which the European Community has initiated more than a decade ago and which are expected to finally bear results in the decade before us. Nevertheless, market shares are consolidating globally after a long period of decline and stagnation of both the rail and inland waterway transport sectors. Inland waterway transport is anticipated to remain at 6% of market share compared to 14% for rail freight and 80% for road freight.

Growth of transport demand in the accession countries is very slightly below that of Western countries (in the selection of five countries – Czech Republic, Hungary, Poland, Slovenia and Estonia), 2.5% p.a. from 2000 to 2010 and 1.7% p.a. from 2010 to 2015 respectively, 2.2% on average. Inland waterway transport demand is expected to grow here well above average, 3.3% p.a. while road freight is anticipated to grow by 3.1% p.a. and rail freight by a mere 0.7% p.a..

3.4 Total transport volumes

Table 13 gives an overview over the development trends of freight transport demand in terms of tonnage (volume) from the STAC forecasts on the basis of a European scenario reflecting EU transport policies as laid down in the 2001 White Paper of the European Commission. Missing in this table is transit traffic that may be important for some of the countries such as Belgium, the Netherlands, Germany and Austria.

Domestic traffic in the CEECs is marginal, increasing modestly. All other trend indicators are constant or shifting only marginally in Western Europe and modestly in Eastern Europe.

Coun-tries	**Year**	**Domestic (NUTS 2)**				**Exports**				**Imports**			
		Road	**Rail**	**Inland water**		**Road**	**Rail**	**Inland water**		**Road**	**Rail**	**Inland water**	
EU 15	2000	2488454	341700	125862	4.3%	587265	76744	147459	18.2%	580866	123986	214756	23.4%
	2020	3937393	620203	205484	4.3%	1137208	153439	284113	18.0%	1197010	247651	418971	22.5%
	% p.a.	2.3%	3.0%	2.5%		3.4%	3.5%	3.3%		3.7%	3.5%	3.4%	
EU 15+2	2000	2534098	349847	125862	4.2%	604510	80083	148686	17.8%	603421	133591	223629	23.3%
	2020	4006241	635740	205484	4.2%	1162286	159382	287061	17.8%	1230782	264840	432322	22.4%
	% p.a.	2.3%	3.0%	2.5%		3.3%	3.5%	3.3%		3.6%	3.5%	3.4%	
CEEC 12	2000	562002	193464	1959	0.26%	54062	80268	6621	4.7%	45427	89375	3386	2.5%
	2020	1036427	172886	3734	0.31%	163741	163285	15972	4.7%	208263	157270	6663	1.8%
	% p.a.	3.1%	-0.6%	3.3%		5.7%	3.6%	4.5%		7.9%	2.9%	3.4%	
EU 15+2 & CEEC 12	2000	3096100	543311	127821	3.4%	658572	160351	155307	15.9%	648848	222966	227015	20.7%
	2020	5042668	808627	209218	3.5%	1326026	322668	303033	15.5%	1439045	422110	438985	19.1%
	% p.a.	2.5%	2.0%	2.5%		3.6%	3.6%	3.4%		4.1%	3.2%	3.4%	

Table 13. Inland Transport Volumes in Europe 2000 and 2020, 1000 tonnes
Source: NEA 2003

Table 13 has been aggregated from the detailed tables 14 and 15 that show the transport volumes by country for the years 2000 and 2020. It must be noted that there are significant differences between Eurostat (see Part B Demand, chapter 1, table 1) and STAC figures for the year 2000. These differences cannot be reconciled: However, the value of the STAC figures are to be seen in the forecasts, i.e. the relative changes between 2000 and 2020 rather than the absolute values.

Country	Domestic (NUTS 2)			Exports			Imports		
	Road	Rail	Inland water	Road	Rail	Inland water	Road	Rail	Inland water
EU 15									
AUSTRIA	58,887	13,773	636	29,235	9,563	1,020	25,368	21,639	5,042
BELGIUM & LUXEMBOURG	106,764	14,736	10,288	94,542	10,894	24,113	69,475	9,043	41,779
DENMARK	-	-	-	3,957	281	23	5,164	442	28
FINLAND	53,065	15,654	0	720	26	85	508	19	5
FRANCE	389,697	57,631	12,340	101,960	16,971	15,676	102,981	12,602	10,778
GERMANY	740,506	120,897	46,476	164,406	25,383	39,549	169,851	27,916	112,813
GREECE	-	-	-	4,269	202	15	5,900	319	1
IRELAND	-	-	-	1,286	13	2	2,602	56	32
ITALY	296,139	26,459	0	51,532	6,177	41	58,546	45,468	55
NETHERLANDS	167,313	4,202	56,122	82,330	3,544	66,893	79,231	3,292	43,810
PORTUGAL	45,049	7,053	0	8,582	77	19	12,060	236	3
SPAIN	198,473	17,853	0	38,605	1,092	4	40,481	1,794	39
SWEDEN	50,659	7,230	0	5,542	2,508	6	8,418	1,112	141
UNITED KINGDOM	381,902	56,212	0	299	13	13	281	48	230
ALL EU 15	**2,488,454**	**341,700**	**125,862**	**587,265**	**76,744**	**147,459**	**580,866**	**123,986**	**214,756**
NORWAY	n.a.	n.a.	n.a.	1,069	3	7	1,816	241	106
SWITZERLAND	45,644	8,147	0	16,176	3,336	1,220	20,739	9,364	8,767
ALL EU 15+2	**2,534,098**	**349,847**	**125,862**	**604,510**	**80,083**	**148,686**	**603,421**	**133,591**	**223,629**
CEEC 12									
BULGARIA	89,377	18,843	81	2,473	1,557	287	1,312	1,056	1,149
CYPRUS	0	0	0	29	20	3	101	15	4
CZECHIA	31,554	29,523	526	15,277	25,296	556	12,975	19,902	648
ESTONIA	5,709	1,990	0	1,045	809	87	659	2,771	10
HUNGARY	116,263	10,308	140	8,517	7,818	1,882	5,399	11,827	1,103
LATVIA	0	0	0	1,278	674	47	697	3,700	2
LITHUANIA	7,053	4,327	0	1,870	6,582	9	1,076	3,840	1
MALTA	0	0	0	10	0	0	80	5	3
POLAND	187,858	88,915	0	14,550	17,199	2,325	13,204	20,717	253
ROMANIA	40,490	25,852	1,212	1,748	2,914	74	1,861	4,890	19
SLOVENIA	18,008	1,268	0	4,182	804	5	5,870	2,513	7
SLOVAKIA	65,690	12,438	0	3,083	16,595	1,346	2,193	18,139	187
ALL CEEC 12	**562,002**	**193,464**	**1,959**	**54,062**	**80,268**	**6,621**	**45,427**	**89,375**	**3,386**
EU 15+2 & CEEC 12	**3,096,100**	**543,311**	**127,821**	**658,572**	**160,351**	**155,307**	**648,848**	**222,966**	**227,015**

Table 14. Inland Transport Volumes in Europe 2000, 1000 tonnes
Source: NEA 2003

Country	Domestic (NUTS 2)			Exports			Imports		
	Road	Rail	Inland water	Road	Rail	Inland water	Road	Rail	Inland water
EU 15									
AUSTRIA	90627	24689	1431	52,296	16,969	3,516	44,466	30,583	11,601
BELGIUM & LUXEMBOURG	153960	27201	17619	186,921	24,142	51,764	154,663	29,946	92,369
DENMARK	n.a.	n.a.	n.a.	7,331	568	101	9,740	911	46
FINLAND	80673	28831	0	1,026	59	186	834	37	15
FRANCE	631368	99581	18748	224,587	36,303	25,936	232,550	32,320	19,903
GERMANY	1120011	215770	65620	280,877	51,513	80,095	314,384	57,820	166,974
GREECE	n.a.	n.a.	n.a.	12,187	724	29	13,183	831	2
IRELAND	n.a.	n.a.	n.a.	2,237	19	6	4,800	67	66
ITALY	482743	50920	0	97,746	12,127	113	98,842	82,011	94
NETHERLANDS	239689	6595	102067	164,505	5,920	122,229	205,942	6,261	127,184
PORTUGAL	85639	12525	0	17,479	137	69	25,243	514	6
SPAIN	371092	40833	0	79,652	2,892	14	78,045	4,366	59
SWEDEN	77595	12233	0	9,761	2,042	18	13,894	1,913	294
UNITED KINGDOM	603994	101026	0	603	24	38	425	72	359
ALL EU 15	**3937393**	**620203**	**205484**	**1,137,208**	**153,439**	**284,113**	**1,197,010**	**247,651**	**418,971**
NORWAY	n.a.	n.a.	n.a.	2,008	7	22	3,540	415	180
SWITZERLAND	68848	15537	0	25,078	5,944	2,948	33,772	17,189	13,351
ALL EU 15+2	**4006241**	**635740**	**205484**	**1,162,286**	**159,382**	**287,061**	**1,230,782**	**264,840**	**432,322**
CEEC 12									
BULGARIA	159,457	19,044	175	6,912	3,172	692	5,505	2,742	2,073
CYPRUS	0	0	0	52	38	7	223	43	7
CZECHIA	59,385	24,676	927	39,777	35,601	1,286	53,642	25,085	1,362
ESTONIA	9,574	1,899	0	3,326	1,453	167	2,408	6,777	29
HUNGARY	189,988	7,691	141	23,012	12,822	4,674	15,790	23,340	2,025
LATVIA	n.a.	n.a.	n.a.	2,927	2,427	108	8,987	3,208	9
LITHUANIA	18,128	3,386	0	14,505	8,858	21	5,790	10,664	6
MALTA	0	0	0	18	0	0	201	13	13
POLAND	357,798	74,408	0	44,287	57,305	5,047	72,291	41,147	620
ROMANIA	97,733	23,200	2,492	5,718	6,170	246	8,373	13,287	65
SLOVENIA	27,719	1,363	0	8,399	1,583	11	12,068	4,121	14
SLOVAKIA	116,645	17,220	0	14,809	33,856	3,712	22,985	26,843	439
ALL CEEC 12	**1,036,427**	**172,886**	**3,734**	**163,741**	**163,285**	**15,972**	**208,263**	**157,270**	**6,663**
EU 15+2 & CEEC 12	**5,042,668**	**808,627**	**209,218**	**1,326,026**	**322,668**	**303,033**	**1,439,045**	**422,110**	**438,985**

Table 15. Inland Transport Volumes in Europe 2020, 1000 tonnes
Source: NEA 2003

Under this European scenario, trade and hence transport demand between Western and Eastern Europe is growing fast, doubling in the 20-year period between 2000 and 2020. In this east-west relation, IWT is growing considerably faster than rail transport, at annual growth rates of 4.3% in west-east direction and 4.4 in East-west direction.

The share of IWT in total west-east directional transport is shifting only marginally from 3.3% in 2000 to 3.5% in 2020. In East-west direction, IWT shares are expected to grow modestly, from 6.4% to 8.2%.

3.5 Transport volume by commodity group

Over half of freight shipped by on inland waterways are construction materials (37% in 2000) and petroleum products (24%). The main growth potential is in the NSTR chapters 9 (machinery & other manufactured goods) with 3.8% p.a., 5 (metal products) with 3.7%, 8 (chemicals) with 3.4% and 1 (foodstuffs) with 3.0%. Changes in the distribution of IW freight between 2000 and 2020 is small, not exceeding two percentage points for any of the commodity groups.

The affinity for IWT (measured as the share of IWT in all inland transport modes) is highest for petroleum products (26% in 2000 and 22% in 2020), followed by solid mineral fuels (21 and 19% respectively) and ores and metal wastes (17 and 16% respectively); however, the latter two commodity groups are not expected to expand significantly in total volume.

NSTR		Transport mode					Group Total
		other	road	rail	inl ww	sea	
0	Agricultural products	1429	346628	31765	14764	17313	411899
1	Foodstuffs	8818	507983	13060	16520	14350	560732
2	Solid mineral fuels	86	28569	48514	19997	2336	99502
3	Crude oil	27377	3821	1035	497	56015	88745
4	Ores, metal waste	244	45953	33248	16282	12777	108503
5	Metal products	2528	179782	66045	7806	17155	273316
6	Building minerals & mat.	1242	676007	50075	98945	32539	858809
7	Fertilisers	230	41862	8386	8058	3752	62289
8	Chemicals	4439	233872	27565	16148	27445	309468
9	Machinery & other manuf.	7446	814431	77932	7436	35086	942330
10	Petroleum products	45008	138372	45129	64092	50511	343112
Group Total		98846	3017281	402754	270545	269278	4058704

Table 16. Total EU15 inter-regional base year 2000 by mode at origin, crude oil included, 1000 tonnes
Source: NEA 2003

NSTR		Transport mode					Group Total
		other	road	rail	inl ww	sea	
0	Agricultural products	1814	460707	46023	21374	23719	553637
1	Foodstuffs	11788	676966	20144	29821	21060	759777
2	Solid mineral fuels	89	28867	53041	19668	2643	104307
3	Crude oil	27377	3821	1035	497	56015	88745
4	Ores, metal waste	277	54810	40523	18760	16101	130471
5	Metal products	4751	322477	127671	16176	32287	503362
6	Building minerals & mat.	1548	932075	80878	161113	48050	1223664
7	Fertilisers	253	52182	11832	8807	4709	77784
8	Chemicals	7103	442419	59688	31587	49591	590387
9	Machinery & other manuf.	16777	1579612	176190	15594	76065	1864238
10	Petroleum products	56878	226737	104435	93665	73645	555360
Group Total		128654	4780671	721460	417061	403885	6451732

Table 17. Total EU15 inter-regional base year 2020 by mode at origin, crude oil included, 1000 tonnes
Source. NEA 2003

The breakdown by country and by commodity group in table 16 for the year 2000 and table 17 for 2020 was also obtained from the STAC study.

	NSTR chapter										
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
AUSTRIA	155	22	0	52	82	33	15	12	543	106	1,020
BELGIUM+LUXEMBURG	290	1,092	497	378	1,890	8,210	1,027	3,220	525	10,695	27,822
DENMARK	1	14	0	0	0	1	0	1	6	0	23
FINLAND	0	0	0	0	0	9	0	76	0	0	85
FRANCE	5,926	1,995	95	15	889	5,460	138	272	131	1,097	16,017
GERMANY	3,394	1,966	257	2,495	3,998	16,318	1,104	4,948	4,392	5,547	44,418
GREECE	0	0	0	0	0	13	0	1	0	0	15
IRELAND	0	1	0	0	0	0	0	0	0	0	2
ITALY	1	3	0	0	2	9	0	2	24	0	41
THE NETHERLANDS	450	4,389	8,391	9,644	959	13,103	3,274	5,319	644	41,308	87,482
PORTUGAL	1	2	0	1	0	8	0	1	5	0	19
SPAIN	0	1	0	0	1	1	0	0	1	0	4
SWEDEN	0	0	0	0	0	0	1	1	3	0	6
UNITED KINGDOM	0	0	0	0	2	0	2	6	3	0	13
ALL EU 15	10,219	9,485	9,239	12,586	7,823	43,162	5,561	13,859	6,280	58,753	176,968
NORWAY	0	0	0	0	3	1	0	2	1	0	7
SWITZERLAND	6	93	7	90	145	46	9	140	449	234	1,220
ALL EU 15+2	10,225	9,578	9,246	12,676	7,970	43,210	5,570	14,002	6,730	58,987	178,195
CEEC 12											
BULGARIA	0	28	4	45	33	85	38	7	13	32	287
CYPRUS	0	0	2	0	1	0	0	0	0	0	3
CZECHIA	14	232	39	17	71	17	136	14	16	0	556
ESTONIA	50	0	1	0	0	13	0	0	13	9	87
HUNGARY	268	225	64	116	430	136	3	14	23	604	1,882
LATVIA	38	0	0	1	8	0	0	0	0	0	47
LITHUANIA	0	0	0	0	0	7	2	0	0	0	9
MALTA	0	0	0	0	0	0	0	0	0	0	0
POLAND	2	6	878	166	108	1,015	115	24	10	1	2,325
ROMANIA	0	3	13	9	13	0	0	13	14	8	74
SLOVENIA	0	0	0	0	0	4	0	0	1	0	5
SLOVAKIA	10	79	17	0	225	89	307	3	3	613	1,346
ALL CEEC 12	381	575	1,019	355	888	1,366	602	76	92	1,267	6,622
EU 15+2 & CEEC 12	10,607	10,153	10,265	13,032	8,858	44,575	6,172	14,078	6,822	60,255	184,816

Table 18. Total inland waterways exports EU15+2 + CEEC12, by country and NSTR chapter, base year 2000, 1000 tonnes
Source: NEA 2003

	NSTR chapter										
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
AUSTRIA	204	39	0	77	269	60	15	52	2,578	221	3,516
BELGIUM+LUXEMBURG	445	2,224	477	467	4,922	13,917	1,026	9,102	1,811	17,373	51,764
DENMARK	1	50	0	0	1	2	0	3	44	0	101
FINLAND	0	0	0	0	0	15	0	171	0	0	186
FRANCE	8,885	4,102	98	23	1,782	7,524	144	793	742	1,842	25,936
GERMANY	5,824	3,875	255	2,959	9,173	21,930	1,265	12,391	14,811	7,612	80,095
GREECE	0	1	0	0	1	22	0	4	1	0	29
IRELAND	0	2	0	0	1	0	0	1	2	0	6
ITALY	3	5	0	0	6	20	0	5	74	0	113
THE NETHERLANDS	761	10,879	8,466	10,494	2,068	20,157	3,472	9,970	1,657	54,305	122,229
PORTUGAL	1	6	0	3	1	16	0	5	37	0	69
SPAIN	0	2	0	0	5	2	0	1	4	0	14
SWEDEN	0	0	0	0	1	0	2	2	12	0	18
UNITED KINGDOM	0	1	0	0	7	0	2	15	14	0	38
ALL EU 15	16,126	21,187	9,295	14,023	18,236	63,664	5,927	32,516	21,787	81,353	284,113
NORWAY	0	0	0	0	7	2	0	9	4	0	22
SWITZERLAND	10	213	8	111	343	57	9	389	1,477	332	2,948
ALL EU 15+2	16,136	21,400	9,304	14,134	18,586	63,722	5,936	32,913	23,267	81,685	287,083
CEEC 12											
BULGARIA	0	62	4	105	196	135	66	28	40	55	692
CYPRUS	.	0	4	0	2	0	0	0	0	0	7
CZECHIA	22	526	40	39	283	34	237	41	62	1	1,286
ESTONIA	87	0	3	0	0	25	0	1	30	21	167
HUNGARY	446	473	67	30	1,918	324	7	88	50	1,271	4,674
LATVIA	56	0	2	0	50	0	0	0	0	0	108
LITHUANIA	0	0	0	0	1	12	5	2	0	0	21
MALTA	0	0	0	0	0	0	0	0	0	0	0
POLAND	5	17	862	220	1,220	2,184	223	288	27	2	5,047
ROMANIA	.	7	12	24	73	0	0	56	42	32	246
SLOVENIA	0	1	0	0	0	8	0	0	2	0	11
SLOVAKIA	22	167	27	0	1,017	150	551	9	11	1,757	3,712
ALL CEEC 12	638	1,253	1,022	418	4,761	2,873	1,089	514	265	3,139	15,972
EU 15+2 & CEEC 12	16,774	22,654	10,326	14,553	23,346	66,595	7,024	33,427	23,532	84,824	303,055

Table 19. Total inland waterways exports EU15+2 + CEEC12, by country and NSTR chapter, year 2020, 1000 tonnes
Source: NEA 2003

3.6 Transport volume by commodity type

DG TREN has commissioned a consortium led by ECORYS Transport to perform a survey "Market observation for the inland waterway sector 2001-2002" for the 15 EU Member States. The annual report (May 2002) contains a medium-term forecast of transport volumes (tonnes) for the current decade until 2010. The key forecast results are:

This forecast is apparently built up from the forecast for the new German Federal Transport Infrastructure investment plan (BVWP 2003) complemented by element from the 5th FP project "European Transport Development Scenarios (CODETEN).

The ECORYS forecast anticipates an annual growth rate of IWT volume (tonnage) of slightly below 1.4% per annum, in contrast to the above mentioned STAC forecast. The interest lies in the forecast broken down by four commodity type: solid bulk freight continues to have the highest share in total volume; its expected growth is, however, far below average. Container traffic has the highest growth potential (3.4% p.a.), followed by general cargo (2.3% p.a.); liquid bulk is only slightly below average.

Commodity type	**2000**	**2005**	**2010**	**Growth 2000 -2010**	
	million tonnes			**% 10 years**	**% p.a.**
Container	16.9	19.9	23.5	39.2	**3.4**
General Cargo	91.5	102.4	115.1	25.8	**2.3**
Liquid Bulk	70.3	74.9	80.1	13.9	**1.3**
Solid Bulk	261.4	270.8	285.6	9.3	**0.9**
Total	**440.0**	**467.9**	**504.2**	**14.6**	**1.4**

Table 20. Forecast of IWT volume by commodity type, 2000 to 2010, million tonnes
Source: ECORYS 2002

3.7 Inland waterway transport per corridor: forecasts[3]

The ECORYS forecast also divides total transport volume in domestic (loaded and unloaded within the same country) and international transport. International transport would be growing at an annual rate of 2.6% while domestic transport would decline by more than 1% annually. Thus, the share of domestic freight would drop from 37% in 2000 to 29% in 2010.

It is impossible to judge where the main growth on the Eastern[4] and the North-South market areas lie. It is also surprising to note that Danube traffic would only grow by 2% p.a. also all navigation obstacles that existed in 2000 have now been removed.

Market Area	2000	2005	2010	Growth 2000 -2010	
	million tonnes			% 10 years	% p.a.
Rhine up	110.8	120.7	131.6	18.8	**1.7**
Rhine down	48.4	51.8	55.6	14.8	**1.4**
North-South	61.9	73.6	87.5	41.4	**3.5**
Danube	26.8	29.5	32.6	21.6	**2.0**
Eastern	27.6	36.7	49.4	79.1	**6.0**
Domestic	164.6	155.7	147.6	-10.3	**-1.1**
Total	**440.0**	**467.9**	**504.2**	**14.6**	**1.4**

Table 21. Forecast of IWT volume by market area, 2000 – 2010, million tonnes
Source: ECORYS 2002

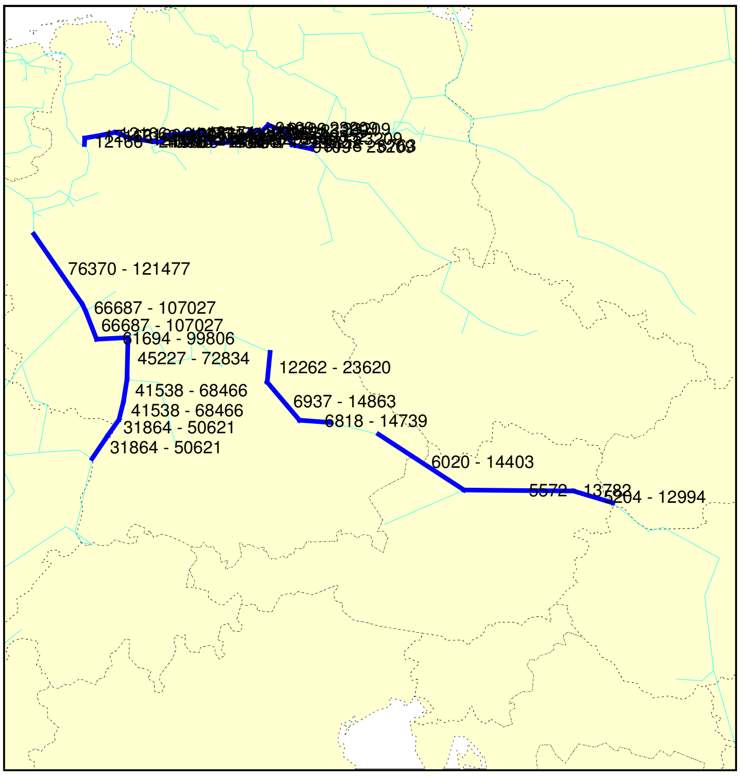
The following graphs and tables from the STAC study show the forecast increase of freight volumes along the four corridors that are given special attention in this study. The volumes are in 1000 tonnes in both directions for the years 2000 and 2020.

---

[3] The corridors presented in this section are not always consistent with the definition of corridors as defined in the Supply part of the project (chapter Infrastructure). Reconciliation has not been possible.

[4] The Eastern corridor „covers the inland waterway transport from Germany to Poland and the Czech republic“.

Rhine and Danube corridors



Rhine	*2000*	*2020*	*Growth*	
	1000 tonnes		*20 years*	*p.a.*
Strasbourg - Karlsruhe	31'864	50'621	159%	2.3%
Karlsruhe - Mannheim	41'538	68'466	165%	2.5%
Mannheim - Mainz	45'227	72'834	161%	2.4%
Mainz - Wiesbaden	61'694	99'806	162%	2.4%
Wiesbaden - Koblenz	66'687	107'027	160%	2.4%
Koblenz - Köln	76'370	121'477	159%	2.3%

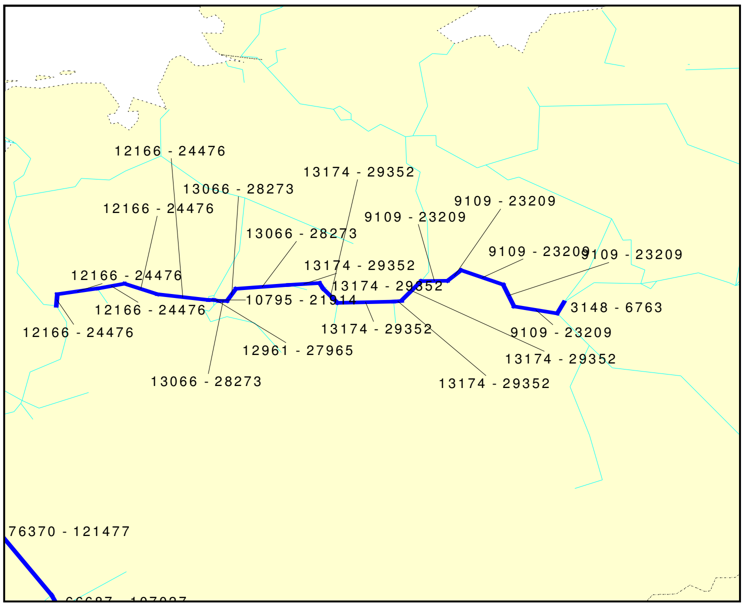
Danube	*2000*	*2020*	*Growth*	
	1000 tonnes		*20 years*	*p.a.*
Bamberg - Nürnberg	12'262	23'620	193%	3.3%
Nürnberg - Kelheim	6'937	14'863	214%	3.9%
Kelheim - Regensburg	6'818	14'739	216%	3.9%
Passau - Linz	6'020	14'403	239%	4.5%
Linz - Wien	5'572	13'782	247%	4.6%
Wien - Bratislava	5'204	12'994	250%	4.7%

Figure 18. Freight volumes along the Rhine and Danube, 2000 – 2020
Source: NEA 2003

On the German part of the Rhine river, the freight volume increases continuously down river, more than doubling from the upper Rhine section to the lower Rhine. On these sections, average annual growth 2000 to 2020 is anticipated to be between 2.3 and 2.5%.

On the Danube, transport volumes vary between 7 and 5 million tonnes except in the section of the Main-Danube canal with 12 million tonnes in 2000. The growth prospects are better on the Danube than on the Rhine albeit from a much lower freight volume. Average annual growth is expected to be between 3.3 on the Main-Danube canal and 4.7% in the area of the Austrian border with Hungary.

3.7.2 East-West corridor



East-West		*2000*	*2020*	*Growth*	
		1000 tonnes		*20 years*	*p.a.*
Elbe-Havel-Kanal		3'148	6'763	215%	3.9%
Mittel-land-kanal	Elbe - Elbeseiten-kanal	9'109	23'209	255%	4.8%
	Elbeseitenkanal - Hannover	13'174	29'352	223%	4.1%
	Hannover - Weser	13'066	28'237	216%	3.9%
	Weser - Dortmund-Ems-Kanal	12'166	24'476	201%	3.6%

Figure 19. Freight volumes along the East-West corridor,2000 – 2020
Source: NEA 2003

The highest freight volume is in the middle section near Hannover (around 13 million tonnes in 2000). Growth prospects vary between 3.6% and 4.8%

3.7.3 North-South corridor

The northernmost part of this corridor in the Netherlands has the highest freight volume in Europe with up to 80 million tonnes per year. This section carries freight to and from Rotterdam. In the Northern part of Belgium, present transport volumes are close to 16 million tonnes per year. In the southern part of Belgium and in France, the volume oscillates around 4 million tonnes per year.

Growth prospects in the Dutch and northern Belgian sections are between 2.6% and 3.0% p.a. over the next two decades, in the southern Belgian sections 4.1% to 4.6%. They are best in France with 5.4% to 7.3%, representing in 2020 three to four times the volume of the year 2000. This forecast takes account of the implementation of the Seine-Schelde canal project now being included in the priority list of the TEN-T.

North-South	2000	2020	Growth	
	1000 tonnes		20 years	p.a.
Rotterdam - Anvers	80'867	135'911	168%	2.6%
	79'801	132'576	166%	2.6%
	60'072	106'144	177%	2.9%
	42'441	77'248	182%	3.0%
Anvers - Gent	15'646	27'972	179%	2.9%
	4'815	10'767	224%	4.1%
Gent - Valenciennes	4'403	10'862	247%	4.6%
	4'415	10'904	247%	4.6%
	4'768	14'526	305%	5.7%
Valenciennes - Compiègne	3'705	12'275	331%	6.2%
	4'378	18'045	412%	7.3%
	4'371	12'744	292%	5.5%
	4'283	12'275	287%	5.4%

Figure 20. Freight volumes along the northern part of the North-South corridor, 2000 – 2020
Source: NEA 2003

3.8 Transport forecast in light of EU-Enlargement

The upcoming EU Enlargement is expected to have major impacts on transport flows. Road transport is expected to rise, but the EU Enlargement will also affect IWT transport from and to the Accession countries. The Accession and Candidate countries that are expected to have the largest impact on IWT flows are concentrated along the Danube.

Reliable figures for the transport volumes on the Danube can be derived from the Austrian statistical office ÖSTAT. On the basis of ÖSTAT data sets the Austrian Institute for Spatial

Planning (ÖIR) created a calculation model, which can be used to deduce differentiated conclusions regarding future transport flows from, to and within the Danube corridor. On the basis of the status quo in the base year 2000 a transport forecast for 2015 is made for two scenarios.

The transport forecast is based on the goods categories defined by the NST/R chapters and are summarised into three goods categories. Following table shows the corresponding NST/R goods categories:

Goods category	Corresponds with NST/R chapters
A	8,9
B	0,5,6
C	1,2,3,4,7

Table 21 Summarised goods categories and corresponding NST/R chapters

The following transport forecasts are based on these three goods categories A, B, and C.

OD matrix for base year 2000

Starting point for the transport forecast is the status quo situation in the year 2000. This situation is displayed in table 22.

Country of unloading

Country of loading	ARA ports	West - inland ports excl. Bayern	Bavaria	Austria	Slovakia	Hungary	Lower Danube	Black Sea ports	Total
ARA ports				1,348.000	136.000	418.000	2.000	0	1,904.000
West - inland ports excl. Bayern				295.000	9.000	44.000	7.000	0	355.000
Bavaria				150.000	60.000	275.000	87.000	1.000	573.000
Austria	338.000	386.000	188.000		81.000	144.000	40.000	14.000	1,191.000
Slovakia	179.000	131.000	547.000	577.000					1,434.000
Hungary	344.000	363.000	419.000	634.000					1,760.000
Lower Danube	5.000	8.000	145.000	2,443.000					2,601.000
Black Sea ports	0	0	14.000	3.000					17.000
Total	866.000	888.000	1,313.000	5,450.000	286.000	881.000	136.000	15.000	9,835.000

Table 22. Status Quo 2000: transport volumes from, to and via Austria (in tons). Source: OIR, 2004

Table 22 shows transport volumes of the year 2000[5], which are split up into different regions. On the Danube the first round accession countries Slovakia and Hungary are separately represented, all other Danube riparian countries (Croatia, Serbia/Montenegro, Bulgaria, Romania, Ukraine) are summarised in the region ´Lower Danube´. Note that these figures reflect the Danube traffic from, to and via Austria. Since Austria is an important interface between the Western and the Danube IWT network, these traffic flows can be regarded as representative for developments along the South-East corridor, especially in light of the EU-Enlargement.

Prognoses for 2015 in tons

Based on the status quo in the year 2000 a base scenario for 2015 has been calculated, which draws following picture:

Country of unloading

		ARA ports	West - inland ports excl. Bayern	Bavaria	Austria	Slovakia	Hungary	Lower Danube	Black Sea ports	Total
Country of loading	ARA ports				1,618.000	226.000	729.000	12.000	0	2,585.000
	West - inland ports excl. Bayern				308.000	13.000	67.000	49.000	0	437.000
	Bavaria				153.000	88.000	408.000	629.000	5.000	1,283.000
	Austria	342.000	398.000	182.000		98.000	178.000	225.000	111.000	1,534.000
	Slovakia	211.000	163.000	670.000	806.000					1,850.000
	Hungary	387.000	429.000	492.000	788.000					2,096.000
	Lower Danube	91.000	17.000	202.000	3,469.000					3,779.000
	Black Sea ports	0	153.000	156.000	111.000					420.000
	Total	1,031.000	1,160.000	1,702.000	7,253.000	425.000	1,382.000	915.000	116.000	13,984.000

Table 23. Base scenario 2015: transport volumes from, to and via Austria (in tons) Source: OIR, 2004

The base scenario for 2015 assumes that the general framework conditions (infrastructure quality, logistics integration, river information services) for IWT remain unchanged in comparison to the status quo in the year 2000.

---

[5] In order to make the status quo comparable to the forecasts, one adaptation of the figures in table 22 has been undertaken: All Austrian imports of ore coming from Hungary and Slovakia have been assigned to the Ukraine (region ´Lower Danube´). The reason therefore is the destruction of the bridge in Novi Sad in 1999, which led to a relocation of ore imports from the Ukraine to Slovakia and Hungary. In future these imports are assumed to have their origin again in the Ukraine.

Compared to the year 2000 a moderate increase of transport volumes is forecast. Therefore, without additional improvement measures as regards the general framework conditions, IWT will only face average growth of traffic flows caused by the EU-Enlargement.

As a second forecast, the effects of an optimised scenario for the year 2015 were calculated. This model variant includes measures for the improvement of the general framework conditions of IWT (infrastructure, logistics applications and river information services). The removal of the infrastructure bottlenecks on the Danube as well as the increased modernisation of IWT by means of logistics applications and river information services would lead to following forecast:

Country of unloading

Country of loading	ARA ports	West - inland ports excl. Bayern	Bavaria	Austria	Slovakia	Hungary	Lower Danube	Black Sea ports	Total
ARA ports				3,317.000	331.000	1,293.000	594.000	3.000	5,538.000
West - inland ports excl. Bayern				1,353.000	99.000	363.000	745.000	18.000	2,578.000
Bavaria				450.000	114.000	642.000	953.000	8.000	2,167.000
Austria	1,069.000	1,062.000	375.000		128.000	626.000	504.000	312.000	4,076.000
Slovakia	338.000	330.000	910.000	1,185.000					2,763.000
Hungary	759.000	887.000	807.000	1,359.000					3,812.000
Lower Danube	563.000	496.000	352.000	4,422.000					5,833.000
Black Sea ports	2.000	244.000	204.000	153.000					603.000
Total	2,731.000	3,019.000	2,648.000	12,239.000	672.000	2,924.000	2,796.000	341.000	27,370.000

Table 24. Optimised scenario 2015: transport volumes from, to and via Austria (in tons) Source: OIR, 2004

An optimisation of the IWT framework conditions in the Danube corridor would lead to nearly a threefold increase of transport volumes on the Danube. It has to be taken into consideration, that only transports interfering with Austria have been regarded, which means that the total transport volume for the whole Danube even would be considerable higher (e.g. all relations downstream Austria between Slovakia and Ukraine are not included in this transport forecast).

Prognoses per transport relation

In the following tables and figures the above used transport relation matrix is categorised in three relations:

Relation	Name	Origin/Destination	Origin/Destination
1	Rhine - Upper Danube	ARA ports West-inland ports excl. Bavaria	Austria Slovakia Hungary
2	Danube internal	Bavaria Austria	Austria Slovakia Hungary Lower Danube Black Sea ports
3	Rhine - Lower Danube	ARA ports West-inland ports	Lower Danube Black Sea ports

Table 25. Considered transport relations

Above table shows the three considered transport relations, which are derived from the original transport OD matrix. Relation 1 represents all transports between the Rhine basin and the Upper Danube (Austria, Slovakia, Hungary). In relation 2 all internal Danube transports are summarized, whereas relation 3 reflects long-distance transports between Rhine and the Lower Danube respectively. Based on these three transport relations an analysis of the pairings of transport volumes has been undertaken.

relation		Status Quo 2000		Base scenario 2015		Optimised scenario 2015	
Rhine - Upper Danube	direction	from West	to West	from West	to West	from West	to West
	transport volume [t]	2,250.000	1,741.000	2,961.000	1,930.000	6,757.000	4,445.000
	pairing [%]	**100**	**77,4**	**100**	**65,2**	**100**	**65,8**
Danube internal	direction	downstream	upstream	downstream	upstream	downstream	upstream
	transport volume [t]	737.000	1,639.000	1,780.000	3,546.000	3,622.000	6,437.000
	pairing [%]	**45**	**100**	**50,2**	**100**	**56,3**	**100**
Rhine - Lower Danube	direction	from West	to West	from West	to West	from West	to West
	transport volume [t]	9.000	13.000	62.000	261.000	1,358.000	1,305.000
	pairing [%]	**69,2**	**100**	**23,8**	**100**	**100**	**96,1**

Table 26. Status quo 2000 and forecasts 2015: Pairings of transport volumes by relations

Above table shows the pairings of transport volumes of the status quo 2000 and the forecasts 2015 by the three defined relations.

For internal Danube traffic petroleum products have a high share in the total transport volume (downstream 115.000 t, upstream 1,128.000 t). Furthermore are ore transports between the Ukraine and Austria (upstream 2,203.000 t) carried out with large pushed convoys, which are due to organisational reasons not loaded in the downstream direction. For the calculation of the parings these two transport volumes were subtracted from the total sum of relation 2.

Prognoses for 2015 per goods category and relation

The development of transport volumes by goods categories and transport relations is shown in following table:

relation		**Status Quo 2000**		**Base scenario 2015**		**Optimised scenario 2015**	
	goods category	direction		direction		direction	
Rhine - Upper Danube		from West	to West	from West	to West	from West	to West
	A	52.000	121.000	44.000	105.000	1,472.000	1,213.000
	B	1,080.000	1,178.000	1,585.000	1,357.000	2,829.000	2,349.000
	C	1,118.000	442.000	1,332.000	468.000	2,456.000	883.000
	total	**2,250.000**	**1,741.000**	**2,961.000**	**1,930.000**	**6,757.000**	**4,445.000**
Danube internal		downstream	upstream	downstream	upstream	downstream	upstream
	A	52.000	45.000	195.000	91.000	1,041.000	659.000
	B	513.000	980.000	1,373.000	1,248.000	2,157.000	1,844.000
	C	287.000	3,937.000	328.000	5,534.000	540.000	7,264.000
	total	**852.000**	**4,970.000**	**1,896.000**	**6,873.000**	**3,738.000**	**9,767.000**
Rhine - Lower Danube		from West	to West	from West	to West	from West	to West
	A	2.000	2.000	11.000	7.000	914.000	637.000
	B	7.000	11.000	51.000	196.000	442.000	539.000
	C	0	0	0	58.000	2.000	129.000
	total	**9.000**	**13.000**	**62.000**	**261.000**	**1,358.000**	**1,305.000**
	all relations	**3,111.000**	**6,724.000**	**4,919.000**	**9,064.000**	**11,853.000**	**15,517.000**

Table 27. Status quo 2000 and forecasts 2015: Transport volumes by relations and goods categories

From this table it appears that the highest growth rates can be expected within goods category A (NST/R chapters 8 and 9) on all relations in the optimised scenario 2015, whereas the same goods categories basically remain on a low level in the base scenario 2015.

Following figures specify transport volumes per relation:

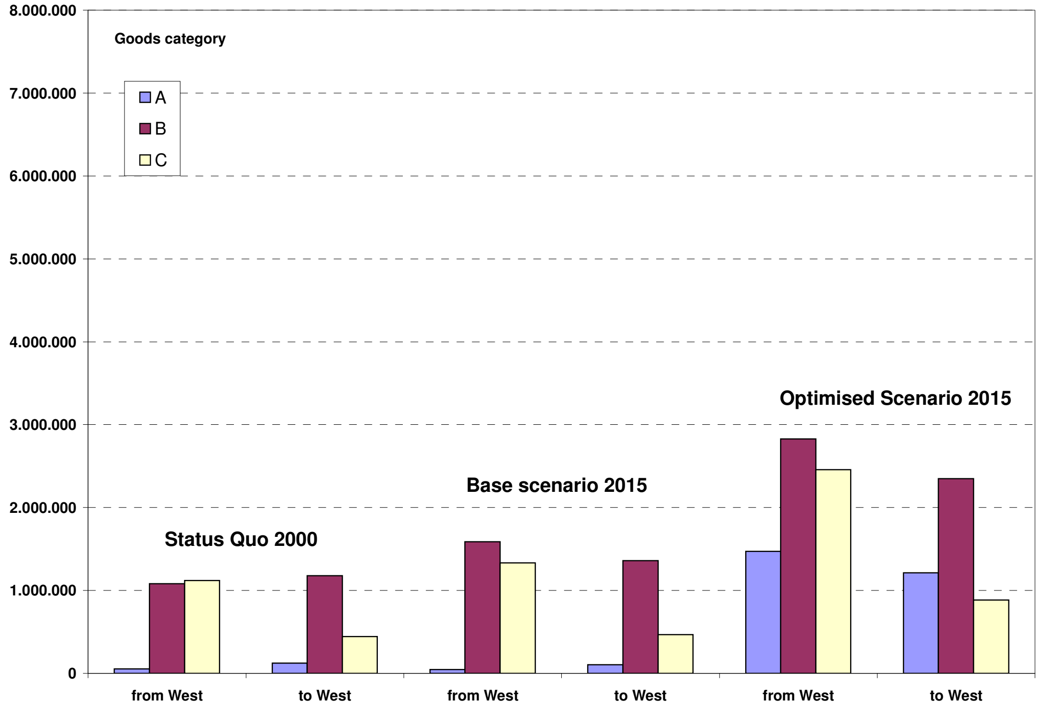


Figure 21. Status quo 2000 and forecasts 2015: Transport volumes by goods categories for relation Rhine – Upper Danube

Figure 21 represents all transport flows between the Rhine basin and the Upper Danube (Austria, Slovakia, Hungary). Noticeable are drastic increases of transport volumes for the optimised scenario and especially in goods category A (corresponds to NST/R chapters 8 and 9).

For relation 2, which represents internal Danube transport flows, following transport volumes are calculated:

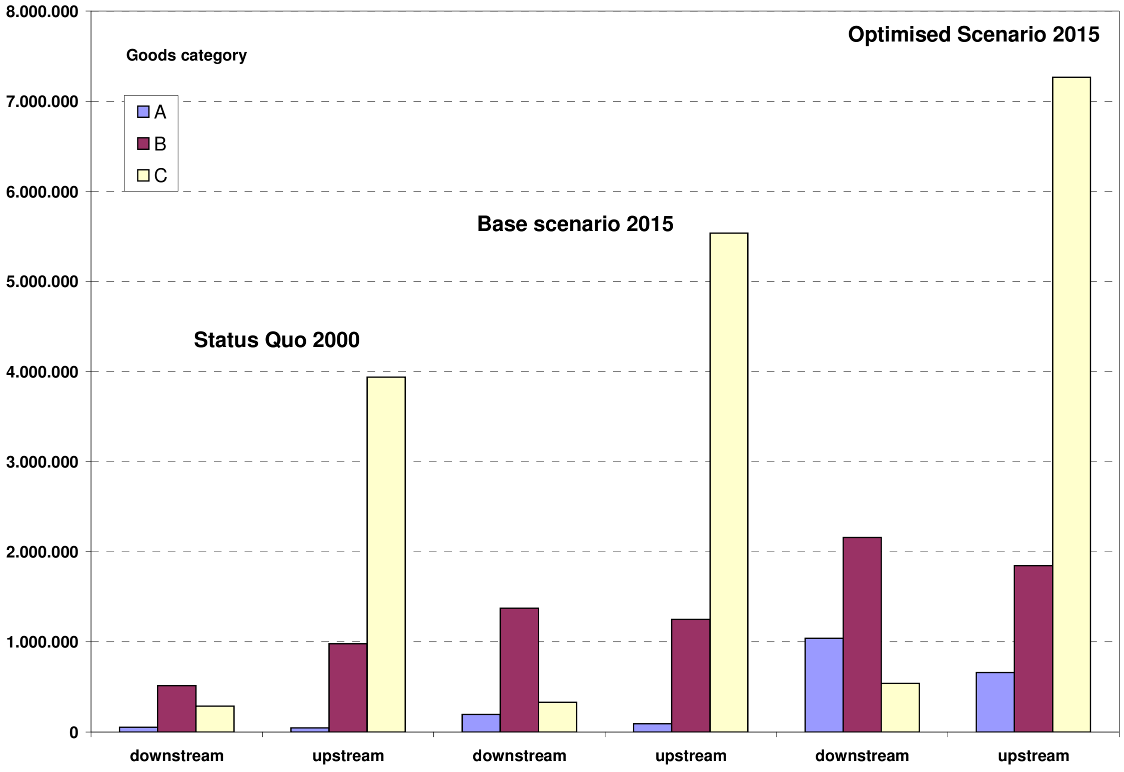


Figure 22. Status quo 2000 and forecasts 2015: Transport volumes by goods categories for internal Danube transports

For internal Danube transports there is a eye-catching difference in goods categories regarding the direction of transport flows: As well in the status quo 2000 as in the forecasts 2015 the dominant goods category downstream the Danube is category B (corresponds to NST/R chapters 0,5,6), whereas upstream the Danube this is goods category C (NST/R chapters 1,2,3,4,7).

Furthermore, the relative shares of goods category A (NST/R chapters 8,9) are increasing in the forecasts for 2015, especially in the optimised scenario.

The third considered relation takes into account transport flows between the Rhine basin and the Lower Danube:

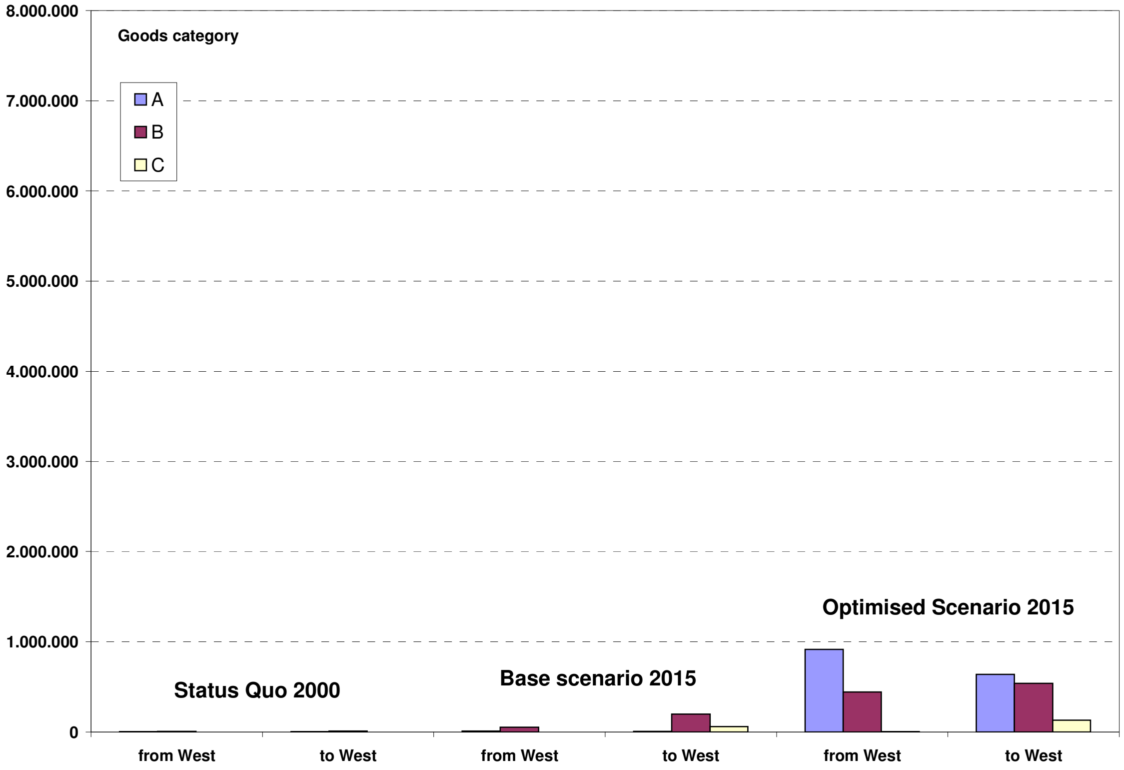


Figure 23. Status quo 2000 and forecasts 2015: Transport volumes by goods categories for Rhine – Lower Danube

Figure 23 shows that transport flows between Rhine basin and the Lower Danube generally start from a lower level than for the other two relations. Nevertheless significant increases in transport volumes are forecast for the optimised scenario, especially in the goods categories A (NST/R chapters 8,9) and B (NST/R chapters 0,5,6).

The goods category A (NST/R chapters 8,9) has a dominant share in the optimised scenario 2015, whereas it only plays a minor role in the status quo 2000 and the base scenario 2015. Furthermore goods category C (NST/R chapters 1,2,3,4,7) is insignificant in the status quo 2000 and gains relative shares in both forecast scenarios in the direction from Danube towards the Rhine basin (“to West”).

Summary

Transport volumes in the Danube corridor – compared to the status quo 2000 – only significantly increase in an optimised scenario 2015, which assumes an improvement of the general framework conditions for IWT (infrastructure, logistics applications, river information services). An average annual growth rate of 7.06% could be reached in the optimised scenario 2015, which means nearly a threefold increase of current transport volumes: from 9.8 mill. tons to 27.4 mill. tons per year. For comparison, the base scenario 2015 – with no additional measures – shows an average annual growth rate of 2,37%, which signifies an absolute increase in transport volumes of only about 40% compared to the status quo 2000.

	Status Quo 2000	**Base scenario 2015**		**Optimised Scenario 2015**	
relation	transport volume [t]	transport volume [t]	growth rate [%/y]	transport volume [t]	growth rate [%/y]
Rhine - Upper Danube	3,991.000	4,891.000	1,36	11,202.000	7,12
Danube internal	5,822.000	8,769.000	2,77	13,505.000	5,77
Rhine - Lower Danube	22.000	323.000	19,61	2,663.000	37,68
total	**9,835.000**	**13,983.000**	**2,37**	**27,370.000**	**7,06**

Table 28. Status quo 2000 and forecasts 2015: Transport volumes and annual growth rates per relation and total

3.9 Conclusions

Market trends forecast for the European Union and CEECs vary considerably depending on the source.

The Prognos European Transport Report 2002 projects transport performance (tonne-kilometres) without separation of domestic and international freight in the order of 2% p.a..

In general, the TEN–STAC study has produced the highest long-term growth potential over a 20 year period (2000 – 2030) with 2.5% p.a. for domestic freight volumes (tonnes), 1% p.a. for intra-EU international freight volumes and 3.4% p.a. for total international freight volumes including trade with Central and Eastern Europe as well as with countries overseas. The anticipated growth is somewhat higher in Eastern European countries than in the present EU-15.

Both forecasts are based on scenarios taking into account policy measures laid down in the European Commission's White Paper of September 2001. The TEN-STAC forecast anticipates in addition the implementation of priority infrastructure projects.

In contrast, the ECORYS consortium projects an average growth of 1.4% p.a. of transport volumes (tonnes) during the present decade. Domestic freight would even decline by 1.1% p.a., international freight increase by 2.6% p.a.

The credibility of the Prognos forecast is backed up by a recently published forecast for Germany (PLANCO 2003) according to which the volume of IWT (tonnage loaded and unloaded in German ports) would grow between 2000 and 2015 by 20% or 1.25% p.a. This relates to a forecast by Prognos in terms of tonne-kilometres of 1.6% p.a.

Given the fact that firstly, growth in terms of tonne-kilometres is usually faster than in terms of tonnage because of increasing average distances and secondly, that transit freight grows faster than domestic freight, these two forecasts are compatible.

Before this background, we firmly believe that the TEN-STAC forecast is far too optimistic, in particular concerning domestic freight in the EU-15. However, without the possibility to undertake a thorough review of the methodology and assumptions, we cannot judge the results.

According to these studies, IWT is expected to maintain its market share of around 6% of all inland freight transport modes in terms of tkm; this however is only possible if the policy measures and the priority infrastructure projects mentioned in this report are undertaken.

Whilst IWT in the six new EU-Member States with a significant level of IWT (Poland, Czech Republic, Slovak Republic, Hungary, with Romania and Bulgaria in 2007) will not add significant volumes to the EU-15, the low IWT modal share in these countries of some 2.5% in terms of tkm in the year 2000 is likely to rise towards the ‘target’ share because of rising demand.

As will also be noted from the above tables, transport volumes show lower modal shares throughout Europe, because the average distances shipped by waterway greatly exceed those by road transport, which reflects on the tonnage shipped.

There are moderate shifts in the composition of freight according to the commodity group (here, we have to rely on the TEN-STAC forecast). The most dynamic growth in demand is expected to occur in NST/R chapters 9 (machinery and other manufactured items), 5 (metal products), 8 (chemicals) and 1 (foodstuffs), all with an annual growth rate of 3% and more; on the other side, growth is expected to be slow for solid mineral fuels (NST/R chapter 2 with even a slight drop over the 20 year period), Crude oil (chap. 2) and fertilisers (chap. 7), all with an annual growth rate of less than 0.5%. Within the 20 year period, all product groups will shift within a 2%-point margin. Building material and petroleum products will keep the first and second ranks; solid mineral fuels will shift from rank 3 to rank 6 while chemicals will move from rank 6 to rank 3. Ores and metal waste will move from rank 5 to 7 while agricultural products will move from rank 7 to 5.

Container traffic has the highest growth potential, followed by general cargo, liquid bulk and solid bulk.

In a regional perspective, the highest growth is forecast for Northern France on the North-South corridor where the implementation of the Seine-Scheldt project has been assumed.. Where the present transport volumes are already high, as for example on the Rhine in Germany and on the North-South corridor in the Netherlands, growth prospects are lowest (below 3% p.a.).

Furthermore, dedicated traffic prognoses showed that the Danube corridor has a high growth potential, especially in light of the upcoming enlargement of the EU. This growth potential however requires strong measures to be taken in the field of infrastructure, logistics improvement measures and river information services; whereas the base scenario (with no additional measures) foresees only 2.37% annual growth up to 2015, the optimised scenario (with measures) results in more than 7% yearly growth of IWT traffic.

PINE

Prospects of Inland Navigation within the enlarged Europe

Part C Policy and legislation

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

Chapter 1 Economic and political framework

1.1 Introduction

An overall review of the role and future of Inland Waterway Transport (IWT) in the European Union, soon to be enlarged, needs to consider the overall economic and political framework in which IWT is working. This framework should include the overall economic situation, with ***globalisation and trade liberalisation*** trends accompanying the EU's own creation and completion of an ***internal market*** free of obstacles and restrictions on the supply of services. The success or failure of efforts to uncouple the ***growth of transport from the growth of GDP*** may be of importance, especially when judging the effects of enlargement.

Within that overall economic framework, the role of ***IWT competing with or complementing other transport modes*** requires an analysis of EU transport and other policies and the instruments created to implement them. In addition, policies to promote IWT adopted by ***international institutions*** other than the EU itself or its Member or Candidate States should be noted and commented upon. This applies particularly to the Rhine (CCNR) and Danube Commissions, but must also include the ECMT (European Conference of Ministers of Transport) and UN-ECE (United Nations Economic Commission for Europe).

Any general review of IWT must note the vital role played by ***meteorological conditions***. The profession is subject – often at short notice – to rain and drought, floods and low water levels, and sometimes icing. At high water, the problem is passing under certain bridges, at low water normally loaded drafts cannot be adhered to. Whilst seasonal low and high water levels of the main rivers can be planned for, severe flooding as on the Rhine, Elbe and Oder in 2002 and the enduring current (summer 2003) heat wave/drought can quickly reduce IWT capacity.

Another general point in the overall look is to note, as does the Commission in its 2001 White Paper on Transport Policy that ***Inland Waterway Transport is energy-efficient, relatively safe and environmentally clean***.

1.2 Method of working

This chapter is built on the general knowledge of the consortium with regard to global economic trends and to transport policies of the European Union in the transport sector and more specifically in the IWT sub-sector. Recent documentation has been downloaded from the internet. In addition, other experts have been consulted. The approach chosen is wide enough to cover the policy aspects with relevance for IWT.

In order to provide a picture on complementary efforts of EU Member States with important IWT interests, we also provide recent information on national policies in five countries (AT, BE, DE, FR, NL). This analyses specific national policies, problems and plans which may be considered alongside EU policy. Whilst Spain, Portugal, Finland and the UK provided some data on their national legislation (see also next chapter), they – and the other countries – did not give policy information. Some of the countries concerned simply stated they had no national IWT policy.

1.3 Economic framework

1.3.1 Globalisation and trade liberalisation

The major objective of the ***EU*** to create an ***Internal Market*** without economic or technical obstacles - and thus to free trade from restrictions and to harmonise the conditions under which enterprises provide goods and services - was included in the founding Treaty of Rome. However it took some 25 years before specific measures were in place at EU level to implement this concept seriously. From the mid-1980s onwards the pace accelerated whilst the EU was enlarged from 9 to 15 Member States; the forthcoming enlargement to 25 or more countries will take ***liberalisation and harmonisation***, the twin pillars of ‘globalisation’, even further.

Inland Water Transport is one of the three inland modes covered by Title 4 (Transport) of the Treaty of Rome. ***No legal distinction*** was made ***between rail, road and IWT*** at the time, but owing to the much greater importance of road and rail transport in most Member States more efforts were devoted to them than to IWT in the development of EU transport policy. Important influences on EU efforts to liberalise IWT were:

- the1860 Mannheim Convention on Rhine Navigation which already provided a measure of free trade in Europe’s most important river system,
- particular factors within IWT such as
- the persistent tendency to oversupply,

- the social (family) aspects of the vast majority of the firms involved, and
- the concentration of navigable waterways in a few Member States (AT, BE, DE, FR, NL);
- the fact that transport is only one aspect of waterway use and may be less important than water household and, in some places, hydroelectric power generation
- the geographic/Cold War division between the Rhine and Danube basins, also reflected along the Elbe and the Oder, which opposed liberalisation of a Pan-European nature.

Despite these problems, it may be said that at present the ***liberalisation of IWT goods transport in the EU*** has gone at least as far as that of the railways, and in some cases perhaps further. For example, the railways' problem of separating operations from infrastructure has never arisen in IWT and therefore did not have to be tackled at EU level. It may be noted that the Commission has always pursued the objective of treating the three modes in the same or similar ways: here the rules on access to the profession come to mind.

An aspect of the political framework relevant to IWT is the existence of two ***specific international waterway bodies***, i.e. the CCNR and the Danube Commission, who have rule-making powers. To avoid discrepancies between these bodies, the EU and its Member States, it is now envisaged that the European Community will become a full member of both bodies, thus allowing it to play a coordinating role.

Finally, as distinct from rail and road, it is important to note that ***passenger transport*** has never played a significant role in international IWT within the EU. In the early days of the EU, river ferries were of some importance – and are today in Finland – but they are usually considered as road links. One of the few exceptions in fulfilling a passenger transport role, and an international one at that, is the hydrofoil passenger link between Budapest Bratislava and Vienna. In general, as an indication of its minor importance, no overall statistics on IWT passenger transport have ever been gathered.

1.3.2 EU enlargement

The enlargement to 25 Member States in 2004 and the possible accession of Bulgaria and Romania in 2007 has added another 9 countries with inland waterway possibilities to the present EU-15. Six of them (PL, CZ, SK, H, BG, RO) are relatively important whilst the three Baltic countries have quite minor prospects[1]. The total length of the additional waterways is over 9 000 km. In 1980 - 1990, IWT goods transport in the accession countries reached about 12 bn tkm in total, but fell back to 9 bn tkm in 2000, or about 2.5% overall modal share[2].

Economic and industrial changes from the Comecon system to a market economy, which favoured road transport as against both rail and IWT, clearly played a role in this decreased use; the other major but more temporary factor was the war in former Yugoslavia which damaged or destroyed Danube bridges.

---

[1] Slovenia, Cyprus and Malta report no IWT activity

[2] But note that in Romania and Slovakia IWT has a 9% modal share.

Policy efforts to ***uncouple the growth of transport from the growth of GDP*** would no doubt be welcome in the accession countries. However, the effect of creating a single market will, on the contrary, lead to increased East-West transport and thus fulfil a rather different objective of enlargement. Attention should therefore be directed to increasing the efficiency and sustainability of whatever transport may be needed.

There are reasons to believe that the recovery of the ***Danube*** from the effects of the war in former Yugoslavia provides considerable potential for increased IW goods transport in an enlarged EU. Whilst not all the countries bordering the Danube are official candidates for EU accession, EU funds are already being used to repair damage to bridges. Indeed efforts to provide better links of the East and West European river/canal systems are being undertaken and will enhance the Pan-European character of Europe's waterways. Moreover in Central and Northern Europe, especially ***Poland***, presently underused capacity may come into its own and help to relieve what will be growing congestion on the road networks. The forecast for 2015 suggests a rise to nearly 14 bn tkm. in the accession countries.

An important step in advancing towards such a Pan-European rather than an EU Waterway system was the ***Rotterdam Declaration***, worked out by a working party composed of the Danube Commission, the Rhine Commission, the European Commission, UN-ECE and ECMT, with member countries commenting on the drafts. The text was signed by the Netherlands and Romanian Ministers of Transport and now awaits more formal adoption. The Declaration's main objectives are to create a 'transparent and integrated Pan-European inland waterway transport market, based on the principles of reciprocity, freedom of navigation, fair competition and equal treatment of the users'. It should be noted that such objectives are fully in line with the EU's own principles.

Prior to 1990, the effect of very much ***lower wage levels*** in the candidate countries led to EU efforts to protect the potentially oversupplied home markets. Somewhat similar actions were taken to prevent technically sub-standard vessels from these countries from entering waterways subject to strict norms. As part of enlargement, and similarly to developments in road transport, a unified IWT market in the EU may create better possibilities for crew from these countries to be employed by Western IWT enterprises, especially the larger ones, and thus effect downward pressure on rates; this would affect the still numerous SMEs in the West, whilst also competing with rail transport. In that respect care must be taken both not to discriminate between crew members from the East and the West and not to allow employment standards to deteriorate. Moreover, just as in road transport there are some fears that liberalisation would also bring in the technically sub-standard vessels still operating outside the EU-15.

1.4 EU transport policies

1.4.1 Liberalisation and deregulation of transport markets

As already noted, the process of liberalisation of IWT goods transport in the EU has been under way for over 40 years. The Commission's recent ***White Paper*** on Transport (in 2001) duly emphasizes the ***energy-efficient***, ***relatively safe and environmentally clean nature of IWT***. However, of the Paper devotes much less space and argument to IWT as compared with rail and road transport. The following paragraphs will review the EU's legislative efforts to give substance to the objective of liberalising IWT.

Access to the market and ***to the profession, tariffs and prices***, as well as ***State aids***, began to be regulated in the 1970s -1980s. These measures were updated in the 1990s, in the wake of the creation of the Internal Market and the resultant introduction of cabotage. In IWT the following legislation now applies:

- Council Regulation 1107/70/EEC and several amendments up to (EC) 543/97 on granting aids to transport.
- Council Regulation (EEC) 1017/68 on rules of competition.
- Council Regulation (EEC) 1191/69, amended in 1990 and 1991, on public service obligations.
- Council Regulation (EEC) 2919/85 on access to Rhine navigation for Member States not part of the Mannheim Convention.
- Council Directive 87/540/EEC on access to the profession of IWT goods carrier and mutual recognition of evidence of qualifications.
- Council Regulation (EEC) 3921/91 on cabotage (non-resident carriers transporting goods or passengers within a Member State).
- Council Regulation (EC) 1356/96 on providing (greater) freedom for inland waterway transport between and in transit through Member States.
- Council Directive 96/75/EC on chartering and pricing in national/international IWT.

In principle, the IWT market was fully deregulated on 1.1.2000 by virtue of Directive 96/75. However, the Commission set up a detailed ***market observation system*** to detect any serious market deterioration in time to allow liberalisation to be temporarily suspended. This system, too, expired in April 2004 and the Commission is now preparing a follow-up measure In so doing it is pursuing policies which for decades have taken into account the persistent IWT tendency for oversupply. The question remains whether – and if so to what extent - such observation could lead to State intervention and whether such intervention could be reconciled with liberalisation of the IWT market now accomplished. The observation system and any follow-up action may well reflect persistent fears that IWT firms of candidate countries or Western employers of Eastern crews might not adhere to the required 'harmonisation', i.e. the technical and social regulations which should result in a level playing field for competition.

This point is closely linked with measures to reduce ***structural overcapacity*** in the sector. Over a number of years and following disparate aid measures by individual Member States to assist in modernisation of fleets and parallel reductions in capacity, in 1989 the EU created a rather complex 'old for new' system, in accordance with

- Council Regulation (EC) 718/99, as implemented by Commission Regulations which fix the ratios of old for new and the 'contributions' to be paid by enterprises which did not scrap old vessels.

This system was, however, ended on 29 March 2003, to be reactivated only in case of a serious market crisis.

1.4.2 Harmonisation of technical and social regulations

Inland waterway transport

As distinct from the market liberalisation measures reviewed above, the Community also adopted ***technical*** and ***social measures.*** Here the following can be listed

- Council Directive 91/672/EEC on recognition of boat master's certificates,
- Council Directive 96/50/EC on the conditions for obtaining such certificates,
- Council Directive 76/135/EEC on the recognition of navigability licences,
- Council Directive 82/714/EEC on technical requirements for IW vessels,

Commission proposals in this field include a

- Council Directive on the transport of dangerous goods by IWT, which will incorporate the provisions of a revised Agreement on Dangerous Goods by Waterway (ADN) being worked out at UN-ECE level.
- Amendments to Directive 82/714 on technical requirements, to bring them up to Rhine standards.

In view of the existence of the Rhine boat master's certificate, the EU created two other groups of certificate: Group A valid for all Community waterways except those where the Rhine Certificate applies and Group B, valid for all Community waterways, except waterways of a maritime character and those where the Rhine Certificate applies. The conditions for obtaining them are no different in principle from those pertaining to (professional) driving licences, i.e. minimum age, physical/mental fitness, proof of professional experience and examinations on professional knowledge.

All the above will be reviewed in detail in the next chapter. As far as social regulations are concerned chapter 2 will also discuss the potential effects on IWT and other modes of a recent judgement by the EU Court of Justice on working hours..

Road transport

EU Social Regulations in road transport concern primarily driving times and rest periods. They continue to be updated from their beginnings in the 1970s, and include in addition to laying down the permissible hours of driving and the compulsory rest periods, specific definitions of what these concepts involve and to whom they apply; the latest efforts aim at defining ‘working time’ in a more harmonised manner. The EU has also laid down methods (e.g. electronic and mechanical tachographs) for recording driving and rest hours as well as standards for official checks on compliance, both in transporters’ premises and on the road. Nevertheless there is much evidence that standards and regulations are often breached, in turn resulting in road accidents.

Rail transport

EU efforts to provide interoperability between national rail networks include the possible employment of drivers and other rail staff outside their country. Drivers’ working hours are usually laid down at national or regional level by agreement with trade unions and may well differ between Member States and even within their territory.

1.4.3 Intermodality

For many years the EU has encouraged the use of multimodal transport, mainly with the aim or shifting transport to less congested and less environmentally harmful modes. Since in the past inland waterways have competed most directly with rail transport, the tendency has been to go for road/rail or road/ IWT rather than rail/IWT. However, the present outlook goes towards a multimodal complementary approach, in which IWT can be combined with rail and/or road transport. Some examples of successful IWT/rail operations may be cited, e.g. in the Rotterdam/Antwerp link. In recent years emphasis has also been placed on short sea transport combined with IWT, especially where technical progress has produced vessels which can navigate both at sea and inland. On the other hand the recognition that the EU has over 200 inland ports - which almost by definition need to act as multimodal terminals - will allow further initiatives to be taken in these ports for improved services.

From 1997 to 2001 intermodal transport was supported by the European Commission in a series of ***PACT projects*** which essentially assisted SMEs and produced some environmental benefits, though it basically accepted the prevailing market structures.

PACT has now been succeeded by the more important ***Marco Polo programme***, fully described on the website http://europa.eu.int/comm/transport/marcopolo/index_en.htm.

Its main objective is to shift international transport of 12 bill tkm from the road to other modes, using a budget of 75 mio € in the years 2003-2006 for the EU-15, with additional prospects for the Accession Member States. The programme supports transport services, both those that are regarded as innovative (‘catalyst actions’) and those that simply shift transport off the road.

It provides a 35% subsidy, limited to large projects costing at least 1.5 mio €. Marco Polo is not available for financing research, studies and 'core' infrastructure; however, ancillary infrastructures, such as adding a short rail extension onto a pier in an inland port, may still qualify, though at a subsidy rate of only 20%. In the list of 'catalyst' actions IWT figures twice, i.e. 'high quality well integrated inland waterway services', and 'improving the inland waterway sector'; here improved procedures and methods in inland ports, and better co-operation between rail and IWT are specifically mentioned.

1.4.4 Transport Infrastructure charging and the internalisation of external costs

The effect on the inland modes of a harmonised and accurate system *of* ***charging for the use of infrastructure*** has been thoroughly analysed and commented upon. In the 1960s, charging at marginal cost was first advocated at EU level, but made very slow headway owing to successful resistance by supporters of road transport and the complications of adapting such a system to the prevailing tax structures. In particular, it was hoped to cover not only the direct costs of the infrastructure, but also a series of 'external' costs, such as accidents, congestion, air pollution, noise and even effects on landscape. The railways in particular hoped, as a less pollutant mode, to benefit.

However, the complexities of an overall, harmonised system, its political implications, especially in passenger transport, and the relative success of technical regulations in the area of air pollution and noise, led to a reconsideration of this policy area. The latest Commission proposal on road tolls and charges would – if adopted – allow Member States a great deal of leeway in setting such charges. The charging bases would be limited to the costs of building and maintaining the infrastructure, of congestion and of accidents not covered by insurance; other 'external' costs are not being considered at present. Moreover the major objective is to allocate costs more fairly to those vehicles which cause them, rather than to increase overall taxes and charges on road transport.

The calculation of ***infrastructure costs of IWT*** was initially attempted in the 1970s and could be revived. Problems here are mainly the allocation of relevant costs to the transport function, rather than to the water household function or – occasionally - to the production of hydroelectric power. There is little doubt that IWT infrastructure charges would be a good deal lower per tonne or tonne-km than for roads, since there are already charges at present relating to locks and the possible additional charges are likely to be small. The pricing effect of introducing road and waterway charges simultaneously is expected to be minor.

As to the inclusion or otherwise of ***external costs related to IWT***, an ideal system would no doubt include possible costs of air pollution. However, the Commission decided recently to exclude them from its proposal on road transport, in view of conflicting scientific evidence as well as political problems. It has now commissioned a study of IWT external costs the results of which could be added to this report. Whatever the specific results of the new study, external IWT costs are likely to relatively low, but an expert look at the problem would help to identify their level – and provide a helpful comparison with other modes.

Congestion on the roads is a very serious problem which causes both internal costs to the road user involved and external costs for other road users, with some estimates putting the costs to the economy as a whole as high as 2% of GNP. This is why the EU has now proposed that road infrastructure charges could vary according to the road section involved and the time of day or night. On inland waterways, however, congestion is a minor problem which essentially occurs in waiting times at locks and in periods of high or low water levels. Such costs are essentially internal to IWT goods transport - because ferries and leisure passenger transport are given priority – and any costs incurred would need to be passed on to the shippers, where market conditions allow.

This subject will be discussed more in detail in the last chapter of this part.

1.4.5 Inland Waterways and Trans-European Transport Networks

It is of interest to put the waterway aspects of the Trans-European Networks (T.E.N.) into the framework of the total network, because many very important waterways already cross frontiers. The total length of EU waterways, including ***navigable canals, rivers and lakes*** regularly used for transport, has in fact decreased since 1970 by almost 10%, to about 29 500 km in 2000. Interestingly enough the rail network has also decreased by about 10% during that period, to 156 000 km, whilst oil pipelines (crude oil and products) have a length of 21 600 km. Waterway length increases in Germany and Finland were more than offset by decreases in France, Italy, the Netherlands and the UK. The way in which the waterways can handle different classes of vessels has already been discussed in Chapter 2.

Trans-European Networks have been and will be created and partly financed at EU level in order to establish better links between national infrastructures. The concept goes back to the mid-1990s. Currently, as far as waterways are concerned, only one project related to IWT, i.e. improvements on the Danube in Germany to facilitate movement between the Rhine/Main and Danube basins. Pan-European corridors followed the TENs along a similar line of reasoning. Here, the Danube was immediately recognised as Corridor No. VII, providing the most important international link with West European systems.

Due to budgetary restrictions ***public investment in transport infrastructures*** has decreased in recent years. Indeed some potentially important projects, such as the Rhine-Rhone link, were dropped because of scarcity of investment funds and/or poor economic viability.

A new approach towards TENs was undertaken recently by the high level Van Miert Group. For IWT it should be noted that in the North- South corridor the proposed 105 km wide gauge canal linking the Seine to northern waterways and thus to the Rhine was included in the new list of projects recommended, though as 2nd priority. This project had been shelved earlier because of relatively poor economics, but recently a final decision in favour of construction was taken. An improved link between the Meuse and the Rhine, requiring a fourth lock at Lanaye, Belgium, seems now to be firming up as well.

In looking at such essentially Trans-European projects it should be remembered that the EU cannot deviate substantially from the various national policies on investment in waterways on Member States territories. The current problem on the degree to which the German Danube stretch should be improved bears this out, as does the refusal - for reasons of public financing policy - of the October Council of Transport Ministers to approve the Commission's latest proposals on TEN Transport Projects.

1.5 National transport policies to promote IWT in selected countries

1.5.1 Austria

After many years when national transport policy attention was devoted almost exclusively to rail and road, greater awareness of the advantages of IWT has begun to be exercised in that policy. For example, in 1999 the Federal Ministry of Transport, Innovation and Technology set up the ***national development agency 'via donau'*** with the aim of increasing IWT competitiveness and thus encouraging a shift from road to waterways.

In 2001 a national grant scheme to ***subsidise combined transport*** on the Danube was set up for the period 2001-2005.

Finally, in 2002 a ***10-Point Programme to promote Danube navigation*** was launched with, inter alia, the following objectives:

- Improving fairway conditions East of Vienna, in the Wachau, and on critical Danube sections in Germany and Hungary;
- Implementing navigation management systems and information services;
- Developing ports into intermodal logistic centres;
- Improving interfaces between rail and IWT;
- Setting up intermodal door-to-door liner services;
- Improving framework conditions for Austrian waterway transporters;
- Promoting industrial locations close to the Danube.

Of the above, an environmental impact study has started on the section East of Vienna.

Following the very ***modest growth rate*** of 2.7% p.a. ***in IWT*** on the Danube during the period 1990-2000, it is forecast that without the above measures there would hardly be any improvement on that rate in the period to 2015 (whilst road transport would grow by 7% p.a.) However, if the fairways were improved and logistics and telematics applied, IWT could increase by as much as 10% p.a. in that corridor (and road transport by only 3.7%).

1.5.2 Belgium

As may be expected in a Federal State, ***authority for IWT*** is ***divided*** between the ***Regions*** and the ***National Government***. The Regions (Flanders, Wallonia, Brussels) are entirely responsible for the 1400 km navigable waterways, providing investment, maintenance and operation (including Information/Communication services), and they also deal with aids to the profession, though in a limited manner. The Federal Ministry of Transport is responsible for regulations as regards boats, crew, dangerous goods transport etc.

In addition to the regionally responsible Ministries, associations for the ***promotion of IWT*** exist in both Flanders and Wallonia. Their aims go beyond goods transport, as they encourage water tourism and try to preserve the environment of the waterways.

Belgium occupies the second place in Europe for the density of its waterways network after the Netherlands; national policy favours the increased use of IWT. The relatively high share (45%) of ***smaller*** commercially usable ***waterways in Flanders*** (Class I and II, suitable for boats of less than 1000 tons) made it of interest to find out what products could potentially be handled, what aid should be given by the authorities on e.g. dredging, infrastructure etc and whether such transport would be economic for shippers and transporters.

The ***study***[3] showed that in 2001 some 5.3 million tons were loaded/unloaded on these canals, mainly construction materials, grains, coal and petroleum products. Traffic in terms of tkm was less impressive, because much of it continued on or originated from the larger waterways. This form of IWT was estimated to generate €42 m socio-economic benefits per annum. Based on the location of industry and inhabited areas close to these waterways up to 30 million tons could potentially be handled, but the reduction of the number of smaller boats and the failure to replace skilled crews made such a large expansion unlikely.

However, the 1998 ***Government*** measure to ***aid IWT*** through ***PPP*** (public-private-partnerships) relating to quay walls has already led to more than 15 such projects. The Region supplies up to 50% of the total funds, with a maximum of 80% of the wall cost, the superstructure being provided by the private investor who also has to guaranteed a volume of traffic for 10 years. SMEs (small and medium enterprises) can obtain a further 15% of costs for improving boats technically. This aid is provided only along waterways, not in ports. An increase in small waterway use of 20% is considered realistic.

IWT pays ***shipping dues*** of B.Fr. 0.01 (€ 0.00025) per tonne-km. Although this covers a very small part of ***infrastructure costs***, the Flemish authorities will retain the system, partly because it provides highly detailed data on shipping (boats, products, etc) and partly in anticipation of a future EU system. Whilst transport modes should be treated alike, waterways have other functions of supplying water, draining, environmental benefits etc which must be taken into account when determining the costs directly applicable to IWT.

---

[3] Studie naar de ontwikkelingsmogelijkheden van de kleine waterwegen in Vlaanderen inzake scheepvaart, Resource Analysis, Brussels, December 2002

As regards the ***larger waterways,*** the main interest lies in improving the narrow section of the Albert Canal close to Antwerp (extra lock and bridge raising) and a further lock at Lanaye in the Liège area which would complete the junction of the Maas (Meuse) basin with the Rhine. By 2006/7 bridge heights of 9.10 m should allow container vessels to be stacked 4 high. These plans are part of the ***Flanders Mobility Plan***, just approved by Parliament, but not yet printed officially. This plan also emphasises the need for Belgian waterways in the 'Seine-Escaut (Schelde)' basin to be brought up to higher standards (1350 t), thus allowing the Northern waterways in France and Belgium to be better linked to the seaports close by, with onward sea shipping to all of Northern Europe.

Whilst the improvements to the ***Canal du Nord*** essentially concern France and the EU, it was noted that Belgian and Flemish Ministers participated in the early October declaration with their Dutch and French colleagues on the completion of the project by 2010.

As far as ***Wallonia*** is concerned, the current 4 year plan to ***aid IWT*** terminates at the end of 2003. Some 220 IWT transporters have been helped since 1996 to upgrade their vessels and another 25 to buy transfer equipment; securing an additional IWT traffic of 2.8 million tons. Indeed the total traffic of 41 m. tons in 2002 was 38% higher than in 1995. The Region's plan for 2004-2007 awaits Commission approval; in addition to the above types of aid it envisages a contribution towards creating scheduled IWT container services.

Finally, it should be noted that the authorities are in touch with the profession by holding 2-monthly meetings with the ***Representative Council*** of IWT Shippers and Transporters.

1.5.3 Germany

Navigable inland waterways in Germany are largely a matter for the federal authorities. The basic law (Bundeswasserstrassengesetz) of 1968 still applies, but has been amended many times, most recently in June 2002. Waterways used for sports and water supply usually fall under the Federal States (Länder).

In general, the ***Government supports EU*** efforts to ***liberalise IWT*** and to allow its modal share to increase. Enthusiastic statements about improving IWT competitivity have been issued by the Ministry of Transport, Construction and Housing, but the relative infrastructure budgets for new investment, replacement and maintenance are well below IWT's modal share of inland transport.

Various ***investment and maintenance plans for waterways*** are running, partly in parallel. They are:

a) The Federal Transport Infrastructure Plan (BVWP) 1992-2002,
b) The Federal/ERDF (European Regional Development Fund) Budget 2000-2006,
c) The 'Anti-Congestion' Budget,
d) The 'Future Investment Programme 2001-2003, and finally,
e) The new Federal Transport Infrastructure Plan 2001-2015.

To some extent, current projects which often take years to complete are covered by more than one of these plans.

According to BVWP a) a total of ***€ 2.0 bn for inland waterways*** was budgeted for the period 1999-2002, of which € 1.3 bn for replacement and maintenance, € 0.6 bn for extensions and new projects. The remainder included a small sum for 'priority' projects and for the first time about € 10 m from the European Regional Development Fund (ERDF). Thus spending was at the rate of about € 500 m per annum.

In the joint ***Federal/ERDF plan b***) and thus the period 2000 – 2006, a very modest IWT budget of approx € 12 m is foreseen, two/thirds from the ERDF. The share of IWT would be only 0.4% of the € 3 bn expected to be spent on inland transport as a whole, nearly 44% going to railways and almost 56% to roads.

The '***Anti-Congestion' plan*** will provide about € 450 m for waterways which

- cause stoppages because of poor construction or lack of safety,
- have insufficient water depth or
- cause high waiting times at locks or lifting devices.

In this plan IWT fares better, obtaining 12% of the total budget or close to its modal share.

The so-called 'Future Plan'2001-2003 envisages spending € 1.4 bn.

As part of its general transport policy the Ministry has examined 3 scenarios for the period to 2015. Under the 'laissez faire' scenario in which no further transport policy measures would be undertaken, IWT freight traffic would increase from 62 bn tkm to 87 bn tkm in 2015, a rise of about 40%. Its modal share, however, would drop from 16.8% to 14.3%. Under the preferred 'integration' scenario, slightly lower figures would be reached (86 bn tkm, 14.1%). In both cases the forecasts are based on a 25% reduction in IWT unit costs.

As mentioned, the planning emphasizes better IWT competitivity, to be reached by

- optimising transfer areas and equipment in inland ports,
- making use of harbour capacity reserves and developing inland ports.

A Federal Directive of March 1998 provides for subsidies to be granted to building combined transport terminals in ports. Some €36 mio have been budgeted for trimodal (rail/road/IWT) terminals and by 2000 seven goods traffic centres of this kind had been set up. There is also emphasis on building 'wet' transport chains.

As regards IWT affinity, Germany is in line with the other countries in looking at

- container transport,
- dangerous goods,
- recycled products and waste and,
- high dimension items as promising.

1.5.4 France

The public institution ***Voies Navigables de France (VNF*), **created by the State in 1991, represents and is responsible for the IWT network in its broadest sense. As such it can play an important role in implementing the desired modal shift from road to IWT, bearing in mind the network's potential transport capacity reserves. A contract with the Government is envisaged for the near future, specifying the aims, competences and sources of income of VNF, as well as the transfer of some Ministry functions with their officials to this body.

VNF's first priority is the '***master' network*** of large gauge waterways, with some connexions between separate basins, the exact extent of which still requires Government definition. Within this the ***Canal du Nord*** improvements, the biggest IWT project in France for decades and an essential link in the Seine-Northern Europe corridor, will play an important role. Having finally obtained No. 1 priority as a European TEN-T infrastructure, it will become eligible for an EU contribution of up to 30% of the cost. VNF is planning preparatory stages to allow construction to be started by 2010 and completed by 2020.

In a more general sense VNF plans to increase the ***reliability of the network*** by preventive maintenance and thus eliminate waiting times at locks, etc, at least on the larger waterways. Clear operating and service standards will be worked out and communications improved by creating '***intelligent waterways***' which will have GPS tracking, faster data transmission and optimal use of locks.

A 15 year programme for ***investment in waterway & structure restoration*** is planned, including e.g. automating a chain of locks and renovating manually handled booms, which are partly unsafe: for the latter € 500m have been budgeted over a 10 year period. Plans also exist for improvements in ***operating the fleet***.

As regards ***Government aids*** policies of subsidising the use of branch waterways and redeveloping inland ports is under consideration, whilst a Higher Institute of Inland Navigation has just opened its gates at Elbeuf for training young recruits to the profession.

After a 30 year decline, the ***volume of IWT*** in France increased 22% in the 5 year period 1997-2002, with container transport more than doubling In the year 2002 tonnage amounted to 58.6 m of which 3% also used sea waterways; traffic was 7.2 bn tkm, with 4% seagoing. As regards products, minerals and construction materials took up as much as 44% of the tonnage and nearly 35% of tkm. In second place, agricultural products accounted for 14% tonnage, but 20% of tkm, whilst solid fuels and petroleum products each took about 10% of tonnage and tkm. Total tonnage transported was 1% up on the year 2001, tkm nearly 3%; domestic traffic increased by 8½%, but international traffic declined by over 3%. The fleet remained practically unchanged.

In this connection it should be noted that a framework ***contract*** was signed with *the* ***cereals business*** in March 2002 regarding the respective IWT and shore investments, leading to 10 projects and additional IWT traffic of 500 000 t. Similar agreements are to be entered into with quarries/construction materials., whilst in the longer run they cold be envisaged for wastes, metals and non-grain agricultural products.

Another subject for discussion between the Government and VNF relates to ***shipping dues***, where VNF wishes to ensure a dedicated income and thus less reliance on the national budget.

Whilst the official statistics for France show a ***modal share*** for IWT of only 2.7 % in 2001, a study[4] has been made of the ***'wet'*** part of the country which makes up just over one half of the national territory. If this were taken as the basis French IWT would account for 5.1% of tonnage and 7.0% of traffic in tkm. The really significant modal share lies in international traffic, making up 24.3% in tons and 16.5% in tkm.

This data can be broken down into river basins, classified in order of importance as follows (using tkm):

	Total market		International market	
	tons	tkm	tons	tkm
1. Rhine	18.1	30.0	50.6	45.7
2. Moselle	14.6	18.4	41.4	32.6
3. Nord/Pas de Calais	4.3	8.7	14.3	22.0
4. Seine-Oise	5.9	18.6		
5. Rhône-Saône	1.6	5.0		

Table 1. Modal share of IWT in percent by river basins (2001)

As regards products overall, coal was by far the most important with an IWT modal share of 37% in tons, followed by petroleum with 12% and minerals/iron & steel at 10%. Within the French total, however, individual basins registered different product mixes. For example in the Seine-Oise basin, building materials came top with 30%, followed by petroleum with 20% and agricultural products with 15%.

1.5.5 Netherlands

In the Netherlands, water transport has a ***larger modal share*** than anywhere else because of the widespread and well maintained waterway network, linked to the important seaports of Rotterdam and Amsterdam.

As regards waterway transport policy, the national Ministry of Transport and Waterways is primarily responsible for the ***network of 2 200 km*** comprising:

- the major waterway axes, defined as carrying a minimum of 5 m. tons p.a. of international IWT to and from the Dutch sea ports and able to handle at pusher units with at least 4 barges.
- the major waterways which carry a minimum of 5 m. tonnes or 10 000 containers p.a. and can handle large motor vessels and pusher units with at least 2 barges.

---

[4] Commissioned and published by VNF in their website www.vnf.fr 2003

- The remaining waterways are managed by the provinces or other local authorities.

All these authorities must see to it that, for example, locks are able to handle waiting vessels with minimum delays, that the formation of ice is prevented or minimised, that major waterways are available 24 hours per day, etc.

Since the Netherlands is a Rhine Commission and EU Member State, ***IWT Regulations*** are largely determined by

- those issued by the CCR (Central Commission for the Rhine) and resulting from the Treaty of Mannheim for the Rhine basin as a whole, and
- EU legislation, mainly in the form of Directives requiring to be implemented by national measures.

Such regulations covers items such as safety and efficiency by providing traffic rules, the provision of overnight facilities, technical requirements for the vessels, rules for the crew as regards working hours, number on board and professional knowledge, rules on access to the profession of IWT operator etc, both national and international.

Until fairly recently, the Dutch ‘IWT Law’ also regulated the alternating cargo system (tour de role) via shipping exchanges, but this was abolished recently in the EU as a whole; since 1998 IWT in the Netherlands operates as a ***free market.***

As for further promoting IWT in a country well provided with it, the deteriorating economic situation of the country, highlighted in the September annual budget, will probably reduce funds for both maintenance and investment on the waterways, but such reductions are likely to hit rail and certainly road transport even harder. Emphasis may well be laid on better informatics and other ‘soft’ promotion techniques. As regards maintenance, € 700 million have been reserved in the national budget for the period up to 2010. Priority will be given to linking the ports of Rotterdam and Amsterdam with the sea and to the corridors Amsterdam/Rotterdam – Germany and Rotterdam-Antwerp, In 2005 a start will be made on dredging the Nordzeekanal and the Waal route.

1.6 Conclusions

A broad review of overall EU transport policy and legislation shows that wherever possible, the three inland modes have been treated similarly. Where it appears that road and rail have received closer attention, this may be due to more pressing problems in these modes, e.g. on access to infrastructure or restrictions on providing services. In fact, IWT goods transport, is largely liberalised, though persistent oversupply remains a delicate problem.

Social and technical harmonisation are rather specific to IWT. Socially, because of the high proportion of SMEs in the sector and the availability of cheap labour outside the EU-15.

Technically, because of the need to adapt vessels to the rising safety and environmental standards currently required whilst catering to new cargo demands. These aspects will continue to need close monitoring, especially to avoid suggestions of unfair competition from sub-standard vessels which might take advantage of more liberalised services at the enlarged EU level. All the same because of the restrictions imposed by the nature of the links between the Rhine and the Danube, and similar restrictions between the Rhine and North East European waterways, such problems ought not to be exaggerated.

The national policies reviewed in 5 important IWT Member States all refer to and implement legislation integrated in the EU's general policy. They also deal, however, with domestic problems of varied character, some of which might call for further harmonisation or adjustment of existing EU policies. Examples here the adoption of the proposal on the transport of dangerous goods, the updating of technical measures on vessels and boatmasters' certificates, some adjustments to the Marco Polo project and the follow-up on the definition, as applied to IWT, of working time.

Chapter 2 Legislative harmonisation and market access

2.1 Introduction

The creation of a transparent and integrated European inland waterway transport market based on the principles of reciprocity, freedom of navigation, fair competition and equal treatment of the users of inland waterways has a long history, dating back to the 1868 Act of Mannheim. The underlying principles were recently reaffirmed in the Rotterdam Declaration [Pan-European Conference on Inland Waterway Transport, 2001] as one of its central objectives. Some remaining aspects deal with harmonising existing conventions, EU-law and bilateral agreements applicable on the Danube, Rhine and other national and international waterways and a uniform regime as regards civil law [Hacksteiner, 2003].

The main conditions for a harmonised legal framework were formulated in Rotterdam as follows [UNECE Group of Volunteers, 2003]:

- equality of treatment of economic actors, irrespective of their nationality or their place of residence;
- equal access conditions for all those who wish to enter the market (including equal access to infrastructures and services);
- equality of rules governing production processes throughout the geographical area covered by the market in question;
- penalising unfair competition practices (including control of private cartels and of state aid);
- freedom of contracts and pricing;
- freedom of movement of goods, persons, services and capital throughout the geographical area covered by the market system.

Whilst at the planned date of 1 May 2004 all the 25 Member States of the EU will have a legally harmonised system permitting free access to the market as well as cabotage for EU vessels, not all the technical and social rules and regulations on the above issues will have been harmonised. This deliverable will first identify the various parties involved in shaping the legal framework for European inland navigation and then deal with the issues which may require further co-operation, harmonisation of legal texts and problems of implementation on the ground.

2.2 Method of working

First literature and desk research has been done on the basis of documentation of the UNECE, European Commission, the CCNR and the Danube Commission. These data have been used to make an overview of the main legal regulations that have already been applied or will be applied in the near future. An overview of the different types of legal fields is given, varying from regulations on boatmasters licences and market access provisions to competition rules. The third part of the deliverable contains a synthesis of existing regulations together with an identification of the legal issues that first and foremost require harmonisation.

2.3 Main actors involved

2.3.1 Introduction

Different organisations play a role in determining the transport-related legislative framework of inland navigation in Europe: the European Union (both 'transport acquis' and other relevant legislation), the Inland Transport Committee of the UNECE (United Nations Economic Commission for Europe), the Central Commission for Navigation on the Rhine (CCNR), the Danube Commission (albeit in the form of recommendations) and national authorities (also concerned in the few remaining bilateral agreements). Each of these actors is responsible for different areas and different parts of the legislative framework. As a result, regulations are not necessarily harmonised across Europe as a whole,: here one must bear in mind that a pan-European inland navigation market – whilst no doubt desirable – is not the direct objective of this Report.

Finally it is worth mentioning labour agreements and social contracts which are handled in different ways.

2.3.2 United Nations: Economic Commission for Europe (UNECE)

Since its establishment in 1947 the UNECE Inland Transport Committee has been the primary agency in the standardisation of inland navigation technical and safety regulations in Europe [Martin, 1998]. It is a framework for intergovernmental cooperation in order to facilitate international transport.

Once they have been ratified by the necessary number of states as Contracting Parties the international agreements and conventions initiated by the UNECE are legally binding. Examples of UNECE Agreements are:

- European Agreement on Main Inland Waterways of International Importance (AGN, 1996);
- European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterway (ADN, 2000);
- Convention relating to the Unification of Certain Rules concerning Collisions in Inland Navigation (1960);
- Convention on the Registration of Inland Navigation Vessels (1965);
- Convention on the Measurement of inland Navigation Vessels (1966);
- Convention relating to the Limitation of the Liability of Owners of inland Navigation Vessels (CLN, 1973);
- Protocol to the Convention relating to the Limitation of the Liability of Owners of inland Navigation Vessels (CLN, 1978). This convention never came into force because it had been ratified by only one country.

The sole difference between conventions and agreements is the form in which a State may express its consent to be bound. Agreements may be signed with or without reservation as to ratification, acceptance or approval. Conventions may, in principle, be ratified.

Other organisations of the United Nations have been involved in the creation of specific private law conventions. UNCTAD – the United Nations Conference on Trade and Development – has together with ICC – International Chamber of Commerce – developed uniform rules for multimodal transport documents. UNCITRAL – United Nations Commission on International Trade Law – is a recently established agency which is developing an international civil law instrument on multimodal door-to-door transport involving transport by sea. This instrument would also apply to carriage by inland waterway before and after the voyage by sea [www.UNCITRAL.org].

2.3.3 European Community

The aim of the European Union is to create an Internal Market in which there is free movement of persons and goods. This implies a series of liberalisation measures, usually accompanied by harmonisation in order to ensure a level playing field and the elimination of distortions of competition. The EU has full competence in the transport field and thus started a process of harmonising legislation in all Member States with inland navigation.

The three kinds of binding legislation the Community uses are:

- Decisions: adopted by the European Parliament and Council, or by the Council alone, or by the Commission in certain circumstances, they are binding on those to whom they are addressed (be it Member States, companies or even individuals);

- Regulations: adopted by the European Parliament and Council, or by the Council alone, or by the Commission in certain circumstances, they are directly applicable and binding on everyone, including Member State administrations;
- Directives: addressed to the Member States and are binding on them as to their effect whilst leaving the choice of means of implementation to national administrations. This means that unlike most regulations and decisions, directives must be transposed into national law.

Recent EU transport policy goals have aimed at achieving a more sustainable transport system from the social (e.g. working hours) and environmental (e.g. reducing pollution and increasing safety) perspective. As usual in the international field, EU legislation takes precedence over national legislation.

The body of EU transport law, the transport acquis, consists of a very large number of Regulations, Directives and Decisions, though many of them do not apply to IWT. Of the latter, the most important are listed in SWP 5.1. Just like existing Member States, the candidate countries have to adopt this legislation at national level, and ensure an adequate level of administrative capacity to deal with the administrative burdens involved[5]. In addition to the transport acquis, inland waterway transport must also abide by a good deal of other specific or general EU legislation, i.e. rules and regulations on competition, procurement, social issues, environment, etc.

2.3.4 River commissions

The Mannheim Convention of 1868 and the Belgrade Convention of 1948 form the basis for the different legal regimes on the Rhine and Danube. Basically speaking, both conventions deal with guaranteeing freedom of shipping and harmonising the technical requirements for navigation. The legal character of the two river commission is however different; the Central Commission for the Navigation of the Rhine (CCNR) has regulatory powers, whereas the Danube Commission (DC) provides recommendations to its members states.

Central Commission for the Navigation of the Rhine

The Mannheim Convention itself provided for freedom of navigation on the Rhine for vessels of its Member States: Belgium, France, Germany, The Netherlands and Switzerland. The Mannheim Convention includes provisions on the freedom of navigation, the equal treatment of all boatsmen and fleets, the exemption from navigation duties, the obligation of member states to maintain the waterway, etc.

The CCNR was set up under the Convention to regulate these provisions in detail and in particular deal with the technical and policing aspects of Rhine traffic. Its main regulations are:

---

[5] See http://europa.eu.int/comm/enlargement/negotiations/chapters/chap9/index.htm.

- Rhine navigation police regulation (in accordance with Code européen des voies de navigation intérieure CEVNI);
- Regulation on the Survey of Rhine Vessels (RVBR);
- Rhine bargeman's licence (patent);
- ADNR Agreement.

The Rhine Navigation Police Regulation of the CCNR can be considered as the basis for all other CCNR regulations. The regulations are generally very detailed (see later sections) and are constantly monitored and updated. The impact of the Rhine regulations is however by no means confined to the member countries of the CCNR. Individual countries have implemented a large part of the technical Rhine regulations in their national legislation, the Rhine patent is valid on all EU waterways, and regulations such as the Regulation for the transport of dangerous substances on the Rhine (ADNR) are practically the basis for similar agreements on the Moselle and Danube.

On the 3rd of March 2002, the European Commission and the Central Commission for Navigation on the Rhine signed an agreement designed to renew and strengthen the pragmatic cooperation between the two organisations, which has been in operation for decades [DG-TREN, 2003]. In the Transport White Paper, the Commission proposes that the Community (i.e. the EU) should become a full member of the CCNR in order to harmonise the legal systems in force on the Rhine and the Community system in force on other inland waterways such as the Upper Danube, the Elbe and the Oder. The cooperation between DG-TREN and CCNR will consist of the coordination of activities and working programmes [European Commission, 2001]. Similar plans are being developed between the EU and the Danube Commission.

Danube Commission

Regulation on the Danube is based mainly on the Belgrade Convention, which was signed by Bulgaria, Yugoslavia, Romania, the Soviet Union, Czechoslovakia, Hungary and the Ukraine in 1948. To date, the eleven members of the Belgrade Convention include Bulgaria, Germany, Yugoslavia, Croatia, Moldova, Austria, Romania, Russia, Slovak Republic, Ukraine, Hungary. By signing the Belgrade Convention, these countries have agreed to maintain the navigability of the river within their boundaries, and to refrain from other measures which would hinder navigation. austria became member of the Danube Commission in 1960. Germany had already possessed the observer status since 1957, but only recently became full member. Currently, observer states are France, the Netherlands, Turkey and the Czech Republic.

Regulation on the Danube is however different from that on the Rhine. The Danube Commission – set up by the Belgrade Convention as an inter-governmental commission to safeguard the implementation of this convention – publishes directives, which are recommendations for the various member countries. The way these recommendations, which do not have direct legal force, are incorporated into national law remains a decision for each member country. Each member country, however, recognises the national regulations of every other member country.

The Danube Commission publishes its recommendations and decisions in three main areas:

- Nautical area: the DFND – the basic conditions for navigation on the Danube – published in 2000 and the Rules to Monitor Navigation on the Danube of 1964.
- Vessel-technical: including for instance the recommendations for technical regulations for inland vessels (1995).
- Environmental protection and waste collection: the ADN-D on the transportation of dangerous goods on the Danube, and recommendations to prevent water pollution resulting from Danube navigation.

A revision of the Belgrade Convention of 1948 is currently under way, in order to bring it closer into line with the acquis communautaire of the European Union, while taking into due consideration the regime currently existing on the Rhine. Nedialkov [2003] summarises the existing harmonisation efforts between the Danube and Rhine regime. Three recent developments underpin the efforts to reach a higher degree of harmonisation between Rhine and Danube:

- The joint declaration of the Danube and Rhine Commissions of 22nd June 2001;
- The Pan-European Conference on Inland Waterway Transport (Rotterdam, 5-6th September, 2001) referred to above;
- The Memorandum of Understanding for the development of Corridor VII of transport ministers from the Danube countries (6 September 2001).

Furthermore, a joint committee of the DC and the CCNR established in 2001 focused their harmonisation efforts on the reciprocal recognition of boatmasters certificates, the harmonisation of technical requirements for inland waterway vessels and the harmonisation of the conditions for access to the market [Nedialkov, 2003].

Moselle Commission

The Moselle Commission was installed on the 27th of October 1956 by the member countries France, Luxembourg and Germany. The Moselle Act (Mosellevertrag) basically determines the nautical and financial questions of navigability of the Moselle. The contracting parties oblige themselves to cooperate in order to make the Moselle navigable for ships up to 1500t between Thionville and Koblenz (a stretch of 270 km). The basic principles of the Moselle Act are very similar to those of the Act of Mannheim.

The main legislative acts set up by the Moselle Commission include the Conditions for levying tolls on the Moselle between Thionville and Koblenz, the Moselle Police Regulation of 1995, and the Regulation on the Transportation of Dangerous Goods on the Moselle.

2.3.5 National legislation

As was discussed before, IWT legislation in the EU Member States largely reflects the transport acquis. The candidate countries are also in the process of adopting this legislation.

The transport chapter 9 of the EU Enlargement negotiations was closed with all candidates in December 2002[6]. Since no candidate country requested a transitional period for inland navigation issues no such arrangements were made, which means that the European transport acquis as regards inland navigation will be adopted entirely and without reservations by the candidate countries in their national law and regulations.

One of the remaining fields where national legislation still supplements the European legal framework lies in the field of the few remaining bilateral transport agreements between some West European countries and non-EU/non-2004 candidate countries from Central and Eastern-Europe (see section 2.4.2).

2.4 Legislative framework of European inland navigation

2.4.1 Introduction

This section contains an overview of the current legal framework of inland navigation within Europe. This overview is categorised according to the theme of legislation (e.g. legislation on transport rights, boatmaster licences). For each of these themes, we have attempted to summarise the main conventions and regulations prescribed on the various levels. The overview is based on an extensive literature review as well as on exploratory interviews with legal experts.

2.4.2 Transport rights and market access

The current inland waterway markets are largely liberalised and will be fully so by the time the candidate countries join in 2004, with Romania and Bulgaria presumably acceding in 2007. Cabotage on the Danube is currently restricted to the national fleets, whereas cabotage on the Rhine is allowed for member countries of the CCNR and the EU, but in practice restricted through technical regulations. Some of the remaining provisions restricting access to the market will be discussed in this section.

European Community's transport acquis

The Regulations 3921/91/EEC and 1356/96/EC provide the right to carry out cabotage and international transport operations within the European Union to EU vessels. Operators of such vessels have to prove a 'genuine link' with a Member State.

---

[6] see http://europa.eu.int/comm/enlargement/negotiations/chapters/chap9/index.htm.

Council Regulation 3921/91/EEC of 16 December 1991 deals with cabotage, whilst Regulation 1356/96 of 8 July 1996 specifies the conditions for international waterway traffic between EU countries and in transit through them.

All of the above implies that the enlargement of the European Union with the candidate countries means that vessels of these countries will attain full access to the EU-waterway network, including the Rhine, as of mid-2004.

Rhine regime

The Act of Mannheim (article 4) and the additional protocols to the revised Mannheim Act (notably Protocol Nr.7 agreed in November 2002) reserves national and international cabotage on the Rhine to vessels belonging to CCNR and EU member states. Protocol Nr. 7 enables the CCNR to recognise vessel certificates and boatmasters licences issued by countries that are not a member of the CCNR (especially recognition of EU certificates). In cases where vessels from countries other than the EU and Switzerland want to transport on the Rhine and its tributaries, authorisation by the CCNR on a case-to-case basis is required. To settle these requests in a more transparent way, a number of bilateral agreements between EU Member States and non-EU countries exist (see section on national legislation) [UNECE Group of Volunteers, 2003]. However, most of these bilateral agreements will cease to be in force after the EU-enlargement in 2004.

Danube regime

The Convention of Belgrade principally provides freedom of navigation in international traffic, including transit traffic, on the Danube; it reserves cabotage to the national fleets. For instance, if an Austrian ship wants to travel to Romania, without the need for intermediate (un)loading, the Slovak, Hungarian, Croatian, Serbian and Bulgarian authorities cannot stop this vessel on the basis of the existing traffic rights.

Different opinions among the parties to the convention as to precisely how this freedom should be interpreted however still exist. More recent agreements between the (formerly state-owned) shipping companies – better known as the Bratislava Agreements – settled the commercial conditions for international Danube navigation, freight tariffs, and an agreement on the assistance to vessels suffering an accident [Gnacek, 2002]. The UNECE Group of Volunteers [2003] also noted that legal situation on the Danube with respect to transport rights needed clarification and saw the future revision of the Belgrade Convention as an opportunity to do so.

National legislation

Bilateral inland navigation agreements between some CCNR member states and a number of Central and Eastern European countries place restrictions on market access to national cabotage and bilateral traffic. Cabotage as a rule is only allowed in exceptional cases, while the participation by vessels of third countries in bilateral traffic is generally discouraged.

Bilateral agreements have been concluded among several Member States, they have however been superseded by EU legislation.

Of the numerous existing bilateral agreements, only following bilateral agreements will still be relevant after the enlargement of the EU in 2004:

- Germany with Georgia, Bulgaria, Romania and Ukraine.
- The Netherlands with Romania.
- Luxemburg with Romania.
- France with Romania.

This situation is however subject to change, as nearly all bilateral agreements exist between existing EU Member States and Candidate Countries. The bilateral restrictions will automatically be superseded by the European transport acquis, which forbids such restrictions in transport rights among Member States. Therefore, where Poland, Czech Republic, Slovakia and Hungary are involved, bilateral provisions are then overruled by the transport acquis. As no transitional agreements have been closed for inland navigation, the new entrants to the European Union and members of the Danube Commission Slovakia and Hungary will full gain access to the EU-waterway network – including the Rhine and cabotage on the Rhine – as of mid-2004.

Until mid-2004 however will third-party transport (e.g. an Austrian vessel wishing to provide transport services between Hungary and Germany) be limited and subject to special permissions, based on the bilateral agreements between Hungary and Germany. Because Hungary does not have bilateral agreements with countries on the Lower Danube, an Austrian vessel could – without the need for permissions – transport goods between Hungary and for instance Romania. There is no legal barrier in the latter case.

Consequences for inland navigation

Restrictions on cabotage could lead to limited profitability of exchange traffic between the Danube and Rhine basins. The long journeys between the different river systems – without the possibility of reducing empty returns by means of cabotage freight – are generally not very attractive [Woehrling, 2002]. As the liberalisation of cabotage on the European waterway network would raise several questions dealing with fair competition, the CCNR requires that liberalisation of these restrictions calls for flanking measures and closer co-operation between EC, CCNR and DC in order to prevent unfair competition [Woehrling, 2003]. To this end, EC and CCNR have closed a co-operation agreement in March 2003. In turn, the Danube Commission has started a process of revising the Belgrade Convention, in which the CCNR and the EC are observers.

2.4.3 Technical and safety requirements for vessels

UNECE

UNECE resolution No. 17 deals with Recommendations on (uniform) technical requirements for inland waterway vessels (14 October 1981). As one of the main activities of the UNECE in this field, this resolution consists of amendments to include minimum manning requirements and working and rest hours of crews of vessels in inland navigation. This resolution is currently being revised and brought in line with the EU transport acquis and the RVBR regulations of the CCNR (see section on Rhine regime). Resolution Nr.17 is however a recommendation, to facilitate mutual recognition of ship's certificates among different countries. If the country involved did not commit to this recommendation, it will have to prove that their national legislation fully complies with the provisions of the UNECE [UNECE Group of Volunteers, 2003].

The ADN Agreement – International Carriage of Dangerous Goods by Inland Waterways – was adopted on the 25th of May 2000 under the supervision of the UNECE and the CCNR. The ADN is aimed at achieving a high level of safety of the international carriage of dangerous goods by inland waterways. Several regulations are annexed to the ADN Agreement containing provisions on the dangerous substances, the required way of packaging, the construction and operation of vessels, as well the criteria for inspections. These specified regulations are identical to the safety regulations of the CCNR.

European Community's transport acquis

The technical regime on the EU waterways outside the Rhine is based on EU Directive 82/714/EEC, laying down technical requirements for inland waterway vessels. It aims to achieve the reciprocal recognition of navigability licences for inland waterway vessels. As matters stand vessels with a Rhine licence are admitted to the entire waterway network within the European Union. Conversely, the Community ship's certificate was only recognised as valid for Rhine navigation in the 7th Additional Protocol to the Act of Mannheim on 27th November 2002. This protocol gives the CCNR the competence to recognise the ship's certificates of the EU and of third countries.

Council Directive 82/714/EEC lays down the conditions and rules for issuing Community inland waterway certificates, provisions applicable to vessels of third countries, as well a list of minimum technical requirements for vessels. This 1982 directive was based on the Rhine rules then in force but updating of the Rhine regulations in 1995 left the EU norms outdated [Lyons, 2002]. The Directive is therefore currently under revision to bring its technical rules into line with those of the RVBR of the CCNR [UNECE, 2002b].

Rhine regime

The CCNR has the competence to lay down regulations, which restrict free navigation provided that this is justified by considerations of safety. The largest part of the rule-making activity of the CCNR is therefore connected to safety issues [Hofhuizen, 2002]. As was mentioned above, the Additional Protocol Nr. 7 of the Mannheim Act enables the recognition of patents and vessel certificates issued by non-member countries, provided that the equality of requirements is guaranteed.

The basic regulation on technical requirements for vessels on the Rhine is captured in the Regulation on the Survey of Rhine Vessels (RVBR). A revised these regulations entered into force on 1 January 1995 [UNECE, 1996b]. The RVBR defines the technical requirements for the licence of vessels to navigate on the Rhine, their stability and strength and equipment, their manoeuvrability and stopping quality as well as the requirements for the machinery space and the steering gears, manning and crew and safety in the working spaces. If the vessel conforms to the regulations, a so-called ‘ship's attest for the Rhine’ (i.e. ship's certificate) is issued. On the Rhine, vessels are only admitted when they carry this Rhine ship’s certificate. This CCNR certificate is recognised by the EU as valid for navigation on all Community waterways [UNECE, 2002b].

The RVBR is updated regularly (almost every half year) in order to cover technological developments and to take into account changing security demands [Hofhuizen, 2002]. For instance a new chapter entered into force on the first of January 2002 to include regulations on the exhaust and pollutant particle emissions from diesel engines. It lays down maximum allowed levels of carbon monoxide, hydrocarbon, nitrogen oxide and particle emissions for newly built engines.

The second important technical and safety regulation issued by the CCNR is the Regulation for the transport of dangerous substances on the Rhine (ADNR). This regulation of the CCNR defines the technical and operational safety requirements for the licence and the operation of inland navigation vessels carrying dangerous goods on board. It describes conditions for exemptions, specific security duties of each party in the logistics chain, transitional regulations for different vessel types, and measures for control procedures.

Any vessel carrying a certificate issued within the framework of the ADNR may carry dangerous goods throughout the territory of the Community under the conditions stated in that certificate. The ADNR is recognised by the European Union as valid for the EU-inland waterway network. The ADNR is also adopted by the Moselle Commission in its Regulation on the Transportation of Dangerous Goods on the Moselle. Therefore, in Western Europe, the regulations for the carriage of dangerous goods are more or less harmonised. A revised version of the ADNR (numbering standardised according to norms of the United Nations) has entered into force on the 1st of January 2003. The contents have remained more or less the same.

Danube regime

The Danube Commission publishes the Recommendations on Technical Requirements for Inland Navigation Vessels, based on resolution No. 17 of the UNECE. These recommendations contain many technical requirements. Some recent changes that have been incorporated deal with the stability of container ships, and the emission of gaseous exhausts and air-polluting particles from diesel engines. These recommendations are developed in accordance with the regulations of the UNECE. These are in turn strongly harmonised with the new European technical requirements [Danube Commission, 2002]. The update of the technical recommendations of the DC will be continued in cooperation with the CCNR.

Although – from a legal perspective and given the character of the DC recommendations – each riparian state has its own technical rules and ship's certificate, the members of the DC recognise each other's ship's certificates. Therefore the UNECE Group of Volunteers [2003] concluded that this situation poses no problems to shipping on the Danube.

As regards the transport of dangerous goods, the Danube Commission adopted its own recommendations (ADND) drafted along the lines of the ADN/ADNR provisions. The main chapters are:

- General provisions;
- Classification;
- Listing of dangerous goods;
- Provisions for packaging of goods and loading units;
- Provisions for shipment;
- Construction and test provisions for packaging;
- Provisions for (un)loading, transporting and other handling of the goods;
- Provisions for the crew, equipment, operation and documentation.
- Provisions for construction

The harmonisation of technical requirements for inland vessels is a laborious process. This process is undertaken on the basis of the harmonisation of Directive 82/714 and the Rhine Vessel Inspection Regulation at the UNECE in Geneva. Nine chapters have already been revised. It is foreseen to publish an updated version of the 'Recommendation on the Technical Requirements for Inland Vessels' of the Danube Commission – taking into account these adapted chapters – by the end of 2003 [Nedialkov, 2003].

However, a legally complex position is held by contracting States to the Belgrade Convention, which are also Member States of the EU. As an example, Austria can only adopt those technical recommendations from the DC when these are not in conflict with the national and EU-law. Therefore, seen from a practical perspective, harmonisation of technical requirements can be realised the easiest way by using the identical transport acquis for the Danube as well. This will happen for most Danube countries via the EU-enlargement anyway.

National legislation

For instance Directive 82/714/EEC has been transposed into the following national laws:

- Austria: among other the Verordnung des Bundesministers für öffentliche Wirtschaft und Verkehr vom 02/03/1990 über die Zulassung von Fahrzeugen auf Binnengewässern (Schiffszulassungsverordnung);
- Belgium: Koninklijk besluit van 01/06/1993 tot vaststelling van de technische voorschriften voor binnenschepen;
- Germany: Verordnung über die Schiffssicherheit in der Binnenschiffahrt Binnenschiffs-Untersuchungsordnung-BinSchUO) vom 7/03/1988;
- Denmark: (1) Industrieministeriets bekendtgørelse nr. 362 af 05/08/1980 om fastsættelse af tekniske forskrifter om skibes bygning og udstyr m.v.. Industrimin.j.nr. 900-B-79;
- France: Décret Numéro 88-228 du 07/03/1988 relatif au servive des bateaux de navigation intérieure destinés au transport de marchandises; Transposition de la directive CEE82/714.
- Italy: Decreto ministeriale del 28/11/1987 n. 572, attuazione della direttiva n. 82/714/CEE che fissa i requisiti tecnici per le navi della navigazione interna;
- Luxembourg: Règlement grand-ducal du 30/01/1985 concernant les prescriptions techniques des bateaux de la navigation intérieure;
- The Netherlands: Koninklijk Besluit van 16/07/1987, houdende bepalingen met betrekking tot de deugdelijkheid van schepen op binnenwateren, de inrichting en de uitrusting daarvan, alsmede ten aanzien van de arbeidsomstandigheden aan boord (Binnenschepenbesluit).

Consequences for inland navigation

Within Europe, different sets of regulations that define the technical requirements for inland navigation vessels exist. Efforts to reach reciprocal recognition throughout Europe of national ship's certificates without additional examinations have so far not been entirely successful. For instance, if no bilateral agreement is available stating otherwise, Danubian ships still have to go through a series of technical examinations in order to be allowed to sail on the Rhine. This situation creates unnecessary administrative and financial burdens [Valkar, 2001]. On the other hand, as was shown by Woehrling [2002], to date about 160 Danubian vessels have acquired the Rhine vessels attest (including 60 Austrian ships). The newer Danube vessels generally meet the requirements of the RVBR without any problems [Woehrling, 2002].

Hofhuizen [2002] states that the differences in content between the various technical regulations in force throughout Europe are probably not so significant that it is financially impossible for shipowners from outside the Rhine basin to satisfy the Rhine requirements. The real problem seems to be that a relatively small number of countries – the five CCNR member states – determine the safety standards to which the inland water operators from other countries have to conform, without these other countries having a voice in the establishment and the development of these standards [Hofhuizen, 2002].

The harmonisation of the conditions for the transport of dangerous goods by inland waterway has already been concluded by means of the European agreement ADN [Nedialkov, 2003]: the ADN-R and ADN-D regulations are largely harmonised.

2.4.4 Manning requirements and social standards

UNECE

At present, the UNECE is working on a Recommendation containing a pan-European standard for minimum manning requirements and working and rest hours of crews in inland navigation [Economic and Social Council, 2003]. Governments and river commissions are invited to transmit by 1 November 2003 their comments and proposals on this draft Recommendation. The various member states as well as the CCNR and the DC have shared their views and recommendations on earlier versions. The draft recommendations of the UNECE contain provisions as regards:

- the minimum number of crew members of a vessel ensuring the safety of its operation;
- the minimum age and qualification for various crew members;
- the required physical fitness of crew members;
- proof of qualification (service records);
- mandatory rest periods (depending on operation mode);
- the requirements on a ship's log and tachograph.

As regards the minimum crew number, a distinction is made for three types of operation:

- A_1 represents daytime navigation for a maximum of 14 hours;
- A_2 is semi-continuous navigation for not more than 18 hours; and
- B reflects continuous navigation for 24 hours and more.

European Community

With regard to working and rest hours, the EU adopted Directive 2000/34/EC laying down minimum requirements for working and rest hours in the transport sector, which is also applicable to inland navigation. The directive, which takes effect in 2003 and should have been transposed into national legislation by 1st August 2003, amended the existing Council Directive 93/104/EC which exempted mobile workers in the transport sector. The new directive does include mobile workers, and requires a reduction of weekly working hours to an average of 48 hours by the end of the transitional period. Employers' and employees' organisations are required to introduce the necessary measures by collective agreement.

However, an important debate is going on about the question whether being present at the working location should be considered as working time. The SiMAP-judgment recently decided by the European Court of Justice in respect of medical staff defines working time as the time during which the employee is present and available for work.

This is in contradiction with some national laws on working times, e.g. the Netherlands Working Times Act (Arbeidstijdenwet en –besluit (ATW/ATB)) which defines compulsory rest times as the time during which a crew member is not performing tasks and is not compelled to do so. The regulations are also part of the Chapter 23 of Regulation on the Survey of Rhine Vessels. The ECJ judgment is being contested, so that the problem of working time has not been settled satisfactorily at European level for IWT workers.

EU rules on the size and composition of crews are under consideration.

As regards the enlargement of the European Union, the candidate countries concerned have agreed to a transitional arrangement which restricts the free movement of workers from candidate countries to the EU during a minimum two-year period from the date of accession. Depending on the extent of labour market disturbances these restrictions may remain in place for a maximum of seven years[7]

Rhine regime

Chapter 23 of the RVBR determines rules as regards the minimum size and composition of crews. Like the UNECE Draft recommendation, the size and composition of the crews are dependent of the vessel's length, the mode of exploitation (14, 18 or 24 hours/day) and the status of technical equipment on board.

Additionally, the CCNR governs the Agreement on social security of Rhine skippers ('Übereinkommen über die Soziale Sicherheit der Rheinschiffer'), which was agreed upon by the CCNR member countries in Geneva on 30th November 1979), which provides for the establishment of a central administration as well as a European agreement on the social security of persons working in inland navigation that includes Central, Eastern and Western Europe [http://perso.wanadoo.fr/ccnr2/De/Missions.htm]. The agreement defines the types of compensations for which the employer is responsible in cases of illness, maternity leaves, disablement, unemployment, etc. Under the terms of the agreement, the contract parties are obliged to determine the conditions for collective labour agreements as far as these are declared binding by the national administration.

Danube regime

No uniform regime regarding the size and composition of crews exists on the Danube. These issues fall under the jurisdiction of the individual Danube states [UNECE Group of Volunteers, 2003].

---

[7] See http://europa.eu.int/comm/enlargement/negotiations/chapters/chap2/index.htm

Collective labour agreements

Collective labour agreements for inland navigation, which set the requirements for labour conditions, exist in several European countries, among others in The Netherlands, Belgium and Germany. In the Netherlands, a collective agreement has been signed for a period of three years, which is declared generally binding. Examples of countries without collective agreements in inland waterway transport include Luxembourg and France.

In Austria, the collective labour agreement was cancelled by the employers in 2001. Since then a new agreement is being negotiated between the trade union and the Employers' Federation (Wirtschaftskammer). This agreement should define minimum wages and regulate maximum working hours and minimum resting periods.

A collective European labour agreement does not exist. Recently, the CCNR has proposed to develop a collective agreement together with employers, employees and government. The European European Transport Workers' Federation (ETF) has drafted a framework agreement for collective agreements in Europe.

Consequences for inland navigation

It is of imperative importance that manning and working hours regulations are harmonised in order to create good and equal working conditions throughout the Union. In the current situation, it is easy to use loopholes in the different national laws. Shipping companies can register their company in country A, hire crew members from country B, charter vessels from country C, and make contracts for captains in country D. As a result, vessel and crew conditions cannot be effectively checked and supervised. In inland waterway transport, labour inspection is not allowed to undertake checks on foreign vessels. In practice, the flags on vessels can therefore be changed during border crossing, in order to circumvent the regulations or to make use of the most favourable legal regime. As a result, tax payments and contributions to social and pension insurance funds are avoided. In order to provide a level-playing field for all companies in the IWT sector, regulations should be harmonised and observed.

For instance, in Germany no labour permission is needed for personnel from third countries on a vessel that is registered in Germany, whereas this is required in Austria. No labour permission is required in Germany for personnel on foreign ships operational in international freight transport either. For this reason, several companies are flagging out to Germany, in order to be able to hire workers from third countries without cumbersome administrative procedures. The main negative impacts of the current situation would lie in the social impacts on crew members and the potential impacts on the safety of navigation.

2.4.5 Boatmaster's certificates

UNECE

UNECE resolution No.31 contains recommendations on minimum requirements for the issuance of boatmaster's licences [UNECE, 2002b], but has no legal status as such.

European Community's transport acquis

In order to facilitate international traffic, Directive 91/672/EEC of the European Union provides for the mutual recognition by the member states of each other's boatmen's licences. The Rhine boatmaster's certificate is accepted as an EU Licence within the European Union. In order for a boatmaster with a Rhine certificate to sail on stretches of the Danube outside of the European Union (i.e. presently excluding Germany and Austria, and soon also excluding Slovakia and Hungary), he/she has to pass an additional examination as well as demonstrate practical experience with a minimum number of trips on the Danube. The same goes for all Danubian shippers – from EU and non-EU Member States – wishing to sail on the Rhine [Valkar, 2002].

Council Directive 96/50/EC of 23 July 1996 defines the minimum common requirements – defining minimum age, physical and mental fitness, professional experience and knowledge – which the applicant must meet in order to obtain a mutually recognised national boatmasters' certificate for inland navigation. Member States may impose additional requirements regarding in particular the knowledge of certain local situations. Moreover, in order to be authorised to navigate with the aid of radar, boatmasters must hold a special radar attestation.

As with the recognition of ship's certificates the provisions of Directive 96/50/EC could not be applied directly to the Rhine, but the 7th Additional Protocol to the Act of Mannheim allowed CCNR to recognise these licenses, as well as those of non-EU countries [UNECE Group of Volunteers, 2003]. An EU boatmaster's licence covering all EU territory does not exist to date, but the European Commission is considering further steps in this field [European Commission White Paper on Transport, 2001].

Rhine regime

The 'Rheinpatentverordnung' (Rhine License regulation) which is incorporated in the national legislative body of the member states of the CCNR defines all requirements needed to attain the five different boatmaster's certificates needed for Rhine navigation (e.g. 'Grosses Patent' for all vessel types; 'Sport Patent' for sports boats smaller than 25m; 'Behördenpatent' for steering boats of the waterway administration and fire squads). Additionally, the Rheinpatentverordnung defines the admission and examination procedures as well as the criteria for suitability and the circumstances for withdrawal of the licence. Each applicant has to show his/her physical and psychological suitability by means of a medical certificate. The knowledge of the river stretches and the sailing hours are to be proven by a 'Schifferdienstbuch' (shipping log or captain's log). This filled-in booklet is therefore a main basis for attaining the Rhine patent. Therefore, these booklets – which are issued by the national authorities – are uniform and meet minimum requirements. The member countries of the CCNR issue some 550 to 600 Rhine patents annually and extend the validity of about 400 licences [www.perso.wanadoo.fr/ccnr2/En/Patente.htm].

Danube regime

The Danubian countries who are member of the DC recognise each other's national licences. The DC has adopted Recommendations on the Establishment of Boatmaster's Licences on the Danube, but according to the UNECE Group of Volunteers [2003], it is uncertain to what extent the DC member states actually follow those Recommendations.

National legislation

The 'Rheinpatentverordnung' is incorporated in the national legislative body of the member states of the CCNR. Likewise the recommendations of the DC are expected to be incorporated into the national legislation of its member countries.

The 91/672/EEC Directive has been incorporated in national legislation, for instance in:

- Austria: Bundesgesetz über die Binnenschiffahrt - Schiffahrtsgesetz (Bundesgesetzblatt Jahrgang 1997, Teil I, Nr. 62, ausgegeben am 30. Juni 1997);
- Belgium: (1) Wet van 21/05/1991 betreffende het invoeren van een stuurbrevet voor het bevaren van de scheepvaartwegen van het rijk, (2) Koninklijk besluit van 30/09/1992 betreffende het stuurbrevet vereist voor het bewaren van de scheepvaarwegen van het Rijk met betrekking tot het goederenvervoer,;
- Germany : Verordnung über Befähigungszeugnisse in der Binnenschiffahrt (Binnenschifferpatentverordnung - BinSchPatentV) vom 15/12/1997;
- Italy: Decreto del Presidente della Repubblica del 12/01/1998 n. 24, regolamento recante norme di attuazione della direttiva 91/672/CEE relativa al riconoscimento reciproco dei certificati nazionali di conduzioni di navi per il trasporto di merci e persone nel settore della navigazione interna;
- Luxembourg: Règlement grand-ducal du 30/12/1992 portant application de la Directive n°91/672/CEE du conseil du 16/12/1991 sur la reconnaissance réciproque des certificats de conduite nationaux de bateaux pour le transport de marchandises et de personnes par navigation intérieure.

As an example, Directive 96/50/EC has for instance been transposed into the French *Décret nr. 2002-1104 relatif à l'équipage et à la conduite des bateaux circulant ou stationnant sur les eaux intérieures*.

Consequences for inland navigation

The European Commission's White Paper on future transport policy emphasises the Commission's efforts of further harmonisation of pilot certificates throughout the Community inland waterway network [European Commission, 2001].

It is claimed that the CCNR and the Danube Commission have made progress in terms of reciprocal recognition of boatmaster licences and patents [Woehrling, 2003]. The main theme of the second meeting of the joint ad-hoc commission of both river commissions has been the reciprocal recognition of each other boatmasters licences. The CCNR and DC concluded that both organisations should on work the development of harmonised 'Schifferdienstbücher' as an enabler of this recognition [Danube Commission, 2002].

The joint committee of the Danube Commission and the CCNR agreed that the reciprocal recognition of boatmaster certificates should have first priority [Nedialkov, 2003]. Based on a comparison, the requirements posed on boatmasters in the Rhine and Danube areas appeared not to fundamentally differ. Therefore, most Danube skippers can acquire the Rhine patent without many additional requirements. The only critical issue is formed by the know-how of specific waterway stretches [Woehrling, 2002]. Subsequently, also the reciprocal recognition of certificates for the use of radar and radio should be realised [Nedialkov, 2003]. Of the outstanding harmonisation issues, the harmonisation of boatmaster certificates has proceeded relatively well [Nedialkov, 2003]. The way towards reciprocal recognition of boatmaster certificates between Danube and Rhine has been opened through the adoption of the Additional Protocol Nr. 7 by the CCNR (22nd November 2001). The different legal status of the Danube Commission (recommending character) and the CCNR (regulatory character) can pose certain difficulties for the complete harmonisation of legal basis for the issue of boatmaster licences. The Danube Commission is optimistic that the upcoming revision of the Belgrade Convention can solve these legal problems [Nedialkov, 2003]. Additionally, both river commissions take part as an observer in the European process of revising the Directive 96/50/EC to attain a European boatmaster's licence.

The European Transport Workers' Federation (ETF) asserts – as opposed to what is agreed on paper – that in practice the reciprocal recognition of boatmaster's licences is by no means harmonised. Certificates are checked intensively in the one country (or even a new exam is required), while in other countries these documents are more easily accepted. This situation would undermine the equal treatment principle and fails to ensure an equal and sufficient level of experience and education on board.

2.4.6 Liability regimes (civil law)

UNECE

A first attempt towards uniformity in intermodal liability arrangements was the 1980 UN Convention on Multimodal Transportation of Goods (MT Convention), which however has failed to attract sufficient support to enter into force [UNECE, 2002].

Meanwhile, the UNCTAD (United Nations Conference on Trade and Development) and ICC (International Chamber of Commerce) developed uniform rules for multimodal transport documents: these Model Rules – adopted in 1992 – have gained world-wide recognition and are used as a basis for several widely used standard transport documents, such as in the FIATA combined transport bill of lading and the BIMCO/INSA COMBIDOC [http://r0.UNCTAD.org]. However, these rules are contractual in nature – not law itself – 'and therefore are by definition subject to any applicable mandatory law and are thus not an effective means of achieving international uniformity' [UNCTAD, 2003].

Recently, the UNCITRAL – United Nations Commission on International Trade Law – has started preparing an international instrument on multimodal door-to-door transport involving transport by sea. This instrument would also apply to carriage by inland waterway before and after the voyage by sea [www.UNCITRAL.org]. In line with this, UNECE undertakes ongoing work on the possibilities for reconciliation and harmonisation of civil liability regimes governing combined transport.

CMNI – Budapest Convention on the Contract for the Carriage of Goods by Inland Waterway

The Danube Commission, the Central Commission for Navigation of the Rhine and the UNECE have jointly prepared the CMNI, which is intended as a harmonised convention to deal with the contract for the carriage of goods by inland navigation. The CMNI is valid for all transport contracts involving international inland waterway transport. It defines harmonised rules as regards:

- The liability of the carrier after loss or damage to the cargo transported;
- The conditions that exempts the carrier from liability.

The convention was originally signed by eleven European states on the 3rd October 2000 and defines the circumstances under which the carrier is liable for any damage or loss of the cargo he has transported. Moreover, it states that the shipper is liable for all the damages and costs incurred by the carrier if dangerous or polluting goods are not marked or labelled in accordance with the applicable international or national regulations or, if the necessary accompanying documents are missing, inaccurate or incomplete. Explicitly excluded from the scope of the convention is the carrier's liability for loss or damage to the cargo caused during the time before and after the goods are on the vessel [Klemens, 2002].

The CMNI further defines the contents of necessary transport documents (e.g. name, domicile, registered office or place of residence of the carrier and of the shipper, the consignee of the goods, the name or number of the vessel) and the maximum sum of liability (e.g. if the carrier is liable for total loss of goods, the compensation payable by him shall be equal to the value of the goods).

The current status of the CMNI convention shows that 16 countries have signed, whereas only Hungary has actually ratified the agreement [http://www.unece.org/trans/conventn/sc3_cmni_legalinst.html]. A minimum of five states should ratify the convention without reservations before the convention enters into force.

Countries such as Germany have indicated that they will only ratify the convention if all other Rhine riparian states do the same. It is suggested by Klemens [2002] that the CMNI convention be a topic for the joint ad hoc committee of the CCNR and the DC in order to improve international legal uniformity.

CRTD - Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels

The existing Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels (CRTD) of 1989 has only been signed by Germany and Morocco, and never entered into force. The main obstacle for the countries that did not sign the convention proved to be the high limit of liability – a maximum of 15 million special drawing rights (SDR).

Therefore, there still remains a need to harmonise the liability for damage caused during the transport of dangerous goods. Therefore, the IVR submitted a draft European Convention on liability for damage in connection with the carriage of hazardous and noxious substances by inland waterways (CRDNI) to the Rhine and Danube riparian states in 2001. The further development of the Draft CRDNI Convention is mentioned by IVR [2002] as an important step towards the harmonisation of liability within inland waterway transport sector. The CRDNI is based on the corresponding convention for maritime shipping of the International Maritime Organisation (IMO) and is ready to be negotiated. The UNECE was invited to participate in formulating the CRDNI, but has chosen to continue the work of the CRTD.

European Community

Within the transport acquis no civil law aspects are incorporated, and should not be because such matters are commercial law.

Rhine regime

Germany, France, Luxemburg, Belgium, the Netherlands and Switzerland have signed the Strasbourg Convention on the Limitation of Liability of Owners of Inland Navigation Vessels (CLNI) on the 4th of November 1988. The CLNI agreement harmonises laws regarding the limitation of liability for ship owners, rescue and salvage forces and transport insurance companies that insure claims resulting from the CLNI agreement. It is based on the principle of the personal liability of the vessel owner or salvor limited to specific amount. The aim of the CLNI is the harmonisation of limitation of contractual and non-contractual liability particularly on the Rhine and the Moselle. The CCNR is the depositary of the convention, which can be acceded by other states (many have been invited to do so).

To date, the CLNI has been ratified and incorporated in national law by Germany, Luxemburg, the Netherlands and Switzerland. Belgium is facing difficulties in implementing the convention [Klemens, 2002], while France is preparing ratification.

Danube regime

The DC has no legal competencies to define or issue civil law itself, but for instance played a role in the preparation of the CMNI convention.

National legislation

At the national level (within the EU) The Netherlands and Germany have specific regimes on intermodal transport. German law provides for a network system in case of localized damage. Carrier's liability for loss of or damage to the goods and delay in delivery is determined by the law applicable to the leg in the course of which the relevant incident occurred. All other rights and obligations of the parties involved are governed by the general transport law [UNECE, 2002]. In the Dutch system, if loss or damage occurs during a combined transport involving road, rail, sea and air transport and it cannot be established at what stage of carriage the damage took place, then the liability of the combined transport operator will be determined by the rules and regulations governing the mode of transport which impose the highest level of liability on the operator [IVR, 2000].

Consequences for inland navigation

Liability rules and contract law are still mostly based on national regulations, and are therefore not harmonised on an international level. This relative legal uncertainty entails a number of practical obstacles to the further development of inland navigation. First, it may cause unnecessary litigation and may raise the insurance costs of transport operations [UNECE, 2002b]. Second, as uncertainties exist about rights and obligations in case of differences or damage, inland waterway carriers could be prevented from accepting transport jobs offered, and shippers from using the services of the inland waterway transport industry.

Steps to improve this situation have already been taken or are currently under consideration, in the form of the CLNI and CMNI Conventions mentioned before. In addition, the UNECE studied the possibilities for reconciliation and harmonisation of civil liability regimes governing intermodal transport. Expert hearings with representatives of shippers, freight forwarders, insurers, maritime, road, rail and combined transport showed that there was a large consensus on the principle of achieving more transparent, harmonised and cost-effective rules to regulate multimodal transport. When talking about solutions, two diverging opinions were distinguished. On the one hand, maritime representatives, freight forwarders and insurance companies generally were not in favour of the preparation of a new Convention with an international mandatory legal regime on civil liability covering multimodal transport operations. On the other hand, shippers, road, rail, and combined transport operators strongly recommended to harmonise the existing modal liability regimes by developing a single international civil liability regime governing multimodal transport operations [UNECE, 2002].

2.4.7 *Transport infrastructure*

UNECE

Under the lead of the UNECE the European Agreement on main Inland Waterways of International Importance (AGN) has been agreed in 1996. It defines the list of important European waterways (E-waterways) as well as ports (E-ports). Additionally, it contains a series of recommendations for the technical and operational characteristics of these waterways (e.g. restrictions of draught – less than 2.50m – and of minimum height under bridges – less than 5.25m – can be accepted only for existing waterways and as an exception). The AGN therefore establishes uniform infrastructure and operational parameters to which future E-waterways should conform. As a recent success, the Russian Federation signed the AGN agreement on the 29th August 2002, to join the 13 other European countries. Austria, Finland, France, Germany and Greece are expected to sign the AGN soon as well [www.unece.org/trans/news/20020705e.html].

The UNECE have updated the list of most important bottlenecks and missing links in the E-waterway network in October 2002. In December 2002, the DC had not yet received data from member states as regards planned or required construction activities on the Danube. This lack of data on initiatives is a disadvantage in planning and acquiring international funding. It was proposed to deal with this question together with the corridor management of Corridor VII and other international organisations.

European Community's transport acquis

The TEN Guidelines / Decision 1692/96/EC of 23 July 1996 on Community guidelines for the development of the trans-European transport network, which aims at providing guidelines to build up a transport network on the European level. Linking up with the previous Council Decision the Regulation 2236/95/EC of 18th September 1995, lays down general rules for the granting of Community financial aid in the field of trans-European networks.

The Decision 1692/96/EC was amended in 2001 to include inland ports and intermodal terminals into the plans. The report of the Van Miert – High Level Group on the Trans-European Transport Network is part of a broader review of the Community guidelines for the development of the trans-European transport network. The group confirmed the need to reformulate the Decision 1692/92/EC. It also found that six years after the adoption of Decision 1692/96/EC only 20 per cent of the projects planned for 2010 had been completed [Van Miert, 2003].

National legislation

The funding and legislation as regards the planning and construction is still mainly a national matter.

The situation on the German Danube stretch between Straubing and Vilshofen, and the national opposition against this in spite of the strategic importance of this bottleneck from a European perspective, showed that the national legislation overrules international recommendations. National governments cannot be forced to realise construction works, but encouraged to do so by means of financial EU contributions.

2.4.8 Miscellaneous legislative issues

The last section deals with miscellaneous legislative issues that are dealt with by only one of the actor groups mentioned in section 2.3 – mostly the European Community. In order to achieve integration of the European inland waterway market, fair competitive conditions are required, especially in the field of social regulations, fiscal laws, and the control of state aid [Woehrling, 2003]. Neither the CCNR nor the DC has any direct legal competence in these fields, they can however provide advice to the European Commission.

Navigation police regulations

Navigation police regulations have been harmonised across Europe to a large extent. The basis for these regulations is formed by the CEVNI agreement – European Code for inland waterways – which was formulated under the responsibility of the UNECE [UNECE, 1998]. The CEVNI consists of seven chapters:

- Chapter 1: general provisions;
- Chapter 2: marks and draught scales on vessels;
- Chapter 3: visual signals (marking) used on vessels (e.g. lights, boards, flags);
- Chapter 4: sound signals on vessels – radiotelephony;
- Chapter 5: waterway signs and marking;
- Chapter 6: rules of the road;
- Chapter 7: berthing rules.

The implementation of CEVNI on international river systems such as the Rhine and Danube is reflected by the Rhine Navigation Police Regulation (‘Rheinschifffahrtspolizei-verordnung’) and the Basic Provisions relating to Navigation on the Danube (DFND) of the DC. The contents of the CEVNI agreement are adopted in these regulations and is supplemented by specific additional regulations for the rivers involved.

The navigation police regulation of the CCNR and the recommendations of the DC have been translated into national regulations, such as the German ‘Rheinschifffahrtspolizei-verordnung’ and the Dutch ‘Rijnvaart Politie Reglement’. These two national regulations are therefore identical with the Rhine Navigation Police Regulation.

In addition to the police regulations for international river systems (e.g. Rhine, Danube, Moselle), each nation usually has its own general navigation police regulation. To name a few examples:

- Austria: ‘Wasserstraßenverkehrsordnung’
- Germany: special Police Regulations for the Rhine, Danube and Moselle exist (determined by the respective river commissions), while the general ‘Binnenschifffahrtsstraßenordnung’ is applicable to the remaining German waterway network (including for instance the Elbe).
- France: ‘Règlement général de police de la navigation intérieure’
- The Netherlands: ‘Binnenvaart Politie Reglement’

The contents of these regulations are usually also in line with the contents of CEVNI, the only fundamental difference lies in the second part – the rules for specific stretches of the national waterways.

Fiscal regimes: infrastructure accounting system

The advantage of fiscal harmonisation on a European level lies in harmonising competitive conditions for companies in different Members States. This advantage has however to be balanced by national policy and tax objectives. The taxation on mineral oil is an important tax with impacts on international competition in the transport sector. Two directives have been adopted in 1992 to determine minimum taxation levels for several mineral oil products (sometimes set at zero) [Lyons, 2000]. This legislation had hardly any impact, due to the large variety of exemptions allowed, including an exemption for the waterway sector. Therefore taxation in the inland waterway sector is still mostly a national matter. Harmonisation efforts (e.g. proposal of the Commission in 1997) have to date failed, due to the highly controversial nature of the tax harmonisation problem and the required unanimous vote of all Member States [Lyons, 2000].

An example of a general environmental tax scheme, which is also applicable to inland navigation, is the Dutch ‘Energy Investment Rebate’ (EIA), which has been in place since 1997. The EIA alllows for tax reliefs of up to 55 per cent. Costs made for environmentally friendly investments (e.g. more efficient engines) can therefore be subtracted from the gross profit that is liable to taxation. The list of projects and technologies that are eligible for these tax reliefs is updated every year, following proposals from private persons and organisations.

Border controls

To increase the fluidity of movement of road and inland waterway transport within the Community but to maintain, nevertheless, controls performed pursuant to Community or national law. Council Regulation 4060/89/EC of 21 December 1989 on the elimination of controls performed at the frontiers of Member States in the field of road and inland waterway transport was introduced.

In addition Council Regulation 3912/92/EC of 17 December 1992 on controls carried out within the Communities in the field of road and inland waterway transport in respect of means of transport registered or put into circulation in a third country, was developed to prevent the disruption of the transport market organisation and to ensure road and inland waterway safety.

State aid

The state aid policy of the European Union is based on the EC Treaty (mainly articles 87 and 88). These articles basically forbid any aid granted by a Member State that may distort competition, whilst defining the circumstances under which exemptions can be granted for subsidies to individual companies (e.g. in areas with an abnormal low standard of living). From these basic provisions secondary legislation and guidelines have been developed.

Transport Regulation 1107/70/EC of the Council of 4 June 1970, amended by the Regulation 2255/96/EC, deals with the granting of aids for transport by rail, road and inland waterway transport. The 1996 Regulation has been designed to facilitate the development of inland waterway transport, in the form of investments in the infrastructure of inland waterway terminals or investments in the fixed and mobile equipment needed for loading and unloading. The aid granted may not exceed 50 % of the total investment. The beneficiaries must comply with the detailed arrangements laid down by the Member State. In addition new guidelines for rescuing companies in difficulty were adopted in 1999. Schemes to aid combined transport, including IWT, have been reviewed elsewhere in this Report.

In the Netherlands, different forms of state support to promote inland navigation are in force. The SOIT (subsidy scheme for public inland terminals) and the SBV (Subsidy scheme for company access to waterways) are the main instruments in opening up new or maintaining existing catchment areas for inland waterway transportation. The French Embranchement Fluviaux, the Belgian Public Private Partnerships for loading and unloading installations, and the British freight facilities grant (FFG) – as foreseen in the Transport Act 2000 – serve a similar purpose. In the UK, any company wishing to move freight by inland waterway may apply for the freight facility grant. The exact amount of the subsidy depends on the value of the environmental benefits and the need for subsidy as demonstrated by the financial case. Similar provisions are available in Germany under the Directive to promote intermodal transhipment interfaces.

Other forms of state subsidies that for instance exist in the Netherlands include subsidies for IWT co-operation platforms, subsidies for social projects in the IWT sector (e.g. for skippers who close their company), or subsidies for sector organisations.

Competition rules

The Treaty establishing the European Community expressly prohibits all agreements between business firms, which have as their object or effect the prevention or restriction of competition. Council Regulation 1017/68/EC of 19 July 1968 represents the separate body of competition rules that has been developed to deal with the specific requirements of the transport sector. This regulation forbids any actions, which prevent, restrict or distort competition within the European Union – such as sharing of transport markets or price agreements. There is however a broad range of exceptions to this general rule. These exemptions apply when transport services can be improved through co-operation, when the continuity of transport services can be increased, etc.

In addition, the Council Directive 96/75/EC on the systems of chartering and pricing in national and international inland waterway transport in the Community prohibits 'chartering by rotation' ('tour de rôle') after 1 January 2000, and effectively meant a liberalisation of the inland navigation market and has led to the elimination of some cartels of small ship-owners, which formerly existed in Dutch and Belgian inland navigation. On the Danube there still exist agreements between the formerly state-controlled national shipping companies, collectively known as the 'Bratislava Agreements' [UNECE Group of Volunteers, 2003].

Environmental law

The general framework for water policy on the EU level is provided by the Water Framework Directive 2000/60/EC of the European Parliament and the Council, which was amended by Decision Nr. 2455/2001/EC. One of the main objectives of this Framework Directive is to protect and improve ground water, and to limit pollution through emissions. Specific regulations for inland waterways include the Helsinki Agreement (Decision 95/308/EC of the Council to settle the protection and usage of international waterways. In this agreement, the framework for international co-operation to prevent and combat pollution is established. Additionally a specific agreement for the protection of the Rhine (Decision 2000/706/EC) already exists. For the Danube, the recommendation 2001/615 of the Danube Commission deals with the environmental co-operation within the Danube-Blacksea region

General regulations as regards the prevention of waste, which also apply to inland waterway transport, are Directives 75/442/EC, 91/156/EC and Decision 96/350/EC. In these Directives, the member states are obliged to give priority to waste prevention and to promote the recycling of material.

Structure and capacity

The Council Regulation 1101/89/EC, on structural improvements in inland waterway transport, deals with the scrapping scheme. The scrapping regulation of the European Commission is a programme under which inland navigation operators pay annual contributions to a scrapping fund: owners disposing of old vessels are paid a scrapping premium. This scheme had been complemented by an 'old-for-new' rule, which necessitated shipowner wishing to introduce new capacity to dispose of an equal amount of tonnage or to pay a substantial contribution to the national scrapping fund [Lyons, 2000]. This regulation expired in May 2003. That is, no vessels need to be scrapped before new vessels are built. The old-for-new mechanism will be kept stand-by for possible future in cases of serious disturbances of the market [Lyons, 2000].

2.4.9 Legislative framework in isolated waterway systems

Most of the legislative issues discussed in the previous sections deal with European law, or are mainly specified for the core inland waterway network of Europe, formed by the Rhine and Danube corridors.

The role of ‘isolated’ waterway systems in countries such as Portugal, Spain, Finland and the United Kingdom are thereby not always considered to the full extent. Therefore, in this section we will briefly discuss some specifics of the legal framework as regards inland navigation in some of these countries.

Portugal

In Portugal there is no separate authority which deals with legislation on inland navigation. For instance the *Instituto de Navegabilidade do Douro* is responsible for the management, maintenance and exploitation of the Douro’s seaworthy stretch. This institute is coordinated within the *Instituto Portuário e dos Transportes Marítimos (IPTM)*: the inland navigation therefore largely falls under the Portuguese Maritime Administration. The IPTM coordinates the competencies of maritime and inland shipping authorities and supervises, regulates and inspects the maritime and inland waterway sector [IPTM, 2002].

Spain

The same set-up basically goes for Spain as well: there is no separate body under the supervision of the Spanish *Ministerio de fomento* to deal with the inland navigation. All the relevant regulations are placed within the context of maritime law. This line of thought was also stipulated by Spain during the signature of the International Convention on Salvage (1989): the waters of ports, rivers, estuaries, etc., which are frequented by seagoing vessels are not considered as inland waters.

Finland

Finland adopted the European transport acquis during its entry to the EC in the 1995. Just as in Portugal, the Finnish Maritime Administration is responsible for sea routes and inland waterways at the same time. Under circumstances, legislation is applied both to sea and inland navigation. A list of recent regulations in force shows that Finland has adopted specific national legislation – to name a few – to deal with ice class certificates, double bottoms in tankers and fairway dues. The Finnish act on fairway dues (708/2002) for instance provides that fairway dues are collected by the customs authorities to cover costs it incurs from the construction and maintenance of public fairways. Any party engaged in commercial shipping on a registered Finnish or foreign ship in Finnish waters is liable to pay these dues. The amount of a single payment is determined on the basis of the vessel’s net tonnage and ice class.

United Kingdom

The administration of the British inland waterway network is in the hands of several (regional) authorities (for instance British Waterways, the Environment Agency, Bristol Port Company, Basingstoke Canal Authority, Manchester Ship Canal, etc.).

Each administration is entitled to develop its own regime for collecting tolls (track access charges) and technical requirements. The transport of cargo on British waterways has however been so limited during the last decades that legislation or even harmonisation of legislation is lacking. Commercial craft do not need to have a licence to navigate British Waterway's 'commercial' waterways but do require a Cargo Carrying Licence to use the 'cruising' or 'remainder' waterways. The Environment Agency is the navigation authority for the whole of the nontidal River Thames. This river is subject to a registration scheme together with a licensing system, and tolls for commercial craft.

In the past, the UK has tended to distance itself from EU inland waterway initiatives, arguing that the country's waterways are not connected to the continental systems. The UK has therefore not implemented earlier Directives (e.g. Directive 82/714/EC on technical standards for vessels, Directive 90/50/EC on reciprocal recognition of boatmaster's licences). There are no national guidelines and standards for technical requirements for barges, nor for boatmasters. In future however, the UK intends to implement the Directive amending Directive 82/714/EC which lays down technical standards for inland waterway vessels.

2.5 Conclusions

2.5.1 Main legislative problems

The analysis of the legal framework at different levels, as undertaken in this chapter, has revealed the main legislative problems at hand. Whereas traditional problems dealing with restrictions on transport rights for 'foreign' vessels are largely being eliminated through the EU-Enlargement, the main remaining issues are:

- Differences in technical regulations for vessels (ship's certificates);
- Differences in the manning requirements and social standards;
- Insufficient harmonisation of the civil law framework;
- Differences in regulations on boatmaster's licences.

These bottlenecks will briefly reviewed in the following sections.

2.5.2 Technical and safety requirements for vessels

The differences between the various technical regulations in force throughout Europe tend to be marginal. This is shown by the fact that for instance the newer Danube vessels generally meet the requirements of the Rhine regime without any problems.

The real problem seems to be that a relatively small number of countries – the five CCNR member states – practically determine the safety standards to which the inland water operators from other countries have to conform, without these other countries having a voice in the establishment and the development of these standards.

The Rhine standards are undoubtedly the dominating standards within Europe: the Rhine ship's certificate, the Rhine boatmaster's licence and the ADNR certificates are recognised by the EU as valid on the whole of the Community's waterway network. The political problem behind this is that – according to the European Commission – these rules should not be decided upon by the small group of CCNR members, but instead within the Community framework.

The new candidate countries will apply the Community's technical directive and acquire the Community's ship certificate in 2004. This certificate is – up till now – not yet recognised by the CCNR. This means that, unless the question of mutual recognition is settled between the EC and CCNR, the vessels of the EU member states will not have free access to the Rhine. A further condition for further harmonisation would therefore be that the contents of the existing legal instruments be kept identical and continually updated. In order to make this possible both parties should work together in preparing such modifications. The first important step in this direction has been made by the conclusion of the agreement between DG-TREN and CCNR, signed on the 3rd of March 2003.

2.5.3 Manning requirements and social standards

The EU Directive 2000/34/EC lays down minimum requirements for working and rest hours in the transport sector, which is also applicable to inland navigation. This directive should have been transposed into national legislation by 1st August 2003, but given recent jurisprudence, the problem of working time has not been settled satisfactorily at European level for IWT workers. It is of imperative importance that manning and working hours regulations are harmonised in order to be able to effectively check compliance with the laws. In the current situation, it is easy to find loopholes in the different national laws.

In order to reduce the negative side effects at the social level and safety on board, regulations on the employment of personnel from third countries therefore needs to be harmonised urgently. This was also concluded in an article written by Dr. Hubert Holland [Schifffahrt und Technik, 5/2003]: the upcoming enlargement of the European Union – apart from the transitional period for the free movement of people from Candidate Countries – does solely shift part of the problem towards the east of Europe. Harmonisation of regulations across Europe would not only make flagging-out and complex company structures – to avoid tax and social contributions – redundant. The company structures would also become clearer and more easy to monitor. If rules were the same all over Europe, international co-operation and co-ordination of the supervision of these rules would become feasible.

2.5.4 Liability

To date, liability rules and contract law are not harmonised on an international level. This may cause unnecessary litigation and may raise the insurance costs of transport operations. Steps to improve this situation have already been taken or are currently under consideration, in the form of the CLNI and CMNI Conventions. Within the framework of a series of expert hearings organised by the UNECE, it appeared that two diverging opinions were distinguished. On the one hand, maritime representatives, freight forwarders and insurance companies generally were not in favour of the preparation of a new Convention with an international mandatory legal regime on civil liability covering multimodal transport operations. On the other hand, shippers, road, rail, and combined transport operators strongly recommended to harmonise the existing modal liability regimes by developing a single international civil liability regime governing multimodal transport operations.

2.5.5 Boatmasters licences

The CCNR and the Danube Commission have made progress in terms of reciprocal recognition of boatmaster licences and patents. the requirements posed on boatmasters in the Rhine and Danube areas appeared not to fundamentally differ. During a recent meeting of the joint ad-hoc commission of the CCNR and DC the reciprocal recognition of each other boatmasters licences was central theme, and it was concluded that both organisations should on work the development of harmonised ‘Schifferdienstbücher’. A basis could be laid by harmonising education and training schemes and the establishment of minimum education requirements. This would simplify the reciprocal recognition of patents and certificates and moreover provide more guarantees for required competencies than in the current situation. The European Union should provide sufficient support for these types of harmonisation.

2.6 References

1 Central Commission for the Navigation of the Rhine (2000), Rheinschifffahrtspolizeiverordnung, Ausgabe 2000.

2 Danube Commission (2002), Bericht über das Treffen der Experten für technische Angelegenheiten, 2 – 6 December 2002.

3 DG Transport (1999), Guide to the Transport Acquis, October 1999.

4 Directorate–General for Energy and Transport (2003), Inland waterways: European Commission signs cooperation agreement with Central Commission for Navigation on the Rhine, in: Newsletter no.41 of 07.03.2003; Energy and Transport in Europe Digest.

5 Lyons, P.K. (2000), Transport policies of the European Union, EC Inform.

6 ECMT (2002), Modal Shift: Conclusions of the Seminar ‘The Inland Waterways of Tomorrow on the European Continent’, Paris, 30 January, 2002.

7 EUDET (1999), Evaluation of the Danube Waterway as a Key European Transport Resource: Final Report, submitted to the European Commission.

8 European Commission (2001), White Paper European transport policy for 2010: time to decide, Brussels.

9 Gnacek, L. (2002), The Bratislava Agreements: view on the actual situation and demands on the future development, 4th IVR Colloquium, ‘Challenges of a free and strong inland waterway transport in the pan-European field, 21–22 March 2002, Bucharest, pp. 32–36.

10 Hacksteiner, T. (2002), Legal Harmonisation in Inland Navigation, European Conference of Ministers of Transport, Seminar ‘The Inland Waterways of Tomorrow on the European Continent, 30th January 2002, Paris.

11 Hacksteiner, T. (2003), Towards a Pan-European system of river navigation, Draft Proposal 10th Febuary 2003.

12 Hofhuizen, C.F:J.M. (2002), The norms applicable on the Rhine: regulations concerning safety and environmental protection, 4th IVR Colloquium, ‘Challenges of a free and strong inland waterway transport in the pan-European field, 21–22 March 2002, Bucharest, pp. 52–57.

13 IPTM (2002), Portuguese Maritime Legislation, Instituto Portuario e dos Transportes Maritimos, Lisboa.

14 IVR (2000), Haftungsvorschriften für die Binnenschifffahrt: Fassung Januar 2000, Rotterdam.

15 Klemens, H.C. (2002), Status quo of international (draft) conventions (CMNI, CLNI, CRDNI): implementation and future development, 4th IVR Colloquium, ‘Challenges of a free and strong inland waterway transport in the pan-European field, 21–22 March 2002, Bucharest, pp. 58–63.

16 Martin, E. (1998), International Waterway in Crisis: the case of the River Danube, Transport Research Institute, Napier University .

17 Nedialkov, Danail (2003), Auf Donau und Rhein: Harmonisierung von Rhein- und Donauschifffahrt, in: Die Internationale Wochenzeitung für Verkehrswirtschaft, 27 Juni 2003, p.6.

18 Pan-European Conference on Inland Waterway Transport (2001), Accelerating Pan-European Co-operation towards a Free and Strong Inland Waterway Transport: Declaration adopted by the Rotterdam Conference

19 Schwetz, O. (2002), Maßnahmen im Bereich der Wasserstraße Donau, in: Verkehrskongress EU-Erweiterung und Verkehr – Was ist zu tun?, Helmut Pripfl (Ed.), 23 October 2002, Vienna.

20 UNECE (1998), CEVNI: European code for inland waterways: Revision 1, Economic Commission for Europe, Inland Transport Committee, Working Party on Inland Water Transport, New York and Geneva.

21 UNECE (1996a), European Agreement on Main Inland Waterways, done at Geneva on 19 January 1996.

22 UNECE (1996b), White Paper on Trends in and Development of Inland Navigation and its Infrastructure, Inland Transport Committee, Principal Working Party on Inland Water Transport, New York /Geneva.

23 UNECE (2002a), Conclusions of the Seminar ‘The Inland Waterways of Tomorrow on the European Continent , Transmitted by the European Conference of Ministers of Transport.

24 UNECE (2002b), Working Party on Inland Water Transport, Informal document No.1 transmitted by the Group of Volunteers on ‘Legislative obstacles’, Agenda Item 5, Preliminary Draft, 4 September 2002.

25 UNECE Group of Volunteers (2003), Inventory of existing legislative obstacles that hamper the establishment of a harmonized and competitive pan-European inland navigation market, Final Draft 3 July 2003.

26 UNECE (2003), Minimum manning requirements and working and rest hours of crews of vessels in inland navigation, Inland Transport Committee, 19-21 March 2003.

27 Valkar, I. (2002), Investment in Inland Waterways? – Infrastructure Needs, CEMT Seminar ‘The Inland Waterways of Tomorrow on the European Continent, 30 January 2002, Paris.

28 Van Miert (2003), High-Level Group on the trans-European transport network: Report, 27th June 2003.

29 Woehrling, J. (2002), Donau und Rhein arbeiten zusammen, in: Schifffahrt und Strom, Folge 180, 11/12 2002.

30 Woehrling, J. (2003), Schifffahrt vereinheitlichen: Zentralkommission für den Rhein und Donaukommission proben die Annäherung, in: Die Internationale Wochenzeitung für Verkehrswirtschaft, 13 Juni 2003, p.10.

31 Zentralkommission für die Rheinschifffahrt (2002), Schiffe der Zukunft: Schlussbericht, Strassbourg.

Chapter 3 Effects of infrastructure charging

3.1 Introduction

For the past 35 years, the introduction of an infrastructure charging system which is fair and equitable as between transport modes has been an aim of the EU. The desirable system is to be comprehensive in the sense that infrastructure users should pay both for the internal costs directly applicable to using roads, railways and waterways, and the external costs of congestion, ‘uncovered’ accidents, noise, air pollution and possibly effects on the landscape.

In practice, despite many studies and closely fought attempts to obtain Council and Parliament to approve relevant Commission proposals, the only EU measure passed so far has been Directive 1999/62/EC on levying fees for the use of certain roads by heavy commercial vehicles (better known as the ‘Eurovignette’ directive). In July 2003 the Commission proposed to supplement and amend this directive, principally by including in the costs to be covered those costs of road accidents not already dealt with by insurance and by better differentiating the charges in accordance with time of day, congestion level, type of vehicle and infrastructure etc. The proposal is limited to HGV’s (defined as minimum 3.5 tonnes gross vehicle weight) and thus does not cover all commercial road traffic.

The Commission’s Transport Policy White Paper of 2001 confirms that – as foreseen by the basic Treaty provisions – the other inland modes of transport should also bear appropriate infrastructure charges. Furthermore it has been announced that a proposal to extend the system to the external infrastructure costs will be made in due course and a new study of this controversial area of transport (and energy and environment) policy has been commissioned.

3.2 Method of Working

In this chapter it has been examined, the extent to which it may be possible - within the time frame of this study to 2010 and pending the completion of the Commission’s external cost study - to arrive at some conclusions on the economic effects on IWT if wide-ranging infrastructure charging systems were to be introduced.

Use has been made primarily of:

- the results of the UNITE study for the EU on marginal cost accounts of global effects on all modes (2003), the RECORDIT study for the EU (2001);
- the UIC study from IWW/Infras (2000);
- and a Prognos study of infrastructure costs and external effects of road and rail for Germany (2003).

3.3 Principles of Infrastructure Charging

Many earlier studies have shown the complexity and controversial nature of charging systems. Much of the revenue to meet the identified road costs comes in the form of direct taxes (e.g. on motor fuels and vehicles). This raises political considerations of budgetary policy: are these general revenues for the State or should they be dedicated to road infrastructure expenses? Can they be used to support transport policy which aims at modal shift and therefore used to help rail or water transport? Do the same considerations apply to road and bridge or tunnel tolls?

A second aspect is the possibility of accurately determining and assigning specific elements of infrastructure costs to particular users (vehicles, trains, ships). Most economists have, over the years, advocated a system of marginal costs in preference to other approaches , the latest proposal suggests an average over 5 years presumably as an approximation for certain categories, but using the (economic) lifetime of the investment for capital cost elements. Total cost coverage being a desirable aim, a problem may arise if ‘marginal’ costs do not cover total costs.

A further element to be considered is that technical improvements in vehicles and the infrastructure affect the costs caused by use, turning some external effects into internal ones or simply reducing external costs. Noise protective walls are an example of the first, improvements in engines and fuels one of the second type. (These points of course constitute only part of the problem of internalising infrastructure costs.)

The three modes do not produce the same external costs. For example, road accidents are more numerous than rail or waterway accidents. Similarly air pollution from fuels occurs basically on roads and waterways (except for diesel trains), but since the process of producing the electricity for rail haul has to be taken into account, some air pollution costs should be allocated to railways. In general, the so-called upstream effects, including the manufacture and maintenance of vehicles, locomotives/wagons and waterway vessels, have become part of the analysis of external effects.

An outstanding feature of waterways is that much investment may have to be made to prevent flooding causing serious damage; other natural phenomena such as silting may also cause costs; these waterway household charges should not – or only partly – be allocated to IWT. Similar considerations apply to hydro-electric production and it is unlikely that simple EU-wide formulas could be found for detailed cost allocation. Similarly, congestion may arise when ships have to wait at locks and costing systems would have to be devised to allow different allocation criteria.

The above outline should be sufficient to show the complexity of the subject and therefore the likelihood that much more time will be needed for the creation of a reasonably satisfactory system of infrastructure charges applied to the three modes. It seems quite unlikely that in these circumstances such a system will be introduced by 2010 and doubtful whether it would be in place by 2015. Nevertheless, the next section will look at

- earlier studies of external costs of IWT to obtain indications of their degree of significance
- examples in which such data are compared to the external costs of the other modes
- a qualitative assessment of possible modal shifts resulting from the introduction of full infrastructure charges including external costs

3.4 External Cost Studies

There is no lack of ***broad studies*** of the phenomenon of external costs, both in the technical sense, examining the types of air pollution, noise etc, and economic approaches ranging between the ‘strict’ application of marginal costing and a more practical method, which takes into account the statistical and other difficulties of such an approach. Indeed, as mentioned above, the Commission has instituted another ongoing study of external costs.

However, for the purpose of this Report, we shall look at four of the more recent, directly ***relevant studies*** of the subject:

- the RECORDIT (Real Cost Reduction of the Door-to-door Intermodal Transport) study for the EU,
- the EU funded UNITE (UNIfication of accounts and marginal costs for Transport Efficiency) study by the Institute of Transport Studies, Leeds,
- a recent Prognos report on cost structures of road and rail in Germany,
- the UIC study by IWW/Infras: External costs of transport.

A reference will also be made to the Commission’s ‘Marco Polo’ proposal in 2002.[8]

---

[8] Proposal for a Regulation by the European Parliament and the Council on the granting of Community financial assistance to improve the environmental performance of the freight transport system. COM (2002) 54 final, Brussels, 4.2.2002

3.4.1 RECORDIT

Starting with RECORDIT, the study has looked at three long international freight corridors or relations, transporting 40 ft. containers, to some extent based on 1997 data. Only one, the 1900 km journey from Manchester to Genoa contains a ***'tri-modal' solution*** involving 860 km of waterway, using the ***Rhine*** from Rotterdam to Basel. Of the three corridors, this is also the only one in which the multimodal solution offers cheaper transport than the road-only solution, although the road distance is about 200 km shorter.

To give some idea of the prices/costs involved, the tri-modal price would amount to € 2245 per loading unit (a full 40' container), as against € 2421 for the road-only. This advantage is almost entirely attributable to IWT which accounts for only € 245 or 11% of the total price. It should be noted that a 20 ft container doing the same journey could be shipped more cheaply by road than tri-modally (€ 1216 versus € 1412) but when 'costs' are compared, i.e. after removing the apparent profits or losses, the preferred solution would again be tri-modal. The problem here is of course that the various parties to the multimodal solution each have different internal cost structures and that from a strictly accounting point of view some would incur losses whilst others would make profits, on the basis of the average prices and costs recorded here.

When it comes to ***external costs***, there are ***two methodological aspects*** to note. In the first place the approach is one of estimated marginal costs, though here too some practical considerations may require averaging to be taken into account. In the second place the road-only solution included estimates for the costs of air pollution, global warming, noise, accidents (not covered by insurance) and congestion.

An attempt was made to widen the scope by considering the energy involved in the construction of vehicles/rail wagons and of the electricity used for rail transport. For IWT, the costs were essentially limited to direct air pollution from heavy diesel fuel and global warming effects. It was clearly stated that because of the rarity of IWT accidents and the even rarer occurrence of personal injury in such accidents, no significant figures could be produced. Noise could also be ignored and congestion, which might occur at times of high or low water levels could again not be reliably included.

In actual figures the study arrived at € 224 per loading unit for the road-only solution as compared to € 84/ LU (loading unit) for the tri-modal which breaks down as follows:

Rail (Genoa-Chiasso-Basel, Felixstowe-Manchester)	€ 24.1
Inland waterway (Basel-Rotterdam)	€ 36.5
Short sea shipping (R'dam-Felixstowe)	€ 14.4
Road post haulage	€ 8.1
Transhipments	€ 0.7
Total	€ 83.8

In view of the different methodologies it may not be strictly correct to relate these figures to the prices/costs shown above, but such a **comparison** at least provides a reasonable view of the dimensions involved. Charging external costs for the tri-modal solution would add 3.7% to the total, whilst charging them to the road-only solution would add 9.25%.

Looked at more specifically, the € 36.5 for the Rhine stretch would increase IWT prices by about 15% if the transporter decided to pass the full charge on to the customer. On the other hand, in the example quoted, the IWT transporter had a gross profit margin of € 29/LU which would allow some leeway for absorbing extra costs. The rail haul, however, incurs losses of 27% on the price charged, because of the very high incidence of 'other' costs, i.e. those not accounted for by depreciation, personnel, fuel consumption, maintenance and track user charges. If the external costs for rail of € 24 were therefore related to total rail costs, they would increase these by just under 3%.

3.4.2 UNITE

The IWT-related study of the UNITE project is again a very comprehensive one and at first sight useful for examining a similar stretch of the Rhine waterway as RECORDIT, i.e. Rotterdam - Mannheim. It explains its marginal cost approach, but immediately issues a stern warning that such an approach is unlikely to be a realistic one for waterway investment and maintenance costs and even external effects. To quote:

'Compared to the other modes of transport, the inland waterways sector has a special position, because marginal costs are virtually non-existent [whereas] other modes of transport will always incur some additional costs per additional vehicle (barge). The results of this case study cannot therefore be generalised to other modes of transport.'

Nevertheless, after reviewing its preferred Impact Pathway Approach to marginal costing, the study deals at length with the technical aspects of two categories of external costs on the Rhine: air pollution, including global warming, and accidents, whilst dismissing effects on water quality and soil as insignificant. Emissions of course are due to fuel consumption, which is reviewed in much technical detail for upstream and downstream movements and are then expressed in g per ton-km and valued per kg, but at different impact rates for the more densely settled Netherlands Rhine stretches than the German ones.

The study goes on to review in detail the 378 accidents in 1998 on this stretch, 57% of which occurred in ports, and arrives at a cost of 0.243 Eurocents per vessel-km, which would amount to € 2.1 for the Rotterdam-Basel stretch examined by RECORDIT and rather supporting the latter's view on the negligibility of accidents as external waterway costs.

In total, a range of 1.2 – 1.8 Eurocents per TEU/km for total external costs is advanced by the authors although the calculations for turning emissions into such values are not shown. If these values were used for the full Rotterdam-Basel stretch, they would amount to € 10.3 – 15.5 per TEU for the voyage. Even if they were doubled to allow for 40-ft containers rather than 20', they would be substantially lower than RECORDIT's € 36.5.

3.4.3 PROGNOS study

This Prognos report deals with road and rail transport, but analyses the general problems of infrastructure costs, including external costs, in a way that is also relevant to IWT.

It deals first with the wide range of approaches to the more ‘concrete’ aspects of direct infrastructure costs, i.e. investment, maintenance and operation. Here it highlights the wide gap between studies that essentially look at past expenditure and those guided by the ‘pay as you use’ future orientated approach. Again strongly divergent results would also be obtained if a commercial undertaking, rather than the government, owned and operated the infrastructure.

Turning to external costs (and ignoring the theoretically interesting, but in practice unimportant aspect of external benefits) the study points out that there is no market and therefore no price for these costs. As a result, quantification is subjective and may depend on social and political targets which in themselves are often controversial. Moreover, real relevant data may not be available.

Two basic approaches to monetary evaluation of external effects may be made: avoidance costs or damage costs. Avoidance costs estimate what would have to be spent so as not to incur the external effect. Here regulations to achieve the desired effect may be required, unless industrial progress already anticipates these and acts voluntarily. This is partly the case for road vehicles as regards fuel consumption, fuel quality and engine design. Progress here should reduce the effects of air pollution and climate change and would therefore result in lower remaining external costs. The process is fully relevant to IWT.

Damage costs present recognition of the fact that external effects have occurred. They can also be assessed in different ways, one of them being ‘willingness to pay’ on the part of those who suffer from the effects.

As regards congestion, the report on the whole considers that it is not an external cost, because the effects of congestion are borne by the other transport users, particularly in the case of road transport. Of course it remains a clear case of the economically inefficient use of infrastructures.

As noted, the Prognos study does not provide data for IWT, but for heavy goods vehicles in Germany external costs are estimated to be € 29 – 74 per 1000 tkm . If this were adjusted to cover the 1700 road km and the 40 ft container of the RECORDIT study of the Manchester – Genoa corridor, it would amount to about € 1085 – 2768 external costs per loading unit (22 t), as compared with the € 224 estimated by RECORDIT itself. Whilst German external costs may not apply to the same extent in the other countries crossed (UK, NL, CH and I), the fact that this estimate would be more than a 4.8 – 12 times higher suggests important differences in methodology and basic data, reinforcing the concern about getting realistic figures for external costs.

3.4.4 UIC study

IWW/Infras have mainly used the approach of willingness to pay to estimate the external costs of transport, in the form of country-specific average cost values for the EU countries, Norway and Switzerland and as short-run marginal costs of passenger and freight transport for specific corridors. They claim that in the case of environmental costs the magnitude of marginal costs for different modes of transport provides a more realistic picture than average costs. Only one corridor is of interest for us, the unimodal freight transport Rotterdam – Basle. Including costs of accidents, noise, air pollution, climate change, urban effects and up/downstream processes, a single road transport of a 40 t – vehicle generates € 28.6 per 1000 tkm, a rail- wagon load € 14.3 per 1000 tkm and an inland vessel € 9.8 per 1000 tkm. This suggests that rail causes 1.5 higher external costs and road 2.9 higher costs than IWT. The IWT costs result from air pollution and climate change.

In comparison to marginal costs the average external costs of IWT were estimated at € 15 - 25 per 1000 tkm in the six IWT-countries of the EU. Austrian and French external costs lie at the lower end of the range, Germany and Belgium in the middle and Netherlands and Luxembourg at the higher end. The mean value of the EUR 17 states for road is € 88 per 1000 tkm, for rail € 19 per 1000 tkm and for IWT € 17 per 1000 tkm. For all modes air pollution, climate change and upstream processes are the relevant indicators whilst accidents play an important role only for road transport; congestion costs are measured only by the marginal cost approach and herein they are also significant for road transport.

3.4.5 Marco Polo programme

The Commission's proposal for the Marco Polo aid programme included a table comparing the Europe-wide 'marginal average external costs' of transport by the various modes in terms of € per 1000 tkm.[9] As far as IWT is concerned, this source estimates them to be zero or negligible as far as noise, accidents, climate change and congestion are concerned. Pollution is estimated at € 3.0 per 1000 tkm, infrastructural (external) costs € 1.0) and taking into account minor costs in the previously mentioned categories, a maximum of € 5.0/1000 tkm is arrived at. This is compared with €12.35 for rail and € 24.25 for road transport, showing up very considerable advantages for using IWT. The report acknowledges that European averages would not necessarily apply in specific situations, but provide a broad comparison.

---

[9] See page 32 of COM(2002)54 final.

3.5 Conclusions

In the overview below, the ranges of external costs of transport are presented for the different modes.

road

0.6	(ca.) RECORDIT: marginal external costs
1.7	LSVA CH[1]: incl. health, damage of buildings, noise, accidents, uncovered infrastr. costs
2.4	Marco Polo proposal
2.9	IWW/Infras 2000 UIC study: marginal external costs
3.1	ZEW[2] 1998: Frankfurt/Main – Milano corridor
8.8	IWW/Infras 2000 UIC study: average external costs

1) Swiss Charge for heavy goods vehicles (already internalised!)
2) Centre for European Economic Research ltd. Mannheim, Discussion Paper No. 98-06

rail

0.1	(ca.) RECORDIT: marginal external costs
0.3	ZEW 1998: Frankfurt/Main – Milano corridor
1.2	Marco Polo proposal
1.4	IWW/Infras 2000 UIC study: marginal external costs
1.9	IWW/Infras 2000 UIC study: average external costs

IWT

0.1	(ca.) UNITE: marginal external costs
0.2	(ca.) RECORDIT: marginal external costs
0.5	Marco Polo proposal
1.0	IWW/Infras 2000 UIC study: marginal external costs
1.7	IWW/Infras 2000 UIC study: average external costs

Table 2. Ranges of external costs of transport for different modes (Eurocent/tkm)

The enormous gap between the above figures may to some extent be due to the use of different methodologies and points of departure. On the other hand it highlights the complexities and unresolved problems of internalising external costs.

The above review of the problems of and proposals for internalising or charging for external effects in transport has provided only two data-based comparisons of IWT and the other two modes. Whilst this example supports the generally held view that IWT has comparatively and significantly low external costs, the discussion also shows how complex the problems are.

Indeed little ‘scientific’ agreement exists so far across the inland modes of transport on:

- what to take into account,
- how to assess the effects that are not borne by transport users,
- how to provide monetary values for such effects,
- how to charge or, alternatively, internalise them, and finally
- how to use any revenues that might accrue from charging.

In these circumstances it would seem reasonable to emphasize the suitability of IWT from an environmental point of view and the advantages to be gained from a modal shift towards inland navigation. It would also seem reasonable to await the Commission’s announced further study of the subject before attempting to predict a potential shift towards IWT that might result from the introduction of a full and fair system of infrastructure charging.

However, one should not place too much hope in significant changes in modal split, as a result of the internalisation of external costs. The results of RECORDIT make it clear once again that in intermodal transport the internal costs of IWT are already very low compared to the other participating modes. The important internal cost categories in intermodal transport (as well as in IWT where origin or destination are not located on the water) are transhipment and pre or end haulage, which will remain the same or may even rise.

The charging of external costs is therefore unlikely to change the cost relations between the modes significantly, particularly where the competition lies between IWT (in an intermodal chain) and road. Perhaps this is regrettable, because the competition between IWT and road is dominated by high value goods which are not only the „growth’ part of the transport market but also the most profitable one and could therefore be of interest to IWT to develop more strongly. At the other end of the market bulk goods are admittedly more sensitive to changes in the relative prices of the different modes. In this segment, however, IWT already has a high modal share and the chances for increasing it seem slight.

PINE

Prospects of Inland navigation within the enlarged Europe

Part D Modes and competition

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

Chapter 1 Modal choice and decision criteria

1.1 Introduction

In reviewing the conditions of competition in IWT, road and rail goods transport, one needs first to look at the requirements of the market. Thus the aim of this chapter is to analyse the general decision-making process in logistic planning and to evaluate the role of IWT within that process.

The determinants of modal choice can be divided into hard and soft factors. Hard factors are based on rational calculations like weighing up costs and quality aspects. Soft factors reflect individual preferences of persons: decision makers, operators, etc. These preferences need not be the result of rational processes, but may well arise from prejudices, ignorance of facts or they may just be a matter of traditional history. Soft factors thus pertain to customer-carrier relationships, whereas rational choice addresses efficiency, reliability, organisational aspects (door to door service, just in time). In addition there are some cargo-related constraints affecting rational decision-making, like the need for specific transport units (secure vehicles, refrigerated boxes) or handling equipment. And finally the batch quantities and the speed of delivery do influence modal choice.

As a result it is not easy to define whether a commodity or a transport is suitable for IWT or not, i.e. whether the performance of inland navigation matches the customer's requirements. Nevertheless, some generalised statements about affinities to IWT shall be made.

1.2 Method of Working

In this chapter, the results of some concrete studies are presented in which the authors have carried out a large number of interviews with carriers and industry in order to provide information about the responsible actors of supply chains and their decision criteria for modal choice. One study on behalf of the EU: SPIN – "Scanning the Potential of Intermodal

Transport", has published its first deliverable.[1] Based on a comprehensive literature research on decision criteria in choice of mode for supply chains the study focuses on intermodal transport, but does not have a special view on IWT. This gap can be closed by the findings of the EU funded "Shifting Cargo" project, which concentrates on shifting potentials for IWT and therefore the effects of user demands on the choice of IWT. Then the foregoing was supplemented with results from previous and recent Prognos projects containing expert interviews on modal choice criteria and customer's requirements on transport operators. In many studies, user requirements and user preferences with regard to modal and route choice have been surveyed from the point of view of shippers, freight forwarders and transport operators.

The findings in this chapter are general and relate to all regional IWT markets. Therefore, the four corridors are not specifically addressed in this analysis.

1.3 Determinants and constraints of modal choice

1.3.1 Actors in the decision-making process

Each transport is initiated by a consignor or a consignee and there are several partners involved in its process. Since the planning of transport is always a part of company logistics, regardless of whether it concerns a single carriage or a regular flow of goods, the analysis of the decision-making process must look at the whole logistic chain rather than only on its transport element. These chains differ according to the degree of complexity and the number of actors.

There are simple chains with only a few actors, e.g. regular flows of crude materials carried directly from the exploitation site to a manufacturing location, using only one mode. In such cases producer and transport operator are usually closely connected and the organisation is relatively simple. On the other hand there are cargo sectors, especially those with high value products, which require a high degree of organisation, combined with special requirements on transportation (loading equipment, transhipment facilities, mode characteristics, quality aspects etc.). To meet these logistic requirements several actors with different responsibilities and different tasks are linked in a complex chain.

The SPIN project has analysed modal choice in intermodal transport for different market sectors and chains. The key actors in decision-making are mainly the shippers (consignors or consignees).

---

[1] NEA, MCA, NETR, NTUA, PTV, Rapp, TFK: SPIN - Deliverable1: Actors and factors in transport mode decision in supply chain, October 2002.

However forwarders, large road haulers and the big ocean shipping lines may also make decisions about the whole transport chain). A further category are logistic service providers and intermodal operators which organise door-to-door transport whose decisions relate to parts of a transport chain. Pure transport operators have rarely any influence on transport organisation.

Levels of influence	**Actors**
Possible decision-makers in total transport chain	Shipper (Consignor or Consignee) Shipping line
Possible decision-makers in total or in parts of transport chain	Forwarder Large road haulier
Possible decision-makers in parts of transport chain	Logistic services provider Intermodal operator (door-to-door services)
No participation in organisational decisions	Intermodal operator (terminal-to-terminal services) Ferry operator Barge operator Terminal operator Small road haulier

Table 1. Levels of influence of actor types on the decision-making process
Source: SPIN, Deliverable 1, 2002 (Origin: LOGIQ Deliverable 1, 1998)

The shipper who generates the freight may organise the transport himself or outsource the logistics to a forwarder or service provider. He can either determine the modal choice or leave the whole organisation to the forwarder.

The latter is asked to deliver a certain quantity of freight from point to point, possibly to meet specific quality requirements or to use a special transport mode. As forwarders often are road hauliers the choice of mode may be predetermined without checking any alternatives, because the responsible persons first have to optimise their company’s benefit by using own resources (manpower, rolling stock etc.), and will only look for alternatives if they operate at full capacity.

Where intermodal operators are involved modes other than road have a good chance, since these operators are mostly well informed about the characteristics of different modes. However, they usually co-operate closely with rail companies or combined transport providers. As inland navigation is to a large amount concentrated on shipping companies IWT is mostly represented by them within the transport chain.

We can conclude that choice of mode is mostly determined by the decision-maker and his particular interests. In many cases the decision-maker is connected with a carrier from a certain mode.

Customer-carrier relationships play therefore an important role in the decision process, particularly where they are based on long-term contracts and traditional history. If customers are content with the forwarder's organisation they do not require a check on possible transport alternatives.

From this point of view, fostering the use of IWT is best done by making efforts to become a member of the decision makers, i.e. to have strong representatives of IWT in these circles. Another important point is that decision-makers will not find an optimal solution for their specific transport problem without full knowledge of the conditions of available modes. As they would normally not spend much time in collecting this information themselves they should receive offers from the representatives or operators of the modes involved. Thus, one way of promoting inland navigation is by cultivating relationships to those actors who place transport orders. Research undertakings have built up on these ideas, for example the work on "Flexible transport chains" for the German Ministry of Research, or "Modal Shift in the Netherlands and Flanders".

1.3.2 Trends in transport markets

The decision-making process is affected by logistical trends: matching customer's requirements with transport offers is a dynamic process in the longer run. Whilst mode characteristics tend to remain relatively constant, the most important trends listed in Shifting Cargo are still valid:

- The share of transportation in the overall costs is declining, as a consequence of changes in the structure of goods, since the increased value per tonne of the product itself reduces the relative transport charge.
- New production methods call for a replacement of storage by transport, production being adjusted to transport needs: "just in time").
- Reduction of manufacturing depth (increase of division of labour).
- Global sourcing - lean production.
- Transport distances are increasing (growth of cross border traffic).
- Transport prices are being reduced due to increasing competition as a consequence of the liberalisation in the transport market and the enlargement of the EU.

As an effect on market requirements we can derive from these trends:

- downward impact on transport prices,
- increasing flexibility and availability of carriers and shipping space,
- increased frequencies and lower sizes of shipments,
- increasing transport speeds, leading to faster turnaround of vessels, vehicles and loading units as a result of shorter circulation times,
- growing reliability and punctuality (just in time),
- tougher security measures, severe requirements for handling sensitive goods.

Most of these factors are not helpful to inland navigation. The advantage of IWT is its high capacity.

This aspect is clearly not in line with the trend to declining batch quantities, increased frequencies and the pressure for ever shorter transit times. Small-sized shipments must first be grouped and bundled in an intermediate storage to make them suitable for mass transport. When time is short, however, the quantities cannot be made up, since the shipments must have the same destination. In this connection the further the distance of a consignee from the waterway transhipment point, the less efficient IWT becomes, because pre- and endhaulage is a high cost factor in intermodal transport.

There are further negative aspects for IWT. For example increased speeds and greater specialisation in transport sectors call for modernisation of the fleet. This is expensive and risky since there may be further changes in future transport trends that again require other attributes on ships, depending in turn on technical developments of loading units, vessels and transhipment facilities. Moreover, higher speeds are often not allowed on waterways as the increased waves would damage the waterway banks.

A further reduction in transport prices would worsen the financial position of many skippers, particularly in West European countries. As freight rates are often based on tonnage on specific origin-destination relations, the declining weight of goods coupled with increased cubic space requirements might become an additional factor for lower profits: the relatively high fixed costs in IWT strongly influence the average costs per tonne. In general terms, high flexibility is a problem for a slow mode which in this case is also tied to a geographically restricted network. The higher the specialisation the fleet, the less flexible IWT will become overall, but such problems can be overcome by technically constructing inland vessels for a maximum of flexible applications with respect to operating costs, draught, speed and affinity to the goods or the various loading units.

Another factor is to provide increased reliability. This can be a problem, especially on rivers which depend on the weather for water levels. Reliability in combination with short time frames is probably feasible for scheduled container services on the Rhine, possibly also on the Danube after it has been cleaned up.

There are, on the other hand, some advantages of IWT which do meet the trends in transport. For example where stock-keeping is to be replaced by transport, the relatively slow transport time of IWT can be considered as an economic value, where this time reflects a saving of storage time and results in reducing total production costs. Longer distances improve the cost ratio between transport and transhipment/storage, thus making intermodal transport with inland navigation more competitive. An enforced change in the fleet with declining capacities might lead to more reliability on rivers with relatively bad nautical conditions as water depth are no longer that much decisive.

Increasing transport movements lead to worse conditions of the road network, declining transport times and higher delays in road haulage. This strengthens the competitiveness of IWT and rail. The growing complexity of logistic chains calls for improved organisation in intermodal transport which in turn demands that transhipment facilities and handling equipment will be technically improved.

We have identified here various trends, some negative ones for IWT, some positive ones. At later stages of the PINE study, it has to be determined what needs to be done in order to best benefit from the opportunities that these trends are opening.

1.3.3 Affinity of goods to transport modes

How far a transport mode is able to meet the requirements of customers depends mainly on its specific characteristics. There may be additional performance criteria, which are determined by individual entrepreneurs, but even a good performance cannot compensate a disadvantage resulting from a specific system characteristic. Hence the system characteristics define the affinity of modes for particular commodity groups. The following Figure 1 shows, in addition to our earlier segmentation analysis, an affinity diagram, which places NST/R chapters in a three mode triangle where each mode has a scale from 0 to 100 % affinity.

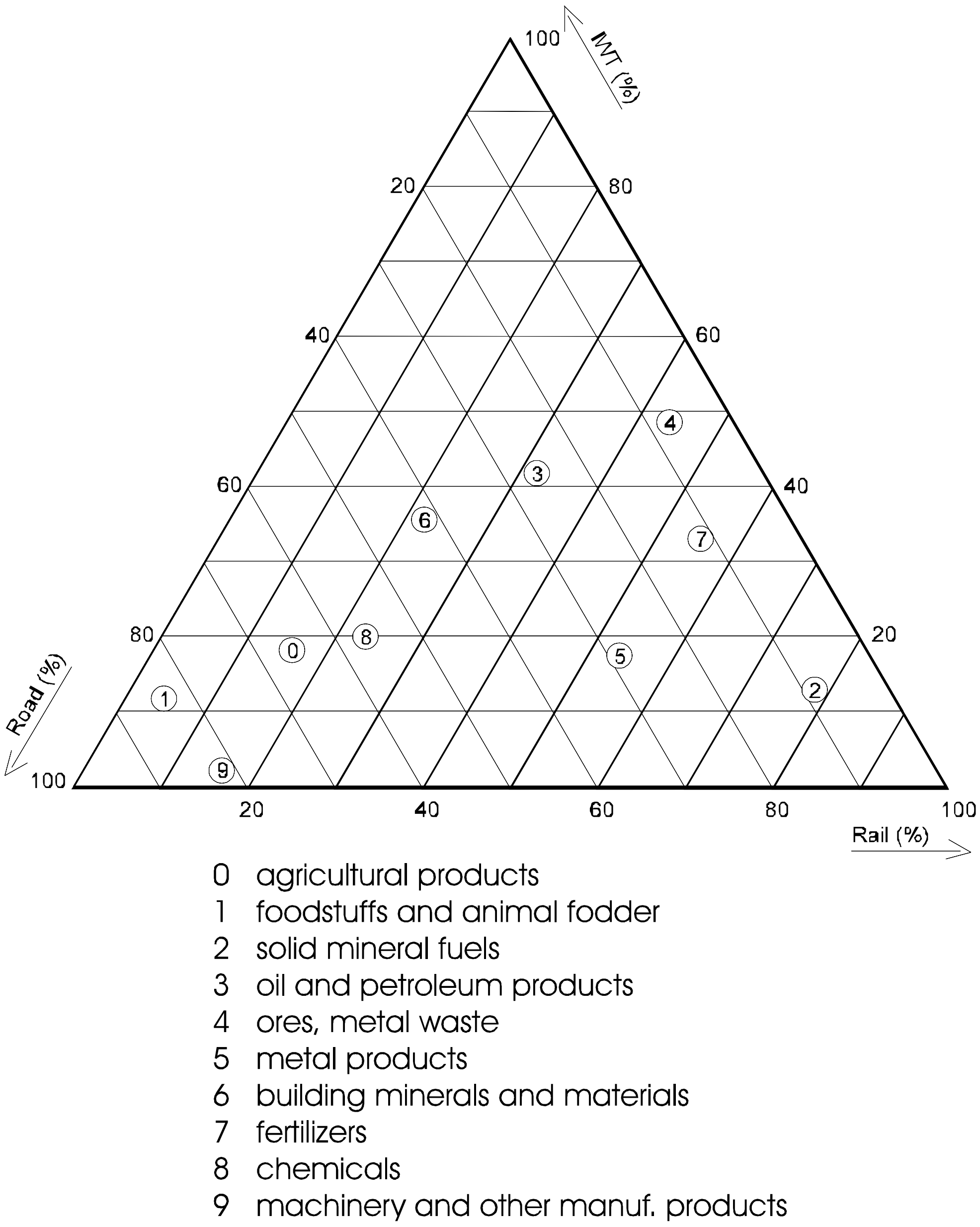


Figure 1. Affinity diagram
Source: Shifting Cargo 1998, Chapter 5 (Origin: Prognos, 1990/91)

The closer a commodity type is to a corner of the triangle, the stronger its affinity to a certain mode. From the number of commodities, which define an area of affinity, conclusions can be drawn firstly on its suitability and secondly on how flexible a mode is to differentiated demand.

In contrast to the most important types of shipments by road haulage, most rail shipments appear to have a stronger affinity to inland navigation. High shares of IWT and road haulage at the same time are unusual. Therefore the quantitatively largest potential for shifting transport to inland navigation is to be found in shipments by rail.[2]

We learn from the diagram on the next page that there must be shipper's requirements in the categories of agriculture, foodstuffs, manufactured products, processed chemicals, solid mineral fuels and metal products which are ***not sufficiently fulfilled by inland navigation.*** As we know well from previous analyses this does not mean that there is any commodity type which can absolutely not be carried by IWT. Nevertheless the affinity concept means there are goods which shippers consider to be more or less suitable for transport on inland vessels.

1.3.4 Infrastructure conditions

As is common knowledge the conditions of infrastructure often determine the modal split in different regions. This arises not only from the fact of the pure existence of some infrastructures, but specifically from their state of maintenance and their capacity. Whereas roads mainly have the problem of capacity dependent on vehicle flows, a problem that is nearly unknown in IWT, the conditions of waterways are strongly influenced by the weather. In both modes this means a factor of uncertainty to shippers of an inability to predict the exact time of delivery. However whilst in the case of road transport these problems may cause delays of a few hours, in IWT navigation bad water conditions may stop shipments altogether.

Thus, IWT on rivers with poor infrastructure conditions constitute a serious hindrance to the transport of most goods. Changing water depths during the course of the year and small but hard-to-predict variations in allowable draughts not only increase costs and reduce the efficiency of IWT, but also reduce the willingness of shippers to shift certain goods to transport by inland navigation.[3]

The affinity of a type of good to inland navigation therefore also depends on nautical conditions of the area travelled. While in the Netherlands and Germany, in the area of the Rhine river, inland navigation has reached a high degree of acceptance due to the advantageous nautical conditions as well as the high industrialisation of the surroundings, on the Danube river and on many waterways of the East and West corridor IWT acceptance levels are much lower, due to more difficult water conditions.[4] Recent draught and flood problems may have an adverse, sometimes even critical impact, in particular when they are interpreted as climate change.

---

[2] Shifting Cargo 1998, Chapter 5

[3] Shifting Cargo 1998, Chapter 5

[4] Shifting Cargo 1998, Chapter 5

1.4 Decision criteria of shippers

1.4.1 General remarks

Transport requirements generally do not differ according to transport corridors, but are based on:

- the characteristics of freight ('transportation sensitivity' i.e. perishable, fragile, oversized, sensitive to cold, heat or water) and
- the demands of the customer (technical or market specific requirements such as delivery time limits as well as subjective preferences).5

To a certain degree, the scope of the requirements may vary depending on the price of the transport services; this means that service quality provided may be lower than the quality originally expected, because of the price paid.[6]

How far requirements can be fulfilled by different carriers depends on the objective system specific characteristics rather than those applied by operators of a single mode. These quality criteria are in general[7]:

- speed,
- capacity for mass transportation,
- capacity to form networks,
- calculability,
- frequency,
- safety,
- comfort of transport service.

We shall now analyse how these indicators reflect the shipper's demand by distinguishing market "must"-criteria, resulting from user characteristics, type of goods and type of transport from the other, optional-choice criteria where quality aspects and costs can be traded off against each other.

---

[5] Voigt 1973

[6] Shifting Cargo 1998, Chapter 5

[7] Voigt 1973

1.4.2 Market criteria

From the shipper's point of view there are the following main modal choice market criteria:[8]

- The ***size of a company*** usually determines the volumes, frequency and regularity of shipments as well as the degree of outsourcing.
- The ***location of the shipper*** affects modal choice in several ways:
  - distance, both from sources for raw materials/other inputs and from outlet markets
  - distance from transhipment points for rail and IWT.

Though the decision on a company's location is mostly strategic, including the aspect of transport (costs and infrastructure), the actual transport conditions often are not the crucial factor in logistical planning; transport costs are therefore neglected. Furthermore decision makers often have insufficient knowledge about different transport options. Once logistic concepts have been decided and locations chosen, the transport mode is already set as "must" criteria to fit into the logistic chain.

As far as the kind of transport is concerned, requirements are based on criteria like

- ***Volumes, frequency and directional imbalances*** of transport: as mentioned above, volumes and frequency are directly linked to the size of the shipper and his logistical concept. In general, high frequencies in combination with small shipment sizes show great affinity to road transport. High transport volumes in combination with regularity (scheduled services) and availability of return load tend to be carried by rail and inland navigation.
- ***Loading structure:*** If shipment sizes are relatively small it depends on the logistic potential whether a number of shipments can be bundled to make them suitable for block train or inland vessel capacity (otherwise they must go by road). Forwarders must be able to organise an efficient distribution system to various destinations. Regularity of shipments travelling long distances contributes greatly to the cost-effectiveness of such part loads.

As regards the kind of goods, two main factors are relevant for modal choice:

- ***Loading requirements:*** Certain commodities require specific types of loading units. We can distinguish crude materials which to be carried in dry or liquid bulk, chemicals to be packaged specially to meet the regulations for carrying hazardous goods, perishable products requiring refrigeration and high value goods to be transferred in secure vehicles. In addition many commodities need special handling operations with different technical equipment, whilst perishable cargo needs to be delivered quickly. Whilst it cannot be said that such specialisations seriously hamper the use of inland navigation, a number of them suit road or rail rather than IWT.
- Intermodal loading units: The specific choice of an intermodal loading unit (container, semi-trailer, swap body) depends on the commodity and its type of packaging /shipping.

---

[8] SPIN 2002, Deliverable1

Palletised cargo, for example, is more suitable to be carried on swap bodies. as the measurements of these bodies have been harmonised with those of Euro pallets. Different loading units, however, are suited to different modes. As mentioned previously the international transport of intermodal cargo in Europe largely uses swap bodies and trailers which can be transhipped without using cranes by means of an efficient RoRo technology. Thus even if swap bodies could technically be stacked, how would this be compatible with the cost-effective technique of RoRo transhipment? The inherent disadvantage of high terminal transhipment costs in intermodal transport using inland navigation will therefore remain a serious hindrance to competitiveness for short or medium transport distances.

1.4.3 Quality and cost criteria

As noted, market criteria sometimes restrict modal choice insofar as certain requirements do not match system characteristics of specific modes. Over and above this, there are other criteria defining quality aspects closely connected to the customer's willingness to pay. Hence the components quality and costs are now treated together in situations where price will decide whether these additional requirements need to be met or not.

The following criteria may be seen as a competitive challenge for rail and IWT as against road transport. The four main quality aspects taken into account by literature are:[9]

- ***Reliability***: This is mainly concentrated on a delivery within the agreed time. Thus the criterion is measured by the number or probability and frequency of delays.
- ***Flexibility:*** This is defined by the time span between the commissioning and the execution of an order.
- ***Safety:*** This is measured by the probability or number and the size of losses or damage.
- Door-to-door transit time: The time period between pick up and delivery of a shipment is an important factor in modal choice, although depending on the commodity type. On the one side, there may be shipments that require quite short time frames as demanded by just-in-time concepts. In this case the transport mode is an integrated part of a specific supply chain. However, just in time does not necessarily mean a minimum delivery time, but rather the aspect of reliability because delivery delays would cause production delays would mean expensive losses. On the other side, a certain amount of transport time might be desirable since the transport mode can be interpreted as a sort of a moving storage, thus reducing warehousing costs. In this respect IWT as a slow mode has a comparative advantage.

---

[9] SPIN 2002, Deliverable 1.

There are other criteria like additional logistic services (transhipment, customs handling, preparation of transport papers, insurance, parking of containers and vehicles). Furthermore information and communication technologies and the use of tracking and tracing are becoming decision factors of growing importance.

Overall, the review of the SPIN project has shown that the majority of customers using intermodal transport is strongly ***cost oriented:*** this group of users will react promptly with modal shifts to road transport if alternative transport prices rise.

The ***quality-cost oriented*** group, on the other hand, interrelates the quality aspects of reliability, safety and flexibility these strongly with costs. This group has a longer-term vision of distribution operations and optimises logistic chains in terms of cost criteria. For example an increase in speed would allow a better turnaround of equipment, higher frequency would allow better use of warehouses, higher safety would lead to lower of insurance costs etc. This group represents an important market potential to intermodal transport as their decisions are based on economic reasoning so that improved performance or sharper competition between modes would lead to increased demand.

There is a third group - which we may call the ***traditional*** group - that barely uses intermodal transport and whose decisions are based on historical reasons (tradition), individual perceptions and regional specificities. They are unlikely to be convinced of alternatives whatever the rational arguments may be, but they make up only 20% of the sample investigated.

The result is that 80% of customers might become clients of rail and IWT, so that 45% are likely to decide on the basis of rational choice criteria. The prerequisite for shifting freight to alternative modes is better market transparency. This means actively informing the shippers and more competition. The latter can be achieved by improving performance (initiated by the enterprises) or by improving framework conditions, i.e. nautical, technical harmonisation and other measures as part of EU policy. Here again, we refer to the already mentioned research undertakings on “Flexible transport chains” in Germany, or “Modal Shift in the Netherlands and Flanders”.

1.5 Weighting of factors

This paragraph reviews the question of how to rank the criteria analysed above when applied by the shipping industry.

The Shifting Cargo study concluded that whilst the studies they reviewed were not directly comparable, they did provide basic trends. According to these, ***reliability***, ***speed*** and ***price*** were the decisive parameters for modal choice.

The SPIN survey came to the following more differentiated results:[10]

- cost/price is the most important decision criterion,
- reliability is the most important quality criterion,
- frequency of services offered is the criterion meeting the shipper's requirements best,
- regularity of shipments is a prerequisite for using intermodal transport,
- ***flexibility*** is the ***least*** important quality criterion.

Small differences can be identified among the factors as far as costs are concerned. For shippers, cost is the first factor, but reliability is also of major importance.

When choosing between road transport and intermodal transport the crucial factors in favour of intermodal transport are by far "a better price", followed by "matching the logistic structure", "higher security" and "others". Criteria that favour road transport are "higher flexibility", "shorter loading times", as well as "a better price" and "matching the logistic structure".

The Confetra study came to the following ranking:[11]

Reliability, ***price***, ***total time of door-to-door transport*** and ***flexibility*** (in this order) are most important factors. Other important factors that have not yet been mentioned are "the quality of the personnel of the transport operator" as well as "the possibility to negotiate the price of transport" and "long term contracts" that are often linked with "tradition".

The latter aspect was also often mentioned in expert interviews in Prognos studies, in particular as regards very complex supply chains. Since high value, sensitive goods require special handling by special transport equipment and during transhipment, the shippers, who in this case are mostly global manufacturers, need to bring transport operators into their logistic system. As they normally do the distribution planning themselves they generally do not work together with logistic providers or large forwarders but are mainly interested in medium-sized companies. By linking these firms closely to their company with long term contracts both parties will profit: the shipper can require investment in special equipment/special IT systems and in training the transport personnel whilst the transport operator is willing to provide the utmost flexibility, as he has security for his business and can apply long term planning. In order to find a transportation partner, large shipping companies often rely on good experience or recommendations from reliable persons.

These "soft" or subjective factors in modal choice should not be ignored while searching for measures to strengthen IWT. Improved performance in inland navigation must fit into the demand profiles of customers, and the performance profile of specific operators should become common knowledge to potential customers. Except for certain commodities with close affinities to road or rail, most of the above mentioned important criteria can be matched by inland navigation.

---

[10] SPIN 2002, Deliverable 1. The conclusions derive from the study LOGIQ, IQ and Confetra and are related to the use of intermodal transport.

[11] SPIN 2002, Deliverable 1, Table 8.

To weight the relative quality criteria for specific commodities an earlier Prognos study provides some answers (see below).

Demand	Agricultural products, foodstuffs	Solid mineral fuels	Crude oil, petroleum products	Ores, metal, build. mat., fertilisers	Chemicals	Machinery, manufact. goods
A Network density and infrastructure capacity	+	-	+	+	+	++
B Transport speed	+	--	-	-	+	++
C Supply of information and communication	+	-	+	-	++	++
D Just-in-time transport and flexibility	+	+	+	+	++	++
E Flexibility of transport supply	-	-	-	-	++	++
F Securing of goods value	+	--	--	--	+	++
G Security	-	+	++	-	++	+
H High capacity transport units	-	--	--	--	+	++
I High payloads	+	++	+	++	-	-
K Attractive transport prices	+	++	+	++	-	-

Demand is relatively -- insignificant - less important + important ++ very important

Table 2. Demand profiles of commodities
Source: Prognos (1992), Ost-West-Güterverkehr, Arbeitsheft 5, Endbericht

We can derive from this table that chemicals and manufactured articles (NST/R chapters 8 und 9) are the categories in which most of the criteria mentioned are of high importance. On the other hand, liquid and dry bulk goods do not call for many quality aspects, reflected in the need for attractive transport prices. As no distinction is made between agricultural products and foodstuffs this sector shows most of the criteria to be of relative importance. A further division of this sector into bulk goods (animal fodder, cereals) and foodstuffs (perishable goods etc.) would allow quality needs to be better distinguished. We can conclude that nearly all goods categories require reliability, both in infrastructure conditions and the expectation that a shipment will be delivered in time.

1.6 Conclusions

Following a summary of the main findings on the market requirements of transport customers we shall outline some conclusions on how far inland navigation can meet these requirements and what does this means in terms of future potential for using IWT.

The previous analysis provided insight in the decision-making process of the customers of transport supply. From this analysis that was based on important international studies we can draw the following conclusions.

As regards modal choice the most ***important actors in the decision-making process*** are shippers, freight forwarders and shipping lines. For parts of a transport chain there may be also logistic service providers and intermodal operators.

Shippers often base their choice on ***subjective criteria*** (tradition, experience and recommendations) without having sufficient knowledge about alternatives, because the transport markets in general are not very transparent. In such conditions modal choice is of limited rationality. Where shippers authorise forwarders to make the choice of mode the fact that these forwarders are often large road hauliers or closely co-operate with rail may restrict the choice even more. Shipping companies, on the other hand, tend to co-operate with IWT.

Mode choice is therefore not only a matter of different performance criteria for certain modes which meet the requirements for specific goods to a greater or less degree, but it is often a question of relationships between customers and carriers.

Fostering the use of IWT therefore requires having strong representatives in the decision makers' circles. It is also important to enlarge market transparency by informing decision makers about the supply conditions of IWT in general and of specific operators.

Other influences on the customer's requirements relate to a general ***trend in transport*** towards a better price-quality relationship. Whereas high value products require high quality, the mass transportation is accompanied by a strong price competition due to the loss of possibilities to differentiating the quality of supply.

Though customers' requirements generally do not differ by transport corridors, modal choice may be influenced by, e.g. the ***capacity of infrastructure*** of competitive modes in such corridors. As regards IWT the water level seriously affects performance and very important quality criteria cannot be respected in poor conditions. For example the advantage of IWT of high payloads no longer applies in case of low water. Reliability in the form of just in time cannot be guaranteed either. The promise of a consistent quality in this respect will be possible only by improving infrastructure.

Changing climate leading to more draughts or floods as in the recent past may have a lasting impact on IWT demand.

From the customers point of view there are particularly the aspects of reliability, frequency, total time of door-to-door transport and flexibility that are the ***most important factors in modal choice*** but strongly related to the transport price.

Most customers of intermodal transport are ***cost-oriented*** which means that the cost of transport is the most relevant criterion for the modal choice. It is also the most sensitive variable: Lower prices of competitive modes lead to a quick change in the transport mode, particularly from intermodal to road transport. The HGV toll charges being introduced in a number of countries including Austria and Germany, can be expected to have an impact on demand for IWT demand.

Quality aspects vary from one ***commodity to the other***. Bulk goods do have a strong affinity to mass transportation modes where an attractive price coupled with high transport capacity are the main modal choice factors.

In the case of foodstuffs, chemicals and manufactured goods, however, high transport quality requirements influence modal choice. The use, of inland navigation for such quality based transports is therefore highly dependent on meeting additional market criteria as regards ***loading structure*** and ***loading requirements*****.**

The ***main advantages of IWT*** of economic efficiency, surplus capacity and traffic safety, coupled with environmental friendliness, are therefore a competitive factor under certain conditions. Efficiency is strongly related to the volumes, the loading units and the distance as mentioned above. The environment is an additional factor of modal choice but clearly ranked by shippers below efficiency and quality needs. Similarly, capacity reserves are an aspect not to be overestimated in the discussion on modal shift, because the shipping industry takes it into consideration only as an additional benefit.[12]

The relative ***affinity of IWT to types of commodities*** can be summarised as follows:

An ideal structure for transport by IWT would include the following:

- goods shipped in large quantities,
- production sites located on waterways,
- goods to be transported to and from the hinterland of sea ports,
- goods transports that are not restricted by short time frames,
- goods of low value, especially in bulk, where IWT has a cost advantage,
- high value goods in containers,
- high value goods where IWT is fully integrated in a supply chain so that transport time on the vessel can save warehousing costs,
- high value goods on long distance intermodal transport where the cost advantage of long waterway transport can compensate transhipment costs and pre-/end haulage by road or rail.

A negative list, on the other hand, can be defined as follows: [13]

- small-sized shipments,
- shipments with short time slots, e.g. perishable goods,
- very sensitive goods (tropical fruits, or sensitivity to water or vibrations).

Goods carried in non-stackable transport boxes seem unsuitable for IWT lacking economic efficiency. On the other hand, Roll on/Roll off technology may be used for an efficient transhipment of machinery, vehicles, bulky agricultural machines, large building elements, etc.; in other words goods whose measurements are too large to comply with infrastructure and vehicle regulations by road or rail.

---

[12] Shifting Cargo 1998, Chapter 5.2.

[13] See Shifting Cargo 1998, Chapter 5.8.

The above leads to the final conclusion that there is no straightforward answer in which the direction IWT policy ought to be developed for maximum effectiveness. We know reasonably well the factors playing a primary role in modal choice and the advantages and disadvantages of IWT. It appears that strong marketing efforts are required in order to overcome misconceptions of shippers and freight forwarders regarding IWT weaknesses.

Chapter 2 Modal shift in practice

2.1 Introduction

This chapter will focus on practical experiences with effectuating modal shift. To be able to make statements on the potentials of modal shift on a European or corridor scale, it is necessary to start at the basis: to explore the interface between Inland Navigation and logistics chains. Only then, possible or desired modal shift developments can be outlined.

It has been concluded before that Inland Waterway Transport has traditionally been identified as a typical mode of transport for bulk goods. These are usually characterised by aspects such as a low value per tonne, large consignments and a rather low circulation speed. For these goods, such as iron ore, building material, coal and other raw goods, IWT is a rather logical choice and has thus been playing a main role for a long time. It has been concluded in before in this project (part B Demand) that the economic sectors shipping these kinds of goods will show low or marginal growth, if any. This means that, with the traditional bulk goods, the status quo regarding the modal split will largely continue. Growth for IWT sector will largely depend on goods transferred from other modalities.

Since about 10 years, active attempts have been made to arouse the interest of these other sectors. Regarding the bottlenecks in particular with respect to road transport, it is becoming more and more important to relieve the highly congested road transport and make use of the free capacities of the European Inland Waterways. This is central in the modal shift idea.

Over the past decade, there has been a growing interest for the concept: transferring goods flows from one modality to another. Usually it concerns goods flows, transported via road haulage, shifted to other modalities such as rail transport, inland waterway transport, shortsea transport and pipeline transportation. This 'shift' is believed to be beneficial for two main reasons:

- on the one hand to be able to guarantee a lasting accessibility of our economic and logistical centres (road congestion relief),
- and on the other hand to reduce, wherever possible, the unnecessarily negative effects of road transport on our environment.

Goods transport comprises shipping and transporting companies. By itself, this is a very fragmented constellation. However, many parties involved are becoming increasingly aware of possibilities and necessities to use alternative modalities for the handling of their flows of goods, in addition to road transport.

As they experience more and more hindrance from the ever-growing congestion, the deployment of multiple modalities (intermodal or multi-modal transport) ensures a certain 'risk spreading' in their transport activities. Pricing developments that distinguish among the main transport modalities used are of further impact and this is expected to grow. Inland navigation is, increasingly, an interesting alternative modality for certain categories of goods.

2.2 Modal shift experiences

European level

On the EU level, many projects and studies have been carried out to map the possibilities of modal shift. Until the beginning of the 90s, emphasis has laid mainly with technical aspects, ICT (im)possibilities, interoperability, safety, legal issues and other aspects at the supply side. During the past ten years, this is changing, as improving supply and supply conditions alone will not (literally) provoke modal shift-like developments. Examples of projects that cover both supply and demand are Shifting Cargo (1996 – 99) and SPIN (2002 – 2005). The EU White paper ‘European transport policy for 2010: time to decide‘ recognises the need to support both supply and demand. This results into initiatives such as the Marco Polo scheme.

In the following sections, experiences resulting from national modal shift policies of some EU countries will be central. We can learn from it, to assess the potential of Inland Navigation, as well as to map possible additional support activities at the national and EU levels. Conclusions will be drawn in the next section.

The Netherlands: Modal Shift Scans

For quite some time the Dutch Ministry of Transport, Public Works, and Water Management has paid due attention to the importance of modal shift. An interesting activity, carried out since 1997, has used an active and individual approach towards trade, industry and the transport sector. This has resulted in State-funded ***Modal Shift Scans*** that have been carried out at individual companies. Several hundred scans have taken place as part of four programmes[14].

---

[14] Modal Shift, Transactie Modal Shift, Modal Shift Gelderland and Logistieke Scans Gelderland.

Gradually a multidimensional approach was developed, including:

1 The original target of (literally) working on modal shift towards alternative modalities

2 Enhancing logistic efficiency: e.g. combining 'less than truckloads' to 'full truckloads'

3 Transport prevention: strategies to prevent transport movement from taking place, e.g. better packaging or printing newspapers at alternative locations.

In parallel, a large number of issues have been addressed, including the actual implementation of the scan results (drawing up of long-term plans to further implement secure the modal shift).

The scanning practice shows that many companies do not, or only partially, examine alternatives to road transport if they are not ***stimulated or assisted.*** Lack of time is a factor in this respect, but certainly also the ***insufficient knowledge*** of what rail transport, inland waterway transport and shortsea transport have to offer. This can be explained partly by the fact that shippers are focusing more and more on their core business and have contracted out transport and logistics to specialised companies. Especially if the costs of transportation constitute a relatively small part of the total production costs, multi-modal transport often tends to fall outside the scope of the management. At first, many companies therefore agree to a scan with a fair amount of scepticism, but the enthusiasm grows once they gain more insight into the possibilities of multi-modal transport and in the cost benefits that can be achieved.

During the year 2003, the attention has turned to the 'do-it-yourself-scan'; companies can have a larger role themselves, possibly with the help of an ICT tool (digi-scan).

Belgium / Flemish Region: VEMOS project

The Flemish Region (Belgium) has also conducted a project containing Modal Shift scans called VEMOS. The approach has been comparable with the Dutch one. Just as in the Netherlands, the scans were carried out at company level, combining the assessment of the current flows with concrete recommendations on possibilities to use alternative modes. The project has also aimed to generate insights on the part of the Flemish Region on how to continue modal shift policies. Hitherto the VEMOS project has not been continued.

Germany: Flexibele Transportketten

This project, which has taken place between 1997 and 2001, was carried out by the Federal Ministry of education and research. Its target was to demonstrate how innovative goods concepts and technologies can contribute to modal shift and intermodal transport, on the basis of concrete goods flows. Like the Dutch and Belgian projects, the approach has been multi-dimensional, aiming to establish modal shift as well as to enhance logistic efficiency. The activities comprised the defining of 16 demonstration programmes in which actors from all relevant parties were active, with the 'ultimate goal' of taking trucks off the road.

The Inland navigation projects were new container liner services, pre- and endhaulage, ICT tools and an intermodal transport concept onto the Elbe river.

2.3 General conclusions from Modal shift projects

In this section, some relevant conclusions of the projects named above will be drawn. In this respect, the following aspects have to be noted:

- First and foremost: the projects have not only looked at shifting goods flows to Inland Waterway Transport, but also to rail, shortsea and pipeline transport. In the text below results will narrowed down to IWT if possible.
- Modal Shift started with the clear objective of shifting goods flows to alternative modalities. Soon, however, it has turned out that enhancing efficiency in road transport is in many cases equally efficient (or sometimes even more) or easier to attain than modal shift. Thus, its role has grown.
- Every company is a case in itself. It can be rather difficult to draw generic conclusions.
- The companies are free to implement the results, or not. This has been surveyed afterwards.

Conclusion I: Modal shift has in this approach a significant chance of success

One of the main conclusions is that for many companies, modal shift constitutes a realistic option in the (near) future. In 80% of the companies scanned, possibilities have been established at the same or at a lower level of costs. It turns out to be possible to quickly implement a shift. The growing interest in industry in modal shift, the increasing possibilities on the supply side and the government / EU policies to support and create the proper preconditions are factors enhancing the potential.

Conclusion II: The approach is also beneficial for smaller companies and for less voluminous flows of goods

In the modal shift projects, it has been attempted to also include SMEs (less than 100 employees). It has been tried to map the possibilities for smaller flows of goods, also in larger companies. The goal in that respect was to establish whether, in addition to the larger and medium-sized companies, modal shift could be of benefit to the smaller companies as well. The participation by smaller companies (18%) and the results obtained, which do not differ markedly from those of larger companies, demonstrate that modal shift is also ‘coming alive’ for this category.

Around 66% of the flows analysed for the smaller companies can be ‘shifted’. The success of a modal shift for these companies, as well as for smaller flows of goods depends especially on whether it can be linked up with existing supplies of services.

Conclusion III: To an increasing degree, opportunities are offered for relatively high-quality goods with fast turn-around times

From the analysis of interested companies, it is clear that the share of companies from sectors, which have traditionally been oriented towards modal shift, is again high this time around. In this connection one can think, for instance, of the sectors involving the chemical industry and the food and leisure goods industry, with a share of 28% and 20% respectively. But also companies, active in the automotive and electronics industries (10%) are highly interested. The conclusion must be that the interest for alternative modalities is beginning to develop a broader support base among different sectors within the economy. It is thus not limited to (e.g.) traditional inland waterway sectors.

Conclusion IV: Modal shift is also feasible on relatively short stretches

The one hundred scans show that ***domestic*** parts of routes over relatively short distances, which are often part of international chains, are well suited to modal shift. Modal shift will therefore not remain restricted to routes spanning large distances. A whole 80% of the recommendations concerning domestic parts of the routes were positive. Especially inland waterway transport has been the decisive factor for success. The domestic rail terminals have scored less. A second comment is that this concerns in particular pre- and/or 'post-transports' of maritime containerised cargo.

Conclusion V: In many cases, modal shift can be carried out within the same turn-around time

Especially in the case of intermodal transport of maritime containers, the time taken up by storage and waiting times of the containers in the seaports (three days on average) can be used for transport to the hinterland. The shipper can subsequently place orders from the terminal in the hinterland and in this way have the goods at their disposal even faster.

Conclusion VI: Modal shift can be cheaper than road transport

The calculations show that in a large number of cases the alternative modalities are cheaper than road transport. A disadvantage, of course, is the additional costs of pre- and end-haulage and the fact that in a large number of cases this entails involving several parties. The project has shown that for 80% of the companies studied and for 60% of the flows examined a promising alternative could be offered. The alternative in these cases was often cheaper, even taking into account the 'extra' costs for organisation and for pre- and post-transport.

Conclusion VII: Modal shift is more complex in comparison with road transport because the chain requires the involvement of a number of different parties.

It turns out that many distributors have signed long-term contracts with hauliers and logistics service providers, who, in some cases, do not offer intermodal services as part of their package. However, it happens that these parties do get involved in a changeover in modality, which sometimes leads to complicated co-operation configurations. On the other side there is the growing number of distributors who in their choice of hauliers insist on exploring the intermodal possibilities. Still more parties (logistical service providers, but also shipping companies) within the transport chain are beginning to concentrate on a 'total product' in which all modalities can be deployed, as a result of which for the distributor no extra parties 'in the chain’ are visible.

Conclusion VIII: For certain incoming and outgoing flows of goods, modal shift offers shippers a good alternative to congested Road Traffic.

Against the background of the increasing road congestion problem, many distributors welcome alternative modes of transport. Thanks to those alternatives many flows of goods can be reliably transported to their destinations at an acceptable price and according to a logistical concept which meets the industry’s requirements.

2.4 IWT-related conclusions

Out of the modal shift projects, the following specific IWT-conclusions can be drawn:

The ***main advantages*** of IWT for modal shift tends to include:

- Reliability: the main advantage over road and rail.
- Rather low tariffs, competing with all other modalities
- (If applying) availability of door-to-door services, further lowering costs.

The (named) ***disadvantages*** of IWT for modal shift are:

- Limitations of the waterway network, including the need for maintenance / dredging especially small waterways
- The efficiency of terminals and handling: extra transhipment boosts costs and is often decisive for intermodal transport to be economically viable: the bottom line.
- Often the lead-time is extended, especially with the longer hauls.

One clear IWT-specific conclusion is that inland waterway transport is well equipped for modal shift. The inland waterway transport's share of positive recommendations was rather high (76%) and, in addition, also in absolute terms it is IWT which can achieved the largest modal shift profit (2,9 million tonnes, taken 'off the road', maximum). It should be noted that possibilities have been observed especially for ***maritime cargo transported in standard containers.***

The shifting of ***bulk*** cargo demands that both sender and recipient are situated near waterways. Any further pre- and post-transport of bulk by road usually turns out to be both expensive and inefficient. However, in these cases extra investments in quay provisions and / or storage capacity (silos) can boost IWT's potential; possibly (further) supported by government. An important aspect is the availability of (public / private) quays. Currently, in many cases these sites are used for companies that will not use IWT, or they are not used at all.

Note (and this might be a more important conclusion) that all of this is based on the ***existing service portfolio*** of IWT operators. If a greater variety of services (e.g. using special ships, or in some cases smaller ships) would be offered, than the total potential might be even greater.

A third conclusion comprises IWT ***generally outstripping other alternative modalities:*** both rail and pipeline transportation. In the case of rail, this might change in the coming decade, as rail operators will more and more seek to explore markets in a rather aggressive way. It has been concluded that rail surely has potential, but does not as yet exploit this sufficiently.

If the Dutch / Belgian 'scanning' practices, as well as the support in the implementation of the outcomes of the scans, could be extended to the scale level of the European Union, the modal shift potential would be considerable. For PINE purposes, it is worthwhile to limit this 'virtual operation' to the four corridors that are central in the project (Rhine, Danube, East-West and North-South corridors). This topic will be taken up in a later stage when recommendations will be central in the analysis. But already in this stage we can conclude that it is crucial that companies are assisted with the 'scanning' of their logistic chains to assess whether modal shift is feasible. 'Just' co-financing or subsidising investments is a good beginning, but in the long term, it will not do. It is also essential to assist the companies in the implementation of the modal shift solutions that have turned up. The fact that these processes can take several years demonstrates that the support should also continue in the longer term.

Chapter 3 Intermodal and intramodal competition

3.1 Introduction

This chapter aims to define and elaborate the conditions under which inland waterway transport as a whole and its enterprises in particular

- compete with other modes (intermodal competition),
- fit into intermodal transport/logistic chains,
- compete with each other within IWT (intramodal competition).

For this purpose it will first review various factors of competition. Some of these tend to be relatively fixed, such as infrastructure networks and vessel characteristics; they determine a substantial part of the costs of IWT and thus its competitivity. Other factors, which can be improved, include market organisation, which can influence timing and reliability, and thus provide greater incentive to shippers to use IWT. In each case examples will be given and a review of the modal split in the countries or corridors concerned will be reported on.

Competition within the industry itself is mainly a matter of enterprises from different countries operating under regulations that are not fully harmonised taking advantage of such differences, especially in international transport passing through a number of countries or through more than one of the four corridors analysed in this report.

This chapter will assess and evaluate opportunities for improved IWT potential directly and within logistic chains. Therefore, investigations about intermodal competitive conditions or successful examples of competition by IWT will be taken from certain corridors or regions in corridors.

In order to achieve a modal shift inland waterway transport has to be competitive with other modes. In the end, the competitivity of individual companies and of the whole IWT industry depend on their ability to meet customers’ logistics performance criteria.

Figure 2 shows the process at work. Column 1 lists the external aspects within which transport is carried out, Column 2 the factors influencing competitive conditions, such as infrastructure, transhipment interfaces, the fleet and market aspects, leading to performance indicators in Column 3 showing the vital competitive elements of transport costs, reliability, transit time, etc. These in turn lead to actual performance in terms of volume, tkm, modal share etc.

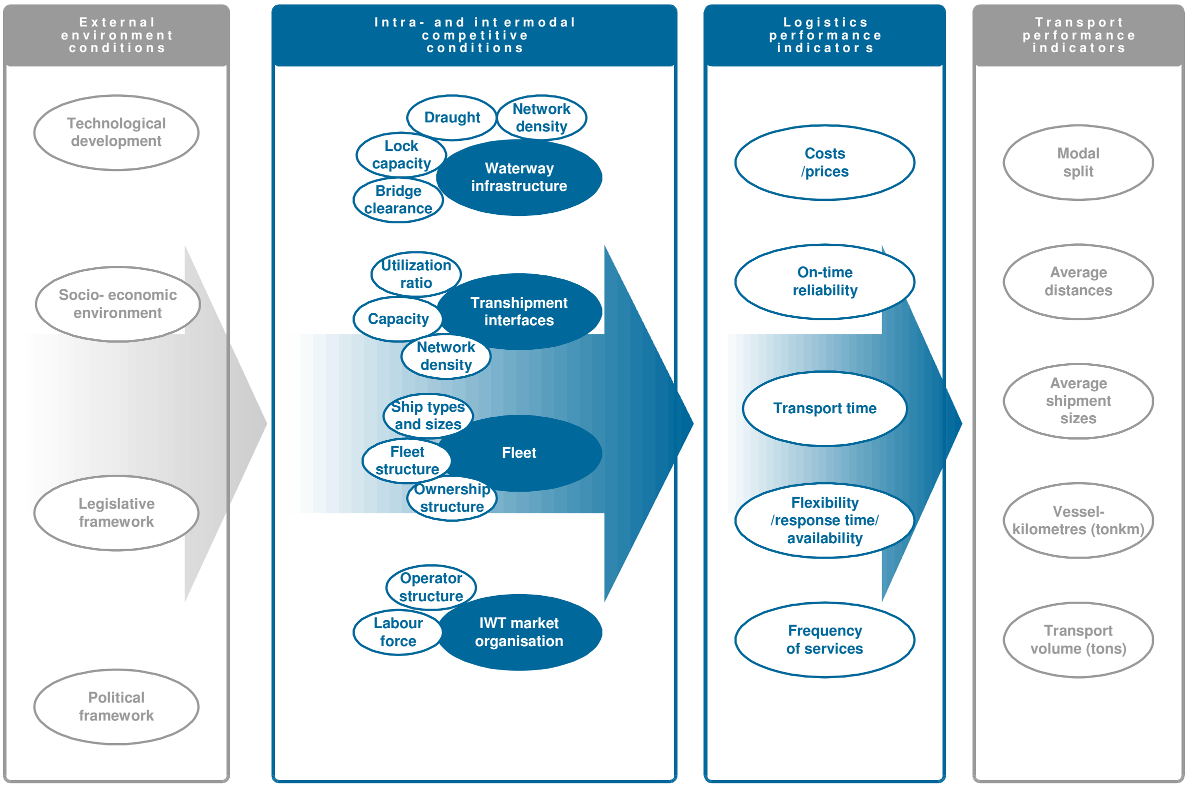


Figure 2. Positioning intra- and intermodal competitive conditions

As regards intramodal competition, companies operating within the same corridor of course face the same conditions as regards the available waterway and transhipment infrastructure; they most probably use the same infrastructure but may have somewhat different kinds of market organisation. This must be borne in mind when analysing the status of intramodal competition because the detailed review in the following sections is concentrated on the corridor level. As regards the conditions for intermodal competition, i.e. the confrontation of the logistics performance of inland navigation with the performance of other modes of transportation, we will first review shippers' demands and then use the analysis of infrastructures and fleets to turn these elements into costs, since these are normally the most important element in shippers' decisions as to whether to use IWT or not.

3.2 Method of working

The costs of shipping on the different European inland waterways varies due to different conditions of waterway infrastructure, the availability and quality of transhipment interfaces, the way the market is organised, etc. Following the analysis of the competitive conditions in section 3.3, we review customers' requirements and the changes in these in section 3.4. This chapter thereby compresses the contents of several previous sections as well as adding expert experiences. Section 3.5 will deal with intermodality and brief conclusions of this chapter will be found in section 3.6.

3.3 Main competitive conditions: supply aspects

The parameters which govern the competitive conditions under which IWT can operate - including taking its rightful place in a logistic chain – may be broadly divided into two categories: those which are essentially ***fixed*** (such as the waterway and transhipment infrastructures and the fleet) and those which can be ***potentially improved*** **(**mainly market organisation with its manifold aspects). These will be analysed in turn, starting with the waterway infrastructure.

3.3.1 The waterway network

Possibly the most striking feature of inland waterways is the restricted network size as compared with railways and roads. The EU-15 have almost 30 000 km of navigable waterways; the 10 acceding States will add another 7 000 km[15]. In comparison the EU-15 railways have over 155 000 km and the acceding 10 countries another 55 000 km. As regards roads, the EU-15 possess more than 320 000 km of motorways and major national roads, with another 90 000 km of such roads in the acceding countries; this comparison purposely omits the 3.6 million km secondary and other roads in the EU-15.

This comparatively small IWT network is coupled with a ***low capacity for forming larger networks****;* many of the major canals and canalised rivers date back to the 19th century and even earlier when rail transport was not yet a real rival. Where interconnected waterways do exist, transport capacity may be low due to physical obstacles.

---

[15] The problem is one of definition. Somewhat varying data are shown in SWP 1.1, based on the inclusion or exclusion of small waterways. For the present purpose a rounded figure is sufficient for the comparison with rail and road.

Moreover, whilst the main arteries can carry large vessels, these cannot be handled by the smaller tributary waterways without substantial investment. Similar considerations apply to the connections between large natural river basins where watersheds may need to be overcome at considerable cost. Of course over a lengthy period of years, even these “fixed” parameters can be modified by investment in new or improved waterways. Indeed since this report is looking at developments up to 2020, such potential infrastructure improvements should not be ignored – the lengthy planning and implementation period required for them makes it likely that they are already under consideration today, such as the Seine-Nord canal.

As regards the present situation it may be noted that generally speaking, a higher waterway network density within a region increases the number of potential transport relations by inland waterway. In chapter 5 (infrastructure) of part A (Supply) was estimated that the network density in the Rhine corridor is significantly higher than in the other corridors. Such greater density clearly favours IWT in competition with other modes.

3.3.2 Technical limitations: locks and bridges

The capacity of waterways to handle traffic, in addition to their length or density, is also influenced by technical limitations in the shape of locks and bridge clearances.

Locks

On canalised stretches, the dimensions of locks restrict the maximum dimensions of ships. Secondly, passing locks is very time consuming (varying from 30 minutes to one hour per lock on most West European routes).

As noted in the chapter fleets (part A chapter 4) lock capacity depends on the number and dimensions of lock chambers, the number of lifts (principally 1 lift per lock), the time required for one locking, the operating times of locks and the dimensions and capacities of the ships.

By way of example, the actual capacity of an Austrian lock was estimated at 40% of its theoretical maximum[16], taking into account the average load of the ships, the utilisation degree of the chamber, repair times and closures caused by ice or high water periods. Locks are not a problem on the Rhine itself, but exist on tributaries in the corridor like the Mosel and the Neckar.

---

[16] Assumptions: lock with two chambers, four ships with a capacity of 1800 t per ship, 32 lockings per day, 365 day operating time per year, maximum capacity 168 million tons/annum.

Bridge clearance

Bridge clearances are a decisive factor for cost-efficient container traffic. As a general rule container transports require three tiers of containers – and the corresponding bridge clearances – to be competitive; two tiers are usually not competitive with road or rail, but can be cost-effective under favourable circumstances (long distances, short pre- and post hauls).

Most current container transports take place in the Rhine and the North-South corridor (mainly hinterland transports of sea-containers with origin/destination in the ARA-ports[17]), where regular container liner services have been established. In the East-West and South-East corridors container transports play a minor role up to now, but there is potential for container transports depending on improved bridge clearances and better organisational conditions. The infrastructure chapter in part A (Supply) provides an overview of waterway sections with deficient bridge clearances.

3.3.3 Physical limitations: fairway depth and draught of ships

The navigability – and therefore the capacity – of a waterway is largely determined by (the predictability of) its fairway depth which is an important indicator for the profitability and competitiveness of inland navigation. The available fairway depth determines the maximum possible draught of ships and their loads. Figure 3 shows the interrelation between the terms “fairway depth” and “draught”.

It is therefore clear that the main infrastructure of inland waterway transport has a direct impact on its daily operational performance: the larger the draught, the more cargo can be transported and unit costs per ton cargo reduced.

In addition, the predictability of the possible draught is of crucial importance. The situation in free-flowing rivers is characterised by high water level fluctuations which are often not sufficiently predictable, whereas canalised sections[18] generally have less fluctuations and larger guaranteed fairway depths. Especially in international traffic corridors with long transit times, predictability of fairway depths becomes an issue of major importance: when the maximum possible draught cannot be predicted reliably over a period of a few days, vessel operators will have to minimise risks and load their vessel according to the expected fairway depths, which leads to more expensive shipments that are than the actual fairway depths would have allowed.

The impact of this factor on IWT costs, which are the most important aspect of competitivity, will be looked at in more detail in the following sections.

---

[17] ARA-ports: Amsterdam, Rotterdam, Antwerp

[18] Canalised sections are stretches of a waterway which are situated between barrages.

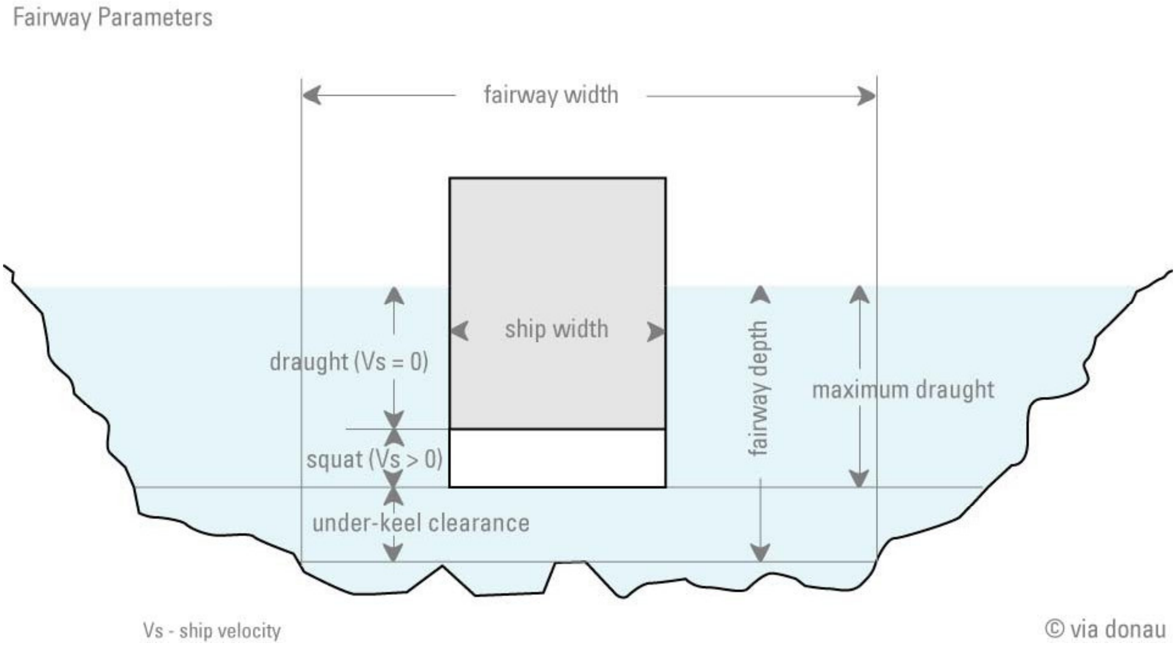


Figure 3. Relevant fairway parameters – Interrelation between fairway depth and draught[19]

Cost impacts of fairway conditions: Rhine corridor

In general, the physical conditions on the Lower and Middle Rhine are excellent. Figure 4 shows the varying water levels and barge movements on the Rhine at the border between The Netherlands and Germany. At this point (Lobith), navigability for barges is usually free of problems. In the period 1990 -1996 navigation was forbidden only once in The Netherlands, during the floods of January 1995.

---

[19] The draught of a ship is defined as the distance between the water surface and the bottom of the ship, when this ship is loaded and not moving (Vs = 0). As soon as a ship starts moving (Vs > 0) the ship sinks deeper under the water surface. This effect – the dynamic immersion of a ship – is called squat. Between the bottom of the ship and the river bottom there has to be (a safety margin called 'under-keel clearance', which depends on how even the surface of the river bed is).

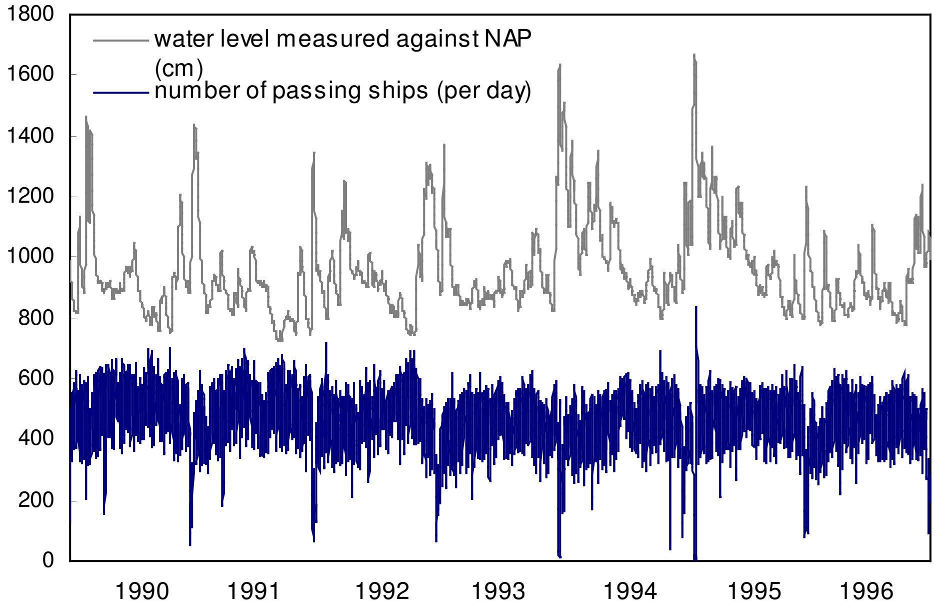


Figure 4. Water levels (in cm) and barge movements (barges per day) on the Lower Rhine 1990–1996
Source: AVV

To appreciate the effects on costs and the market it should be noted that high water levels on the Rhine typically last only a few days, but do impose higher costs and delays. Mostly in Spring, the Rhine receives a wave of melting water from the Alps which may cause the authorities to forbid navigation. High water periods also cause faster water flow, leading to higher fuel costs for going upstream. Varying water levels cause price turbulence in the market: skippers in Rotterdam predict the expected draught, but if the water level falls strongly, the barge may have to be partly unloaded along its way. This can cost the shipping company several thousand euros for even small volumes of 50 tonnes. On the other hand skippers can profit from a sudden rise in water levels, since the negotiated price per tonne could be higher because it was agreed upon in times with lower water levels.

Problems with low water levels may arise in the case of heavy bulk cargo. For example, dry bulk transports (e.g. coal, iron ore) with 6-unit pusher units are not allowed if the water gauge at Lobith drops below 9 metres. During Summer 2003, the Rhine at Lobith dropped to a historic low of 7.15 metres. These cost impacts will be taken into account in the following.

Figure 5 shows an example of standby[20] cost increases caused by low water levels on the Rhine for a typical vessel (self-propelled dry cargo with a maximum draught of 2.70 m). Such a vessel can be used 100 per cent on 270 days per year. In the remaining time, utilisation is reduced due to low water conditions.

---

[20] Standby costs = fixed costs of a shipping operator (personnel costs, maintenance/repair costs, depreciation, interests, insurance), see part A Supply, chapter 4 Fleets.

In the worst possible case it may drop to as low as 57 per cent, thus increasing standby costs per cargo unit by about 76 per cent. However, this cost increase only applies where 'transport volume guarantees' are given, i.e. shipments for which a fixed cargo volume needs to be transported at specified times, regardless of the fairway conditions. During low water periods additional ships must be used in order to transport that cargo volume, thus causing additional operating costs. Transport volume guarantees are not necessary for less time-critical goods, which can wait for the fairway conditions to improve.

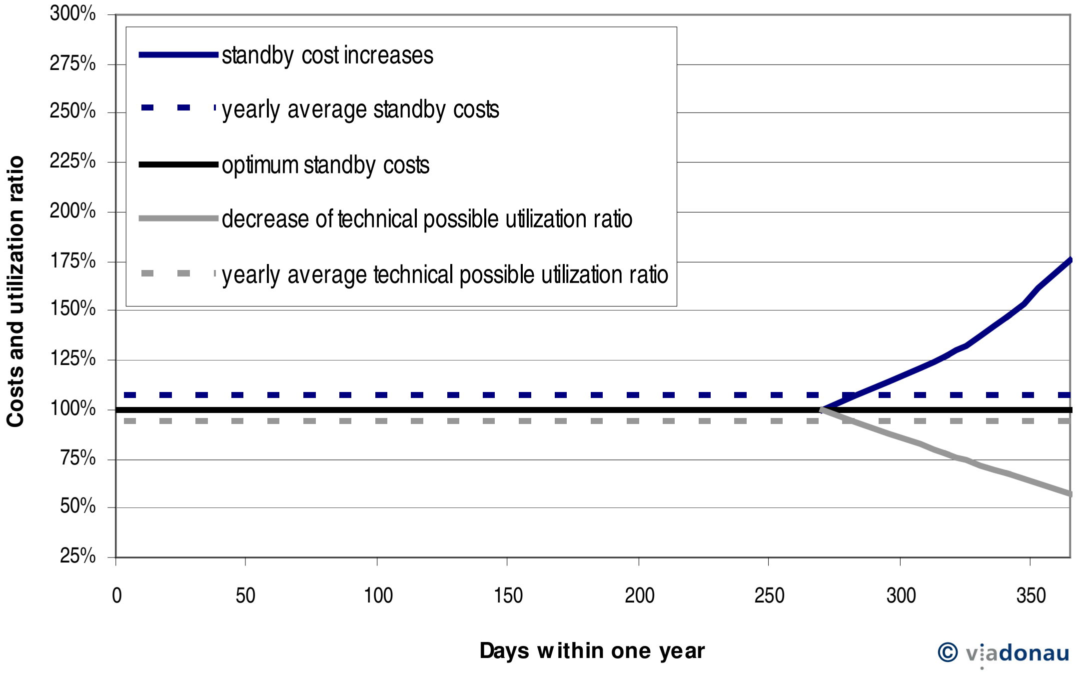


Figure 5. Low water induced standby cost increases for transports with guaranteed transport volumes on the Rhine, self-propelled dry cargo vessel with maximum draught of 2,70 m

A 'transport volume guarantee' can be an important criterion for shippers: it can provide a reliable transport service even during unfavourable water conditions. This reliability is given on the Rhine, where the yearly average utilisation ratio is 94 per cent and operating costs are only about 8% higher than the "ideal", leading to calculable transport costs and homogenous transport prices throughout the year. Such reliability (which is a major customer requirement) clearly enhances IWT competitivity in relation to road or rail.

Cost impacts of fairway conditions: Danube corridor

By contrast Figure 6 shows the situation for the same ship type on the Upper Danube. Full capacity use is only possible on 106 days; during the remainder of the year the utilisation rate may diminish to 36 per cent in the worst case and standby costs increase by about 179 per cent.

Yearly average use is only approx. 70 per cent and operating costs 60 per cent higher, and therefore considerably worse than on the Rhine because of the poor water levels and large fluctuations in the free-flowing sections[21]. For long-distance transports using both the Rhine and the Danube corridors water levels cannot be predicted with sufficient accuracy[22], so that shippers loading cargo in Rotterdam have to provide additional draught safety margins or lighten the barge before passing the critical river sections.

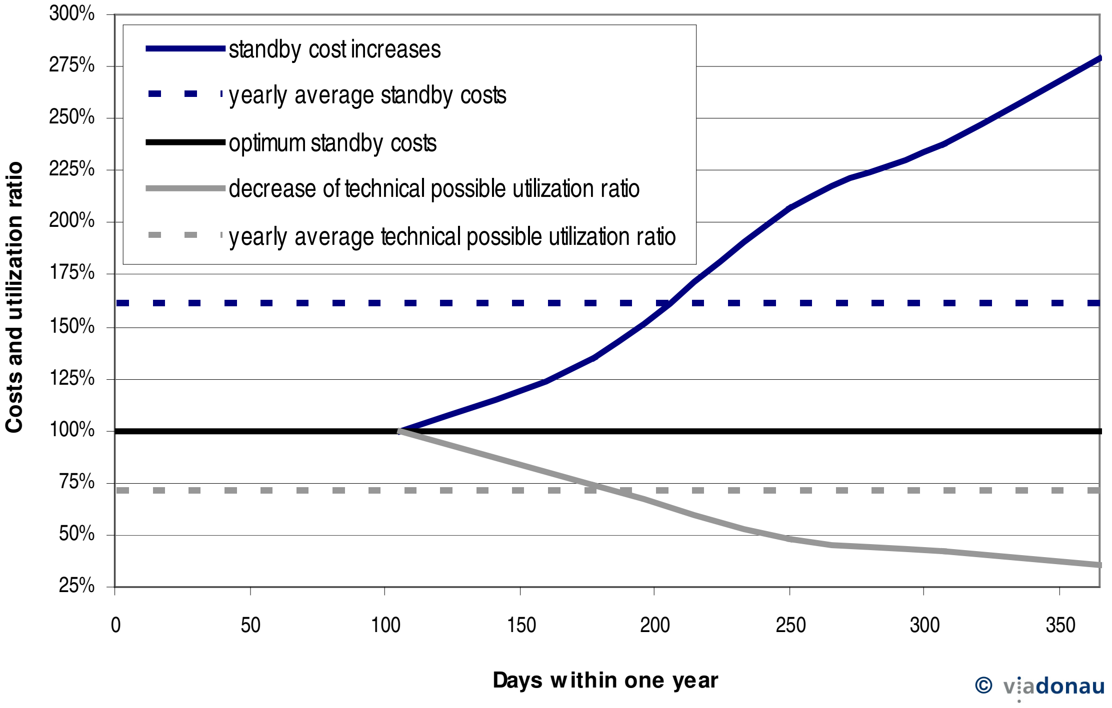


Figure 6. Low water induced standby cost increases for transports with guaranteed transport volumes on the Upper Danube (long distance relations), self-propelled dry cargo vessel with maximum draught of 2,70 m

The main conclusion is that – given the current fairway conditions on the Danube – the current “pan-European” inland navigation system cannot provide homogeneous market prices throughout the year. This price uncertainty inhibits the competitivity of IWT both intermodally and in multimodal logistic chains.

---

[21] These unfavourable sections are also addressed as bottlenecks in the TEN guidelines and the UN/ECE inventory of bottlenecks (see Swp1.1).

[22] Transport distance for e.g. relation Rotterdam – Bratislava: 1602 km; this corresponds to a transport time of 7-12 days, depending on the ship type and operation mode. Reliable water level prognoses can only be made for about three days in advance.

Where transport volume guarantees cannot be justified large shippers located directly along the waterway (e.g. the ´VOEST´ steel plant in Linz) tend to have their own storage facilities and conclude contracts specifying an annual transport volume, whilst allowing the shipping companies to adapt their sailing schedule to the water levels. Such consignors/consignees solve their problems by stock keeping. Such a solution is not possible for smaller shippers or those with irregular transport demands; If they need to have certain volumes transported at specified times under all circumstances, they have to face considerable cost/price variations.

Cost impacts of fairway conditions: East-West corridor

The East-West corridor is connected to the Rhine by a well-established network of canals. The improved Mittelland Canal constitutes the main link and offers stable waterway conditions. The Weser, Elbe and Odra are the main waterways of this corridor; but inland navigation on the Elbe and Odra are hindered by fluctuating water levels in the free flowing sections. Generally the East-West corridor only allows the operation of smaller vessels, whilst the middle course of the Odra has unfavourable water conditions and represents the bottleneck for the entire eastern part of the corridor. In cold winters navigation may be suspended because of ice, the river Elbe in the Czech Republic with its fully canalised network is an exception to this general corridor status. This corridor does not – at least at the moment – dispose of the same possibilities as the other three and its relatively modest transport volumes reflect its relatively high unit costs.

Cost impacts of fairway conditions: North-South relations

The North-South relations are characterised by a well-developed system of waterways between the Netherlands and Belgium on the one hand and a large number of minor waterways in France and Belgium on the other hand. In France the rivers Seine and Rhone are characterised by both high maintenance/safety standards and high transport capacities. The north-western network of smaller waterways, which only allows vessels of about 250 t capacity, cannot at present fulfil its potential function as a link between the higher classified waterways in the Netherlands and Belgium and the rivers Seine and Rhone. To permit more cost-effective inland navigation for the whole corridor requires the planned connection between the high-capacity waterways to be implemented.

Cost impacts of fairway conditions: Canals

Figure 7 displays the situation on a canal, where water conditions are stable throughout the year. Since this applies all canals, our example is not limited to a specific canal.

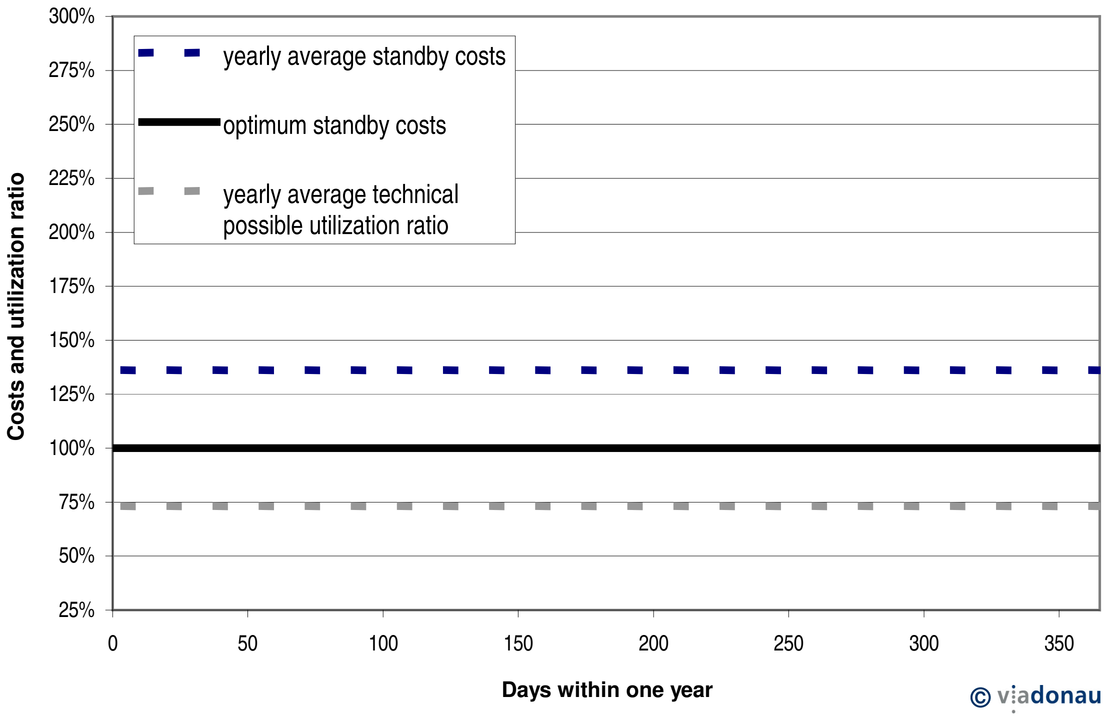
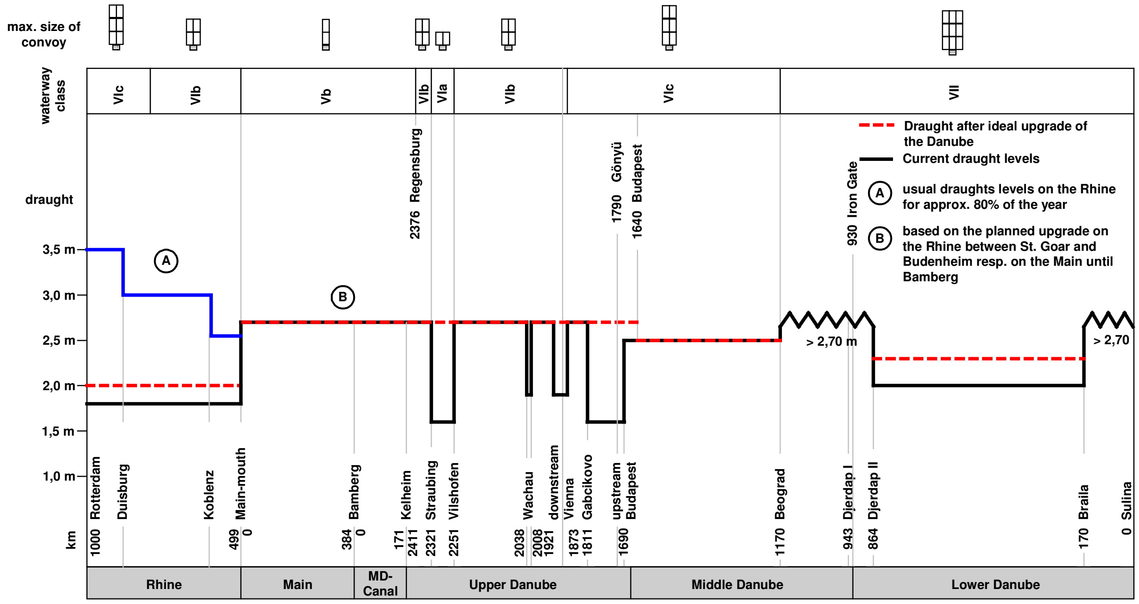


Figure 7. *Low water induced standby cost trend for transports with guaranteed transport volumes on a canal (2.20 m available draught throughout the year), self-propelled dry cargo vessel with maximum draught of 2.70 m*

The critical dimension here is the draught. For our “standard” ship with a draught of 2.70 metres, the 2.20 m draught available implies a degree of utilisation of 73 % throughout the year, and a (stable) 36 % increase in standby costs. Such reduced utilisation and increased standby costs are mainly compensated by predictable (i.e. constant) conditions the transport cost levels. The result is that the Mittelland canal has lower costs than the Upper Danube.

Comparing fairway conditions on the RMD corridor

Finally we note that the navigability of a waterway is defined by its weakest section. The effects of weak sections (“bottlenecks”) on the navigability are shown below, providing an example connected to Figure 5 above, by looking at a journey using both the Rhine and Danube corridors together.



© via donau 2003

Figure 8. Actual and ideal draught of the Rhine-Main-Danube-Waterway

The calculations in Figure 8 are based on a self-propelled large motor vessel in long distance traffic. Except in the stretch marked (A), the fairway conditions are measured against the reference level Low Navigation and Regulation Level (LNRL) which corresponds to the water depth available for 94% of the navigable season, i.e. excluding periods of ice.

The graph clearly shows the existing bottlenecks for a journey using Rhine, Main and Danube waterways. In the indicated four free-flowing sections on the Upper Danube the available draught throughout the year is considerably lower than in adjacent sections. For free-flowing rivers, the fairway depth and the possible draught on a waterway stretch is the main factor that determines the size of the ships that can be used on this stretch. This in turn influences the capacity of the waterway (in terms of tons throughput per year).

The effect of having a weak section or link is also illustrated by the fact that on its own, the Upper Danube stretch might be improved to a theoretical capacity of 70 million tonnes. However, traffic to and from the Rhine to the Upper Danube would be limited to about 20 million t by the large number of locks on both the River Main and the Main-Danube Canal.

3.3.4 Transhipment facilities

Transhipment facilities constitute the second group of 'hardware' and therefore relatively fixed factors that affect the competitiveness of inland navigation. Ports (which for the purpose of this report also include wet transhipment sites) are the IWT starting and end points and act as interfaces to other modes. Port infrastructures allow IWT to be integrated into multimodal chains and offer value-added logistics services.

The competitiveness of multimodal chains often depends on the efficiency of port operations; their costs and lead times are an important element in the success or failure of an intermodal transport service.

In the different waterway systems in Europe the number of ports, their density in the network, as well as their capacity and service quality differs greatly. Most of the elements have already been discussed in earlier chapters.

Number and density of ports

The number and density of ports were analysed in the chapter on “Interfaces”. As expected, the Rhine corridor accounted for a high proportion (45%) of the total European E-Ports included in the AGN classification. Numerous other public ports and several hundred private ports and wet transhipment sites are also located in the Rhine corridor.

The average distance between Rhine E ports is only 20 km. Distances in the North-South and East-West corridors are approximately twice as high as for the Rhine, whilst in the South-East corridor E-ports are located on average about every 90 km .

Quality, capacity and utilisation degree of ports

In addition to port numbers and density, their competitive quality in terms of costs, time taken etc. was assessed in the chapter on “Interfaces”, which looked at port objectives, functions, components and links. In order to determine theoretical capacity and the degree of utilisation the analysis considered annual throughput and available facilities, such as length of berths, number of portal cranes and open/covered storage areas. Based on these figures some indicators were devised in order to compare a representative sample of typical ports situated on different waterways.

Ports characteristics in the corridors

As expected availability (length of berths and number of cranes) and throughput of the major port facilities is higher in the Rhine corridor than elsewhere. Rhine ports also lead in the number of different functions and value-added services provided.

Conventional inland ports in the Danube corridor have lower average throughputs and crane utilisation rates. Most Danube ports in Germany and Austria achieve high quality standards but, for example, container liner services hardly exist at present in ports located in the middle and lower Danube. Nevertheless the establishment of such services on the Danube as a whole is in preparation, for example reach stackers, which can handle up to 45 TEU per hour, are now available in most Upper Danube ports, though in south-east Europe, they are usually still confined to the larger ports.

The East-West corridor has a relatively dense network of “E-ports” as well as numerous small ports and transhipment sites between the Elbe and Odra and in the densely populated area around Berlin. These ports suffer from harsh winters and ice which often leads to difficulties in, or the suspension of, inland navigation, especially in the eastern part of the corridor.

Port density in the North-South corridor is comparable to the East-West corridor, which has numerous small ports and transhipment sites. In the chapter on “Interfaces”, the ports of Paris and Lyon are shown to be characteristic river-sea ports. A particularity of the bigger ports in the corridor is that operating zones and terminals may be scattered over a large port area.

Principally for reasons of commercial confidentiality this review of the differences in port size and quality has not been able to assess resulting cost data which would obviously contribute to or detract from competitivity. It would help to stimulate modal shift towards IWT if such data showed that costs were being reduced by improved port and transhipment facilities.

3.3.5 Fleet and crew

Fleet and crew costs borne by the individual operators are an important element of intramodal as well as intermodal competition. In relation to the fleet they are made up essentially of depreciation and maintenance, fuel and manning costs.

Depreciation and maintenance costs are related to ship types and sizes and, in case of a shipping line, to the fleet structure concerning ratio of self-propelled ships / pushed barges, the number of units, overall and average capacity, average output, average age and level of equipment.[23]

As already indicated in earlier the different nautical conditions of rivers and canals – fairway width and waterway depth or available draught, locks and the bridge clearances – result in different ship types being used. However, market conditions and customers' requirements – in terms of shipment sizes, required prices etc. – also influence the type and size of ship and therefore the costs of inland navigation.

Larger ships obviously enjoy economies of scale. Nevertheless the operation of smaller ships is technically and economically justified on waterways with less favourable nautical conditions. The expected degree of utilisation of ships may be decisive for the selection of a certain ship type and size in a waterway area.

As far as intra- and intermodal competition is concerned total costs and cost structure of inland vessel operators are also determined by the registration/flag of the ship owner.

---

[23] See SWP 2.1 for an overview on the classification of the most common European inland vessels and their standard sizes.

Beside the important aspect of the operator structure (family skipping vs. skipper with employees vs. shipping line with economies of scale) the crew structure differs significantly in East and West, having a great impact on crew costs. Whereas up to now wages, including social payment, are significant lower in the East than in the West the composition of a crew and its employment conditions for comparable ship types are quite different between East and West. For this reason the larger quantity of crew members in Eastern European countries compensate the advantage of lower wages which in the end leads to comparable manning costs for competing operators registered in East and in West. This "registration effect" may vanish by the time the Accession countries adapt their regulations to EU conditions. However, to reduce crew costs the Western operators today hire Eastern personnel to lower wages and worse social conditions[24]. To avoid social dumping and guaranteeing a fair competition the EU should take care on fair regulations of labour conditions as well as having a good control on its practise. Otherwise in IWT sector the same problems may arise than in the road sector concerning illegal employment of Eastern European personnel.

Nevertheless, intramodal competition should well reflect the different cost structures and efficiency levels of the crews between Eastern and Western fleets, as this is one of the factors of the expected overall growing European market. In this context, however, intramodal competition is limited by some technical restrictions regarding the extent to which fleets are adapted to their particular local waterway area.

The operating area mainly determines costs, which depend on nautical conditions (draught), i.e. costs, related to the size and the utilisation rate, as mentioned earlier. These costs affect intermodal competition within each corridor. The operating area, however, has also an influence on investment, insurance and maintenance costs as up to now most operators are located in the corridor where they sail. As shown in the chapter Fleets (Part A supply, chapter 4) on some examples investment costs seem comparable in East and West whereas maintenance costs are lower in East than in West.

We will give an overview on cost advantages and disadvantages of the Eastern and the Western fleet, related to the examples of ship types in chapter 4 (Fleets) of part A (supply), in terms of average costs per ton of carrying capacity (i.e. no consideration of the utilisation ratio):

- total costs per t are 10-25% lower in East (both Czech R. and Danube) than in West,
- large cargo motor ships are 10-20% cheaper per t than Europe type ships,
- Danube pushed trains only have 45-70% of the costs per t than Europe-type but they cannot compete with other ships beyond the lower Danube.

---

[24] A legal practise today is hiring personnel only for a couple of month to avoid paying vacancies.

3.3.6 Market Aspects

Market aspects cover a wide range of factors, which influence competition. Whilst the requirements of consignors/consignees will be discussed in the next section, the ***organisation*** of individual firms and the market for IWT is of vital importance.

An equally important parameter is the ***affinity*** of types ***of goods for waterway transport*** (see chapter 1 part A and chapter 1 part E potentials for IWT). Bulk goods of all kinds are pre-eminently suitable for IWT, ranging from dry bulk (agricultural goods, construction materials, minerals, coal, etc.) to liquid bulk (petroleum products, chemicals). More recently the transport of containers, especially on the larger waterways, has extended IWT affinity to higher value manufactured goods, and somewhat similarly, to the transport of cars. Dangerous goods are suitable because the IWT safety record is good and finally the sheer size of an indivisible load to be transported may make it vital to use IWT.

The concepts of ***speed*** and ***reliability***, are market factors, but have already been reviewed earlier in this chapter under the headings of infrastructures and fleets. Attention was also paid to the ***nautical conditions,*** which may interfere with shipments in total or by reducing transport capacity of the vessel concerned (low water, bridge clearances).

The need for organisational improvements

In two 1996 studies [AVV and EU] some important market organisation requirements for the future development of inland navigation were identified:

- abandoning of regulated markets;
- flexibility and accuracy;
- continuity in services;
- transparency as regards prices and tariffs;
- marketing of integrated door-to-door services and not of separate modes.

The low degree of internal IWT organisation was thought to hamper innovative initiatives as it was not clear how investment and risk management would take place. The three cargo segments of inland navigation (dry and liquid bulk and general cargo) are all organised differently. For bulk flows, the system mainly functions on demand. In the dry bulk sector, private shipping companies usually work for the same customer on a contract basis, whilst specialised shipping companies take care of liquid bulk transportation. Shippers play a more dominant role in the liquid bulk sector than in the dry bulk sector. Contrary to the full loads in the bulk sector, container transport by barge is based on scheduled services usually offered by an association of ship-owners or ship-owning companies exploiting a fleet of vessels.

Container transport by IWT often involves multimodal transport chains, whereas bulk cargo is mostly transported to facilities located in the direct vicinity of the waterway. Typical for shipping containers is the large number of parties involved. In addition to consignors and consignees, five or six different companies may be involved: Forwarders, stevedores, brokers, barge operators, truck operators, rail operators, private skippers may take care of one or more parts of the logistical chain.

This obviously creates co-ordination problems. Waiting times – and consequently additional costs – between links of a logistical chain often represent insufficient co-operation between the different partners.

Although closer co-operation between container lines is feasible, the problem still figures as an important limitation on inland navigation. The organisational obstacles include: a low degree of organisation, with the accent on individual interests and therefore lack of co-operation. The system of cargo acquisition and handling is inefficient. For instance, as confirmed by a manufacturer of artificial fertilisers, it is common practice for a ship broker to look for suitable and available ship-owners and negotiate prices for 3 to 4 days. Although demand for fertilisers is quite predictable, the shipper had never thought of establishing tighter relationships with shipping companies, in order to reduce waiting times. The present process seems to be accepted by the final consumers, so that time losses are not causing serious problems.

In the following the aspects of operator structure, mode of operation and the labour market will be considered.

Operator structure and mode of operation

The historical differences in operator structure of small enterprises in the West and large shipping companies in the East, as well as the gradual change in the latter have already been reviewed above (Fleet 2.5).

The mode of operation is linked with that operator structure and the size of the ship. For independent ship owners with small vessels (e.g. ship of “Europe”-size) an operating time of 14 hours per day is usual, whereas large self-propelled vessels (e.g. GMS-type, “Large river motor ship) tend to a continuous (24 hours per day, mode B) or semi-continuous mode of navigation (18 hours per day, mode A2). For pusher convoys a continuous mode of navigation is typical. The type of operation of course affects the cost of running the ship and therefore affects competition.

Crew

The fleet’s chapter in part A Supply has looked at the European inland navigation personnel costs and social payments. The number and quality of available personnel as well as their wages are a decisive intramodal and intermodal competitive factor. As already noted it is difficult to make precise estimations about this topic for the different countries. In some West European countries (e.g. Germany) a lack of qualified domestic personnel has led to the employment of crew members from Eastern Europe who are usually cheaper (as regards wages and social expenses). A change of flag by West European shipping companies is sometimes used to avoid national labour and social regulations. As an example the crew on German ships is sometimes registered with a service company in Luxembourg in order to reduce the level of social payments.

The same applies to German and Austrian shipping companies operating on the Danube and registering parts of their fleet or single vessels in East European countries in order to obtain access to the local labour market.

Whilst of course it affects intermodal competition this factor of labour costs is one that is particularly relevant to intramodal competition between IWT shipping companies. Here they can seek to profit from an ability to reduce an important cost factor as compared to their rival, something they cannot do with regard to costs arising from the waterways themselves or the ships used. It may be that such firms operate on the borders of legality in this respect, but until full harmonisation of the regulations and strict controls on their observation are achieved these issues will remain an important element in internal IWT competition.

3.3.7 Interrelations between competitive conditions

The previously described main supply factors determining intramodal competition within inland navigation and intermodal competition with road and rail are of course interrelated and their interactions are sketched in Figure 9.

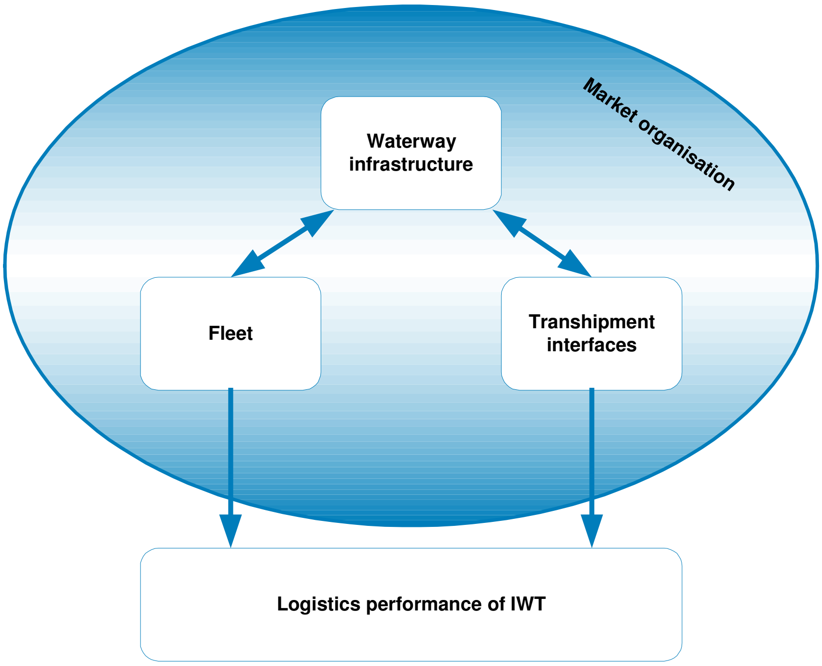


Figure 9. Interactions between IWT competitive factors

It has already been shown that the dimensions (fairway) and nautical conditions of the waterway strongly influence the type of vessel used, both technically and as regards its degree of utilisation; differences in the former lead to differences in the latter. Port facilities also play a role, especially for transhipment and connection with other modes and value-added services. However in the end it is the market, which determines what will be shipped and shippers' requirements in turn affect the actual ships used, manning and the resultant costs.

What is therefore of main interest is how these elements which ‘produce’ the logistics performance actually affect competition between IWT firms intramodally, and between IWT and the other modes intermodally. This competition is based in the first place on the total cost (per ton or tkm) of IWT and secondly on the qualitative response of the shipper to market requirements in terms of speed, reliability, scheduled services, ability to fit into a multimodal chain, clear and transparent market organisation etc. As noted above and mainly for reasons of commercial confidentiality it has not proved possible to obtain direct comparative data, but some examples of consignors’/consignee’s reactions to IWT will be provided in the following section 2.4.

3.4 Competitive demand aspects: customer requirements

In the eyes of most customers of transport services – the shippers – making a modal choice is not the first or most important decision that needs to be taken. Shippers need transport services for their products at affordable prices, within certain time limits, in sufficient time intervals, and in a dependable way. In other words, shippers need services that conform to logistics performance requirements in terms of costs, time, frequency of service, and on-time reliability. This section concentrates on these requirements and discusses the effect of recent changes on them. It concludes with some examples of the comparative performance of different modes.

3.4.1 Strategic shifts in customers’ requirements

Recent trends in shippers’ demands

The European freight transport market has undergone structural changes in the last decennia. They have resulted in the first place from the implementation of the EU’s Internal Market which has led to more international traffic and a shift from primary and secondary industrial production to the services sector and to higher value goods which has affected the preferred modes of transport. These developments have been accompanied by a general rationalisation of distribution networks, increased outsourcing of logistics services (production companies concentrating on their core business), supply chain integration (e.g. inventory reduction schemes), and time compression (e.g. just-in-time, efficient consumer response).

Outsourcing of their transport operations to specialised logistics service providers has made shippers more mode-independent, but has encouraged service providers to look for a suitable mode that meets the pre-defined logistics criteria.

New market opportunities for intermodal transport alternatives (including the integration of inland navigation) are being created; these will be dealt with in the next section.

Modelling modal choices

Figure 10 shows a simplified example of the basic trade-off underlying a shipper's modal choice, i.e. the confrontation between supply of and demand for transport services. On the one hand, the dotted line reflects the value-of-time or the willingness-to-pay for transport services (the demand curve). The steeper this line is, the more time-critical shippers are. In many business industries, such a shift has actually taken place, explaining the increased modal share of road transport in these industries. On the other hand, the relative logistics performance of the various modes of transportation are also shown as a cost versus time supply curve. Air and road transport generally provide faster services, but charge higher tariffs. Rail transport and inland navigation are usually slower but require lower prices in turn.

The point where both lines intersect determines the actual modal choice: the shippers that are willing to pay more for faster services will opt for air transport, whereas less time-critical customers might choose inland navigation. An improved competitive position of inland navigation is shown by the different grey dots in the lower part of Figure 10: by offering faster services – possibly combined with higher tariffs – inland navigation could capture a larger market share.

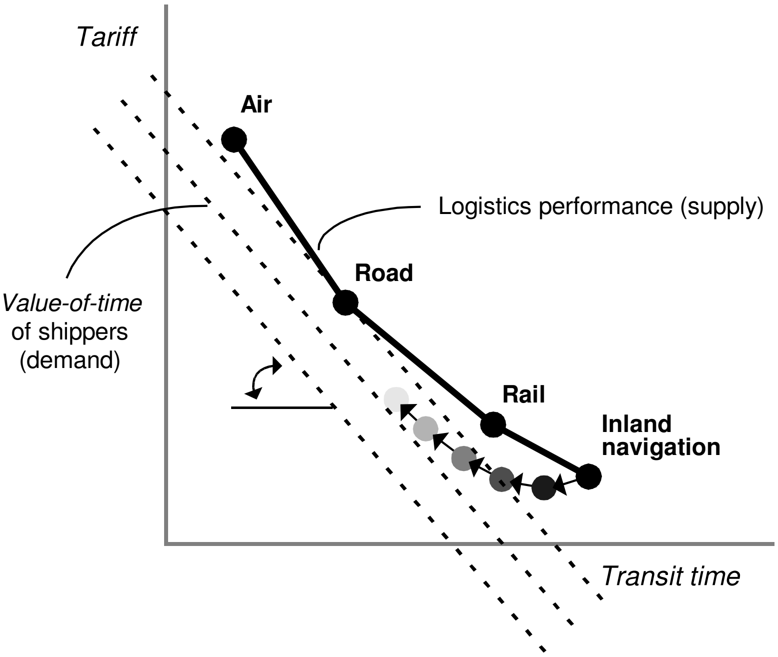


Figure 10. Modelling modal choices (for illustrative purposes only)

This figure only displays the trade-off between transit time and costs for transport services. Modal choices are of course not only determined by these two factors, but also by logistics performance requirements such as on-time reliability and frequency of services, or 'soft' factors such as the customer's experiences with specific modes of transportation.

3.4.2 Implications for inland navigation

Low costs are still and will continue to be the main argument for many shippers to opt for inland navigation. Gradually, however, transit time and reliability have become critical factors in transport processes, also for inland navigation. Especially containerised goods are considered time-sensitive. Traditionally, inland navigation used to be related to the movement of low-value raw materials. This picture has however changed, as is shown by examples in the German and French steel industry. Buffers of ores and coal at the production sites have become smaller and smaller in the last decades. For instance in the German steel industry, the most important ores currently have an inventory of approximately 30 days, whereas this used to be months in the past [Van Geenhuizen et al., 1996]. Transport and production processes are not as decoupled by large stocks as they used to be. As a result, these types of bulk shippers have also become more time-critical in recent years and have introduced floating stocks concepts, which pose higher requirements – in terms of transit time and timely delivery – upon inland navigation operators.

Ranking of logistics performance requirements

The relative importance of logistics performance requirements for different groups of shippers has been studied in several projects.

A survey of market representatives in the Netherlands, France, Germany and Belgium [European Commission, 1996] showed that price was the decisive factor for bulk sectors, whilst reliability was most important for container transport.

The Transport Research Center [AVV, 1996] found that absolute transit speed is not all that important for (potential) users of inland navigation, but that fast door-to-door service along the full logistical chain is crucial. Frequency and price were found to be the most important modal choice criteria for the shippers interviewed. These results were confirmed by a study among shippers of maritime containers destined for the European hinterland [Van Ham, 1997]. More than 50 per cent of the shippers regarded transport costs as the most important feature of an intermodal transport alternative. Moreover, frequency was considered more important than transit time (almost 40 per cent of the shippers found frequency the most important criterion.

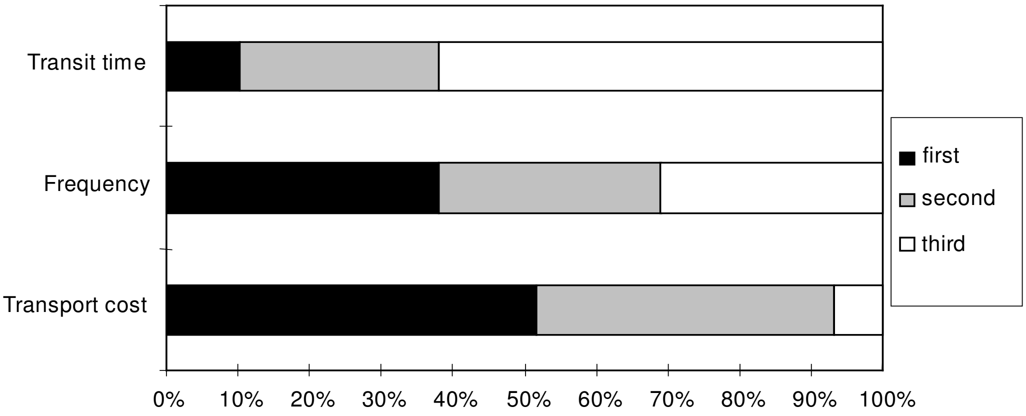


Figure 11. Priority of logistics performance requirements among shippers (n=29)

In an empirical study in 1998 encompassing 45 large trading and production companies in the Amsterdam region, firms were asked to explain why they chose road transport for hinterland shipments to Germany. This resulted in ranking speed first, followed by door-to-door service. Factors such as flexibility, ease of use and price were mentioned on the third place. The wish for door-to-door service is tied to reliability: the companies interviewed perceived door-to-door services as more reliable than multi-modal solutions. Confronted with a feasible multi-modal alternative (road-water multi-modal transport), 29 % of the firms stated that the multi-modal variant should at the least be cheaper than the single road solution which suggests some opportunities exist for IWT.

Stated Preference Studies

In addition to ranking, several studies also attempted to quantify the logistics requirements by using the so-called stated-preference methodology.

Business industry	**Transit time**	**Frequency**	**Reliability**	**Transport costs**
Food industry, Netherlands [Muilerman, 2001]	0.30	0.14 to 0.63	5.02	1.00
Perishable consumer products, Netherlands [HCG, 1992]	0.93	0.16	0.47	1.00
Durable consumer products, Netherlands [HCG, 1992]	0.83	N.A.	0.64	1.00
Beer brewing industry, United Kingdom [Fowkes et al., 1989]	0.88	N.A.	5.00	1.00

Business industry	Transit time	Frequency	Reliability	Transport costs
Chocolate and sugar confectionery industry, United Kingdom [Fowkes et al., 1989]	0.21 to 0.39	0.02 to 0.29	0.40 to 5.00	1.00

Table 3. Trade-off between transport costs and quality criteria in time-critical business industries

The first column reflects the value-of-time for different ‘time-critical’ business industries. The second and third show the values of frequency and reliability compared to the costs. The coefficients found resemble the slope of the demand curves in Figure 10. For instance the first figure of 0.30 shows that the average logistics manager in the Dutch food industry is indifferent between a change of the transit time by 1 % and a change of the transport costs by 0.3 %. The most noteworthy result is that, when measured in terms of costs, reliability appears to be the most important requirement for ‘time-critical’ customers; for every additional per cent improvement in reliability (anywhere between 90 and 100 %), the logistics manager was prepared to pay 5 % higher transport costs. When ranked according to this cost ratio, reliability clearly becomes the most important attribute in the Dutch food industry, followed by transport costs. Transit time and frequency share the third position. Other research findings basically confirm this order of magnitude.

These results put into perspective some claimed ‘disadvantages’ of inland waterway container transport, especially its slow speed. It appears that even in the most time-critical industries, on-time reliability is in most cases more important than speed itself. This finding opens up opportunities for inland navigation, which is generally a very reliable mode of transportation. For instance, inland navigation companies currently guarantee delivery times of containers from Rotterdam to Southern Germany within a margin of one hour.

3.4.3 Comparisons of logistics performance

To provide more specific evidence as a follow-up to the examples shown in 3.2, three cases where alternative modal arrangements can be compared are given below.

Case I: Containers from Rotterdam to Heidelberg

Transport costs still play an important role in modern logistics supply chains. For a first cost comparison, we use data from NEA [1995]: they calculated the operating costs for a shipment of one 1.44 TEU on average from Rotterdam to Heidelberg in Germany for three modes, direct road as well as IWT and rail requiring a road end haul. The inland navigation solution is 30 % cheaper than rail and 27 % cheaper than direct road on this route. The short end haul by road, including the terminal costs required, is more expensive than the long IWT haul.

Chain element	road	inland navigation	rail
Sea-terminal	41	55	41
Truck & overhead	455		
Ship & overhead		141	
Rail & overhead			314
Inland terminal		45	45
End-haulage by road		123	123
Total	496	364	523

Table 4. Cost analysis of modal alternatives (market prices in Euro)
Source: NEA, 1995

When these costs are compared with the time performance of the various modes, the following modal comparison emerges (see Figure 12). On this relation, and given the costs calculated, the rail alternative is hardly competitive with road and IWT, whilst the good starting position of inland navigation is negatively affected by the cost and waiting times of the intermediate processes (e.g. terminal transhipment).

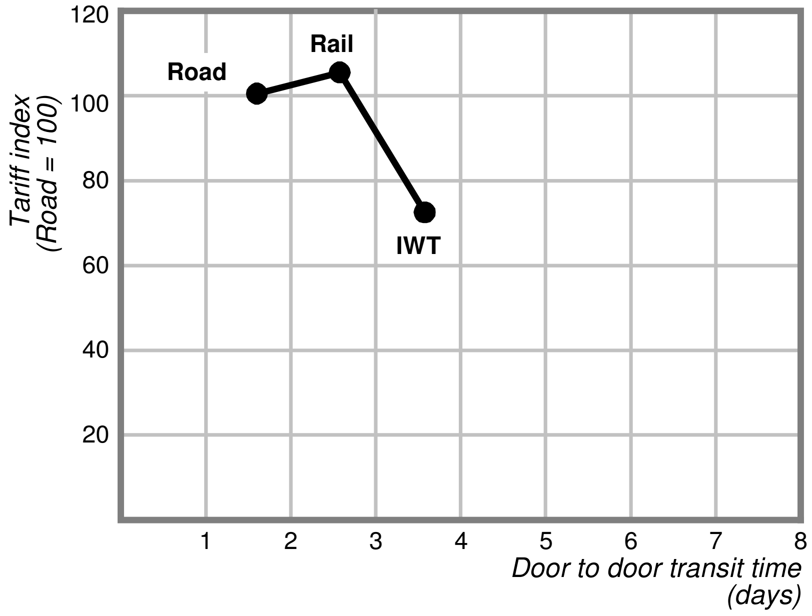


Figure 12. Modal comparison for one container from Rotterdam to Heidelberg

Case II: Liquid bulk from Rotterdam to Vienna

This case deals with the shipment of dangerous liquids from Rotterdam to Vienna (approximately 1,200 road kilometres). The current logistics organisation uses truck transport. The costs and performance of potential intermodal alternatives were analysed in order to determine whether they would be commercially acceptable and viable.

The actual door-to-door transit times as well as the costs for the various alternatives were calculated as follows (see Figure 13).

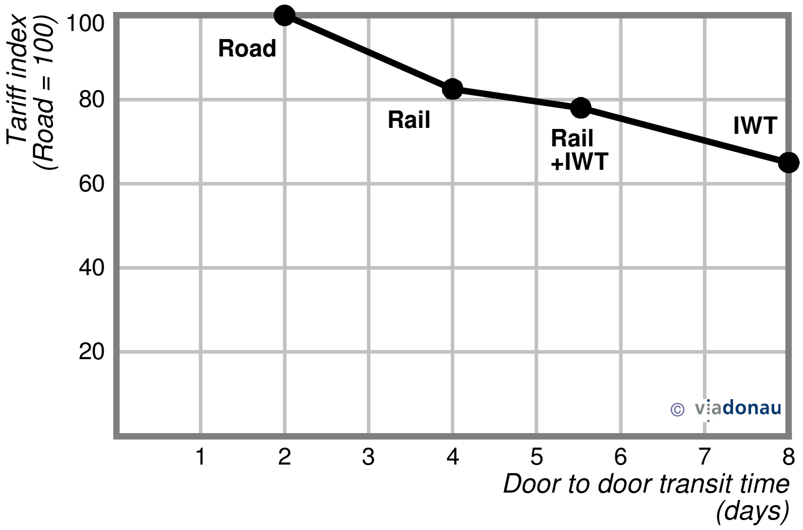


Figure 13. Modal comparison for shipment of dangerous fluids from The Netherlands to Austria

The current road journey with tanker trailers was obviously the most expensive (index = 100), but also the fastest (two days door-to-door transit time). Three intermodal alternatives were analysed:

- Rail transport using standard tanker containers would last four days, and cost around 80 % of the road solution
- Rail and IWT: if the first stretch (using the Rhine) would be carried out by inland waterway, and transhipment made to rail for the second stretch. This option would avoid lower fairway capacities, delays caused by locks on the Main and Upper Danube, and shipping tolls on the Main and Main-Danube Canal. The total transit time would be approximately 5.5 days and the price only marginally lower than the rail-only alternative.
- IWT: Shipping the liquid cargo in tanker barges of 1000 t, would be the cheapest but also the slowest option (eight days) because 66 locks would have to be passed.

The fact that the shipper required low volumes rather than large shipments at a time, led to the rejection of the intermodal alternatives. The current absence of regular container services on this long haul proved to be the main knock-out criterion for intermodal transport incorporating inland navigation.

Case III: Passenger cars from Austria to Romania

The third example deals with shipments of passenger cars from Austria to Romania (distance approx. 1250 km). Currently, these passenger cars are distributed by truck (trailers carrying eight cars at a time).

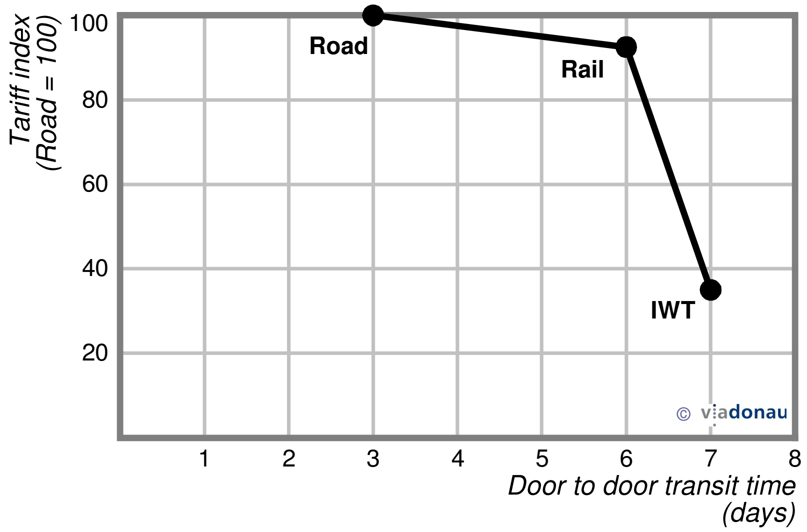


Figure 14. Modal comparison for shipment of passenger cars from Austria to Romania

This case is still under investigation, and revealed good opportunities for a modal shift towards inland navigation. IWT is by far the cheapest alternative (measured in door-to-door costs), but cannot compete with the door-to-door transit times that are offered by road. Some of the additional time needed is consumed by transhipment processes between the modes.

The main question in this case will be whether the worse time performance can be fully traded-off against the lower costs and the loss of part of the flexibility (reduced frequency of shipments). The logistics concept of the supply chain links before and after the transport process would have to be adapted accordingly.

3.5 Intermodal transport

Whilst many of the competitive aspects treated in the earlier sections also relate – at least in part – to the integration of IWT into multimodal logistic chains, it is useful in such a wide ranging report to look more specifically at the competitive elements and opportunities of such intermodal transport which includes IWT. To put this into perspective, some general analysis of the modal shares of the three inland modes and a review of goods affinity to IWT is also provided.

3.5.1 Prerequisites of intermodal transport

Modal shift (see also chapter 2 of this document), especially from road (and sometimes from rail) to IWT is considered beneficial from a socio-economic viewpoint. The Netherlands approach involving 600 firms and revealing a potential shift of 7-8 million tonnes to IWT is an outstanding example of what could be done elsewhere, even if the characteristics of the dense Netherlands waterway network cannot be reproduced in other areas. The process is one of developing a policy and “selling” it to the parties involved, with some at first surprisingly favourable results as regards costs. Whilst in certain cases IWT can directly substitute road haulage, most potential modal shifts involve the need for transporting the goods multimodally.

Such multimodal transport, as part of a logistic chain, requires both the appropriate waterway infrastructure and transhipment superstructure for transferring goods between vessels and rail and/or road, as well as the market organisation to initiate and supervise multimodal carriage. Unless the combination of IWT, transfer and onward shipment (or vice versa) proves to be cheaper over a period of time than and as reliable as the direct single mode transport, it will not prevail.

It is therefore important to ascertain the importance of the socio-economic factors mentioned in this Report and the willingness of the authorities to ***subsidise or compensate*** the actors in the multimodal chain in order to overcome the potentially higher costs of multimodal transport. In addition to national schemes the European Commission has for some years provided assistance in this regard, first through the PACTS scheme and currently the ***Marco Polo*** project. It must be said, however, that whilst this project has attractions for international transport, its rules render it inapplicable for domestic (national) transport. For example, enterprises from different Member States must be included in each specific project. To overcome this barrier subsidies would have to be provided at national, regional or local level and it would have to be ensured that the aid given would not infringe EU State Aid legislation. Taking this thought further, future EU schemes might consider that the full implementation of the Internal Market would – as a logical conclusion - no longer require participation by firms from different Member States, especially in view of the fact that they all now have market access, including cabotage rights, in all Member States.

In general, ***State Aid*** is not permitted for operational aspects, but infrastructure can be supported and innovation rewarded. Moreover the rules for SMEs are often more generous than for larger enterprises. An interesting development in respect of potential aids is that of containers – a growing form of transport which is used for products of relatively high value compared to their weight and which is thus not at first sight highly affinitive for IWT.

Maritime ***containers*** are nearly always stackable and IWT is developing vessels with up to four layers on the largest waterways with adequate bridge clearances. We are not aware of any aid given to the development of the containers themselves, but technical improvements of the vessels and dockside installations may qualify.

On the other hand ***swap bodies*** are not stackable, mainly because they are carried one-high by heavy goods vehicles and rail. It has recently been suggested that they might be technically adjusted to allow them to be shipped by IWT two-high and therefore more economically transportable, or at least made top-liftable for stowing in barges. Pursuing this point it is thought that such adjustments might qualify for State Aid as an innovation. The question here concerns the pre-eminent role of swap bodies for road transport. Is it conceivable that they could – and should – be changed for this new job? Could such adjustments be carried out in a restricted area where there are promising new IWT developments and thus not interfere with the use of swap bodies for essentially road/road or road/rail transport? A few examples will be reviewed below in Section 3.5.3.

The prerequisites for IWT-based intermodal transport with swap bodies may be specified as follows:

- The length of transport on IWW must be in due proportion to the length of pre- and end haul;
- The infrastructure must be adequate (transhipment facilities, bridge clearances, depth of the fairways, dimensions of locks);
- In the starting phase there would not be enough volumes for carrying just swap bodies on ships, especially as ship sizes are dimensioned for locks and bridge clearances and not for optimisation of swap body stowage; a more economically concept is mixed stowage of swap bodies on container ships or on bulk carriers.

Economical carriage of ***palleted goods*** requires the following:

- Technically improved solutions for efficient and careful transhipment;
- Integration of pre- and end haulage;
- Connecting transport with storage (using transport time for storage);

It is beneficial if shipping companies or ship owners co-operate with forwarders or hauliers for pre- and end haul. Examples in the Netherlands of river shuttles with fixed stations show that even on short distances IWT can handle pallets at short notice.

A further comparative advantage of IWT may in future play a more important role in its favour. This would be the introduction of a fair and scientifically supported system of ***infrastructure charges.*** Since the Commission has ordered a specific study to be carried out on this subject, its potential impact will not be analysed in detail (see part C policy and legislation), but we may say that using the broadly accepted concept of marginal costs as a charging basis, the burden on IWT is likely to be the lowest per tonne or tkm of goods. Some countries (e.g. Belgium) are already levying such charges on a very low basis, others may have to be tested against the Act of Mannheim's prohibition on shipping dues on the Rhine. All that needs to be said here is that such a system is likely to produce a cost advantage for IWT as compared with rail and road.

3.5.2 Modal split and the IWT potential within logistic chains on selected origin-destination relations

Having put the question in broad terms, we shall now review, the ***modal split*** and the potential for more IWT. As somewhat better data are available for the three inland modes road, rail and IWT, the figures below on modal split will relate to them, thus excluding pipelines, short sea shipping and air transport.

In Western Europe IWT increased from 102 bn tkm in 1970 to 125 bn tkm in 2000, but lost market share from 12% to 7% over this 30 year period. Individual countries vary greatly: for the year 2000 one might mention the high IWT share of 43% in the Netherlands, 12-14% in Belgium and Germany, 5-9% in Austria and Luxembourg, and 2% or less in France and the other countries. Again, within these totals, there were substantial differences between the international and domestic markets, reflected in – or sometimes caused by – different average distances linked to the size of the country and the extent of its waterway network.

In judging the ***potential*** for ***future IWT,*** especially multimodal transport, it is vital to look at its market share in different ***commodity groups***. Here, the available statistics are usually in terms of volume (tonnes) rather than performance (tkm). We also found that the statistics provided by different sources diverge considerably and therefore need more thorough analysis.

To start with, some 740 m. tonnes were reported by in the 6 most important IWT countries (BE, DE, FR, LU, NL, AT) as having been handled (loaded/ unloaded/transited) in the year 2000. However, if the 125 bn tkm performed in total and referred to above indeed averaged 280 km per journey, only 446 m. tonnes would have been carried. To check this calculation and avoid obvious double counting we excluded international unloadings from the total of 740 m. tonnes. This brought the total down to 516 m. tons, a figure still too high because some transit volumes would have passed through more than one country and some domestic tonnage may have been reported as loaded and unloaded. A further analysis in the Demand part (part B, chapter 1) provided data on the domestic IWT in these 6 countries which amounted to just over 200 m. tonnes; this would imply international traffic of about 245 m. tonnes.

Within the total tonnage of 446 m. tonnes some ***300 m. tons*** in 2001 were analysed by Eurostat ***by commodities*** (10 NRT classes). Easily the largest group with 30% of the total was minerals and building materials; it was followed by petroleum products (17%), ores and metal wastes (12%) and solid mineral fuels (11%), so that these four IWT high affinity product categories accounted for 70% of IWT volume.

The contribution of the ***accession countries*** in 1999 was a mere 8.5 bn tkm or 7% of the West European total. For a number of reasons IWT, having reached a peak of 13 bn tkm in 1980, had dropped in 1999 by about 14% from its 1970 level. Its modal share in that year reached about 9% in Romania and Slovakia, over 5% in Hungary, but 3% or less in BG, CZ and PL.

No data was available on commodity classes, but there is reason to believe that similar affinities to bulk shipments prevailed in Central and Eastern Europe as they did in the West.

Turning to the ***IWT performance potential***, analyses on future transport volumes (part B chapter 3) shows that according to the Prognos forecast the 125 bn tkm achieved in Western Europe in 2000 may rise by 35% to 167 bn tkm in 2015. Whilst modal shares are likely to remain relatively constant, after a long fall both for IWT and rail, IWT might lose another percentage point by 2015 to reach 6%.

The ECORYS forecast in chapter 3 part B (demand, future transport volumes) expects an increase of only 15% in the earlier 10 year period to 2010. The breakdowns by 4 transport classes (solid bulk, liquid bulk, general cargo and containers for ECORYS) tend to be in line with each other as regards IWT affinity and the changes to be expected in the ranking of commodities to be transported by IWT in future. A clear tendency for slower growth in the traditional goods and faster growth in containers and other niche goods is common to both.

In this connection reference should be made to the detailed analysis in the last part (E potentials for IWT, prospects in present transport markets) where each of the 10 commodity groups is appraised for its potential growth. What matters most in this Chapter is the extent to which IWT can compete with other modes for these commodity groups. Whilst it may be said that building materials are ideal for IWT, they are often used at some distance from the waterways or ports. This is less likely for minerals, ores and metal wastes, but petroleum products may well need to be shipped further by road or rail and this also applies to agricultural products, foodstuffs and goods in containers.

It is also of interest to see IWT ‘s modal share in combined transport. Expressed in tkm, Figure 15 below shows that whilst it grew - very slowly – as a percentage of total IWT performance between 1993 and 1998, it had only reached about 4% of total IWT performance by 1998. This must be compared with the substantial growth of combined transport in the rail sector to over 25% of rail tkm by that year. In other words, further substantial efforts by the inland waterway profession and also by the authorities are needed before IWT can play a really significant role as part of logistic multimodal chains.

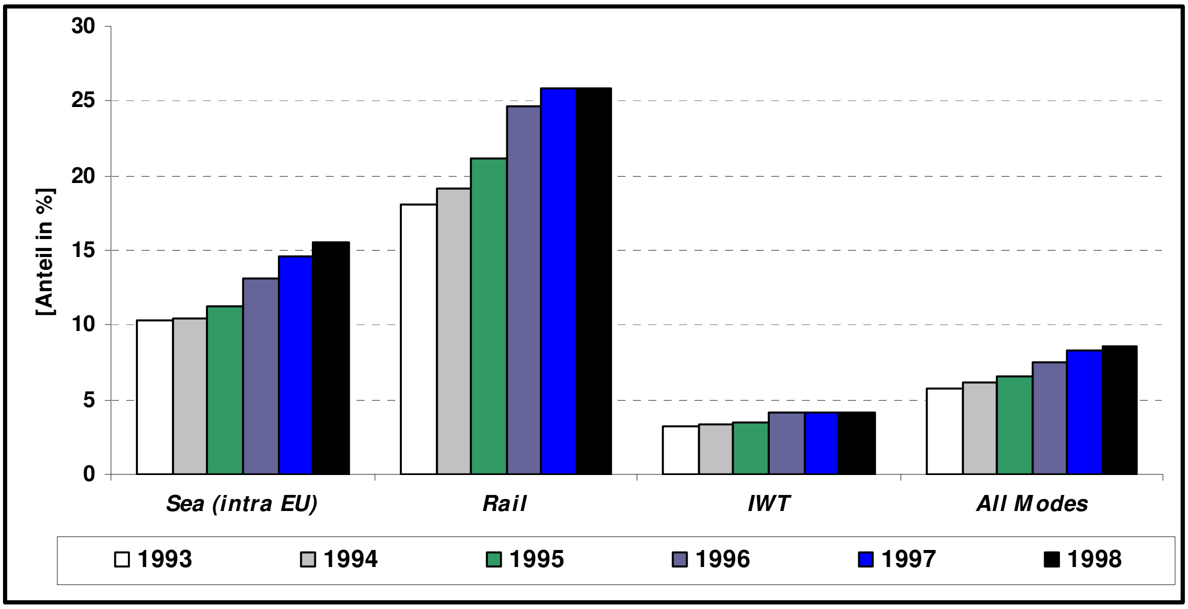


Figure 15. Share of Combined Transport 1993 – 98 in the transport performance of various modes and the total of all transport in the EU (in %)
Source: EUROSTAT, Energy and Transport in Figures 2002

To conclude we are aware of a likely future stagnation in bulk goods which are still the main cargo carried by IWT. If IWT wants at least to keep its modal share in European Transport, it needs to increase the transport of general cargo (NST/R 9). Efforts must be made to enhance container transport which is a growing market with high affinity for IWT, especially in the hinterland transport of the overseas ports, but in addition the huge and growing outlet of palleted goods in inland transport, both as part load or in swap bodies, should be opened up in the future. Looking at the market position of IWT by focusing on the development of transport volumes in tonnes does not show the right tendency. High value goods have higher freight rates and can be more profitable than bulk goods. The shipping companies should therefore look carefully to what extent the use of available loading capacities on ships can be improved.

As regards the goods themselves suitable branches are the transport and automobile industries, the chemical industry, foods and beverages and construction materials.

Evaluation of opportunities

Improving the economics for IWT will depend on its ability to continue to provide relatively cheap and reliable transport services, coupled with adaptation to technical progress and modern management methods, including better means of communication. Progress in container transport in the recent past has shown that there are no barriers to IWT which cannot be overcome, other than the basic nature of the network which may require very costly and time-consuming infrastructure projects.

Unfortunately the proponents of IWT have not yet found a way of persuading the authorities at national and EU level to provide substantially more investment for waterways, at a time when they are giving rail expansion and upgrading first priority. Indeed it may be claimed that in this respect there *is* ***no level playing field*** for the two modes.

Evaluating ***specific opportunities for a modal shift*** requires a more detailed look at the transport business and the logistic chains involved than so far tackled in this chapter. Whilst we have concentrated on the direct competitive situation, the role of IWT in multimodal chains – ***intermodality*** or IWT integration into overall logistics – will also be reviewed in part E (potentials for IWT) chapter 2.

Even so, we should like to underpin our broad analysis with an ***example***, by reporting an attempt to establish a new logistic chain reaching from the Upper Rhine into Italy. Since many barges going upriver from the Lower Rhine have spare capacity after discharging their cargoes in the middle and upper Rhine ports, a consortium (ART) was formed to transport cargo, usually in containers and often chemicals, from these Upper Rhine ports to Basel for onward shipment by rail to a terminal in Novara, Northern Italy. The Consortium included two rail companies (DB, BLS), the terminal owners, some Italian integrators and 3 Rhine shipping companies. This novel international initiative could count on aid from the EU PACTS programme and it was established that schedules could be handled and costs kept lower than direct road freight or the use of HUPAC rail/road services. However, in the end, the project did not get off the ground because of the reluctance of the shippers to commit themselves to a logistic chain whose costs were only marginally beneficial and where the costs of the hardware – i.e. the modification of swap bodies so that they could be safely handled into and out of the barges - appeared in the end excessive and/or too risky.

As opposed to this relative failure, it was noted earlier that short sea shipping and IWT can be combined. Indeed a service in containers was established from inland ports like Emmerich on the Lower Rhine to Felixstowe in the UK by using specially adapted vessels. In the EU-funded project InFreDat as an example of intermodal chains the transport of automobiles from the production site in Spain to their outlet in Germany was investigated. One alternative looked at was to use short sea shipping to the ARA ports first and then to carry the vehicles by IWT close to the selling agencies in the hinterland.

A recent German investigation which focused on the potential of transporting swap bodies in IWT contains a case study for the relation Emmerich-Wörth (Rhine) including a comparison of transport prices between an intermodal chain with IWT/road and a single road transport. The result is shown in the following diagram:

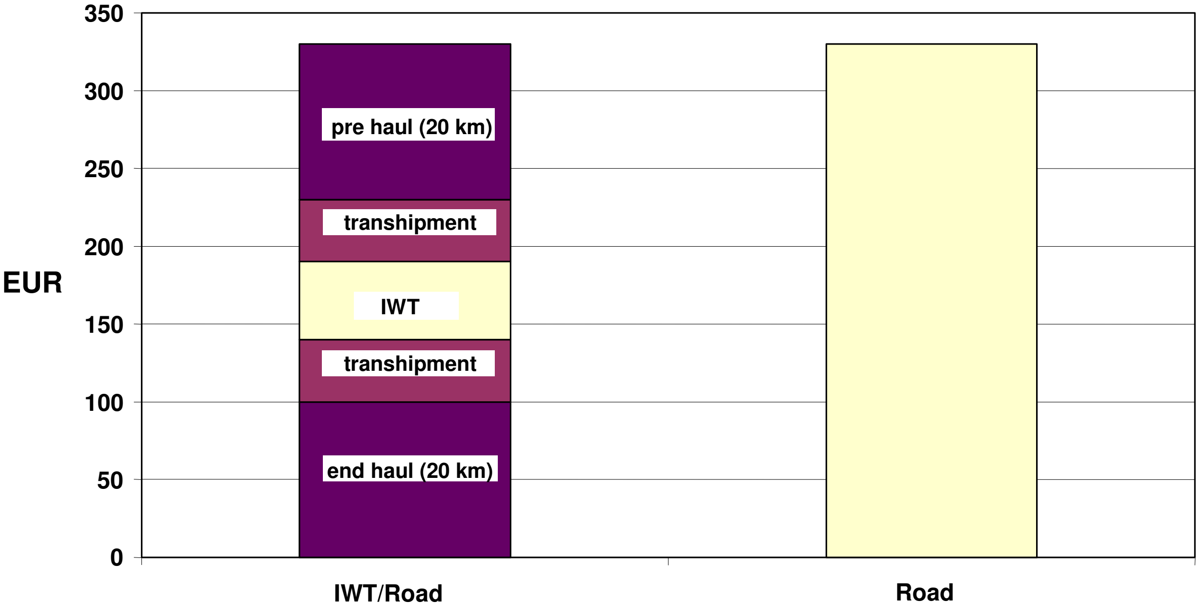


Figure 16. Cost comparison between intermodal transport with IWT and direct road transport in the case study Emmerich-Wörth, Kessel+Partner/SGKV 2002[25]

It is clear that the transhipment costs and even more the costs for pre- and end haulage by far exceed the monetary amount that remains for IWT, although the longest part of the transport (486 km) is by water. As the 50 € remaining available did not cover the IWT cost-the intermodal chain in this case was not profitable. But if the direct road transport had to pay the planned 15 cent/km user charge for the German highways on top of its costs, the IWT freight rate could more than double, which would be profitable provided load capacity were underutilised. If the shipping company could do the trucking himself intermodal transport would get a chance to be economic for that relation. In quoting this example the authors underline that transhipment costs are a main aspect in intermodal transport to the cost of which should decline due to investments funded by government. The technical and organisational prerequisites of carrying swap bodies with ships are the stackability of swap bodies and to take the swap bodies as additional cargo to ISO containers for optimising load.

Whilst other examples can no doubt be cited, we do not believe that these are specifically related to corridors, but that each must be able to stand up in its own merits, nationally or internationally.

As far as intermodal transport is concerned, due to the dimensions of locks the width of storage available on current vessels is rarely compatible with the normal width of swap bodies.

---

[25] Studiengesellschaft für den kombinierten Verkehr, Kessel und Partner: Bestimmung des Marktpotenzials für den Transport von stapelfähigen Wechselbehältern in der Binnenschiffahrt und Betriebsversuch, im Auftrag BMVBW, Freiburg/Frankfurt 2002.

As a result, the transport of stackable swap bodies is usually only economic, if these units are transported together with containers as mixed loads or if they are shipped as supplementary loads to container (or bulk load) shipments. In addition the infrastructural conditions play a significant role in attaining efficiency, because they determine maximum stacking height. And last not least from a policy viewpoint the promotion of combined transport should focus on lowering handling costs, because these often lead to the non-profitability of intermodal chains. Moreover cooperation between the parties involved in the chain and the creation of regular traffics are sensible measures for limiting the high costs of pre- and post transport proportionately. Intermodal transport using IWT is hardly a technical problem any longer, but above all an economic one. In many cases it is not (yet) worth while because the quantities needed for a origin-destination traffic are simply not there.

3.6 Conclusions

The physical and technical supply factors of inland navigation with regard to waterway infrastructure, transhipment facilities, vessels and labour have been discussed at some length in this chapter. The objective was to show how they affect IWT's logistical performance. This performance represents the supply side in a competitive environment and needs to be expressed in terms of costs to the IWT enterprises and their ability to provide appropriate services. On the demand side the requirements of shippers (consignors/ consignees) in terms of price, speed, reliability, door-to-door services, organisation etc. were reviewed to see how they could be matched with the supply factors. Within this general background, some differences were found in IWT competitiveness according to whether it was intermodal, intramodal or part of a multimodal chain.

A review of different studies showed up the varying importance for specific types of inland waterway transport of the elements of price, speed, reliability and frequency of service. In so doing it revealed a number of problems which inland navigation needs to overcome in order to at least maintain its current relatively low share of the freight transport market and preferably - from a socio-economic viewpoint – to increase it.

For example, organisational improvements are required, such as more transparency and better co-ordination between the many parties involved in a logistic chain; if they cannot be provided service characteristics such as speed, reliability and flexibility will suffer. Indeed inland navigation cannot afford a deterioration of service performance in a competitive business environment calling for higher delivery standards as well as lower costs.

Second, closer attention to nautical conditions and better communication techniques would improve IWT economics by allowing better planning of movements. Innovative technology on ships and at shore sites is needed to help reduce costs. These aspects particularly concern growing IWT markets like container transports which require tight scheduling, as well as other niche markets. Where physical and technical limitations tend to push up costs without providing better performance, shippers will look for alternative solutions.

As an example the Dutch Railways gained a few new clients (coal and iron ore shippers) as a result of the 1995 floods on the Rhine [Nederlandse Spoorwegen, 1996].

The current market share of inland navigation is of course dependent on macro-economic developments and (future) transport policy which tends to try and restrict road traffic. However, shifts in the freight market show that the demand for non-bulk commodities is rising whilst bulk flows showing strong affinity to water transport are decreasing. Whereas inland shipping companies traditionally shipped goods for customers mainly focussing on transport rates, in future they will have to commit themselves to tighter time schedules, even for bulk cargo such as iron ore. The concept of floating stocks is gaining ground. Unless the appropriate action is taken, these developments can pose a serious threat to inland navigation, for its competitors road and rail will try to take advantage of any weaknesses. On the other hand, due to the comparatively long transit time inland navigation might be seen as a sort of a moving storage, thus reducing warehousing costs. As long as reliability in the form of just-in-time can be guaranteed IWT certainly has opportunities to compete with road and rail even within advanced logistical concepts.

Inland navigation and rail transport are both suitable for transporting bulk goods over long distances. Because of this competition, the same delivery conditions that may have worked for inland navigation in the past, may not work anymore in today's freight markets.

Nevertheless, in the face of these potential threats our review of competitive conditions between IWT and other modes has also shown that ***IWT can develop its share of the market*** by a judicious combination of

- sufficient infrastructure conditions
- technical adaptation of vessels and infrastructure (including transhipment),
- better communication techniques,
- the discovery and development of niche markets and
- reforming the arrangements needed to construct logistic chains at lower overall costs.

IWT's advantages of vessel size, basic reliability and safety can create new outlets and succeed in effecting a modal shift, especially where growing road congestion suggests that shippers need to consider alternative ways of moving cargo. The imposition of a fair system of infrastructure charges should also help IWT to become more competitive.

However, the IWT profession cannot be expected to take all these required actions on its own. At a time when national governments and the EU appear to be favouring rail by granting aid and investing in new lines and upgrading existing ones, ***inland waterway transport*** often appears to be ***left out***. Just one long awaited IWT project has made it to first priority in the latest Trans-European Transport Network list, being approved by the Council of Ministers apparently against objections voiced by the Commission. As infrastructure conditions clearly influence the intermodal competitiveness, the aspect of maintenance and improvement of waterway infrastructure is very important with respect to acquiring a larger market share.

It seems possible that IWT is being considered as less attractive than its main competitor the railways, in part because it does not have such an organised voice with the authorities via well organised unions and managements still closely linked to the State. A more balanced consideration of the socio-economic advantages of inland navigation should redress that situation.

PINE

Prospects of Inland Navigation within the enlarged Europe

Part E Potentials for IWT

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

Chapter 1 Prospects in the present transport markets

1.1 Introduction

This chapter focuses on a differentiated market analysis in the EU countries and, as far as data was available, in the Accession countries. This market analysis takes into account socio-economic development, the analysis of branches with a high transport market affinity and the economic productivity in the EU and Accession countries.

In section 1.3 we first outline the general development of the European economy and second, show GDP and its future growth rates in EU-25, for agriculture as well as for industry. A differentiated analysis of seven sub-sectors with interest on IWT follows, but only for the EU-15, as up to now these data are not provided for EU-25. After this task we make a goods segmentation of IWT, based on the previous and present split of commodities by NST/R chapters, and further give an overview on the different commodity shares for as well IWT, road and rail. These analyses are followed by prospects of inland navigation by commodity groups which reflect a broad overview of estimations of forecast experts in Europe. The prospects finish with a table in which we draw conclusions of the previous analyses concerning possible IWT potentials by market segments and loading characteristics (dry bulk, liquid bulk, intermodal and RoRo). Section 1.3 concludes with some visions of development directions in the IWT sector concerning the impact of changing market segments, e.g. changes on the type of vessels and necessary adaptations of the performance of inland navigation and logistic chains.

Section 1.4 contains a market analysis of river corridors regarding the future development of market segments in IWT.

In the next chapter, an analysis of the market potentials for the inland waterway transport will be made. Therefore, already in this chapter commodity groups will be pointed out with a high interest for inland navigation, especially in the future.

1.2 Method of working

To be able to present data on market segmentation and market potentials, a lot of sources have been used. Some examples are the Prognos World Report 2002, the NewCronos database and other sources of Eurostat as well as the latest information on the NEA database and relevant European projects.

The market segmentation has been made by commodity types per country as well as for river corridors. As corridor specific data from NEA was not available in time, use has been made of a corridor approach by clustering the countries involved in certain corridors and building corridor-specific average growth rates by NST/R chapters. These growth rates were derived from the country-based 2000 data and 2020 forecasts made by NEA. The corridor analysis was supplemented by statistical information from the Rhine Commission and the Danube Commission as well as by forecasts of previous studies about inland navigation. In this context only the EUDET study provided useful information about the future development of market segments.

1.3 Market segmentation

1.3.1 Development of market segments in the European economy

The general development of the European economy was shown in part B (Demand). The main findings are that the GDP is expected to grow faster in the future than in the past, mainly triggered by the integration of East European countries into the Single European market. Secondly, external trade in European countries will continue to grow even faster than GDP, especially in the period 2000 to 2010, and particularly in the Accession countries. This is caused by the continuing increase in the horizontal and vertical division of labour, resulting from globalisation and liberalisation. Thus, in addition to the ongoing structural changes in the economy, economic development is being driven by the transformation process in the Accession countries and their step by step inclusion into the European Union.

These two factors will considerably influence the transport market. On the one hand the basic industries will be partly shifted to the new members as they become the low-wage countries of the EU, a process that already began in the 1990s. The import of crude materials will therefore follow different routes and more semi-finished products will be carried from East to West European countries.

On the other hand the Accession countries represent a large market outlet for high value products which will generate transport flows from West to East. This is because the production of high value goods will remain mainly in Western Europe where infrastructure and manpower resources provide better conditions.

Up to now there is no precise information on the present and future flows of goods by NST/R chapters within European regions. We shall therefore concentrate in the following on market sectors. This could be done by differentiating between agriculture (including forestry and fishing), industry and construction, but as construction key figures show little difference from those for industry we shall look at both sectors together. Furthermore we shall omit the service sector, as it is not relevant to the focus of our study. The analysis can be supplemented by further information about different sub-sectors of industry but this additional information is only available for EU-15.

The following two tables show the data by country. In the year 2000 the agricultural sector of the EU25 produced 257 bn US$ (at 1995 prices), or 83% of all European countries (310 bn US$). The Candidate countries have a share of 9% of the EU-25 total. This is expected to marginally increase to 10% in 2010. The average annual growth rate from 2000 to 2010 is 0.5% in the EU-15 and 0.6% in the EU-25. Altogether, the data show no significant changes in this sector.

From this picture it can be concluded that transport flows in NST/R chapter 1 will not change significantly either. There may be some regional shifts, for example possibly increased imports into Austria from Slovenia. The Czech Republic, Lithuania and Slovakia also have above-average growth rates, which may generate somewhat higher export flows.

	at 1995 Prices, in Billion US$			Growth Rates in % p.a.	
Agriculture	1995	2000	2010	95-00	00-10
Austria	5.6	6.3	6.9	2.4	0.8
Belgium	4.2	4.6	4.7	1.9	0.2
Denmark	5.8	6.4	7.5	1.9	1.6
Finland	5.4	6.0	6.8	1.9	1.3
France	46.6	52.2	55.5	2.3	0.6
Germany	29.5	33.2	35.0	2.4	0.5
Greece	10.7	11.1	12.1	0.7	0.9
Ireland	4.8	5.0	5.4	0.7	0.8
Italy	33.4	35.8	37.4	1.4	0.4
Luxembourg	0.2	0.2	0.2	1.3	-0.9
Netherlands	13.6	14.7	15.4	1.5	0.4
Portugal	5.1	4.9	4.6	-0.8	-0.6
Spain	24.8	28.6	31.3	2.9	0.9
Sweden	5.6	5.5	6.1	-0.3	1.0
United Kingdom	18.6	18.6	17.1	0.0	-0.8
European Union	213.9	232.9	245.9	1.7	0.5
Bulgaria	1.8	2.2	2.4	3.7	1.0
Czech Republic	2.3	3.0	3.6	5.5	1.8
Estonia	0.3	0.2	0.3	-0.9	1.1
Hungary	2.6	2.5	2.9	-1.0	1.5
Latvia	0.4	0.4	0.4	-1.2	0.8
Lithuania	0.6	0.7	0.9	2.2	1.8
Poland	7.7	7.7	8.7	0.0	1.3
Romania	7.0	5.2	5.5	-6.0	0.6
Slovakia	1.0	1.1	1.3	2.5	1.4
Slovenia	0.7	0.7	0.9	-0.4	1.9
EU Candidates	24.5	23.7	26.8	-0.6	1.2

Table 1. Gross domestic product by country of origin – Agriculture
Source: Prognos World Report 2002, Prognos Economic forecasts for Eastern Europe, 2002

The industrial sector, on the other hand, is 10 times more important. Moreover, its average annual growth in the EU-25 at 1.7% is much higher than in the agricultural sector. The Candidate countries only accounted for 5% of the EU-25 total of 2760 bn US$ in 2000; that share will rise, but only to 6% in 2010. Incidentally, 18% of industrial production is accounted for by the construction sector, which is rising at 1.2% p.a.)

The leading country by far is Germany with 750 bn US$ (27%), followed by France (420 bn US$), United Kingdom and Italy (340 and 330 bn US$). Poland as the leading country of the Candidates with 60 bn US$ falls between Austria (80 bn US$) and Finland (50 bn US$). The Czech Republic and Hungary (21 and 17. bn US$) have much lower industrial production than “the taillights” of the EU, Portugal (36. bn US$) and Greece (28. bn US$). Even if annual growth in the Candidate countries is expected to be higher than in the EU-15 the ranking shown will not change up to 2010.

	at 1995 Prices, in Billion US$			Growth Rates in % p.a.	
Industry (incl. construction)	1995	2000	2010	95-00	00-10
Austria	68.7	81.2	94.6	3.4	1.5
Belgium	73.2	85.5	102.5	3.1	1.8
Denmark	40.1	44.7	54.2	2.2	1.9
Finland	37.2	53.6	71.2	7.6	2.9
France	378.4	423.2	517.7	2.3	2.0
Germany	740.2	748.1	825.5	0.2	1.0
Greece	24.3	28.2	40.5	3.0	3.7
Ireland	22.7	44.0	69.0	14.2	4.6
Italy	310.3	329.0	376.5	1.2	1.4
Luxembourg	4.1	5.2	6.5	5.0	2.2
Netherlands	107.6	119.9	139.1	2.2	1.5
Portugal	29.3	36.4	45.4	4.4	2.2
Spain	166.5	202.8	262.0	4.0	2.6
Sweden	65.9	81.5	101.0	4.3	2.2
United Kingdom	323.2	344.2	372.8	1.3	0.8
European Union	2'391.7	2'627.5	3'078.6	1.9	1.6
Bulgaria	3.9	3.3	4.4	-3.1	3.0
Czech Republic	20.4	20.7	29.2	0.3	3.5
Estonia	0.9	1.3	1.9	7.1	4.1
Hungary	12.1	17.2	26.1	7.3	4.3
Latvia	1.3	1.6	2.3	4.6	3.8
Lithuania	1.8	2.0	2.9	1.9	3.6
Poland	43.1	58.2	83.4	6.2	3.7
Romania	14.0	13.3	16.4	-1.1	2.2
Slovakia	6.6	6.6	8.9	-0.1	3.1
Slovenia	6.1	7.8	11.1	5.0	3.6
EU Candidates	110.2	132.0	186.8	3.7	3.5

Table 2. Gross domestic product by country of origin – Industry (including construction)
Source: Prognos World Report 2002, Prognos Economic forecasts for Eastern Europe, 2002

Looking at industrial development in the EU as a whole, the process of change and adaptation witnessed in the past seems likely in future to slow down somewhat. Annual growth from 1995 to 2000 ranged widely from -3.1% in Bulgaria up to 14.2% in Ireland; three Candidate countries had growth rates over 6% p.a. This shows that the transformation of the former East bloc states to market economies produced substantial changes in economic production which process is now being converted to a steadier development of economic growth.

In the Western countries (Ireland excluded), the differences in the past growth rates were smaller than in the Accession countries but nevertheless ranged between zero growth in Germany to 7.6% p.a. in Finland. In contrast, the growth rates expected from 2000 to 2010 only vary between 1 and 2 % p.a. Major changes in transport flows took place in the last decade and will probably continue, though at a slower pace. Since the main economic strength will remain in Western Europe so will the transport flows. Here again although growth rates will be higher in the Candidate countries than in the West output is still at a relatively low level and so are transport volumes.

For the EU 15-countries we also have information on industrial sub-sectors and their prospective growth. Industry is first divided into two sub-sectors: Mining/Quarrying and Manufacturing. The ***Mining sector*** is highly relevant for IWT. As a low value product it accounts for less than 3% of industrial GDP in the EU-15 and even this will decline from 58.0 to 55.1 bn $ between 2000 and 2010. Germany will continue to register the largest loss in production, but this is a natural sequel to the previous decades: for example from 1995-2001 there was a decrease of 10.7%. This will have consequences for IWT, especially on the Rhine. There will be fewer transports of mining/quarrying products within the continent, but this may be balanced by import flows, mainly coming from the North Sea ports. However, the overall transport volumes in this sector will stagnate.

Manufacturing with an overall EU-15 GDP of 1870 bn $ in 2000 can be further divided into different sub-sectors:

- ***Food, beverages and tobacco*** have a high share of GDP (12%) and will grow at 0.9% p.a. until 2010, but are of relatively limited relevance to IWT because of short delivery periods and the need to use specific types of container for refrigerated foodstuffs.
- ***Fuels***, on the other side, are of major importance to IWT. The production of solid fuels has been declining in the EU itself. Amounting to about US$ 28 bn it is likely to stagnate at this level up to 2010. At the same time, however, imports from overseas are rising and the need to transport them inland from the seaports makes IWT the favourite mode. In that connection it is of interest that, as between the individual countries, substantial changes in fuel movements may be expected because of the changing production/ import ratio.
- ***Chemicals*** account for more than 9% of the industrial GDP; they are expected to grow by 2.2% p.a. until 2010, but this growth does not necessarily mean higher volumes in basic chemicals which are an important IWT cargo.
- ***Non-metallic mineral products*** at 4% GDP are of interest to IWT and are expected to grow at 1.2% p.a. on average, but ranging between Germany with a -0.5% loss to France with a 1.4% gain; overall this sub-sector should provide a modest chance of rising IWT volumes.
- ***Basic Metals and Metal products*** account for 12% and a growth rate of 1.2% p.a., mostly generated in IWT countries so that IWT volumes may grow in this sub-sector.
- A small potential to IWT may be seen in the market of ***paper products;*** including 9% of industrial GDP. This is a question of the quality of transhipment as paper is a very sensitive good in handling. On the other hand paper transport flows have the required distance, are often connected with maritime transport (ports of Belgium, Germany, Poland) and will grow with 1.8% p.a.
- The biggest expansion rates (approx. 3% p.a.), however, are expected in investment and consumer goods and these are the products with the highest industrial GDP in the EU-15; more than one third of GDP is accounted for ***machinery equipment, transport equipment and electrical equipment***. As these goods are generally carried in inland containers and swap bodies there has to be done great efforts in improving vessel capacity (measurements) and standardisations of stackable transport boxes in the next years if IWT should stronger participate on these segments.

1.3.2 Goods segmentation in IWT, road and rail

Our review of the general economic development in an enlarged Europe now needs to be adjusted to analyse in particular those sectors of the economy, which have affinity to IWT. This analysis is complicated by the fact that the breakdown of the overall economy into NST/R chapters is only available for the EU-15 (including their transport relations to Eastern Europe).

The following Table 3 shows the share of NST/R chapters in overall surface transport in the European IWT countries compared with the share of IWT, based on 1992 data from the Shifting Cargo study[1]. The third column represents the commodity shares in 2001 (EUROSTAT data). With the exception of Switzerland the investigated area in both databases is the same.

The breakdown of goods volumes moved by all three inland modes shows that building materials, manufactured articles and agricultural products including foodstuffs are most important. Solid mineral fuels, ores and fertilisers have low transport volumes.

Commodity Groups in % (NST/R)		**3 modes 1992 (SC)**	**IWT 1992 (SC)**	**IWT 2001 (NC)**
0	Agricultural Products	10	4	4
1	Foodstuff, Animal Fodder	16	6	6
2	Solid Mineral Fuels	5	10	11
3	Petroleum Products	8	19	17
4	Ores and Metal Waste	4	10	12
5	Metal Products	7	4	3
6	Minerals, Building Mat.	21	36	30
7	Fertilisers	2	3	5
8	Chemicals	7	5	6
9	Machinery, Manuf., Misc.	21	3	7
	Total	**100**	**100**	**100**

Table 3. Shares of commodity groups (in %) based on transport volumes (in tonnes) in the main IWT countries of Western Europe, 1992 (Shifting Cargo: SC), 2001 (NewCronos: NC)
Source: Shifting Cargo 1998, NewCronos, 2002

As expected, the breakdown of volumes moved by IWT is quite different. Its dominance is concentrated on heavy bulk goods like solid mineral fuels, petroleum, ores and building materials. Three quarters of 1992 IWT transport took place in these four commodity groups, and still 70% in 2001. Another tenth of IWT volumes are of agricultural products, food and animal fodder. Comparing 1992 and 2001 data one can see a decline in petroleum products, metal products and building materials, contrasting with growth in fertilisers, chemicals and manufactured articles.

---

[1] Shifting Cargo, Chapter 4 (Analysis of transport statistics), 1998. The statistics are based on the following countries, including transport relations of these countries with the Near East: Belgium, Luxembourg, Netherlands, France, Germany, Austria, and Switzerland.

Compared to the distribution of commodities for all modes IWT shows a high share of overall transport in NST/R chapter 2, 3, 4, 6 and 7, a medium share in chapter 5 und 8 and a low share in 0, 1 und 9. The Shifting Cargo study drew from their data a conclusion that differs a little bit from this. They see a high affinity in chapter 2, 3, 4, 5, 6 and 7, a medium affinity in chapter 0, 1 and 8 and a low affinity only in chapter 9. Note that especially the low affinity segment has obviously gained more volumes in recent years. We therefore see chapter 9 ascend to a medium affinity segment if the above mentioned general conditions concerning transhipment facilities and the characters of standardised transport boxes will be accomplished. Furthermore the rising container transport from overseas gives great chances to growing IWT of containers which mainly move manufactured goods and the like.

The next graph shows latest data of Eurostat (Panorama of Transport) which al least is not coherent with New Cronos but there may have been some corrections in the IWT database within the last month. However, the difference is not too big and therefore the comparison of the modes and the actual overall split of goods may give an idea of affinities. On the other hand, the basis are transport volumes and therefore nothing can been said about the length of transport of specific goods. For example road transport has its highest share on building materials that in fact is short distance transport to construction sites and hence not shiftable. The other commodities in road transport, thereby, look small in their share but would have higher shares on a tkm-basis. Moreover, a certain, but definitely significant share of road carriages, in particular of bulk cargo, is pre- or endhaulage from rail and inland waterway transport. Anyway, a comparison of the three modes indicates that the more important competitor of IWT is the rail. In the growth intensive segments, NST/R chapter 8 and 9, the competition is mainly between road and rail. Another growth intensive transport segment, the metal products, is mainly concentrated on rail whereas foodstuffs are concentrated on the road. With other words, potentials of shifting cargo are not obvious in the aspect of entering a specific market niche (e.g. defined by a carriage of a certain cargo segment on a certain competing mode on certain relations) but has to be opened up in many directions respectively from several market segments.

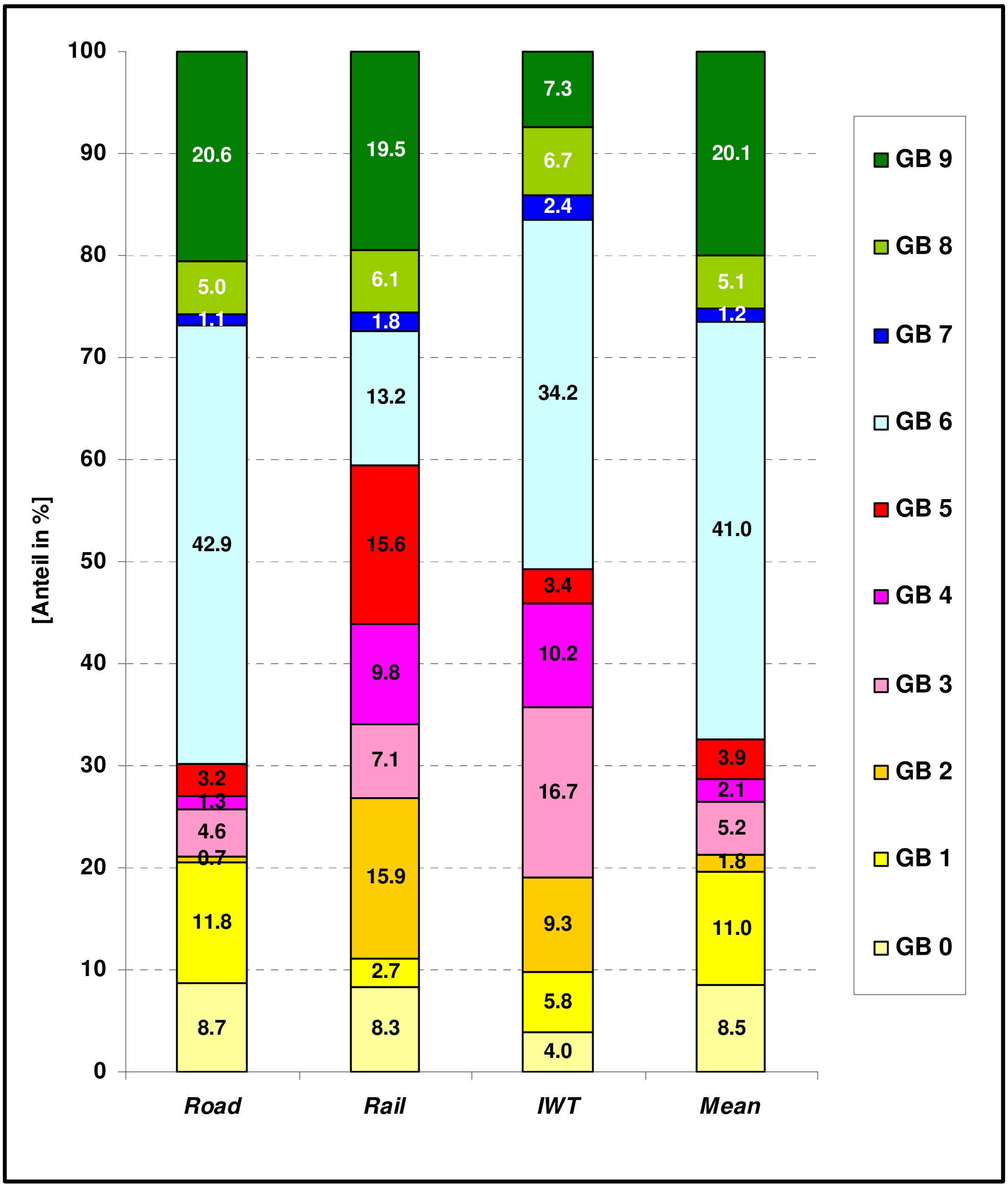


Figure 1. *Share of commodity tapes (NST/R-chapter) on total transport volumes for road, rail and inland waterway, including the mean, 2001 (in %)*
Source: Panorama of Transport, Eurostat 2003

1.3.3 Prospects by commodity groups

The future prospects of IWT by commodity groups are described below.[2] In view of the availability of relevant data up to now they relate more to the Rhine corridor or the EU-15 states than to the Candidate countries but as shown earlier, IWT is and is likely to remain much more important in the West. An overview on the development in special corridors is described in section 1.4 of this chapter.

NST/R-chapter 0 and 1:
No change is expected in the European ***agrarian sector*** as regards volumes of transport. The liberalisation of this sector has led to an increase in the use of IWT but this will not continue in future.

NST/R-chapter 2:
Imports of ***coal*** will grow but less than before. IWT is best prepared as far as facilities in the North Sea ports are concerned and thus has an advantage over rail.

NST/R-chapter 3:
Oil consumption has remained static in the last few years. This trend is expected to continue in the future and consumption may even decrease in the long term. Moreover a shift of refinery capacities in Europe has to be faced with a further decline in transports of mineral oil products.

NST/R-chapter 4 and 5:
The gradual process of restructuring in the European ***metal*** industry will lead to a decline in capacity and an increase in specialisation. Up to now IWT in this segment has been stable, probably due to its strategic starting position, since the industry is mostly located on waterways. However, in the longer term the production of crude steel will decline further in favour of refined processing of recycled material. As a consequence transport volumes in this sector will decrease further than was already the case in previous years.

NST/R-chapter 6:
The IWT of ***building materials*** in the Rhine basin may decrease in future years as the places for extracting these materials are likely to change from inland areas to the sea. On the other hand within the recycling process IWT may play a relevant role, gaining transport in equal or even greater volumes.

NST/R-chapter 7 and 8:
Since the ***chemical industry*** is a key industry in Europe growth rates above average are expected. The basic chemical products are important to IWT but they will not grow at the same rate as the industry as a whole. Moreover the chemical industry may relocate their production sites which would mean a loss of transport volumes to inland navigation.

---

[2] Source: Schiffe der Zukunft, Final Report 2002, on behalf of the CCR.

NST/R-chapter 9:
Whilst intercontinental ***container transport*** will continue to rise for the time being, it is expected to stagnate in the long term. Hence the growth rate in IWT container transport will gradually decline. Since container transport is concentrated on the North Sea ports there will be growing competition to IWT when the new BETUWE line becomes operational since it will compete strongly for hinterland transport by rail. Nevertheless container transport will be the most important segment of IWT in the future. The main competitive factor of IWT in contrast to the other modes is its capacity. In addition to the general measurements of vessels which enable them to carry up to 200 TEU, containers can be stacked up to four layers (on the Rhine) whereas road and rail do not have this ability. On the other hand the most common boxes in inland transport by road and rail are swap bodies which up to now are not stackable although research has pointed the way to producing such bodies. This has been a serious disadvantage for IWT and it is not yet clear how this will develop in the future. Even if the construction of stackable swap bodies is no longer a problem, the market penetration of a new generation of swap bodies will be a question of profitability and of the willingness of carriers to rearrange the operating processes in goods transport. Those processes come along with a reorganisation of logistic chains and new or changed actors. Within the transport market the role of inland navigation will heavily depend on how far IWT can be integrated into multimodal logistic chains. The conditions of profitability will only be fulfilled if IWT becomes an inherent part of the system, otherwise there is no chance to influence the standardisation of loading equipment or to establish stackable transport boxes in the European inland transport. Apart from this special issue there are market potentials in the transport of palletised goods between the manufacturing sites and the distribution centres. However, the higher the standard of transport conditions, the more specialisation is required of loading equipment and vessels by all modes.

In conclusion:

- The traditional commodity groups using IWT do not offer growing potential for the mode as they tend to stagnate.
- Container transport will witness a substantial increase and IWT will participate in this growth. This sector will be the most important one to IWT because of its high growth rate. On the other hand, if present overall economic and legal conditions remain, future IWT volumes will not be sufficient to keep the present modal share.

From the previous analysis the conclusion can be drawn that the following segments will have future potentials to IWT (see Table 4). This is connected with a correlation between commodities and transport categories (cargo segment, vessel type, loading unit, transhipment). The fields that are filled in are suitable to IWT.

NST/R	Commodities	Dry Bulk		Liquid Bulk		Intermodal	RoRo
		normal	silo	tanker	slurry		
0,1	Food products	🟦	🟦	🟦			
2	Coal	🟦					
3	Mineral oils			🟦			
4	Ores	🟦					
4,5	Iron and steel; scrap metals	🟦					
6	Construction materials	🟦			🟦		
6	Construction wastes; contaminated soils	🟦			🟦		
7,8	Chemical products	🟦	🟦	🟦			
	Recycling products	🟦					
9	Vehicles						🟦
9	Intermodal loading units					🟦	🟦

Table 4. IWT potentials by market segments

The high capacity of inland vessels does still make IWT the ideal means for mass transportation requiring little effort on logistics. Shipments of logistically-intensive mixed cargo which are also understood to be shipments in the size of truckloads or railway carloads, are only economically sensible if they occur in homogenised and mass quantities. This is only achievable through the use of containers or roll-on, roll-off technology. For this reason IWT has good chances in this type of logistic system if larger quantities of containers are to be shipped or rolling units are bundled with a few loading and unloading places, and the transport by water does not mean greater disadvantages regarding travel times and reliability. Because of the greater leeway regarding the disposition of travel times this also applies to a lot of sea port hinterland traffic.[3]

1.3.4 Visions of development directions in the IWT sector

The liberalisation process has already increased IWT in specific market segments. This has been accompanied by a specialisation of shipping space which will further go on.

Future shipments may require smaller loading units for particular goods (excluding sea port hinterland traffic with containers).

Within logistic chains IWT can also be efficient for short transport distances if transhipment can be avoided (if the consignor / consignee is sited on waterways) or, on the other hand, if transhipment is less cost-intensive and time-consuming, e.g. in hinterland transport of sea ports (container) or with RoRo techniques.

In addition to the trend towards bigger IWT vessels there is a trend to specialised transports with shorter time slots.

---

[3] See Shifting Cargo 1998, Chapter 5.

To meet these market requirements the fleet of inland vessels has to diversify and adapt to certain market segments (niches) in different river basins: Where waterway conditions and transport volumes allow, ships should have maximum capacity to be most efficient because the high fixed costs are declining with the quantity of loading. Where high frequencies and high flexibility in goods deliveries are requested, vessels should in some niches be smaller but faster and must have special transport equipment.

An important factor in multimodal chains is the quality of transhipment. Time and costs must be minimised as they determine the profitability of those chains. (Note that transhipment and carriage in IWT often have comparable costs on average[4]). Logistic integration of inland navigation depends on how far the organisation and functioning of those terminals will be managed.

The trend to build up niche markets does implicate an increasing division of work between the actors of logistic chains. On this account inland navigation has different options to participate in those chains. The sector might develop pools of transport operators closely allied with logistics providers. Alternatively skippers might obtain project related contracts from forwarders fulfilling a certain part of the transport chain. Then again the IWT sector might be more engaged in itself organising transport processes, i.e. providing value added services and one hand solutions by itself. Such schemes need the co-operation of skippers offering a diversified vessel pool to meet the specialised and demanding market requirements. Another possibility is to specialise in market segments providing a high frequency circulation of vessels or guaranteed carriages on certain routes, ideally connected with forwarders that organise the pre and end haul if necessary.

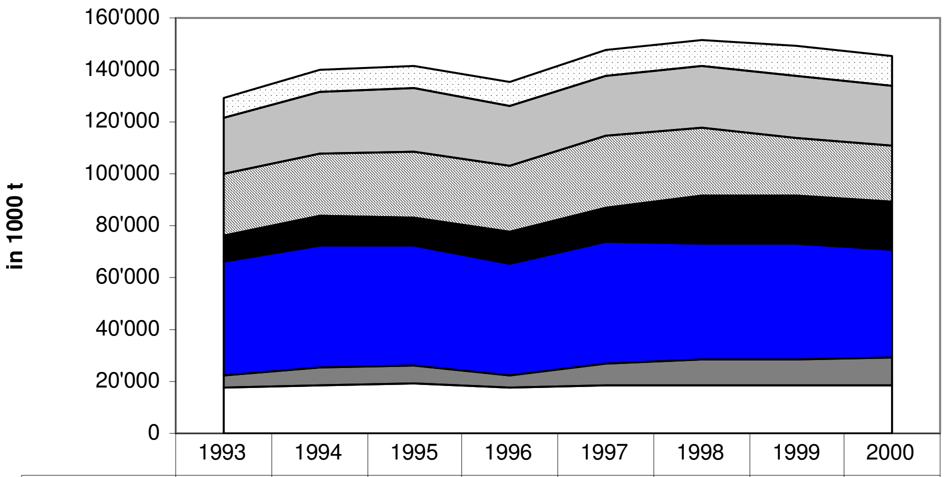
1.4 Market segmentation in IWT by river corridors

1.4.1 Rhine corridor

For the Rhine corridor we only have data on market segments from the transport that passes the Dutch-German frontier. In the past (1993-2000) little has been changed concerning the split of commodity groups (see Figure 2). Note that metal industry has its highest share on goods transported on the Rhine, followed by building materials and petroleum products. There was a small decline in petroleum and metal products within this period and a significant increase in chemicals, coal and other products. The latter seem to be manufactured articles etc. Agricultural products and building materials tend to stagnate.

---

[4] See: Schiffe der Zukunft, Final report 2003, on behalf of the CCR. Surely that depends largely on distance and market segment.



	1993	1994	1995	1996	1997	1998	1999	2000
□ chemicals	7530	8494	8749	8955	9551	10026	11337	11301
▨ building mat.	21712	23706	24879	23063	23457	23919	23845	23092
▧ petrol	24108	23693	24812	25623	27143	26052	22643	21494
■ coal	9989	11222	10885	12395	13320	18439	18106	18181
■ metals	43663	47099	46351	42954	46792	44615	44615	41700
■ various	4946	7133	7305	4571	9054	9865	10021	11232
□ agriculture	17409	18403	18865	17646	18105	18569	18585	18077

Figure 2. Transported goods by market segments in 1000 tonnes (Dutch - German frontier), 2000
Source: Central Commission of the Rhine 2003

By distinguishing traffic flows upstream and downstream you can see remarkable differences in the goods split. Whereas building materials and agricultural products dominate downstream there is quite more transport from metals, petrol and coal upstream.

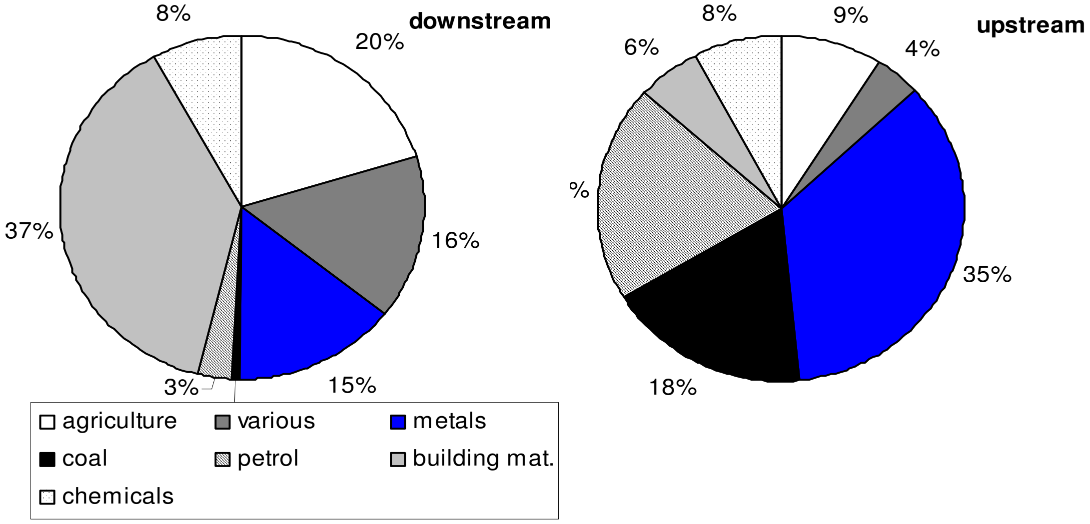


Figure 3. Split of goods segments in Rhine transport downstream / upstream (dutch-german frontier), 2000
Source: Central Commission of the Rhine 2003

Looking on future potentials the NEA forecasts by NST/R chapters and countries are used (presented in part B, Demand table 14 and 15, export data).

	NSTR chapter										
Rhine corridor: Growth of total IWW Import 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
BELGIUM & LUX	1.61	2.07	1.07	1.11	2.98	1.43	1.25	2.45	3.82	1.54	1.60
NETHERLANDS	1.48	2.28	1.09	1.12	2.16	1.57	1.14	1.95	6.23	1.74	1.52
GERMANY	1.56	2.20	1.04	1.10	2.88	1.50	1.17	1.88	3.37	1.50	1.41
SWITZERLAND	1.42	1.84	1.04	1.22	2.26	1.58	1.10	2.30	3.19	1.30	1.52
ALL	1.53	2.19	1.07	1.11	2.76	1.51	1.20	2.08	3.97	1.55	1.49
Rhine corridor: Growth of total IWW Export 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
BELGIUM & LUX	1.53	2.04	0.96	1.24	2.60	1.70	1.00	2.83	3.45	1.62	1.86
NETHERLANDS	1.69	2.48	1.01	1.09	2.16	1.54	1.06	1.87	2.57	1.31	1.40
GERMANY	1.72	1.97	0.99	1.19	2.29	1.34	1.15	2.50	3.37	1.37	1.80
SWITZERLAND	1.67	2.29	1.14	1.23	2.37	1.24	1.00	2.78	3.29	1.42	2.42
ALL	1.70	2.28	1.01	1.11	2.36	1.49	1.07	2.34	3.29	1.38	1.60

Note that crude oil (NST/R chapter 3) is not treated but petroleum products as chapter 10

Table 5. Growth rates 2000-2020 in IWT by NST/R segments in the Rhine corridor, in % based on tonnes
Source: NEA (TENT-STAC) 2003

As described in the demand part, the NEA forecasts by far exceed the Prognos forecasts concerning the annual growth rate of IWT. Hence we can follow that all potentials for IWT are already included in the NEA data. To build up corridor related growth rates of market segments for this chapter we clustered the country related NEA data. As a result table 5 shows us for the Rhine corridor the growth rates in import and export by each commodity type and country. The last line does hand out the weighted average growth rates of all the Rhine countries. This is a good approximation on the exact value as most of the IWT volumes of Germany account for the Rhine as well as the majority of the volumes in the BENELUX states do.

The growth rates in import and export do vary in some fields but in the weighted average the difference is not too big. The highest growth potentials are seen in NST/R chapter 9 as expected but it starts from a low level as Figure 2 clearly demonstrate. Also more than a doubling is expected for the chapters 1, 5 and 8. To conclude, the main focus is lying on manufacturing products, furthermore on chemicals, metal products and foodstuffs. These commodities are largely falling in the category of middle and high value products, often carried by intermodal loading units. Coal, ores (and fertilisers) tend to stagnate in the future but on a high level of volumes. The overall growth on the Rhine transport will not exceed 50 to 60 % of the 2000 volumes in the next 20 years. Note that the difference between import and export is rather small compared to the following corridors where the Accession countries are widely involved. Furthermore the growth rates of the Rhine countries are in general much lower than those of the Accession countries as this should be expected.

1.4.2 Danube corridor

The Danube Commission presents figures for 21 commodity groups for the Danube corridor. We transformed these data into NST/R chapters as good as possible. You can see the result in table 6 that divides data into loaded and unloaded goods in Danube ports. (Thus they are not directly comparable with the Rhine figures divided into upstream and downstream.) The total volumes give us a good impression of the commodity split in the Danube corridor.

NST/R		Load	Share	Unload	Share	Total	Share
0;1	Agriculture/Foodstuff	1'624	8.3	1'535	6.0	3'159	7.0
2	Solid Mineral Fuels	1'565	8.0	2'438	9.5	4'003	8.8
3	Petroleum Products	1'821	9.3	3'000	11.7	4'820	10.6
4	Ores and Metal Waste	10'263	52.2	16'388	63.8	26'652	58.7
5	Metal Products	3'038	15.4	1'039	4.0	4'077	9.0
6	Minerals, Building Mat.	354	1.8	640	2.5	994	2.2
7	Fertilisers	740	3.8	323	1.3	1'063	2.3
8	Chemicals	104	0.5	200	0.8	304	0.7
9	Machinery, Manuf., Misc.	172	0.9	127	0.5	298	0.7
Total		19'680	100.0	25'689	100.0	45'370	100.0

Table 6. Goods transport by NST/R segments in Danube ports in 1000 tonnes, shares in %, 2000
Source: Danube Commission 2002

Nearly 60 % of the total volumes transported on the Danube are ores and metal waste. Beyond this the chapters 3, 5, 2 and 1 (in this sequence) do play a role but all other chapters are quite unimportant up to now. Hence the Danube has a quite different goods split than the Rhine. Figure 4 demonstrates the difference in the split of NST/R chapters between loaded and unloaded volumes.

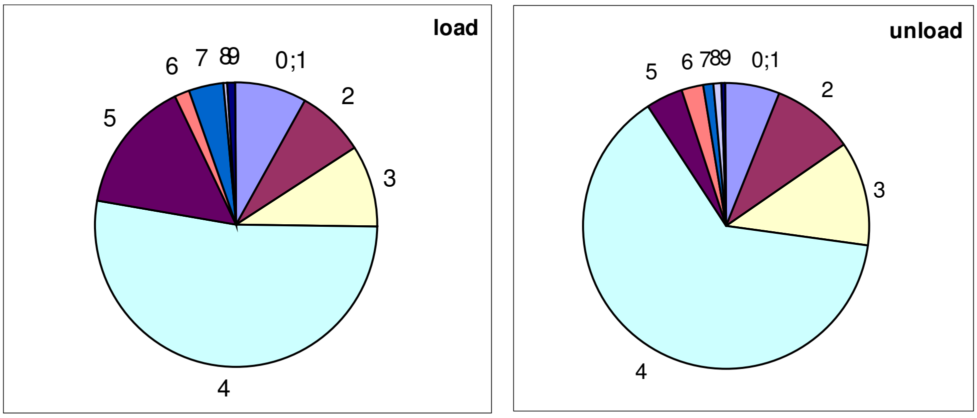
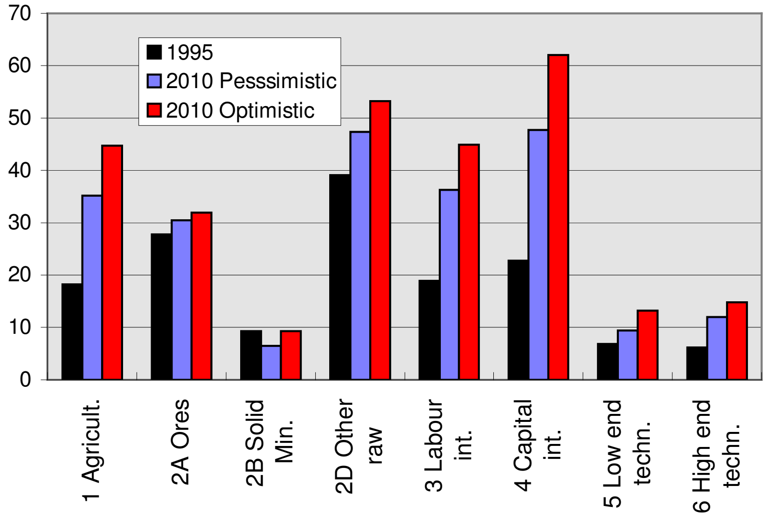


Figure 4. Split of NST/R segments in Danube ports, loaded and unloaded, 2000
Source: Danube Commission 2002

In the EUDET project (1999) the ÖIR has made a potential forecast of market segments for the Danube. Base year was 1995, the year of forecast 2010 which was varied by a pessimistic and an optimistic version. You can see from Figure 5 that agricultural products as well as labour intensive and capital intensive goods do have the highest growth potentials according to their base volumes but, on a much lower level of volumes, even technology products may more than double within 15 years. As data is not comparable with figures of other sources mentioned in our report we cannot check where we are standing today.



Commodity Groups mn tons	1995	2010 Pessimistic	2010 Optimistic
1 Agricultural	18.3	35.2	44.7
2 Raw mat. & material intensive			
of which ores and solid minerals*	37.1	33.6	36.5
other	39.1	40.9	46.0
3 Labour intensive	18.9	36.2	44.9
4 Capital intensive	22.8	47.7	62.1
5 Low end technology	6.8	9.4	13.2
6 High end technology	6.2	12.0	14.8
1, 3-6 Medium and high valued comm.	72.9	140.5	179.7
2 Raw materials and mat. int. Products	74.5	74.1	82.5
All Commodities	147.4	214.6	262.2

Note: table only contains international relations parallel to the Danube River (see 4.1.2), and no country internal transports. * Crude oil not considered in transport matrix

Figure 5. Prognosis of transport volumes in Danube Region, by commodity group (mn tons)
Source: ÖIR 1999

As for the Rhine corridor, the growth rates of NEA import and export data will be used. Note that NEA has not included all the Danube countries that are mentioned in other data sources. The volumes are therefore lower in the NEA data. However, only growth rates are shown in the next Table 7.

As can be seen, there are sometimes greater differences between import and export growth rates than in the Rhine corridor and the growth rates itself are much higher. For example for chapter 5, 8 and 9 NEA prognoses between 4 and 5 times higher volumes in 2020 compared to 2000 (some countries do reach even more than seven times higher volumes). Note that these are the same commodities with high growth expected as for the Rhine corridor. In some countries there are also other commodities with quite a high expected growth as well, e.g. the import of agricultural products (and foodstuff) in Romania and Hungary, or the export of petroleum in Romania.

	NSTR chapter										
Danube corridor: Growth of total IWW Import 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
AUSTRIA	1.31	1.78	1.03	1.95	4.97	2.09	1.29	4.46	2.42	2.52	2.30
HUNGARY	3.01	1.91	-	1.18	4.77	3.29	1.08	4.00	1.52	2.37	1.84
ROMANIA	3.67	3.00	1.00	2.71	3.00	3.25	-	-	7.50	-	3.42
BULGARIA	1.90	1.39	1.20	3.51	4.30	2.58	2.62	-	4.42	3.00	1.80
SLOVAKIA	2.56	2.41	-	0.85	7.67	2.20	-	-	7.00	2.16	2.35
ALL	2.36	1.90	1.17	1.75	4.75	2.27	1.38	4.44	2.43	2.49	2.16
Danube corridor: Growth of total IWW Export 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
AUSTRIA	1.32	1.77	-	1.48	3.28	1.82	1.00	4.33	4.75	2.08	3.45
HUNGARY	1.66	2.10	1.05	0.26	4.46	2.38	2.33	6.29	2.17	2.10	2.48
ROMANIA	-	2.33	0.92	2.67	5.62	-	-	4.31	3.00	4.00	3.32
BULGARIA	-	2.21	1.00	2.33	5.94	1.59	1.74	4.00	3.08	1.72	2.41
SLOVAKIA	2.20	2.11	1.59	-	4.52	1.69	1.79	3.00	3.67	2.87	2.76
ALL	1.55	2.10	1.12	1.06	4.44	1.95	1.76	4.76	4.57	2.45	2.79

Note that crude oil (NST/R chapter 3) is not treated but petroleum products as chapter 10

Table 7. Growth rates 2000-2020 in IWT by NST/R segments in the Danube corridor, in % based on tonnes Source: NEA (TENT-STAC) 2003

1.4.3 East-West corridor

For the East-West corridor we do not have any corridor specific statistical data. We therefore can only have a view on the countries' figures of Poland, Czechia and Germany. But as the IWT volumes of Germany are dominated by the Rhine (85 %) they are not meaningful to this corridor. A weighted average of growth rates does therefore not make any sense. Hence the last line in each the import and export table reflects an unweighted average but anyway, we should concentrate more on the figures of Poland and Czechia.

Especially for Poland the metal products and chemicals do have a high expected growth which means in export 11 to 12 times higher volumes, in import 5 to 7 times higher volumes than today. This is much less the case for Czechia but in chapter 9 there is also a solid growth potential for IWT. The other growth figures are in line with those of the Danube. To conclude, the classic segments of IWT will stagnate or will only have a small growth potential. This trend is in East and West Europe quite similar.

	NSTR chapter										
East West corridor: Growth of total IWW Import 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
GERMANY	1.56	2.20	1.04	1.10	2.88	1.50	1.17	1.88	3.37	1.50	1.41
POLAND	2.13	2.02	3.00	0.50	5.00	2.68	-	6.67	-	1.25	2.45
CZECHIA	2.31	1.90	1.67	1.65	5.00	2.77	1.23	2.74	2.00	-	2.10
AVERAGE	2.00	2.04	1.90	1.08	4.29	2.32	1.20	3.76	2.68	1.37	1.99
East West corridor: Growth of total IWW Export 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
GERMANY	1.72	1.97	0.99	1.19	2.29	1.34	1.15	2.50	3.37	1.37	1.80
POLAND	2.50	2.83	0.98	1.33	11.30	2.15	1.94	12.00	2.70	2.00	2.17
CZECHIA	1.57	2.27	1.03	2.29	3.99	2.00	1.74	2.93	3.88	-	2.31
AVERAGE	1.93	2.36	1.00	1.60	5.86	1.83	1.61	5.81	3.32	1.69	2.10

Note that crude oil (NST/R chapter 3) is not treated but petroleum products as chapter 10

Table 8. Growth rates 2000-2020 in IWT by NST/R segments in the East West corridor, in % based on t
Source: NEA (TENT-STAC) 2003

1.4.4 North-South relations

There is no “corridor” related data for these relations as well. Like in the East-West corridor the unweighted average has been chosen as it is unknown which part of the BENELUX traffic flows belong to the French connection. Herein growth rates do have Western European standard and the highest growth, particularly for France, is expected in chapter 9 and partly in 5.

	NSTR chapter										
North South relations: Growth of total IWW Import 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
FRANCE	1.62	2.33	1.07	1.11	3.90	1.38	1.10	2.44	5.73	1.59	1.60
BELGIUM & LUX	1.61	2.07	1.07	1.11	2.98	1.43	1.25	2.45	3.82	1.54	1.60
NETHERLANDS	1.48	2.28	1.09	1.12	2.16	1.57	1.14	1.95	6.23	1.74	1.52
AVERAGE	1.57	2.23	1.08	1.11	3.02	1.46	1.16	2.28	5.26	1.62	1.57
North South relations: Growth of total IWW Export 2000-2020											
Country	**0**	**1**	**2**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**ALL**
FRANCE	1.50	2.06	1.03	1.53	2.00	1.38	1.04	2.92	5.66	1.68	1.62
BELGIUM & LUX	1.53	2.04	0.96	1.24	2.60	1.70	1.00	2.83	3.45	1.62	1.86
NETHERLANDS	1.69	2.48	1.01	1.09	2.16	1.54	1.06	1.87	2.57	1.31	1.40
AVERAGE	1.57	2.19	1.00	1.29	2.26	1.54	1.03	2.54	3.90	1.54	1.63

Note that crude oil (NST/R chapter 3) is not treated but petroleum products as chapter 10

Table 9. Growth rates 2000-2020 in IWT by NST/R segments in the North South relations, in % based on t
Source: NEA (TENT-STAC) 2003

1.5 Conclusions

In the European economy GDP is expected to grow faster in the Candidate countries than in the EU-15. However, these countries only account for 5% of the EU-25 GDP and this share will rise not more than to 6% in 2010. The industrial sector in the EU-25 will grow with 1.7% p.a. substantial higher than the agricultural sector but within the industrial sector there are also major differences in economic growth. However, to draw conclusions we will refer to the transport related data from NEA as they already include the transformation of GDP growth of certain branches into transport volumes by NST/R chapters.

First result of the transport forecast is that since the main economic strength will remain in Western Europe so will the transport flows. Here again although growth rates will be higher in the Candidate countries than in the West output is still at a relatively low level and so are transport volumes. The forecasts divided into market segments show that the various parts of industry will develop differently. IWT of raw materials like coal and ores (exception import East) will stagnate both in East and West. An exception is petrol that will rise particularly in export. Low growth is shown in agricultural products and fertilisers (with exception of export East). With average growth rates of between 2 and 2,5 times of the 2000 volumes foodstuff and building materials (especially export) are placed in the middle of a growth ranking of commodity groups in European transport. A high increase in transport volumes are prognosed for metal products and chemicals (especially in export) as well as manufactured goods (except import East with an average rise).

These developments will influence the market segmentation of IWT but as the segments of currently low volumes will rise most and the segments with a high share of transport volumes will tend to stagnate

- The overall growth until 2020 is lying in-between a rise of 100-160 % in export and 50-60% in import (the lower rates belong to the West)
- The change of the split of goods will not be significant.

Today IWT shows a high share of transport volumes in NST/R chapter 2, 3, 4, 6 and 7, a medium share in chapter 5 und 8 and a low share in 0, 1 und 9. In the future, chapter 9 may ascend to a medium affinity segment if general conditions concerning transhipment facilities and the characters of standardised transport boxes will be accomplished. The NEA forecasts have included a lot of improvement measures in this aspect as they are based on a European scenario, which reflects the EU policy of the White Paper 2001.

Chapter 2 Additional IWT markets: logistic chains and new concepts

2.1 Introduction

A main part of the PINE project consists of giving well-founded statements on the ***current and future demand*** for Inland Waterway Transport, including estimations to what conditions, and in response to what developments, demand would grow. In this chapter, a match is made between various aspects, central in the growth of Inland navigation:

- Transport flow prognoses.
- The (im)possibilities of usage of IWT from the demand side. This has partly been described in earlier chapters, especially the demand part (B). In this chapter the aspect ‘logistic chain’ is added, from supply chain know-how.[5]

In this chapter we will start in section 2.3 with a short outline of earlier research on the demand side, with a description of traditionally strong IWT sectors and their future potentials. In section 2.4 the logistic chains of IWT sectors will be described including the trends within these chains.

Section 2.5 describes the potentials and opportunities for expanding the use of IWT in the future. Section 2.6 gives a closer look to the IWT potentials in the four corridors and section 2.7 draws conclusions for the potentials in general and in the corridors in specific.

2.2 Method of working

For this chapter, limited literature and Internet desk research has been carried out as well as review of earlier reports. Furthermore, a brainstorm meeting took place with experts,

---

[5] For practical reasons the term ‘logistic chain’ will be used.

mainly working for companies on supply chain projects. Their perspective provides the realism, needed to make a viable account of IWT growth possibilities in these sectors.

2.3 IWT markets

2.3.1 Introduction

In this section we will take a good look at the current and future goods markets for IWT and how they are structured. The goal of this section is to get to a clear set of market segments with most potential for IWT. Note that for the definition of market segments we take a broad view by including both traditional sectors (like NST/R categories) but also other economic categories, e.g. sectors of economic activity. Just working with NST/R categories has as an advantage that statistics are relatively well available. A major drawback is that they are too rough to use to ('bottom-up') discern potentially successful IWT initiatives. Also they do not do justice too well to the division in the economic sectors playing an important role. This will be further explained later.

2.3.2 Traditionally strong IWT markets: now and in the future

IWT ranking today

It is clear that IWT is more appropriate for some types of goods than for other. This has been addressed before in this project. The traditional view is IWT 'does best' with heavy, low-value bulk loads on the medium to long distance.

The demand part showed that IWT today has a high share of transport volumes in solid mineral fuels, petroleum products, ores & metal waste, minerals & building materials, fertilisers (NST/R chapters 2, 3, 4, 6 and 7). IWT shows a medium share in metal products and chemicals (NST/R chapter 5 and 8) and a low share in agricultural products, foodstuff and machinery (NST/R chapter 0, 1 and 9).

These traditional IWT products are mainly transported as bulk. Other loading units are not so common used. However, the last year's containers are becoming more common.

IWT forecasts

In part B (Demand) different forecasts are studied and the results vary depending the source, see table 10. Differences in growth rates between these studies exist because the studies have different scopes (goods transport market, NST/R chapters versus loading units) and there is a difference in units (tonnes versus tonne-kilometres). The difference in the year of the forecast (2010, 2015, and 2020) isn't an issue because the percentages represent annual growth.

Prognos European Transport Report (Goods transport market) **Tkm.** **2000-2015**	TEN STAC Study (NST/R chapters) **Tonnes** **2000-2020**		ECORYS Consortium (Loading units) **Tonnes** **2000-2010**	
	Domestic	**International**	**Domestic**	**International**
+2.4%	**+2.5%**	**+3.4%**	**-1.1%**	**+2.6%**

Growth per annual (%)

Table 10. Forecasts IWT different studies

The Prognos European Transport Report gives an overview of goods transport performance by country and mode in tonne kilometres (while other studies use tonnes). In this study a 2.4% annual growth is forecast for the total transport market. The demand for inland waterway transport is expected to grow by 2% per annual.

The TEN STAC study (source: NEA) gives a ranking for IWT European transport based on current market trends. In this study metal products, chemicals, manufactured products are the most promising sectors. Foodstuffs and building materials will grow with 2 to 2,5 times volumes of 2000 and low growth is expected in agricultural products and fertilisers. The IWT of raw materials (except petrol) will stagnate according to these forecasts.

The study from the Ecorys consortium gives forecasts per commodity type (container, general cargo, liquid bulk and solid bulk). According to the study the container traffic has the highest growth potential followed by general cargo, liquid bulk and solid cargo.

2.3.3 IWT affinity

Without denying the fact that IWT is very suitable for the above-mentioned products, the PINE project has to go beyond these traditional markets. In the Demand Part, the concept of 'IWT affinity' was introduced.

It centres on the possibilities of market segments / commodities to be transported by IWT. Therefor the characteristics of IWT were placed in several diagrams and tables together with the market requirements and NST/R chapters.

These earlier diagrams showed that IWT is very suitable for bulk products and that NST/R chapters with a high IWT affinity are petroleum products, metal waste, building materials and fertilisers. This leads to the conclusion that there is no NST/R chapter or economic sector with a high IWT affinity, which doesn't use IWT already as a transport mode. Commodities, for which IWT is obvious, already use IWT, but sometimes a better use of current affinity could lead to a limited rise in IWT's share.

New opportunities have to be found on a different level than the NST/R chapters. They ***have to be found in niche markets and changing demands caused by logistic trends***.

Dynamics in the use of IWT affinity

With a view to the (the estimations of) future developments we introduce a time dimension: possible ***changes*** in affinity. Note that with all factors taken into account, ***the IWT affinity of market segments could change.*** To stimulate IWT, or to reach a modal shift with a considerably larger share for IWT, the following lines of thought are important:

1. ***Making better use of current affinity*** could lead to a limited rise in IWT's share: it could be an quick change for the shipper to use IWT instead of other transport modes, provided organisational possibilities exist among the companies involved and companies receive assistance.

2. ***Working towards a change in affinity*** so that IWT's share could grow further: a changing of the IWT affinity could result from ***external factors*** (transport-related) as well as from ***internal factors*** (commodity-related).

    - ***External factors*** would involve ***Pull factors*** and ***push factors.*** Pull factors involve greater attractivity of the IWT sector making it more interesting. This could involve improvements of infrastructure, better vessels, more or better terminals or services, etc. Push factors are comprised by other transport modes growing less interesting for shippers, for whatever reason. Although it is necessary to assess the dynamics, involving all pull and (especially) push factors would go beyond the scope of the PINE project.
    - ***Internal factors:*** there can be changes / developments 'inside' the logistic chain of the shipper that would have consequences for the IWT affinity. This depends upon the design of the logistic chain and how actors in the chains have set thing up. This might or might not bear a degree of rationality.

2.3.4 Conclusions: market segments with IWT potentials

Sectors with a traditionally high IWT affinity are:

- Building materials & minerals
- Chemicals (bulk)
- Petroleum products

For the future potentials of the IWT it is necessary to keep this strong position in these traditional products, but according to forecasts (based on current trends) there will be a small change. ***Promising products for the future are***:

- Metal products
- Chemicals (containerised)
- Manufactured products
- Foodstuffs

But there are indications that the IWT affinity of market segments can change from transport related as well as commodity related factors. This means that next to these (traditional) products new opportunities will arise. IWT can strengthen its position in niche markets like waste materials and recycled goods and automotive, although this are limited opportunities.

Apart from promising products and niche markets ***new potentials arise*** when ***containers*** are used as a different loading unit.

2.4 IWT markets and their logistics chains

2.4.1 Introduction

In the conclusion of the previous chapter market segments with IWT potentials were named. In this chapter we take a look at the most important trends within logistic chains of IWT markets. To get a good view, of each basic sector three aspects will be taken on:

- Structure and general (economic) trends
- Logistic trends
- Consequences / consequences for IWT affinity

Apart from trends in logistic chains, developments in ***containers*** are described as a ***very promising IWT market.***

Some common logistic trends can influence the use of IWT as a transport mode:

- Door-to-door transport
- Containerisation
- Just-in-Time deliveries
- Smaller batch sizes
- The pursuit of logistic efficiency

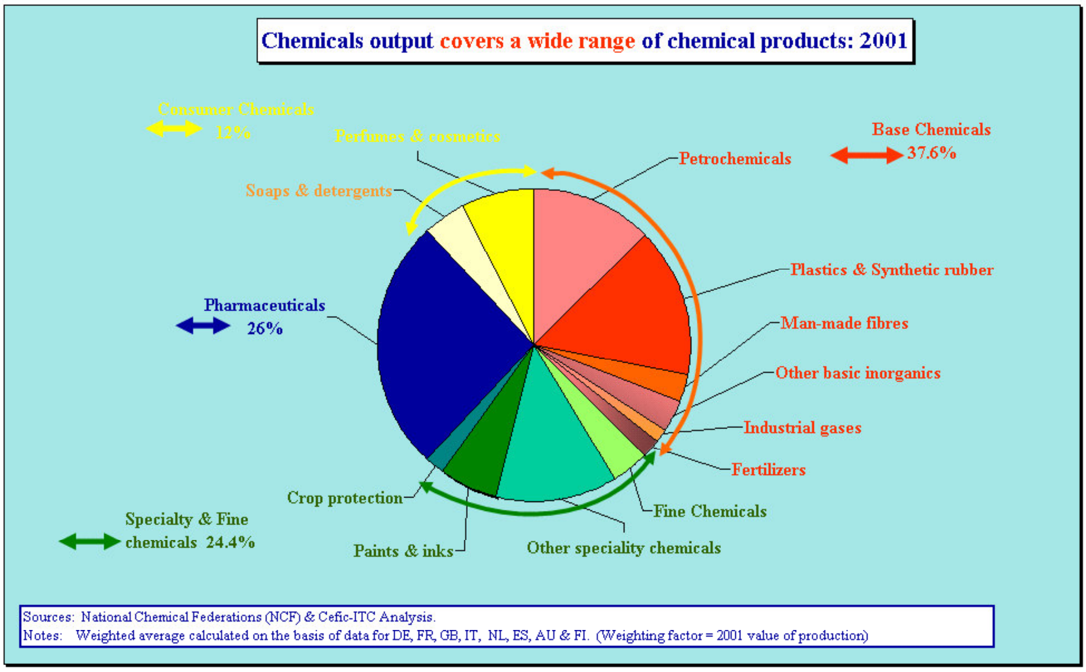
2.4.2 (Petro) Chemical sector

The sectors Chemical and Petro-chemical industry will from now on be referred to as ‘chemical sector’. This sector shows a great internal variation, encompassing consumer products, as well as industrial and pharmaceutical products.

It is also a very dynamic sector. Within the overall picture the following aspects play a role:

- Research and Development remains important;
- Strong focus on development of new applications of chemicals (e.g. performance materials)
- The market tends to be of cyclical nature (e.g. related to the oil markets)
- Product approval regulations vary and are difficult to cope with
- Focus on sustainable development throughout the whole chain

On the European scale, average yearly turnover lies around €500 Billion, which makes Europe the globally the second largest chemical producer (after Asia). The chemical industry supplies to practically all other sectors of industry; chemical products are often ingredients or base material for other products. Basically, the sector is divided into two main groups: ***the Base Chemicals*** and ***Speciality Chemicals.*** Within these groups we see sub-groups as illustrated in the next figure.



Chemicals output covers a wide range of chemical products: 2001

Sources: National Chemical Federations (NCF) & Cefic-ITC Analysis.
Notes: Weighted average calculated on the basis of data for DE, FR, GB, IT, NL, ES, AU & FI. (Weighting factor = 2001 value of production)

Figure 6. Chemicals: sub-markets

Within both groups there is a split in:

- Bulk products (large volumes, mainly full loads, silo storage, bulk transport)
- Packed products (volumes depend on product, packaging strategies important, LTL transport common, etc)

The figure below gives an overview of the production column, illustrating the wide variety again.

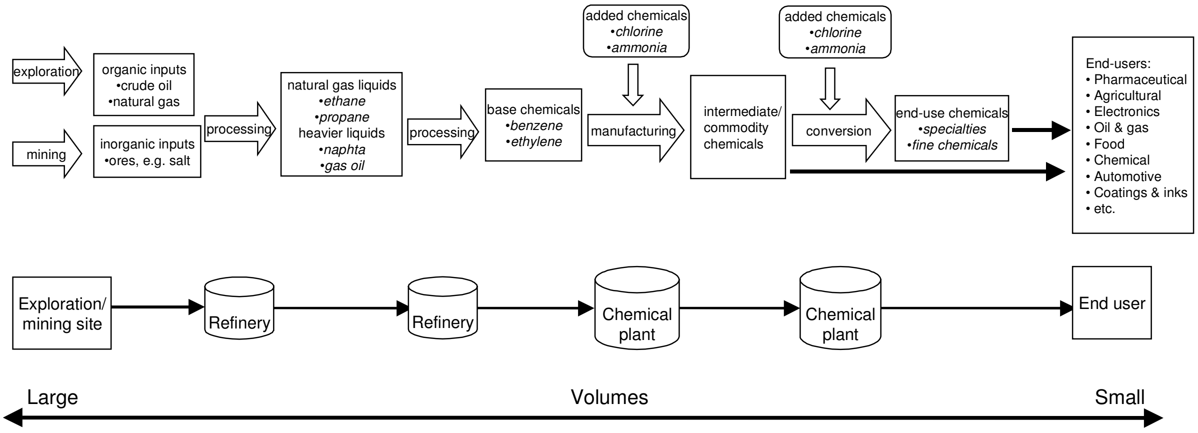


Figure 7. Chemicals: production column

The next table indicates the main differences between base chemicals and speciality chemicals.

Speciality chemicals	**Base chemicals**
e.g. ethylene, propylene, etc.	e.g. soap, pigments, perfumes, etc.
Large batches	Smaller batches
Low price per selling unit	Higher prices per selling unit
Small margins	Higher margins
Large investments in production processes	High investment risks (R&D focused on products and applications)
▪ B2B: chemical and other manufacturers ▪ end users, e.g. paints	B2B: chemical and other manufacturers
Both subsectors feature: ▪ packed goods ▪ bulk goods	

Table 11. Comparison speciality chemicals / base chemicals

Logistic trends

There are several logistics trends that play a role in the chemical industry's IWT affinity.

- First, there are some basic trends in relation with geographic factors. Especially with the base chemicals, more and more, production is shifting to low-wage countries, especially Eastern Europe. This means the cargo flows are also shifting eastward, but this may as well provide a counter flow westwards in refined products.

- Containerisation is ever increasing. The flexible tank container (see figure 8) is getting more and more popular, at the expense of tanker wagons, trailers and drums. Since 1995 the use of tank containers has been rising by 5-10% annually. The decreasing batch size, by the way, necessitates tanker containers with several compartments. It is estimated that also in intercontinental transport this trend is revealing.

Figure 8. Tank containers
Source: www.vanhool.com/ downloads.asp?ID=5

- High demands on safety and environmental aspects are of an equally growing importance. This is strongly triggered by the increasing strictness safety, environment and health regulations. Dangerous goods may be stored on even fewer locations, and in ever smaller quantities. As an effect, cargo flows get more and more fragmented in stead of concentrated.

- Because of the increasing focus on core activities, logistics and logistics-related activities are more and more outsourced. This goes not only for transport, but also for warehousing / tankage, warehouse management and VAL (Value Added Logistics) activities such as mixing and packing. These can or cannot take place at the production site. It is estimated that costs of these logistics activities amount to 4 – 10% of the total turnover, making many chemical companies consider outsourcement. The producers often still do traditional tasks, such as tankage and the pipeline network.

- A main trend, visible in all sectors of logistics, is ***the pursuit of logistic efficiency:*** the rather high costs of logistics, stated above, necessitates ongoing explorations of ways to lower costs of the door-to-door transport (all of the chain). A concept, which is very well combinable with IWT, is 'Floating Inventory'. The concept consists of large batches being shipped, before it is actually clear who the buyers will be. The sender holds limited storage capacity and the large quantities of products 'on their way' are regarded as inventory. The character of IWT (slow, large batches, safe) renders it excellent for using it in this way.

Conclusions / Consequences for IWT affinity

It is especially ***base chemical subsector*** for which intermodal transport, and especially IWT, can play an increasing role[6]. In this the typical advantages of IWT come forward. This is demonstrated in the following drivers, and especially IWT's ability to combine them:

- Reliability: an IWT quality that is difficult to be equalled by the other modes. Because of the increasing demands made by especially the chemical sector, it should be made sure that things will stay that way.
- Safety: risk management, which is in this sector of increasing importance, can be optimally facilitated by IWT. Terminals should co-operate with this.
- Cost advantage: especially making a big difference with larger bulk consignments.

An important additional precondition is that the IWT sector will be prepared to assist in realisation of the logistic wishes of the shipper, including the floating inventory concept. The sector should take an innovative stand here.

However, there are also barriers that stand in the way and can limit the Modal Shift potential of the Chemical Industry.

- Fragmentation: from trends in the chemical sector it turns out that batch size is likely to decrease. This stands contrary to the large consignments for which IWT caters best. This barrier especially plays for sub-sectors, other than base sector.
- Hesitance towards change, inertia in the chemical sector
- ICT: flexibility is lacking: IWT could take more pro-active role.

---

[6] For the fine chemicals the situation will be dependent upon containers.

2.4.3 Building and minerals sector

There are two main sub-sectors, raw and manufactured building materials:

- Raw building materials
  - Sand, gravel, clay and slag
  - Salt, iron pyrites, sulphur
  - Other stone earths and minerals
- Manufactured building materials
  - Cement, lime
  - Plasters
  - Other manufactured building materials, such as semi-manufactures (e.g. prefab components).

The NSTR category is largely linked to two economic sectors: the building industry and its suppliers (mainly mining). Many of the goods that are part of this sector can overall be classified as bulk goods. This takes us into one of the more traditional IWT domains. The parties involved in the mineral and building logistic chains are:

- The building sector with the sub-sectors:
- Construction sector
- Road and rail building and ground and water works
- The building material sector (sub-sectors are various kinds of materials)
- Commissioners (such as project developers)
- The wholesale and logistics sector working for the building sector

Overall trends at work in the building sector include the following.

- The (turnkey) contractor is more and more responsible for the final product: ideally, one party (or a consortium of parties) directs the integral logistic chain. This places a rather high emphasis on subcontracting and outsourcing.
- However, the supplying industry has a growing impact, e.g. new materials and technologies and assembly of prefab elements at the building site. This is part of an overall trend of parties moving up in the production column.
- There is only limited co-operation between parties in the chain, resulting into a relatively high ‘degree of failure’, combined with increasing demands by the commissioner.
- In response, the sector attempts to put a sharp focus on lowering of costs, and thus, increased emphasis on efficiency.

Logistic Trends

A trend, rather specific for the building industry is the industrialisation of the building sector. This consists of the trend that activities, traditionally carried out at the building site, are more and more taken over by other actors than the construction companies. The status of standard materials and project-specific components is getting more important, resulting into material flows, previously going through wholesale, now being prepared by the building materials industry.

The figure below illustrates this.

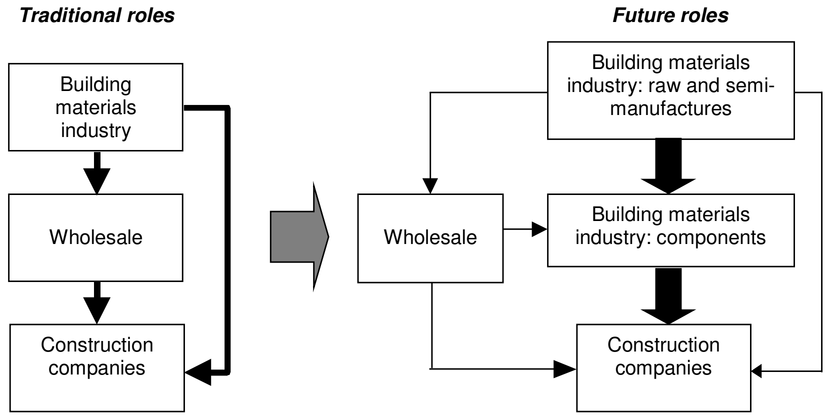


Figure 9. Changing division of roles in the building logistic chain
Source: BCI, 2003

Conclusions / consequences for IWT affinity

It is not expected that the role of IWT can expand to the building site. For this, the consignments are too small, which is only amplified via the need to receive JIT deliveries. Development towards prefab components could contribute to containerisation. As it was concluded in part B (Demand), the typical bulk segments such as the supply of raw building materials will remain an important market sector, but there not be much more growth in these sectors.

2.4.4 Agro- and food sector

The agro sector has a comparable situation as the building (materials) sector. It is a ‘traditional’ bulk sector, for which IWT has already been playing a role for a long time. Consequently, the possible modal shift potential is rather limited, but there are examples (see box 1).

Supermarket concerns are beginning to dominate the whole chain of the food sector. They demand jit-deliveries (several times a day, small batches) which has its effect on the whole chain. IWT has to prepare itself if it wants to keep its strong position. Reliability can be a strong point of inland navigation but asks for planning and co-operation between parties in the logistic chain.

BOX 1 Modal shift in agro- food sector

A firm in fructose syrup had two production locations, and aimed to enlarge the manufacturing volumes. The manufacturing process of this syrup requires it to be transported from the between two plants at a high temperature and within 36 hours after its transformation process. During the harvesting period from September until December, the company leases two tankers, equipped with an isolated double hull tank allowing the transported liquid to remain at a constant temperature of 60℃. During the launch, some 74.000 tons were transported from Warcoing to Valenciennes (Belgium) and back by 2 ships a day. After the transformation process, into fructose syrop, the cargo is returned to Warcoing by using the same vessel, to be packaged before being distributed to the end-users.

The reason waterway transport was chosen for this process is threefold:
Some 35 trucks movements a day, impossible to manage at the Warcoing plant at the same time as the chicory harvesting, are avoided;
Administrative formalities and maintenance work are kept to a minimum – only 1h30 to charge the small 400-ton tanker
Reliability and cost effectiveness: costs have been reduced by two-thirds compared to road transport.

(source: INE)

2.4.5 Container transport on Inland Waterways

One of the most promising sectors of European Inland Waterways Transport is surely transport of containers. What is special about container transport is the basic characteristic that can contain almost anything. This, of course, explains the success, not only in IWT, but also rather on a global scale (road, rail and especially sea transport). It also gives container transport also a particular place in the PINE analysis. As was observed before in this study, affinity of goods for IWT can change. Transport in containers / containerisation can make a change because of the suitability of containers for inland navigation. As global containerisation is still growing, so is the potential market share for IWT.

This versatility also makes it difficult to say something about ‘the logistics of containers’ as containers can better be seen as a part of the logistics of what they contain. That is why this section of the analysis is different than the ones on the chemical and the building sector.

Structure and General trends

The standard ISO container was introduced in the mid-sixties. Since the first containers were transported into Europe’s hinterland via IWT in the seventies, growth has been considerable, and is expected to go on in the years to come. The graphic below gives an indication for container transport on the Rhine, where the largest success was attained.

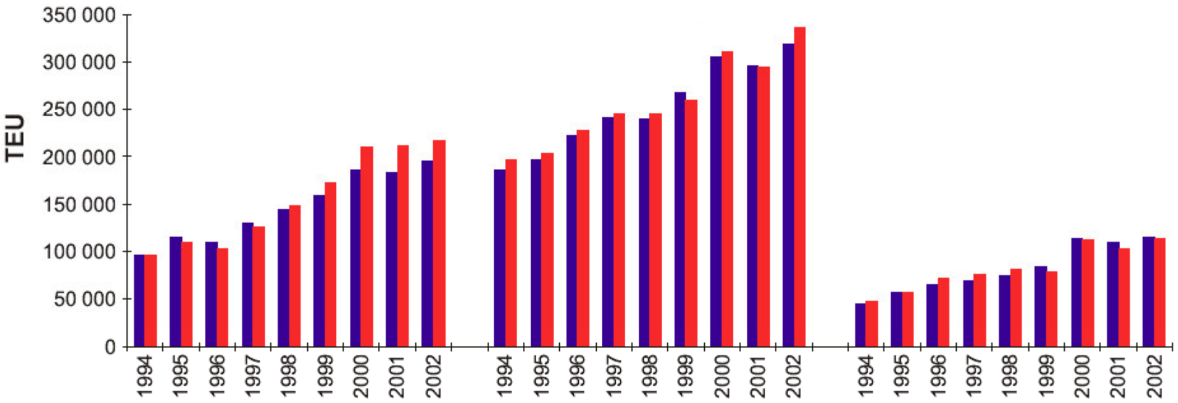


Figure 10. Growth container transport on the Rhine 94 – 01 on lower Rhine (left), Middle Rhine (centre) and Upper Rhine (right). Blue bars indicate loaded goods, red bars unloaded goods. Source: CCNR

The structure of container traffic within Europe can be explained by geographical nature and by presence or absence of (regular) liner services. Liner services usually connect seaports with their hinterlands. Non-liner services (to be referred to as charters) sail for one specific, 1-time batch of containers. The following structure summarises the container traffic found on European Inland Waterways, roughly in order of intensity:

- International: Rhine corridor (line traffic) as well as connecting rovers / canals
- International: North-South corridor traffic: largely between sea ports of Rotterdam and Antwerp and between Rotterdam and some inland ports in Belgium
- National container traffic: line traffic largely between Seaport and Hinterland. Only to be found in:
  - NL,
  - Belgium and
  - France (Seine: Paris – Le Havre)
- Non-line (charter) traffic on the above and other (PINE) corridors
- Non-line traffic on isolated systems (sporadically found)

With containers we usually mean maritime containers having ISO specifications. The only exception to this rule would be the use of other containers, specifically for waste transport. This will be treated in Section 5.5.

The ***Rhine container traffic*** was already shortly touched upon. In it we incorporate connecting infrastructure. There is limited container traffic onto the Rhine-Main Canal but no liner services onto the Danube corridor as yet (although there has been some in the past). Also there are services on the connecting Moselle to Thionville and Metz. The large figure on the next page gives a schematic presentation of the terminals and connecting infrastructure of the Rhine corridor.

It is clear that, being the largest market, it has the largest-scale container traffic, going so far as ships nearing 500 TEU[7]. Several large and professional operators are active, each with their own terminals, featuring several departures each day. Usually, there are some terminals in each turnaround journey. The customers comprise shippers / forwarders (merchant haulage) as well as sea shipping companies (carrier haulage).

The market is generally divided up into the three parts Upper Rhine (until Köln), Middle Rhine (until Karlsruhe) and Upper Rhine (until Basel). In total about 1,2 Million TEU is shipped annually, of which 700.000 via Rotterdam and 400.000 via Antwerp.

We have to keep into mind that 90% of all container transport is to or from one of the ARA ports. This can probably be linked directly to the fact that the success of containers in IWT can be explained by scale: if you have many containers then you fill a ship. If you can fill a ship, you can transport the containers in a cheaper mode, than using (literally) hundreds of trucks.

The ***north-south corridor traffic*** has as a most important component feeder traffic between the seaports of Rotterdam and Antwerp, since it is quicker to do it via IWT than to use short sea traffic, and cheaper than via road or rail transport. Of course this is directly correlated with the high volumes, explained by the scale of the seaports. In this market, the sea shipping companies are the clients of the IWT operators. Despite the large scale of operation (about the same flow as between Rotterdam and the Rhine corridor: 700.000 TEU) one could see it as inter-seaports traffic than as genuine IWT. Probably parallel to what has happened in the seaports, this market has been on the rise as well.

---

[7] TEU = Twenty feet Equivalent Units. In container transport statistics these are used as a standard dimension.

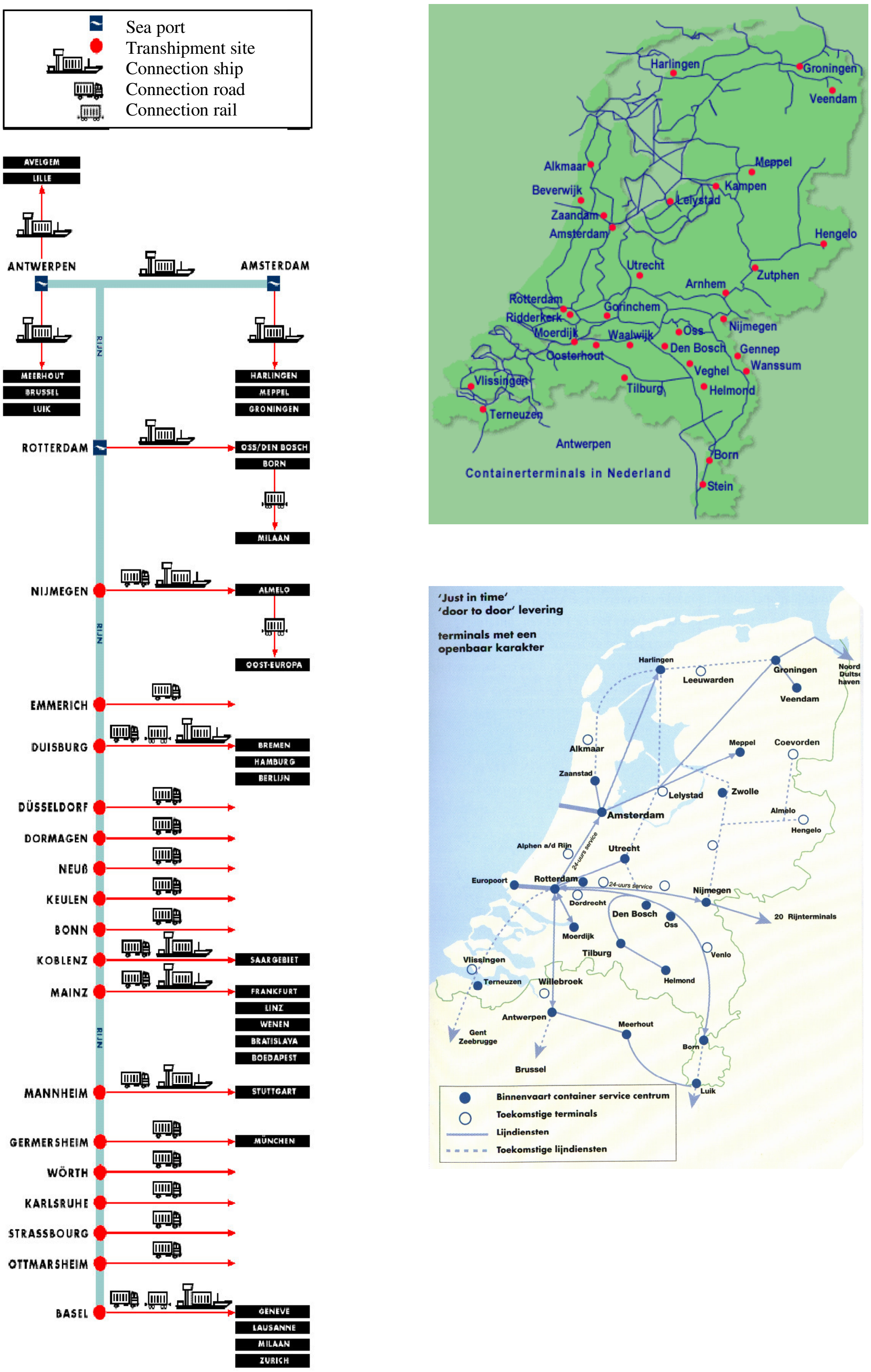


Figure 11. *Structure of Rhine corridor (with multi-modal branches) as well as container terminals and liner services in the Netherlands and Belgium. Source: Basisdocument Containerbinnenvaart (2003) and 'Goederenvervoer over water (2003)*

National liner services for containers are found in Belgium and the Netherlands, both countries with a dense waterway network. Of course, domestic volumes are generally outstripped by the international traffic (on corridors named above) but surely all other growth in (especially) the Netherlands of the last decade has been impressive. A main role has been played by the network of fixed liner services, combined with a network of inland container terminals, rendering IWT a rather secure link in logistics chains. Even on distances lower than 50km, IWT turns out feasible. The map below displays the Dutch container terminals as well as the main lines.

Total container haulage between the ARA seaports and the inland terminals amounts to 500.000 TEU in the Netherlands and 200.000 TEU in Belgium. As said, in France there are liner services on the Seine between France and Le Havre, estimated to transport up to 10.000 – 12.000 TEU per year.

Logistic Trends

For logistic trends we look at the overall container logistics sector.

- The growth in container transport was estimated at 7% per year a few years ago. Despite the current economic downturn, according to several authoritative institutes, for the coming years, significant growth of 5% will continue. Growth of container traffic will remain considerable because of the ongoing containerisation as well as the fact that growth will be more recognisable in semi-finished and finished products.
- Scale enlargement has been the main trend, ever since the first containers were transported. This goes not only in container logistics but also in its main driver: international trade and industry. This trend causes concentration of the activities with ever fewer ‘global players’, on fewer locations: reduction of the amount of links in the logistic chain, so it can be better managed. This controlling of the overall logistic chain is the target for the logistic service provider, who can, this way offer a door-to-door concept in which IWT can play a considerable role.
- Comparable with international aviation, it is expected that hub-and-spoke networks will play a more important role, with apart from the main hubs, satellites being introduced. In line with scale enlargement liner IWT liner services could be introduced between the hub and the spokes, which can be located further into the hinterland, and not just between the hubs (e.g. Rotterdam and Antwerp). This more extended geographic spread in distribution, resulting from the larger catchment area of the hubs and the spokes, generates longer distances: it becomes more interesting to use IWT.
- Also in the container logistics, concepts emerge like JIT (Just-In-Time delivery), RIT (Right-In-Time delivery whereby a continuing flow delivers goods at fixed times), and the ‘floating inventory‘ concept already explained. To this, the logistics of empty containers can be added; recent experience of the ‘Incodelta’ project proves that better co-operation between operators and logistic service providers can yield smart empty container logistics and usage of IWT, instead of trucking for the repositioning of empty containers.

Conclusions / consequences for IWT affinity

In the case of Inland Navigation, a continuing success story can be expected from the prognosticated growth. This will be amplified if the sector will go on working on its strong points like reliability, low rates, and safety. The growing road traffic congestion, as well as the trends named above, will work to its advantage. Scale enlargement on the main arteries (especially Rhine) will go on, but it might be accompanied by scale reduction on side waterways.

To support the modal shift of containers to IWT, a lot is expected from the new Marco Polo programme, as well as pricing mechanisms that could be started in the near future. Reaching new markets by new liner services on IWT links currently not served can further expand the role if IWT, but only if supported by infrastructure improvements including bridge height and improved reliability at locks. Then, on the east-west, Danube and north-south corridors, more liner services can be set up; also in lower-scale tributaries with lower bridges on a smaller scale. However, it is important to stress that the extended infrastructure networks in the Netherlands and Belgium are largely non-existent outside those two countries so it is unlikely that the achievement there can be equalled. A main point is pre- and end haulage, which is the main costs barrier of container transport via IWT. The haulage by IWT as such is a very cost-attractive part of the chain but pre- and end haulage tend to make it rather expensive. There should be more integration in these chains, so that costs can be brought down by the offering of an integrated 'door-to-door' product. In the near future, a crucial role will be played by the 'chain directing' global players who should be capable of this.

2.5 Potentials for IWT

2.5.1 Introduction

The growth potentials for IWT can be found in different market segments:

- Expansion in sectors with a high IWT affinity
    - Traditional IWT sectors
    - Promising sectors
- Niche markets

Containerisation is very promising for IWT. In contrast to bulk products, which is common in limited economic sectors, almost all economic sectors use containers and therefor IWT can be introduced to various economic sectors.

Apart from these promising market segments the use of IWT can be stimulated by:

- New logistic concepts
- Modal shift

Each of these segments will be reviewed in this section.

2.5.2 Expansion in sectors with a high IWT affinity

Sectors with a ***traditionally*** high IWT affinity are low value bulk products:

- Building materials & minerals
- Chemicals (bulk)
- Petroleum products

The traditional sectors already intensively use IWT as a transport mode so big relatively changes can't be expected, but it is necessary to keep this strong IWT position in these sectors. The building of ***regional transhipment centres*** can stimulate this. A regional transhipment centre is an inland terminal for bulk, which is used by several shippers on regional scale in order to serve diverse shippers by inland shipping.

So far the transport of bulk by IWT is mainly company based. The consequence is that IWT is only interesting for a company as long as it has adequate volumes. But the logistic trend is that individual companies need ***more frequent, smaller batches*** (reducing stock). By building regional transhipment centres for bulk products it will be possible for companies with smaller volumes to use IWT as well.

For the future there is a small upgrading visible as foodstuffs, metal products, chemicals and machinery are ***promising sectors*** with a growth of one or two percent. These sectors often use intermodal loading units as pallets and containers, which will be described later.

2.5.3 Niche Markets

Apart from expansion in the current market, new markets are coming up. Waste and recycled goods and car distribution are examples of rising niche markets.

Waste materials and recycled goods

An example of a new market for IWT is waste materials and recycled goods**.** Increasing ecological awareness results in more and more diversification of waste materials and recycling which results in more transport streams over longer distances.

The logistics of waste materials and recycled goods differs greatly from other branches of logistics. The most important differences are:

- It concerns ‘reverse logistics’: it is a kind of supply chain, but the other way round. Whereas in common logistics chains it is meant to optimise flows toward the end user, this is not the case with reverse logistics.
- There are many providers and few receivers: converging logistics (collection), in stead of diverging (distribution) patterns.
- Waste / garbage has a negative value: it costs money to dispose of it.
- Less importance is give to the punctuality of delivery at the processor, as long as the flow has a certain regularity.
- However, frequency of collection does bear importance as the party, which disposes of waste does not have unlimited storage possibilities
- Environmental and safety aspects play an increasing role.

Furthermore, waste and recycling materials by themselves have characteristics rendering them even more appropriate for IWT:

- Often, the materials are bulky. It has been stated before in many cases that bulk products are often suitable for IWT.
- The materials do not require handling with care.
- The materials can (in many cases) be transported with containers (ISO or non-ISO) or other loading units.

Automotive: car distribution

Another example is the car distribution within the automotive. The supply streams within the automotive are mainly JIT deliveries and therefor IWT isn’t a suitable transport mode, but for the distribution of manufactured cars IWT might be a solution.

The car distribution from the production plant involves often long distances to places all over Europe with large volumes. Intermodal transportation can be very sufficient then. Rail is commonly used for the transportation of cars but IWT can be used as well.

The Ford production plant in Genk (Belgium) has recently made a shift from rail towards IWT for one distribution line. In the past cars were produced in Genk and went from there to the harbour of Zeebrugge for the ferry to the UK. Now there are experiments to transport these cars by inland waterway to the harbour because of the reliability of IWT.

2.5.3 2.5.4 Containerisation

Since more and more products are transported by containers, the possibilities for inland navigation grow. A practical problem is that a lot of companies don’t have enough containers to fill a whole ship while other companies don’t have access to water. These companies end up with road transport in stead of inland navigation.

By building inland container terminals more companies can use IWT as a mode for transporting their containers.

The containers will be collected at the container terminal and from there shipped to their destination. Since most costs are made by transhipments to other modes, this is only cost-efficient as the number of transhipments can be limited. Inland container terminals are often used for the transport of containers to international harbours. The containers will be shipped from there to destinations all over the world.

2.5.4 2.5.5 New logistic concepts

Because of its characteristics, IWT isn't suitable for the transport of certain kind of products. With the introduction of new logistic concepts this can change. New markets can be opened and existing markets can be expanded.

Floating Inventory

A concept, which is very well combinable with IWT, is 'Floating Inventory'. The concept consists of large batches being shipped, before it is actually clear who the buyers will be. The sender holds limited storage capacity and the large quantities of products 'on their way' are regarded as inventory. The character of IWT (slow, large batches, safe) renders it excellent for using it in this way.

Pallets: the Distrivaart concept

One main example is the ***Distrivaart concept.*** Distrivaart (NL) was set up to attempt to combine the floating inventory concept with the transport of palletised goods on special ships. The bundling of goods flows, previously transported by truck, plays an essential role in the concept. This makes IWT in this case possible because of the cost advantage.

It concerns flows of non-perishable goods between suppliers and distribution centres of large supermarket concerns. The concept needs ships, modified for transport and transhipment of palletised goods. The main example is the ship the Riverhopper, which played a central role in the pilot project. As part of the pilot project, the Riverhopper has provided services between three locations (where beer and soft drinks were loaded) and the distribution centres of three distribution centres.

The pilot, subsidised by the Dutch Ministry of Transport, is successfully finished and recently the project is officially assigned to the market.

In February 2004 the ship will sail twice a week. So far different shippers (Grolsch, Interbrew, Bavaria, Coca Cola, Kimberly-Clark) will use Distrivaart for the distribution of their products to the supermarkets of Laurus[8].

- A main prerequisite of Distrivaart, but also other palletised goods is the fact that there is ***close co-operation*** within the logistics chain. This results into the following advantages:
- Co-operation boosts the possibilities to set up liner services.
- Setting up liner services results in economies in scale. Further growth could then increase the frequency, enhancing quality and attracting further goods: this could form an upward spiral.
- Co-operation between inland terminals and other parties involved eases the offering of more logistics innovation, which individual actors could not (easily) achieve alone.
- Co-operation with the involvement of large (supermarket) companies could cause them to shift more (types of) goods of their huge operations, boosting demand for IWT. The split in slow-moving, 'plannable' goods and the fast-moving, perishable goods that should be available on request stands central: principally the first sector could be shifted if initiatives like this will have success.

It has to be noted that the difficult point of companies working together is comprised by competition: logistic service providers are usually not very eager to give their co-operation as this could weaken their commercial position. In the pallet sector, the competition of road transport will remain fierce. Also, mind that a (subsidised) pilot project will have to prove itself on a commercial basis. This could be difficult with only one ship.

Collecting goods in logistic networks

Logistic developments like smaller volumes and the need for quicker and more frequent deliveries are the main reasons for shippers to choose a different transport mode then IWT. By collecting the goods of different companies in a logistic network it will be possible to optimise logistics chains and to stimulate IWT.

Logistic networks can on one hand, lead to individual advantages for companies by lowering the costs by a more efficient completion of goods and on the other hand lead to social advantages by more intermodal transport.

---

[8] www.zibb.nl 2004-01-27.

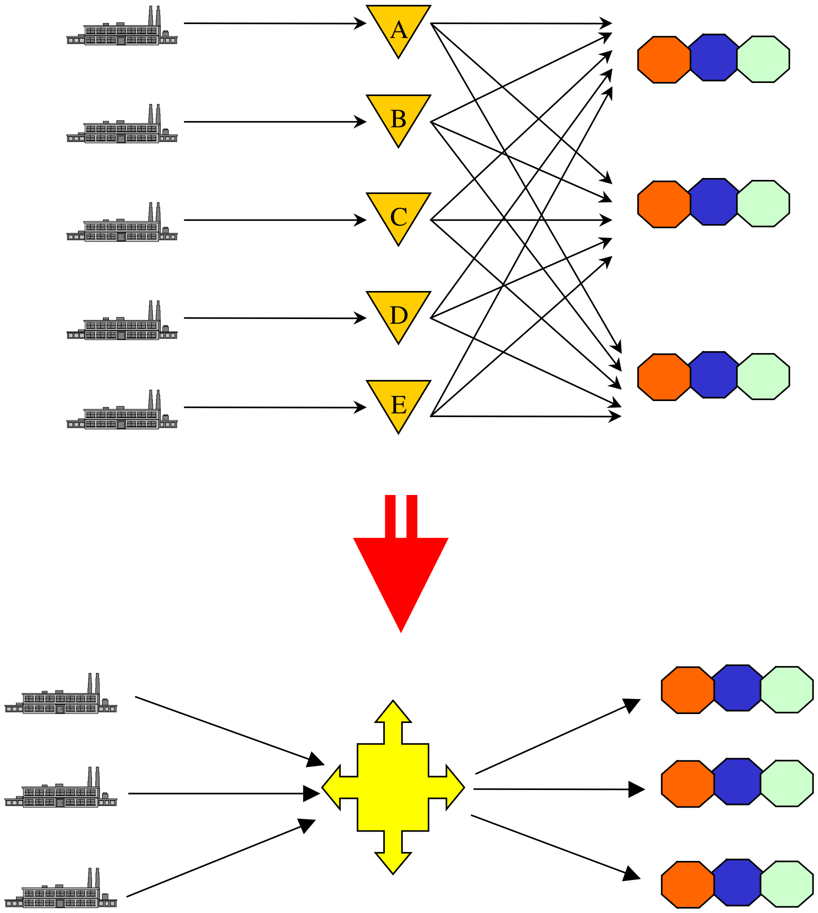


Figure 12. Collecting goods in a transport network can lead to more efficiency
Source: BCI

2.5.5 2.5.6 Modal shift

Over the past decade, there has been a growing interest for the concept of modal shift: transferring goods flows from one modality to another. Usually it concerns goods flows, transported via road haulage, shifted to other modalities such as rail transport, inland waterways transport, shortsea transport and pipeline transportation. This 'shift' is believed to be beneficial for two main reasons:

- on the one hand to be able to guarantee a lasting accessibility of our economic and logistical centres (road congestion relief),
- and on the other hand to reduce, wherever possible, the unnecessarily negative effects of road transport on our environment.

Within the EU several projects and studies have been carried out to map the possibilities of modal shift. For example the German Federal Ministry of education and research carried out a project named Flexibele Transportketten.

Its target was to demonstrate how innovative goods concepts and technologies can contribute to modal shift and intermodal transport, on the basis of concrete goods flows. The Dutch Ministry of Transport, Public Works and Water management has paid attention to the importance of modal shift by carrying out modal shift scans by individual companies. The Flemish Region (Belgium) has conducted the project VEMOS that is comparable to the Dutch one. These project were earlier described in part D (Modes and competition), chapter 2 (Modal shift in practise). Conclusions from earlier projects must be noticed to assess the potential of stimulating modal shift on project base.

General conclusions from earlier modal shift projects

Earlier modal shift projects have not only looked at shifting goods flows to Inland Waterway Transport, but also to rail, shortsea and pipeline transport. But there are still conclusions to be made that might be useful for this study:

- One of the main conclusions is that for many companies, modal shift constitutes a realistic option in the (near) future.
- Modal shift is also beneficial for smaller companies and for less voluminous flows of goods.
- To an increasing degree, opportunities are offered for relatively high-quality goods with a faster turn-around time.
- Modal shift is also feasible on relatively short stretches
- In many cases, modal shift can be carried out within the same turn-around time.
- Modal shift can be cheaper than road transport.
- Modal shift is more complex in comparison with road transport because the chain requires the involvement of a number of different parties.
- For certain incoming and outgoing flows of goods, modal shift offers shippers a good alternative to congested Road Traffic.

IWT-related conclusions from earlier modal shift projects

One clear IWT-specific conclusion is that inland waterway transport is well equipped for modal shift. The inland waterway transport's share of positive recommendations was rather high (76%) and, in addition, also in absolute terms it is IWT which can achieved the largest modal shift profit (2,9 million tonnes, taken 'off the road', maximum). It should be noted that possibilities have been observed especially for ***maritime cargo transported in standard containers.***

The shifting of ***bulk*** cargo demands that both sender and recipient are situated near waterways. Any further pre- and post-transport of bulk by road usually turns out to be both expensive and inefficient. However, in these cases extra investments in quay provisions and / or storage capacity (silos) can boost IWT's potential; possibly (further) supported by government. An important aspect is the availability of (public / private) quays. Currently, in many cases these sites are used for companies that will not use IWT, or they are not used at all.

Note (and this might be a more important conclusion) that all of this is based on the ***existing service portfolio*** of IWT operators. If a greater variety of services (e.g. using special ships, or in some cases smaller ships) would be offered, than the total potential might be even greater.

A third conclusion comprises IWT ***generally outstripping other alternative modalities:*** both rail and pipeline transportation. In the case of rail, this might change in the coming decade, as rail operators will more and more seek to explore markets in a rather aggressive way. It has been concluded that rail surely has potential, but does not as yet exploit this sufficiently.

2.6 Potentials in corridors

This section will briefly map out the potentials of the four corridors used in the PINE study using expert's option and team analysis. A main limitation that has to be made is that an overall analysis on the pan-European level cannot get to the detail of individual transport relations in market segments. For this, a detailed bottom-up study would have to be carried out in each corridor, taking account of the economic structure, developments and IWT initiatives that are taken or left.

2.6.1 Rhine corridor

Figures presented in the Demand Part show that metal industry has its highest share on goods transported on the Rhine, followed by building materials and petroleum products.

The expectations for expanding the use of IWT on the Rhine are limited, because the Rhine is already intensively used as a transport axis. The additional potential is of another nature, in comparison to the other corridors. Nevertheless, forecasts demonstrate that growth is still possible in promising sectors like manufacturing products, chemicals, metal products and foodstuffs.

Clearly the Rhine has set the picture for containers via IWT. It is expected that this will continue, but in a lower pace (which is showing in the statistics of the years 2002 - 2003). If more liner services are set up in Rhine tributaries (Moselle, Ruhr Area / Dortmund-Ems-Kanal, Main and Neckar) could very well further boost the container potential.

2.6.2 Danube corridor

Nearly 60% of the total volumes transported on the Danube are ores & metal waste. Beyond this other chapters do play a role but are quite unimportant up to now.

The expectations for the use of IWT are high, since many of the accession countries are located within this corridor. There are several reasons for these expectations:

- The economic forecasts for these countries are higher than for the EU-15, and so will be the growth of transportation.
- The forecasted transport growth comes at a time with modal shift being advocated at several levels of government. Whereas in the western part of Europe the growth was absorbed by road traffic, it is expected that policies will divert a significant part of the transport growth towards IWT so there is a certain leverage effect on IWT's prospects.
- Because of the possibilities of free transportation of goods within the EU the transport streams between accession countries and the EU-15 will grow.
- Transport streams will also grow because of the trend of production plants going eastward.

Because of this, forecasts for IWT foresee a bigger growth within this corridor as in the Rhine corridor. Growth will be possible in the current market, with the so-called promising sectors.

Apart from this growth there must be more possibilities for IWT, since containerisation is not yet far developed in these countries. Dependent upon door-to-door initiatives and the establishment of container terminals in the Danube corridor, the transport of containers from the Black Sea on to the Danube might certainly have a future. As on the Rhine corridor this goes in line with the development of innovative swap bodies.

2.6.3 East-West corridor

This corridor reaches inland via Germany, Poland and the Czech Republic. This means that two out of three countries are accession countries. Therefore the conclusions will be comparable with those of the Danube corridor, albeit on a slightly lower scale because of the lower-class infrastructure. Poland features traditional sectors with a high IWT affinity. It will depend on the connection to the eastern part of Germany whether these traditional bulk sectors will stagnate or have a small growth potential. Growth will be possible in the so-called promising sectors, and the container sector, depending on the rise of initiatives.

The main bottleneck of this corridor (near Magdeburg) was recently dissolved. This might give extra opportunities for the use of IWT within the German part of this corridor.

2.6.4 North-south corridor

IWT is already used well within this corridor. It is expected are that there will be growth in the sectors metal products and machinery & other manufactured goods. The chemical industry is a big sector within this corridor. This might give extra opportunities for expanding the use of IWT as containerisation is coming up within the chemical industry.

Extra growth can be expected, as the main bottleneck in this corridor, Canal Du Nord, will be dissolved. Recently there has been the decision that this canal will be upgraded.

2.7 Conclusions

2.7.1 *The opportunities for inland shipping*

Building materials & minerals and petroleum products are the most auspicious economic sectors for IWT but these products already use IWT as a transport mode. Modal shift programs might reach a limited growth. Such programs will analyse the opportunities for expanding IWT on company level. IWT can become interesting for more companies with bulk products by building regional transhipment centres.

For the future there is a small upgrading visible as promising sectors (foodstuffs, metal products, chemicals and machinery) will grow. Apart from these IWT sectors there are some opportunities in niche markets. Waste and recycled goods and car distribution are mentioned, but there are probably others as well. Stimulating these niche markets by programs will be difficult. Costs aspects and other grounds as traffic congestion are the drive of these niche markets.

Logistic trends indicate a lasting growth of containers. This means that IWT becomes interesting for more and more goods on the condition that companies have access to water. Inland container terminals can provide this access.

An active approach and a creative mind of the IWT sector itself (new logistic concepts) can create extra opportunities and adapt to logistic trend as the demands for more frequent deliveries of smaller batches. This trend is visible in all kind of sectors, also in traditional bulk sectors.

The next table summarises the potential segments for IWT with the different stimulating possibilities as presented in this document.

IWT Potentials	Stimulating possibilities
Expansion in the current market • Traditional bulk sectors	Modal shift Regional transhipment centres
Expansion in the current market • Promising sectors	Modal shift New logistic concepts
Containerisation	Container inland terminals
Niche markets	
Various	New logistic concepts

Table 12. IWT potentials and stimulating possibilities

2.7.2 *Opportunities in the corridors*

There are differences between the corridors in the potentials for IWT. Accession countries are more promising than the EU-15. There are several reasons for these expectations:

- The economic forecasts for these countries are higher than for the EU-15, and so will be the growth of transportation.
- The forecasted transport growth comes at a time with modal shift being advocated at several levels of government. Whereas in the western part of Europe the growth was absorbed by road traffic, it is expected that policies will divert a significant part of the transport growth towards IWT so there is a certain leverage effect on IWT's prospects.
- Because of the possibilities of free transportation of goods within the EU the transport streams between accession countries and the EU-15 will grow.
- Transport streams will also grow because of the trend of production plants going eastward.

Accession countries are part of the Danube- and the East-West corridor so IWT opportunities are more promising in these corridors than in the Rhine and North-South corridor. The opportunities within the promising sectors (foodstuffs, metal products, chemicals and machinery) are a little bit more then they are in the EU-15. Apart from this there must be possibilities for containerisation since this isn't far developed in these countries. Extra growth can be reached by stimulating IWT as mentioned before (modal shift, new logistic concepts etc.).

Chapter 3 **Improvement of infrastructure**

3.1 Introduction

The Pan-European waterway network can be regionally divided into four waterway systems (North-South corridor, Rhine corridor, South-East corridor, East-West corridor). These corridors all have heterogeneous characteristics (regarding e.g. the density of ports, the number of industrial settlements, the fleet structure, the average transport distances, the structure of goods, etc.). Beside these characteristics the quality of the waterway infrastructure varies strongly in the different waterway basins. The UN/ECE has defined a list of shortcomings of the infrastructure, where missing links and bottlenecks have been defined. The objective of this chapter is to describe the effects of resolving major missing links or the removal of severe bottlenecks. This study exemplarily describes the potential positive effects of a removal of missing links and bottlenecks by means of three concrete case studies: The missing link Seine Nord and the bottlenecks along the river Danube and the Elbe. The Seine-Scheldt project represents a missing link of strategic nature (long-term, large construction works), whereas the Danube and Elbe projects represent studies to improve navigability on relatively short-term to mid-term by means of low-water regulation.

3.2 Case study I: Seine-Scheldt

3.2.1 Introduction

This case study addresses the Seine-Scheldt project, the French part of the navigable route from the Seine to the Scheldt (called Schelde in Dutch and Escaut in French). As developments go very fast, mind the time of writing of this section: January 2004. Recently, the decision has been taken to realise this large-scale upgrading operation of 105 km. This section will treat backgrounds, argumentation, perspectives and latest developments around the project.

Without any doubt, the Seine-Nord link forms one of the main bottlenecks within the countries featuring the highest IWT profile. The exact situation of the 'Canal du Nord' is displayed in the figure below. It is the connection between the river Oise, leading to the île de France and Paris via the Seine, and the Canal Dunkirk – Escaut.

Figure 13. Map of the area where the Canal du Nord upgrading will take place (axis = red)
Source: Voies Navigables de France

The current CEMT category for the Canal du Nord is II with a maximum tonnage of 650 tonnes in which there have been no investments for over 40 years. The connecting infrastructure on the north side features Class Va to Lille / Dunkirk, and III / IV to Charleroi / Namur. The connection via Noyon with Paris (and Le Havre) has class V. Since the 1960s there have been debates on the project, which would involve the enlargement of the main IWT network of the Low Countries far into France. Only during the last decade, momentum started to emerge, especially in view of the success of IWT in the Low Countries and, of course, in France where growth amounted to 22% during the last five years.

3.2.2 Advantages of the project

Not many comparable works of infrastructure have been carried out the last decades. Despite the fact that there is already a canal, to extend it to such a large-scale a waterway has drastic impacts for the area involved. ***Arguments*** to carry out the project include:

- On a pan-European scale, France becomes well connected to the thriving large-scale IWT networks of Belgium and the Netherlands. This means that the north-south corridor can start to develop itself like the Rhine corridor has for years.
- Opportunities are opened especially for container transport, and chemicals, considering the axis Benelux–Seine is not only on the EU level, but even globally the most important relation. Surely, also for other IWT (sub) sectors potentials become attainable.
- Several experts have calculated that the traffic on the link could triple the IWT transport between the Seine and Scheldt estuaries. Most of this is taken off the roads, but a considerable part will surely be newly generated.
- The connection would give an answer to several main logistics trends that play on the EU level. Apart from the rise of intermodal transport, think about containerisation, volume growth, scale enlargement, internationalisation of transport, etc.
- Economically, a useful connection is made between the Paris region, and the regions westward along the Seine to Le Havre, to major European core areas such as:
  - the core areas of the Randstad (metropolitan area including the large cities Rotterdam, Den Haag, Amsterdam, Utrecht)
  - the Flemish cities Bruges, Antwerp, Gent and Brussels
  - the Lille – Tourcoing – Roubaix area

- The north-south corridor has a lot of traffic problems, on the roads as well as on the rail system. IWT could, within traditional as well as within innovative market sector, give a considerable contribution to the internal accessibility of this area. The Seine-Scheldt connection can relieve at least 30 per cent of the congested north-south road corridor between the economic centres, cities and ports of the Benelux and the Paris region.
- The corridor will also contribute to a more balanced spatial-economic development. This is highly attractive on the regional level, with Northern France's economic difficulties. Also the bordering Belgian region takes a profit, but on the EU-regional level more balance in economic development becomes possible.

Figure 14. Location of the Seine-Escaut bottleneck within the further EU IWT networks
Source: Voies Navigables de France

3.2.3 Current status

On December 5th, 2003, the Council of Transport Ministers of the European Union unanimously agreed to add the Seine-Scheldt project to the list of priority projects proposed by the European Commission, when reaching political agreement on the guidelines for the trans-European transport networks (TEN-T). This list was derived from the Van Miert list also featuring the Straubing – Vilshofen stretch of the Danube, which then was the only IWT project. TEN-T co-financing means that international infrastructure improvements can be funded up to 20% of the costs.

Only two weeks later, on December 18 of that year, The French inter-ministerial committee on land use planning (CIADT) chaired by Prime Minister Raffarin decided to include the Seine-Scheldt project in the list of 50 large infrastructure works planned until 2025 in France. The realisation of the project, leading to admission of ships and push-barges of up to 4.400 tonnes, will cost approximately €2.6 billion. A major part will be born by the French state and the involved regions, but it is expected that funding will be provided by private parties and, of course, European funds.

In January of 2004, Voies Navigables de France has announced the preliminary studies and time frame of the project. Preparation and 'declaration of public interest' will take about 3 years (2004-2006) and realisation 7 years (2006-2012). It is expected that the opening of the canal will be in 2012.

3.3 Case Study II: Upper Danube

3.3.1 Introduction

The Rhine-Main-Danube waterway links the North Sea with the Black Sea over a distance of 3,467 km (Rotterdam-Sulina) and is as such the only transcontinental waterway in Europe. The fairway conditions on this major European waterway are by no means homogeneous. Whereas the Rhine is characterised by favourable and stable waterway conditions, the situation on the Upper Danube from Kelheim (km 2,411) to Budapest (km 1,640) is ambiguous. On the one hand, the Danube is defined as an international waterway with waterway classes VI to VII (AGN). This means that the existing waterway infrastructure would meet the highest standards for inland navigation. On the other hand, some stretches of the Upper Danube are typified by insufficient and strongly fluctuating water levels in the free flowing sections. Consequently, shipments over long distances (e.g. Rotterdam-Bratislava 1,602 km, 7 to 13 days transit time depending on ship type and mode of operation) are faced with unpredictable water levels, since reliable water level prognoses can only be made up to three days in advance. Transport distances on the Rhine are generally much shorter (< 500km); water levels can be predicted more reliably.

3.3.2 The problem of unpredictable water levels

Impact on utilisation rates

As a result of the above-mentioned differences, average utilisation rates for typical vessels operating on the Rhine and on the Danube strongly vary. Following tables show the annual transport volume and the average utilisation rates on two characteristic border sections.

	Perl-Apach (Rhine-Moselle)		**Passau (Upper Danube)**	
Year	*Annual transport volume (in 1000t)*	*Average utilization rate (%)*	*Annual transport volume (in 1000t)*	*Average utilisation rate (%)*
2001	8,542	86	6,109	60

Table 13. Average utilisation rates and transport volumes on selected border sections

On the Upper Danube the average utilisation rate is significantly lower. This can only partly be explained by the different fleet structure (push-boat system is prevailing on the Danube) and the relatively asymmetric transport flows on the Danube. One of the other main factors with a negative influence on the utilisation rate is lack of reliable water level prognoses.

The impacts of unpredictable water levels over long transport distances can *de facto* only be determined by monitoring vessels that travel the entire route themselves. In practice, vessels with origin in Western Europe and destination in Eastern Europe are often lightened in Regensburg in case of low water conditions on the Upper Danube. An alternative to this procedure is the transhipment to dedicated Danube vessels.

In an analysis of the impacts of unpredictable water on the average utilisation rates these lightening or transhipment effects have to be eliminated. A method to eliminate these effects is to concentrate the analysis on the Dutch fleet operating on the Rhine-Main-Danube corridor. These vessels mainly carry the cargo directly from the point of origin (e.g. Rotterdam) to its final destination (e.g. Bratislava) without intermediate transhipment. Data of these Dutch vessels are also available on the corridor Rhine-Moselle.

Year	**Number of passing vessels**	**Total capacity [t]**	**Average capacity per vessel [t]**	**Total transport volume [t]**	**Average utilisation rate [%]**
2001	313	430,034	1,374	259,558	60.4
1999	348	454,372	1,306	278,982	61.4
1997	218	280,205	1,285	161,119	57.4

Table 14. Average utilisation rate of Dutch vessels at border section Passau (Germany-Austria)

Table 14 shows that – even under comparable fleet circumstances – the average utilization rates of the Dutch fleet at the border section of Passau are about 30 per cent lower than at the border section Perl-Apach (see Table 13). As fairway depths on the Rhine (2.1m at LNRL[9]) and the Upper Danube (Pfelling: 2.0m at LNRL) are only slightly different, the lower average utilization rates on the Upper Danube can only be explained by the problem of unpredictable water levels caused by long transport distances and large water level fluctuations.

---

[9] LNRL = Low Navigation and Regulation Level is the water level that corresponds to the flow available for 94% of the duration of the navigable season, i.e. excluding the winter periods of break of navigation affected by ice

Potential versus actual draughts

Figure 15[10] shows the potentially available draught and the actually realised draughts during the course of the year 1997 at the water gauge in Pfelling. The year 1997 was characterised by relatively poor fairway conditions. This gauge is the decisive level for shipments on the route Rotterdam-Upper Danube. The potentially available draught also includes the common safety margins needed to cope with the dynamic immersion of vessels and the required underkeel clearance. Immersion and underkeel clearance usually makes up a reduction of about 40-cm. The actually realised draughts haven been derived from the monthly statistical publications.

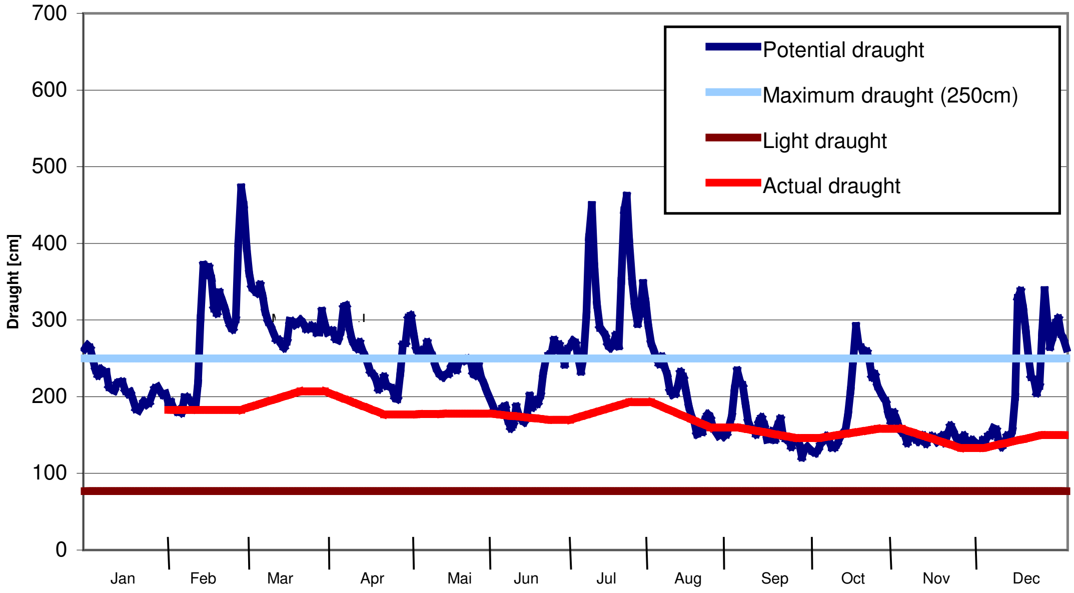


Figure 15. Comparison of potential and actually realised draught at water gauge Pfelling in 1997

The difference between the blue and the red line therefore shows the additional safety margin, which has been chosen by the operators due to insecurities in forecasts of water levels over long time intervals. This additional safety distance accounts on average for more than 40 cm per trip (in relation to actually realised draughts). Since the year 1997 had very poor water level conditions (in terms of available fairway depth), the question arises if higher water levels throughout the year lead to a reduction of the additional safety distance.

---

[10] Following WSA Regensburg 1997: LNRL = water gauge Pfelling 298cm which corresponds to a fairway depth of 2,0 m; Immersion and underkeel clearance = 40 cm; potential draught [cm] = water gauge [cm] – 98 cm – 40 cm.

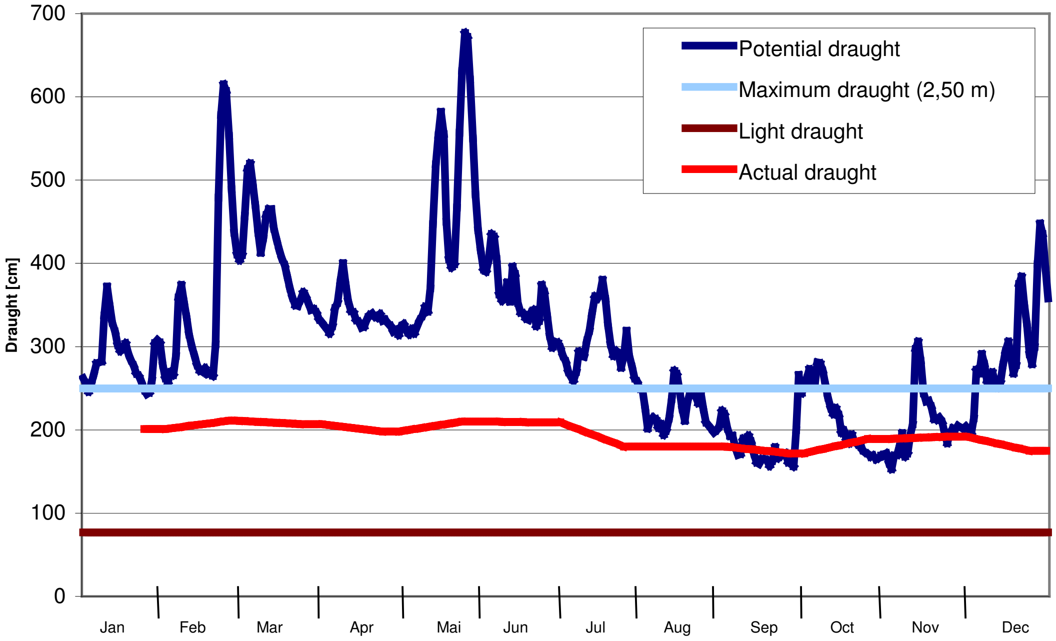


Figure 16. Comparison of potential and actually realized draught at water gauge Pfelling in 1999

Figure 16 shows that water level conditions were considerable better in 1999 than in 1997 generally higher water levels especially in the period between March and June. The high potential draught in this period could however not be effectively used by vessel operators originating from Western Europe. Given the large water fluctuations – in periods with high water levels the draught can drop by 2.5 metres within just a few days – force vessel operators to be careful in determining the draught of their vessels upon departure. As a result, the average difference between potential and actual draught is even larger in the – in theory – more favourable year 1999. The average safety distance accounted for almost 70 cm in 1999 (as compared to 40 cm in 1997).

This gap between potential and actual draught causes higher unit costs for inland waterway transport than would actually be necessary. In the highly competitive world of intermodal transport, these efficiency losses therefore have strong impacts on the competitiveness of inland waterway transport as a whole. Therefore, the impacts of fluctuating water levels on transport costs are analysed in the following section.

3.3.3 The impact of water level fluctuations on transport costs

Figure 17 shows the difference of standby[11] cost increases and possible utilisation rates caused by low water levels for the transport relations Rotterdam–Moselle and Rotterdam–Upper Danube.

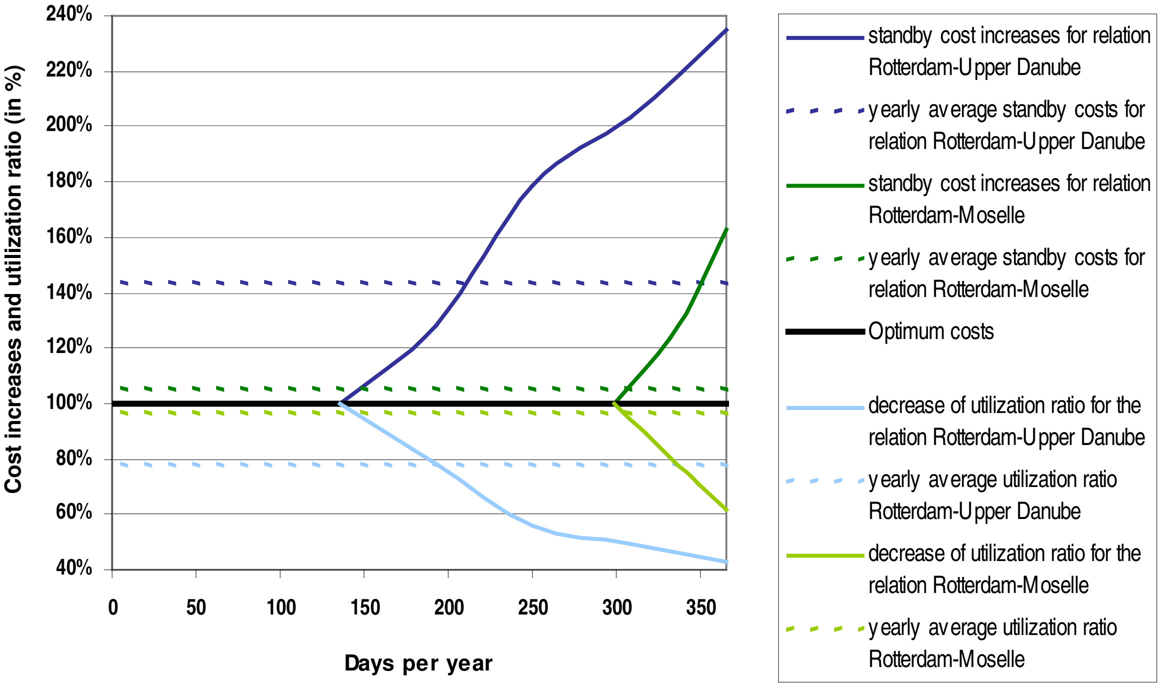


Figure 17. Low water induced standby cost increases for transports with guaranteed transport volumes on the Upper Danube and on the Moselle, self-propelled dry cargo vessel with maximum draught of 2,50m

As appears from the above figure, the situation for the relation Rotterdam–Moselle is by far better than for the relation Rotterdam–Upper Danube:

- A utilisation rate of 100 per cent is possible on 300 days per year on the relation Rotterdam–Moselle, this is only on 140 days on the relation Rotterdam–Upper Danube.
- The average utilisation rate on the relation Rhine–Moselle amounts about 96 per cent, whereas this is only 77 per cent for the relation Rhine–Upper Danube.
- Homogeneous transport prices – average annual standby cost increases of only 105 per cent – can be realised on the Rotterdam-Moselle route, whereas average standby costs rise up to 143 per cent for the relation Rhine–Upper Danube.

---

[11] Standby costs = fixed costs of a shipping operator (personnel costs, maintenance/repair costs, depreciation, interests, insurance), also see SWP 2.3.

As already explained in the Policy and legislation Part (chapter 3), this cost increase only applies to transports having a so-called “transport guarantee”, i.e. shipments for which a fixed amount of cargo volume needs to be transported at specified times, regardless of the fairway conditions. During low water periods it is necessary to use additional ships in order to transport the same amount of cargo, which induces additional operating costs. Such transport guarantees are above all necessary for goods that are time critical, and that can not wait for the fairway conditions to improve.

The price/performance ratio for the relation Rotterdam–Moselle is predictable and competitive, whereas this is not the case for the relation Rotterdam–Upper Danube. Furthermore there is insufficient additional shipping space in case of extremely low water level conditions on the Upper Danube. It is therefore of major importance to improve the existing fairway bottlenecks on the Upper Danube.

3.3.4 Possible measures/variants

To obtain comparable competitive conditions as on the Rhine, it is essential to improve fairway depth at LNRL on the Upper Danube. The four major bottlenecks on the Upper Danube, which need to be improved, include:

- Straubing-Vilshofen (Germany)
- Melk-Dürnstein (Austria)
- Vienna-Bratislava (Austria)
- Gabcikovo-Budapest (Hungary)

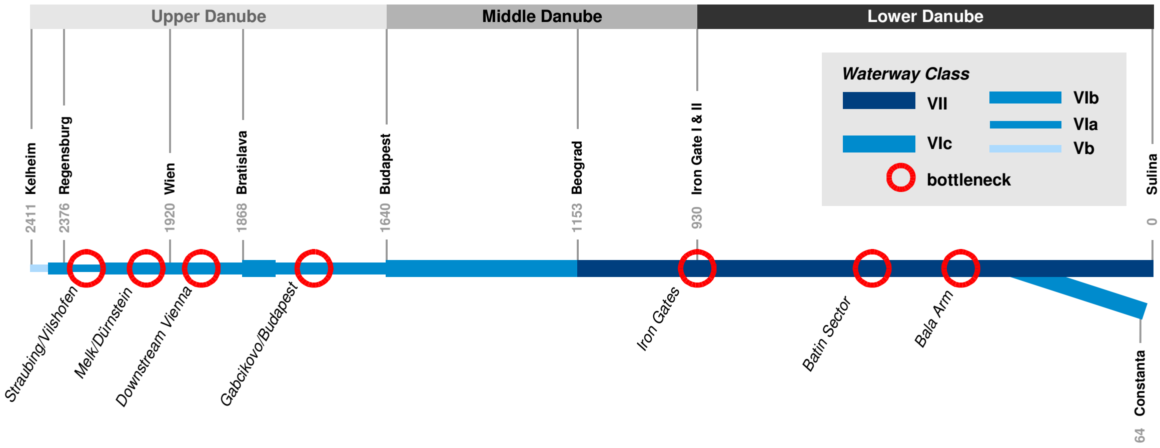


Figure 18. Infrastructure bottlenecks on the Danube

Figure 18 shows the infrastructure bottlenecks of the Danube. As we have seen, the bottlenecks on the Upper Danube are characterised by highly unpredictable and fluctuating water levels throughout the year, which limit the cost-efficiency of inland navigation.

Feasibility studies for the improvement of the situation between Straubing-Vilshofen (Germany) and Vienna-Bratislava (Austria) have already been carried out and started respectively. The bottlenecks on the Lower Danube can be mainly removed with regular maintenance works and minor local investments in river engineering works.

The most critical section lies between Straubing and Vilshofen. As measured against the LNRL, this section is guaranteed with 94% probability to a water depth of only 2.00-m (allowing a potential draught of 1.60 m). In-depth analyses for this section have been initiated by the German and Bavarian government to evaluate the different technical options from an economic and ecological standpoint, and the information generated was used in the political decision making process. A final solution on how to improve this particular section has, however, not yet been found.

In the Wachau (Melk/Dürnstein), riverbed-engineering measures carried out in 1986/87 have improved water depths by restoring 2.50-m at LNRL. Since then, maintenance measures have been aimed with the goal of maintaining a water depth of 2.30 m at LNRL. Over the last decades, navigation downstream of Vienna at 2.00-m draught has not been possible for an average of 84 days, and at 2.50-m draught for an average of 155 days respectively. The Austrian Government has renewed its obligation to assure fairway conditions east of Vienna. At present, an environmental impact assessment is undertaken for the stretch Vienna-Bratislava. Additionally, a project to improve fairway depth as well as the ecological situation in the national park area has been initiated. Among other things, a cost-benefit analysis has been undertaken, which evaluates the effects of an improvement of fairway depth and draught on the competitiveness of inland navigation (expressed in future transport flows). These activities are funded within the TEN-T Programme.

In the following sub-section, the main results of this project are summarised to show the benefits of improved fairway conditions.

Current situation between Vienna and Bratislava

The Danube stretch between Vienna and Bratislava is currently faced with the problem of river bed erosion: each year the river bed becomes 2 to 3.5 cm deeper. This means that the groundwater level continually drops, which endangers the existence of the nearby national park Donau-Auen. Furthermore the fairway depth on this free flowing stretch of the Danube river represents a bottleneck for inland navigation, especially in case of low water.

In order to stop the process of riverbed erosion and to improve the available fairway depth between Vienna and Bratislava, several construction variants have been identified within the Austrian UVE project. These variants differ according to the type of riverbed consolidation and the minimum fairway depth at LNRL (25 dm, 27 dm, 32 dm).

Effects of improvement measures

First a variant is examined, which is aimed at achieving 1.9m draught at LNRL on the Upper Danube up to Bratislava.

The assumption is made that these fairway conditions are also guaranteed on the Straubing-Vilshofen stretch (which represents Variant A in the existing Straubing-Vilshofen studies).

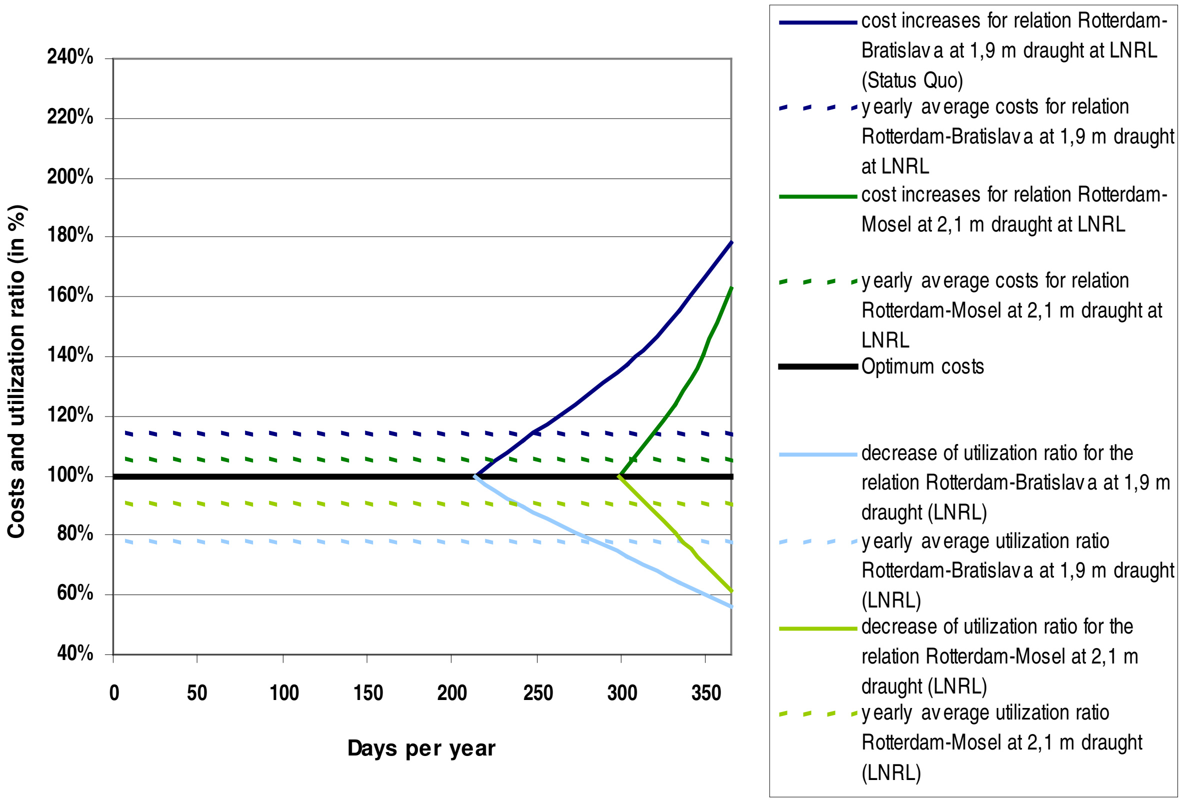


Figure 19. Construction variant with 1.9m draught at LNRL

In this situation, the average cost increases amount to 114 per cent, whereas the 100 per cent utilisation can only be realised on 241 days per year. This still is relatively low compared to the circumstances on the Rhine-Moselle.

The impacts of a second variant (2,5 draught at LNRL) is displayed in the following figure.

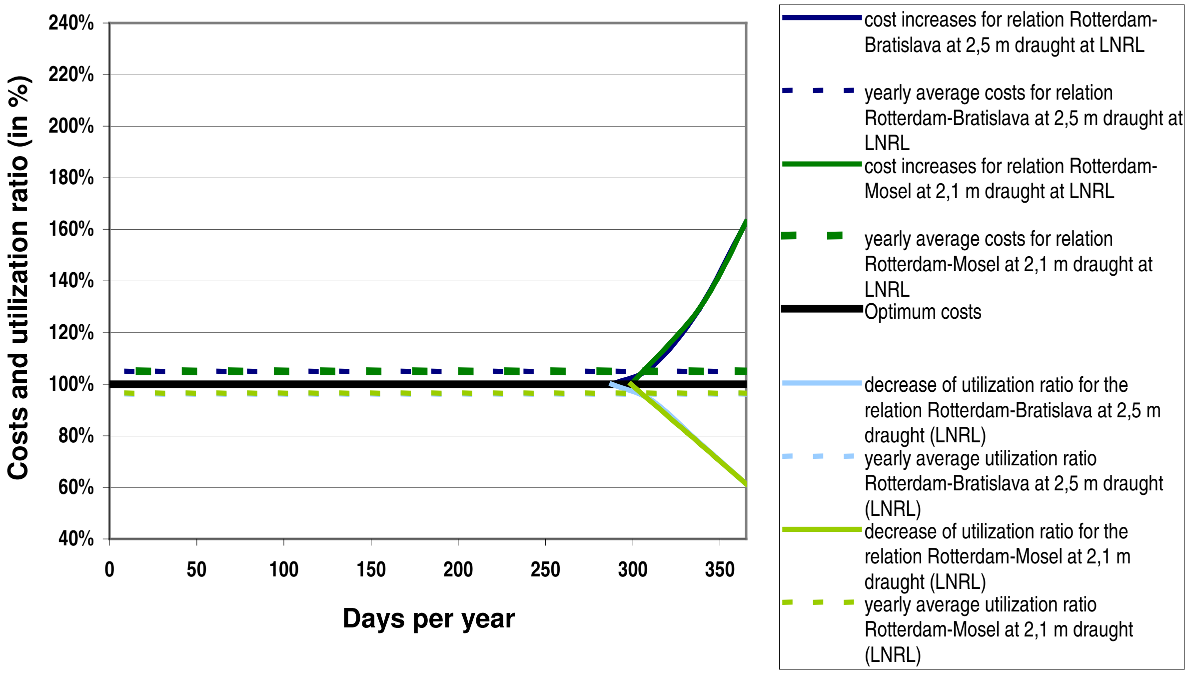


Figure 20. Construction variant with 2.5m draught at LNRL

This variant shows that an improvement of the draught on the Upper Danube would create comparable navigability conditions (and competitiveness) as are currently attainable on the Rhine corridor. The average costs increases would be reduced to 105 per cent and a 100 per cent utilisation can be achieved on 288 days per year.

Macro-economic benefits of the project

Sufficient fairway conditions on the Upper Danube (2.5m draught measured against LNRL) have following benefits:

- Savings on investments in the road system
- Savings on external costs of transport:
  - Reduction of accident costs
  - Reduction of congestion costs
  - Reduction of CO2-emissions (Kyoto-objective)
  - Reduction of noise
  - Reduction of space consumption

3.4 Case study III: Elbe

3.4.1 *Characteristics of the river Elbe*[12]

The river Elbe has an overall length of 1.091 km, of which 364 km are allotted on Czech and 727 km on German territory. For centuries it is used for inland navigation and with its tributaries and adjacent canal sections it opens up a region, which covers beside the Czech Republic seven states of the Federal Republic of Germany. With the river Elbe, Hamburg, the second largest container port in Europe, has an ecological alternative regarding traffic relationships with its natural hinterland in Central and Eastern Europe.

Figure 21. The river Elbe in the context of the European inland waterway network
Source: Verein zur Förderung des Elbstromgebietes

In the middle of the 19th century the river Elbe was Europe´s busiest waterway, based on the number of the ships. After two world wars and decades of the German division (while those a section of the river Elbe being a part of the earlier border between east and west) as well as lacking measures for river construction and maintenance in this time inland navigation on the river Elbe could not develop further.

---

[12] Source: Verein zur Förderung des Elbstromgebietes e.V. sowie “Die Elbe – Bindeglied für den Europäischen Verkehrsraum”; report of the “working group Mittelelbe” / authority for economy and labour fo the “Freie und Hansestadt Hamburg”; Hamburg April 2003

However, after the German reunification in the year 1990 the chance for the Elbe arised, to regain its function as an important traffic route in inland navigation. It has to be considered however, that inland navigation is substantially affected by sections with intensive draught restrictions (see also infrastructure measures p. 10 ff) and partly long lasting low water periods during summer time as well as by partially extreme flood phases.

The recent example is the low water period of the year 2003, in which water depths in several sections dropped below 1 m over longer periods which almost completely stopped inland navigation during these times. The other extreme was the "century flood" (summer 2002), which among others led to a temporary stop of inland navigation and a substantial damage of waterway infrastructure as well as, on different sections, to a further reduction of the available draughts caused by sedimentation.

These uncertain water levels are to be attributed mainly to the fact that the river Elbe does not have, as for example Rhine or Danube, supplies of meltwater in summer times. For inland navigation this means a serious disadvantage both compared to other means of transport as well as other waterways. This applies particularly, because on the one hand reliability is a crucial criterion for the choice of the means of transport and on the other hand ships could only use a part of their capacities in case of draught restrictions, which results in a substantial loss in efficiencies and competitiveness. In this context it has to be considered, that usually the strongest bottleneck on a planned route determines the load capacity and thereby the efficiency of the whole transport.

3.4.2 Stock-taking and possible construction measures

The Czech section of the river Elbe is canalised/regulated by means of 21 dams with locks. In contrary to that downstream the Strekov lock (Czech Republic) on German territory improvements of the nautical conditions were made without dams in order to preserve the character as a free-flowing river. These construction works already have been realised in the 19th and the beginning of the 20th century. The works comprised groins, dykes as well as other measures in order to keep an acceptable water level in periods of low water and to stabilise the stream flow. This kind of regulation is prevailingly present till nowadays, characterising the construction standards of the river Elbe from Strekov to the double lock Geesthacht (appr. 30-km upstream Hamburg). Downstream Geesthacht the water depth depends on the tide cycle.

During the decades of the divided Germany improvement measures on the Elbe practically were not applied and maintenance measures only in a very limited extent. Consequently the above mentioned regulating construction structures were and partly still are more or less considerably damaged during the time or even partly demolished, for instance by strong flow streams or floodings.

Fairway depths

In order to assess the fairway characteristics and depths a proper approach is to analyse readings of water level gauges at suitable sites over a corresponding period of time.

Thereby the cross sections at Magdeburg and Wittenberge are decisive for the draught determination on the German stretch of the Elbe; the allowed draught is on both sites mutually very similar. In the following example the level gauge at Wittenberge is analysed. The average numbers of days per year when a certain draught is ensured are shown separately for all the years from 1990 to 1999. Beside the curves for the years with low (1991) and favourable (1995) draught records the overall average of the 10-years period also has been determined.

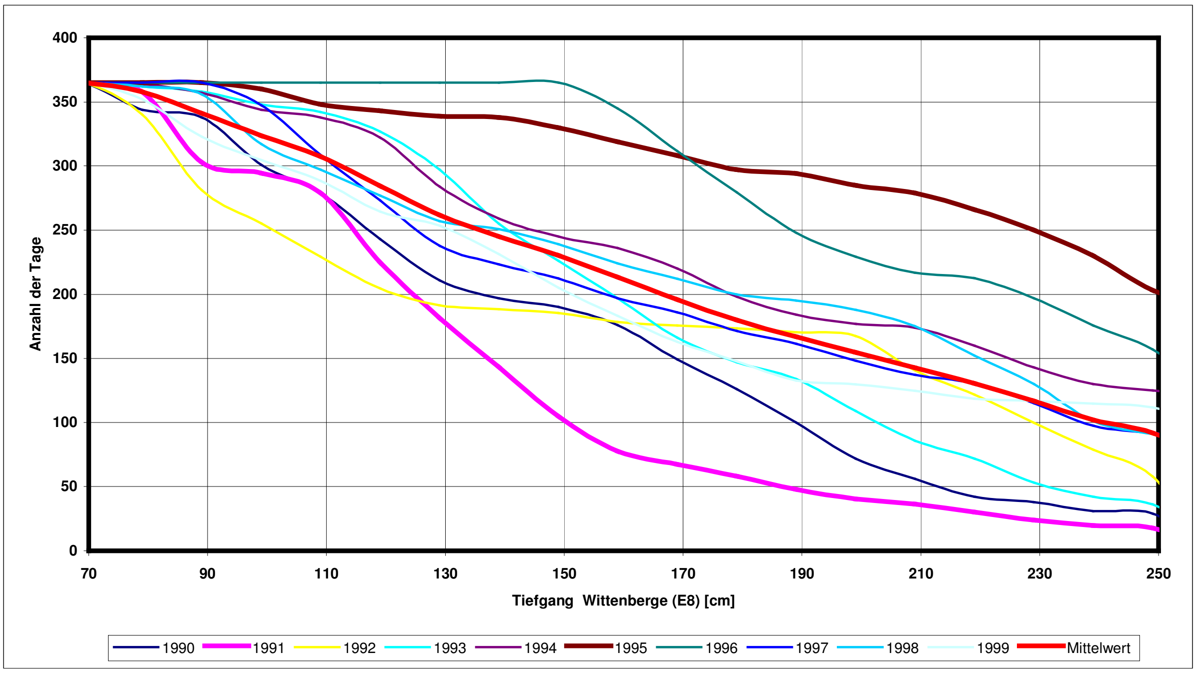


Figure 22. Number of days ["Anzahl der Tage"] per year when the water level gauge at Wittenberge (Elbe) indicated a certain draught ["Tiefgang"], individually plotted for the period 1990-1999
Source: VBD calculations on the base of level gauge records

For instance it becomes clear that in the unfavourable year 1991 a draught of at least 140 cm was ensured during only about 130 days[13]; this means that the restrictions of draught to less than 140 cm were applied during about 235 days in that year. A draught of at least 100-cm was provided on about 290 days[14], i.e. during 75 days the draught was less than 100 cm. In contrary to that in the favourable year 1995 a draught of 140 cm was ensured on about 340 days, while strong restrictions below 100 cm were made only on about 5 to 10 days.

The extreme water level conditions of the years 2002 (flooding and its consequences) and 2003 (extremely low waters) are not yet included in this analysis. The consequences of the flooding in 2002 were among others movements of riverbed sediments at various sites,

---

[13] A draught of 140 cm corresponds with a water depth of 160 cm, as demanded in the previous German federal traffic infrastructure plan (see below).

[14] Depending upon type and size of a vessel the empty draught of the vessel is within the range of about 40 cm to 100 cm.

which caused further reductions of the available draughts. There are different information on the scope of these effects and their influence on inland navigation; however it seems evident that the fairway depth in particular stretches is lowered by more than 0.5 m through the movements of sediments. Detailed evaluations for the year 2003 are not yet available; but in the second half of the year the navigation on the long stretches of Elbe was restricted in a large extent during months and even more, for certain time intervals it had to be completely ceased.

Infrastructure measures

After the German reunification measures to improve the navigation on the Elbe have been specified within the Framework of the previous German Federal Traffic Infrastructure Plan in 1992 (Bundesverkehrswegeplan 1992, BVWP´92). After implementation of these measures it was envisaged to provide a waterway with 2.50 m fairway depth during at least half of the year along the long-term time span. Additionally, it was intended to ensure at least 1.60 m fairway depth (i.e. about 1.40 m loading draught) during about 345 days a year. According to the information of the Association for the promotion of river Elbe (Verein zur Förderung des Elbstromgebietes[15]) such improvements would allow up to a 25 % increase of loading draught in the annual average and consequently result in considerably higher efficiency and competitiveness of inland navigation on the river Elbe. Moreover, such improvements would ensure transports by ship almost all the year round which is a very important argument for the shipper/freight forwarder to decide to use inland navigation for his transport needs.

These measures comprised among others repair and completion of groins as well as river bed covering/protection and ducting of the stream flow. Additionally the following further infrastructure improvement measures were planned on particular stretches[16] (compare figure 23 below):

1. Compensation of removed material on the so called „erosion stretch" ["Erosionsstrecke"] Mühlberg-Wittenberg (km 120 to 230) as well as completion of the so called "rocky stretch" near Torgau ["Torgauer Felsenstrecke"] (km 155)
2. Completion of the stretch along the City of Magdeburg ["Magdeburger Stadtstrecke"] (km 322,9 to 329,6)
3. Completion of the so-called „rest-stretch" ["Reststrecke"] between Hitzacker und Dömitz (km 508 to 521)

---

[15] „Die Elbe – eine unverzichtbare Wasserstraße", Position paper related to the stop of construction measures on the river Elbe, Verein zur Förderung des Elbstromgebietes e.V., Hamburg 2003.

[16] Source: Verein zur Förderung des Elbstromgebietes e.V.

Re 1: "Erosion stretch" [“Erosionsstrecke”] Mühlberg - Coswig and “Torgau rocky stretch” [“Torgauer Felsenstrecke”]

In the range of so-called "Erosion stretch" between Mühlberg and Coswig there is a permanent deepening of the river bed which together with a follow-up lowering of the water surface cause extremely negative effects on the environment and the infrastructure buildings. In order to prevent further erosion gravel or an appropriate mixture of sand and gravel are added on several localities since 1996. This kind of measure also has been successfully implemented on the river Rhine. The peaks in the rocky river bed in the fairway stretch at Torgau were removed in the meantime and do not represent a bottleneck for the Elbe shipping any more.

Re 2: Completion of the “Magdeburg city stretch” [“Magdeburger Stadtstrecke”]

Due to underwater rocks the fairway of this section is narrow and exhibits shallows. Thereby during certain water levels high water speeds occur. In order to eliminate this bottleneck for inland navigation from and to the Czech Republic and Dresden, the rock in the fairway should be chiseled in order to get an adjustment in the height of fall as well as in the fairway cross-section.

Re 3: Completion of the so-called „rest-stretch“ [“Reststrecke”] between Hitzacker und Dömitz (km 508 to 521)

In contrast to the other sections in this section the „low water regulations“ have not been carried out due to the Second World War. As a consequence, the flow speed remains low resulting in sedimentation of boulder materials. Strongly moving sandbanks require constant dredgings and prevent a stable fairway. Apart from the „Magdeburg city stretch“ this section represents the strongest bottleneck on the river Elbe. In order to remove the obstructing sedimentation of sands presumably extended groins should ensure the same regulation quality as above and below of this section.

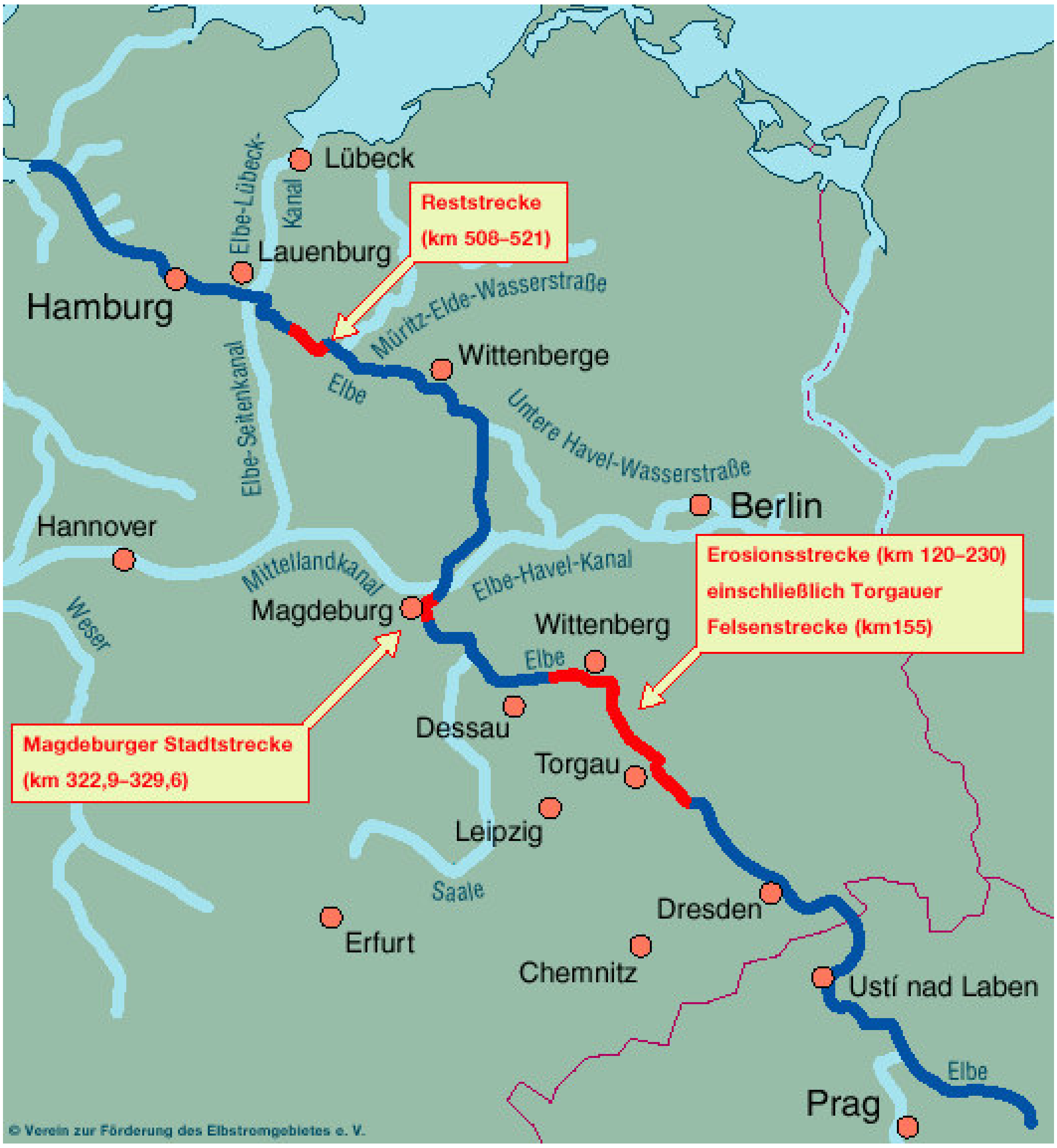


Figure 23. *Measures to improve flowing conditions of Elbe*
Source: Verein zur Förderung des Elbstromgebietes e.V.

Further restrictions

Apart from the above mentioned fairway restrictions further restrictions exist regarding container transports on the river Elbe due to low air draughts at the river section above Magdeburg. Therefore, for this section an adjustment of air draughts to a three-store container transport was intended in accordance with the previous BVWP 92. According to actual information from the German Federal Ministry of Transport, up to now, some but not all bridges have been adjusted; therefore, this restriction still remains, since the lowest bridge determines the air draught of the whole route.

Consequences and current development

Due to these infrastructure restrictions inland navigation is embarrassed in accentuating its characteristic cost and performance advantages on the more than 600-km long Elbe stretch between the German-Czech border and Geesthacht (the so-called "Mittelelbe"). This is a consequence of the partially insufficient fairway draughts and the intensive water level fluctuations during the course of a year, resulting in a substantial impairment of competitiveness of inland navigation vs. rail and road.

According to the original plans of the previous BVWP´92 the mentioned measures should be terminated up to the year 2008. In the past years a substantial part of the repairs on groins, dykes etc. already could be realised. Furthermore due to both, public support measures and private capital investments several inland ports have been modernized in a substantial extent. Many of them already today have achieved a modern state of construction, which corresponds to the goals of the previous federal traffic infrastructure plan 92. In total, only in the German section of the Elbe river more than 400 million € have been invested in the infrastructure of waterways and ports. On more than 85 % of the Elbe river the intended fairway conditions are already realised[17].

Within the recent years several construction measures already have been „temporally stretched“ due to financial bottlenecks. Furthermore, after the devastating flood disaster in August 2002, the present German Federal Government first decided, to check all construction measures on „flood neutrality“ and, thereafter, not to realize "Construction measures and in their effects comparable maintenance measures" on the „Mittelelbe“ (i.e. from the German-Czech border to the Geesthacht lock close to Hamburg) as well as on the Elbe tributary Saale. Consequently, the current federal traffic infrastructure plan 2003 does not include a continuation of the above mentioned river construction measures. According to the German Federal Ministry of Transport the status quo, which had been realised until the flood in August 2002 shall be preserved. This includes the bottlenecks at the so called „Magdeburg city stretch“ and the „rest stretch“ between Dömitz and Hitzacker.

3.4.3 Potentials

The analysis of the potentials of inland navigation on the river Elbe primarily relies on an enterprise questioning[18] accomplished in the year 2003. Furthermore an analysis provided by LUB Consult GmbH in the year 2002 as well as an updated traffic prognosis caried out by Prognos AG in the year 2001 have been considered.

---

[17] Source: Die Elbe – eine unverzichtbare Wasserstraße; Position paper related to the stop of construction measures on the river Elbe, Verein zur Förderung des Elbstromgebietes e.V., Hamburg 2003

[18] Source: “Die Elbe – eine unverzichtbare Wasserstraße” Position paper related to the stop of construction measures on the river Elbe, Verein zur Förderung des Elbstromgebietes e.V., Hamburg 2003

Subject of the mentioned enterprise questioning was the importance of inland navigation on the river Elbe for the enterprises under today's conditions and under improved navigability respectively. This questioning was conducted by the "Verein zur Förderung des Elbstromgebietes e.V." in co-operation with the adjoining "Chambers of Commerce and Industry" of Berlin, Dresden, Dessau, Hamburg, Luebeck, Magdeburg, Potsdam and Lueneburg-Wolfsburg. 118 enterprises from industry, trade and transport economy with production sites between Hamburg and Decin (Czech Republic) took part in this questioning.

Altogether these enterprises comprise a cargo volume of approximately 8.6 million tons per year transported on the river Elbe and/or on the adjacent waterways including the Elbe river. In comparison to that the above mentioned source quantifies the cargo volume transported by inland navigation (in 2002) in this part of the Elbe basin with 11.24 millions tons. Accordingly, more than three quarters of these transports of inland navigation are alloted to the enterprises which took part in the questioning.

The interviewed enterprises quantified their entire transport volume per year (all modes) to approximately 35.4 million tons. Until the year 2010 they expect a 17 % rise to approximately 41.5 million tons per year. Depending on the future infrastructure standards of the river Elbe (improved or not) these enterprises expect a very different development of their future inland navigation volume:

In the case of a retention of the present construction standards the transports of these enterprises via inland waterways will decrease by 1% in the year 2010. However, in the case of completed river construction measures on the Elbe in accordance with the previous federal traffic infrastructure plan (BVWP ´92) including an upgrading of the Elbe confluence Saale a rise of the transport volumes of these enterprises on inland waterways is to be expected around approximately 133% until the year 2010; this would mean more than a duplication of the transport volume on these inland waterways. These figures clearly demonstrate the enormous development potentials for inland navigation, which could be realized with a relatively moderate improvement of the infrastructure conditions (as represented by the measures of the previous BVWP 92).

In particular the container transport on the Elbe river might profit from these infrastructure measures, since more intensive breadth and air draught restrictions exist on the possible alternate route over the Elbe-Seiten-Kanal and the Mittelland-Kanal, which only allow single-lane pushed convoys and two-store container stacking. However, conditions for container transport are feasibility and reliability of the transports, which are given in the case of all year round sufficient water levels only. For 46 and 54% of the enterprises respectively improvements of the draught and particularly stable and reliable minimum draughts are most important.

According to the "Verein zur Förderung des Elbstromgebietes" the results of the questioning are in line with other studies[19], which have been accomplished in the past years on behalf of the German Ministry for Transport: A study conducted by LUB Consult GmbH, Dresden in 2002 analyses the potentials under the premise of completed river construction measures on the Elbe and Saale rivers. Therein the volume of inland-navigation-affin cargo for the section of the Elbe between the German-Czech border and Magdeburg is quantified to 5.6 million tons. Included are approximately 2.0 million tons for border crossing transports with the Czech Republic and 1.2 million tons for transports on the river Saale. Accordingly, the inland navigation transport potentials on this section are about four times larger than the present quantities (approx. 1.5 million tons in 2002, according to source quoted above).

The traffic prognosis of Prognos AG for 2015, updated in the year 2001, also bases on a completion of the river construction measures around 2008. In this study the inland navigation transport volume for the section Magdeburg-Geesthacht (30 km above Hamburg) is quantified for the year 2015 to 4.6 million tons, which means more than twice as much than the transport volume of the year 2002 on this section (1.9 million tons, according to source above).

3.5 Conclusions

The quality of the infrastructure is one of the main competition factors of IWT, but there are many bottlenecks on several parts of the network. Local bottlenecks can have a major impact, as alternative routes are often not possible because of the limited network density.

Some of the bottlenecks take the form of water level fluctuations causing draught and size restrictions, thus reducing the reliability / utilisation level and efficient navigability. Others, like Seine-Scheldt, are more of a strategic nature. In any case, they influence the efficiency of the whole network and influence modal choice in favour of IWT in a negative way. Clearly, the rather expensive construction of new IWW infrastructure in general will only be considered in exceptional situations and when potentials are obvious and undisputed. Preference might be given to the strengthening of existing waterways or sections respectively.

The effects of resolving major missing links and the removal of severe bottlenecks are described in three cases.

---

[19] Quoted in: “Die Elbe – Eine unverzichtbare Wasserstraße”, Position paper related to the stop of construction measures on the river Elbe, Verein zur Förderung des Elbstromgebietes e.V., Hamburg, 2003.

The Seine-Scheldt project represents a missing link of strategic nature (long-term, large construction works), whereas the Danube and Elbe projects represent studies to improve navigability on relatively short-term to mid-term by means of low-water regulation.

The first case is the ***Seine-Scheldt.*** Recently the decision has been taken to realise the large scale upgrading of the Seine-Scheldt. Reasons to carry out the project include:

- The connection of France into the IWT networks of Belgium and the Netherlands and between Paris and major European core areas
- Extra IWT opportunities are opened (in particular for container transport and chemicals)
- IWT can play an extra role in transport and therefor lessen (growth in) road transport. IWT could give a considerable contribution to the internal accessibility of the north-south corridor.
- The connection would give an answer to several main logistics trends (intermodal transport, containerisation, volume growth, scale enlargement, internationalisation etc.)
- The connection could give a more balanced spatial-economic development. This is highly attractive on the regional level.

The second case is the ***Upper Danube***. Some stretches of the Upper Danube are typified by insufficient and strongly fluctuating water levels. There are four major bottlenecks that need to be improved: Straubing-Vilshofen (Germany), Melk-Dürnstein (Austria), Vienna-Bratislava (Austria), Gabcikovo-Budapest (Hungary). The bottlenecks limit the cost-efficiency of inland navigation.

Sufficient fairway conditions on the Upper Danube (2.5m draught measured against LNRL) have following macro-economic benefits:

- Savings on investments in the road system
- Savings on external costs of transport:
    - Reduction of accident costs
    - Reduction of congestion costs
    - Reduction of CO2-emissions (Kyoto-objective)
    - Reduction of noise
    - Reduction of space consumption

Another case is the ***Elbe river.*** The deficits of the waterway infrastructure of the Elbe river consist in particular insufficient draughts and intensive water level fluctuations. If existing infrastructure bottlenecks would be eliminated the potentials are high. According to the results of the enterprise questioning the inland navigation transport volume on the river Elbe and the adjacent waterways could be more than doubled up to the year 2010. If the minimum standards would not be realised:

- The hinterland connection of the port of Hamburg would be impaired
- It would be questionable, if rail and road capacities would be sufficient against the background of increasing transport demand

- The intermodal competition and its “disciplinary” effects on prices of road and railway transport would remain quite limited and
- The economic development of the corridor as well as the connection of the acceding Czech Republic to the EU-core area would be affected.

In almost all cases, missing links and bottlenecks tend to increase overall transport costs, the reduction of which would be a benefit for a specific project. As already noted, however, the objective of the PINE project was not to provide new cost-benefit analyses for IWT projects. We believe this to be a difficult undertaking which may require new insights, because the range of benefits of potential improvements should in our view be extended. For example they should include indirect impacts on other modes, environmental effects on various scale levels, and economic effects e.g. on the logistics sector. On the costs side, one has to take into account that waterways have more than a navigation function. In that context we would point out an overall (political) vision on the total EU-27 waterway network has not yet been compiled. Sometimes the TEN-T network is proposed for this. The TEN-T network with its list of priority projects, although valuable, cannot function as a framework to take such decisions at European level.

Our impression is that a Strategic Masterplan might very well be needed to create an overall vision, and that in parallel, combining top-down with bottom up, individual Cost/Benefit analyses should be carried out on individual projects. These should also take into account the infrastructure quality of the competing modes corresponding improvement of the infrastructure in ports and transhipment sites as well as the respective road and rail connections in the hinterland of the inland ports.

3.6 References

1. “Die Elbe – eine unverzichtbare Wasserstraße”; position paper related to the stop of construction measures on the river Elbe, Verein zur Förderung des Elbstromgebietes e.V., Hamburg 2003

2. “Die Elbe – Bindeglied für den Europäischen Verkehrsraum”, report of the working group Mittelelbe / authority for economy and labour of the “Freie und Hansestadt Hamburg”, Hamburg April 2003

3. Verein zur Förderung des Elbstromgebietes e.V.

Chapter 4 Smaller waterways

4.1 Introduction

This section treats the potential of smaller waterways. It therefore contains a particular position in the overall PINE structure. In this chapter the importance of sizes, volumes, scales plays a different role. The central focus is on the following topic: Small Waterways of the EU25, and their current and future utilisation: possibilities and impossibilities.

Following this, the emphasis is less on large-scale infrastructure and operations, large transport volumes, important links. The feasibility of IWT operations remains an essential aspect but on a lower scale. A further point is that, apart from IWT operations, also other uses of the waterways are part of the picture.

The report has the following structure:

- Section 4.3 takes a broad, general focus. It starts with some definitions and subsequently treats use and role of SWWs, including examples of SWWs and SWW systems that exist in Europe, building on experience of the Supply Part;
- Section 4.4 describes various characteristics of Small waterways, influencing their current use and modal shift potentials;
- Section 4.5 draws conclusions on the general level.

4.2 Method of Working

This chapter has been made up of study of existing sources. Especially dedicated studies from Flanders and the Netherlands about (respectively) small waterways and small ships have been used (see literature overview). Also, maps and overviews of the situation in Europe were studied such as the Infrastructure chapter of the Supply Part of this study and a map ‘Mitteleuropäische Wasserstraßen-Karte’.

Furthermore, limited team analysis was carried out.

4.3 Definitions

A clear distinction between large (or ‘important’) waterways and small waterways has been given as part of the Infrastructure chapter of the Supply Part of this study. The CEMT classification method is leading. To start with, all waterways of international importance (CEMT class IV and up) are taken into account. Waterways of lower classes are only taken into the analysis if of regional importance, especially if there are no links of higher classes in this region. Fundamentally, in a study on the pan-European level, all WWs of class I, II and III would have to be included. Clearly this has not been feasible, in the Infrastructure chapter of the Supply Part of this study nor in this part of the project.

Exhaustive sources mapping all navigable waterways are not available on the European level, but do exist on the (European) regional or country level. An example is the INTERREG IIc project ‘Sustainable Canal Restoration’. As part of this, detailed maps were made of the area comprised by the Netherlands, Belgium, the British Isles, Northwestern Germany and Northern France (NWMA). Other examples include management authorities such as British Waterways for England and Voies Navigables de France publishing fine maps and overviews for recreational use.

For the PINE project, as well as generally on the European level, it seems useful to introduce a lower border for commercial IWT. We will put this at the class-0 waterways, meaning that we classify category I, II and III as Small Waterways. The following arguments point into this direction:

- Small ships have a lower loading coefficient, meaning the loading capacity cannot be used to its full extent.
- With small ships, it is more difficult to cover operating costs. The exploitation costs have to be covered with fewer revenues, which are limited anyway because of the low transport rates in IWT. Some sources even argue that it has become impossible to efficiently (i.e. covering costs) operate a Peniche (Spits) vessel which can sail on Class I waterways. For Class 0 an even smaller ship would be needed.
- Very few small ships are built nowadays. For quite a long time no small ships were built at all, but since a few years, in the Netherlands, the Neo-Kemp ships are being built, representing a new market. If there are few modern small ships there is not much function for the SWWs.
- The logistic efficiency of small ships is limited because of their typical loading capacity, which is too large for most firms currently working with trucks, and too low to gain scale advantages in the general / common IWT market.
- Class 0 waterways have limited technical specifications and it is questionable to what extent it can be taken as a network, as the higher-class waterways.
- The current IWT utilisation of the smallest waterways is moderate, to very low. This goes for the Class-I waterways, but especially for the Class 0 waterways. In many cases there is a more important function for recreational uses, which can, but not always do combine well with intensive commercial goods transport.

These arguments can also be used as arguments to keep a realistic view on the use of SWWs for commercial transport. This will continue to play a role in this part of the study.

Principally, this analysis will limit itself to the navigable Waterways officially classified as CEMT Class I, II and III as well as those navigable waterways, unclassified but comparable to these waterways in dimension. The systems that are taken into consideration will be explained later. Statistics reveal that in the main IWT countries Belgium, the Netherlands, Germany and France, a significant or even large part of the network belongs to this category.

Country	**Total length of Small Waterways**	**Percentage of total IWW infrastructure**
Belgium	596	39%
The Netherlands	1802	36%
Germany	1613	25%
France	6250	74%
Total	10261	48%

Table 15. Total length of small waterways
Source: AVV,1999

In this analysis a main emphasis lies on commercial navigation. However, because of the importance of recreational navigation, this will be involved more than in other parts of the study, though still in a limited way.

With small ships we mean ships with a maximum length of 73m. and a dead-weight of 1000 tonnes. The following table indicates, for the same countries, those portions of the fleet that can sail on the small waterways.

Country	**Total amount of small ships**	**Percentage of total fleet**
Belgium	1183	26%
The Netherlands	1850	41%
Germany	636	8%
France	1108	25%
Total	4504	25%

Table 16. Total fleet, active in 1999, under 1000 tonnes / below 73m.
Source: IVR, 1999

Figure 24. A Class-II container ship (Tilburg Container Terminal) on its way to the Rotterdam seaport
Source: AVV 1999

Because of the scale enlargements in the fleets the percentage of small ships has been decreasing during the last decade. This is expected to continue.

4.4 Occurrence of small waterways

The following table summarises the SWWs that can be found in the EU25, as well as a rough estimation of their current use. Note that in some cases there are small fragments of higher-class waterways with Class I, II and III. These have not been listed, as well as Class-0 and higher-class IWWs. For any further details we refer to the Infrastructure chapter of the Supply Part of this study and its Annex.

Country / region	What rivers / canals / (sub)system of SWW	Current use
Netherlands	Channels in south (Class II): Noord-Brabant	Commercial: considerable, for class 1 low or negligible Recreational: considerable
	Channels in west (Class I, II, III): Noord-Holland, Zuid-Holland, Utrecht, Flevoland	Commercial: considerable, for class 1 low or negligible Recreational: considerable
	Channels in east (Class I, II): Gelderland, Overijssel	Commercial: considerable, for class 1 low or negligible Recreational: considerable
	Channels in north (Class I, II): Friesland, Groningen, Drenthe	Commercial: considerable, for class 1 low or negligible Recreational: considerable
Belgium	IJzer basin (Class I): West-Vlaanderen	Commercial: considerable, for class 1 low or negligible Recreational: considerable
	Canals in Central-Belgium (Class I, II): Oost-Vlaanderen, Antwerpen, Vlaams Brabant, Brabant Wallon	Commercial: considerable, for class 1 low or negligible Recreational: considerable
	Campine canals (Class II): Antwerpen, Limburg	Commercial: considerable, for class 1 low or negligible Recreational: considerable
France	Northern French canals (Class I, II)	Commercial: moderate Recreational:
	South of France: Inland part of Loire (Class I) and between Paris / Montreau and Lyon (Class I, II)	Commercial: negligible Recreational: ?
Germany	North-east (Brandenburg, Mecklenburg-Vorpommern; Class I) and Spree-Oder Canal (class II)	Commercial: Considerable Recreational:
Italy	Limited (unclassified) waterways (Valle di Padana)	Commercial: none Recreational: moderate
United	Caledonian Canal (Scotland), canals upstream from Goole (Northern England), parts of Severn	Commercial: limited

Country / region	What rivers / canals / (sub)system of SWW	Current use
Kingdom	and Trent	Recreational: considerable
Poland	Oder, Wisla, Oder-Wisla Canal (Class I, II, III)	Commercial: negligible to limited (seasons) Recreational: idem
Danube basin	(Parts of) tributaries to Danube in Austria, Hungary, Romania (class I, II, III)	Commercial: negligible Recreational: negligible
Lithuania	Part of Nemunas river up to Kaunas (Class III)	Commercial: limited (seasons) Recreational: ?
Iberian Peninsula	Parts of Ebro, Tejo (Class I)	Commercial: negligible Recreational: moderate

Table 17. Small waterway (systems) in the EU25

In summary, the following main types can be defined:

- Small waterways in the high-profile countries NL, B, F and D (Rhine and north-south corridor), having connections to higher-class waterways, with limited to considerable commercial use and intensive recreational use. Compared to other parts of Europe utilisation is rather high. It generally varies with the ECMT classes: class III can get rather high, class I low to negligible.
- Tributary waterways in the east-west and Danube corridors, with fairly to very low commercial utilisation
- Non-connected waterways in mid- or low profile countries like the UK and Sweden (almost) exclusively used by recreational craft.

4.5 Characteristics

4.5.1 Introduction

Small Waterways have a number of specific characteristics that will be explained in this section. These characteristics can then be used as criteria to determine the possibilities for utilisation for commercial transport, as well as their potential to generate growth. The characteristics will be described divided in three domains:

- Characteristics of the waterways themselves
- Characteristics of their situation
- Characteristics of their current use

This ‘trio’ was not coincidentally chosen as it represents supply, demand and the coming together of supply and demand.

In this and the following sections, SWWs will be described either as a single waterway, or as a system. Systems of small waterways consist of interconnected links in the same region, that can functionally be taken together and has comparable characteristics and functional aspects.

4.5.2 Characteristics of the waterways

Scale

An essential fact is that SWWs have limited dimensions, putting limitations to the types of ships that can use them. This lies in the dimensions of the fairway itself (breadth, draught, height of bridges) and its locks (and in some cases, ship elevation systems). In special cases it might be possible for push-barge combinations to use SWWs with locks in which only parts of the combination fits. The combination is split up before, and put back together after passing the lock. Experiments for this have in 2003 been carried out on canals in the South of the Netherlands. However, in most cases the limitations carry a ‘hard’ character, which means that larger ships cannot enter and small ships are needed. Scale is measured in the CEMT class and there are thus 3 types of SWWs: I, II and III.

Ports and transhipment points

A waterway without ports and other transhipment points cannot be used for commercial transport. This plays a rather high role with the potentials of small waterways because of the competition with road transport. A Belgian source argues that in the bulk sector, SWWs can only be used if the companies are directly located on the waterway. In other words, the smaller the waterway, the more difficult it becomes to use a regional bulk terminal (like the ones in the Netherlands). The extra transhipment movement heavily influencing the overall cost picture plays a larger role than with higher-category waterways. This point shows coherence with the economic location, to be treated further on.

Locks

Small waterways are often canals and canals need locks. Locks, as well as other devices like ship elevators, determine much of the limitations for the ship that uses the waterway, as well as its efficiency. There are class-I canals in France featuring as much as 40 lock in 60km of waterway and it is clear that this heavily influences their competitiveness with road or rail.

Touching on recreation, ship elevators can, in contrast, add recreational value. This is illustrated below. To the left, there are the old ship elevators of the Belgian Canal du Centre, and to the right its recently opened bypass for commercial IWT at Strépy-Thieu.

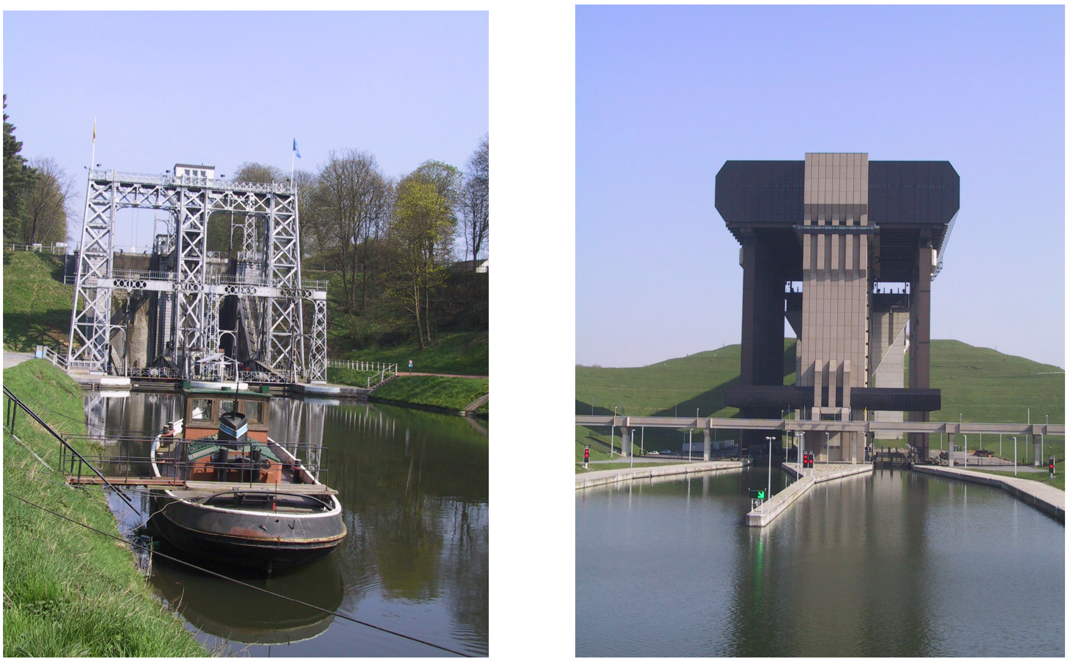


Figure 25. 150 years of Belgian ship elevation technology
Source: IMMUNITY

Season-related influences

Many regions in Europe feature rivers and canals that are unusable for a large part of the year because of freezing. For small Waterways this is especially the case for Poland and Lithuania. This involves a considerable decrease of attractiveness, as logistics chains do not reckon with reduced reliability or even closure of a waterway in wintertime.

Figure 26. Birmingham: Grand Union Canal
Source: http://www.virtualbrum.co.uk/images/canals/iwe11.jpg

4.5.3 Characteristics of waterways' situation

Isolated ↔ Integrated

A second characteristic concerns the integration of small waterways in the International network of IWWs. They can be directly connected, connected by a sea route, or isolated.

Integrated	It has been described before that a part of Europe is covered with a fine network of IWWs of which a considerable portion has a CEMT classification lower than IV. Most of these SWWs are more or less directly connected to higher-category waterways. Much of the transport on SWWs consists of ships to and from these larger waterways.
Isolated by sea	PINE has already paid attention to isolated IWWs in countries like Spain, Portugal and the UK. Many small waterways are isolated from the European higher-category waterways, but in such a way that vessels

would have to be seaworthy to make the connection. Clearly these ships cannot be called ‘small ships’. River-sea navigation and shortsea are because of the maritime character left out of the analysis.

Isolated However, there are also portions that are not connected at all to Europe’s international system of IWWs. The transport on these waterways is limited to local transport since ships cannot reach the larger waterways.

Companies with IWT affinity close-by

A last criterion in this category has to do with the economic structure of the region. The concept of IWT ‘affinity’ was used in WP 4 and we have concluded that, despite huge variation, for several sectors IWT is really a viable alternative. If the economic structure of a region is such that there are no companies (or not enough companies) showing that profile than IWT will in principle not be interesting for the regional economy, and thus not develop potential for a modal shift.

Core economic area ↔ periphery

One of the main prerequisites for transport flows in the first place is economic activity, which generates all demand for transport. An important criterion influencing the perspectives of SWWs is thus their ***spatial-economic location,*** and vicinity to economic activities, determining the extent to which it forms useful infrastructure for these economic activities. This is of course a highly dynamic phenomenon. The economic importance of small waterways, and a location on one of them, will never reach the level of the 18th and 19th century. The figure below provides a way to define ‘economic core areas’ in Europe, derived from EC sources.

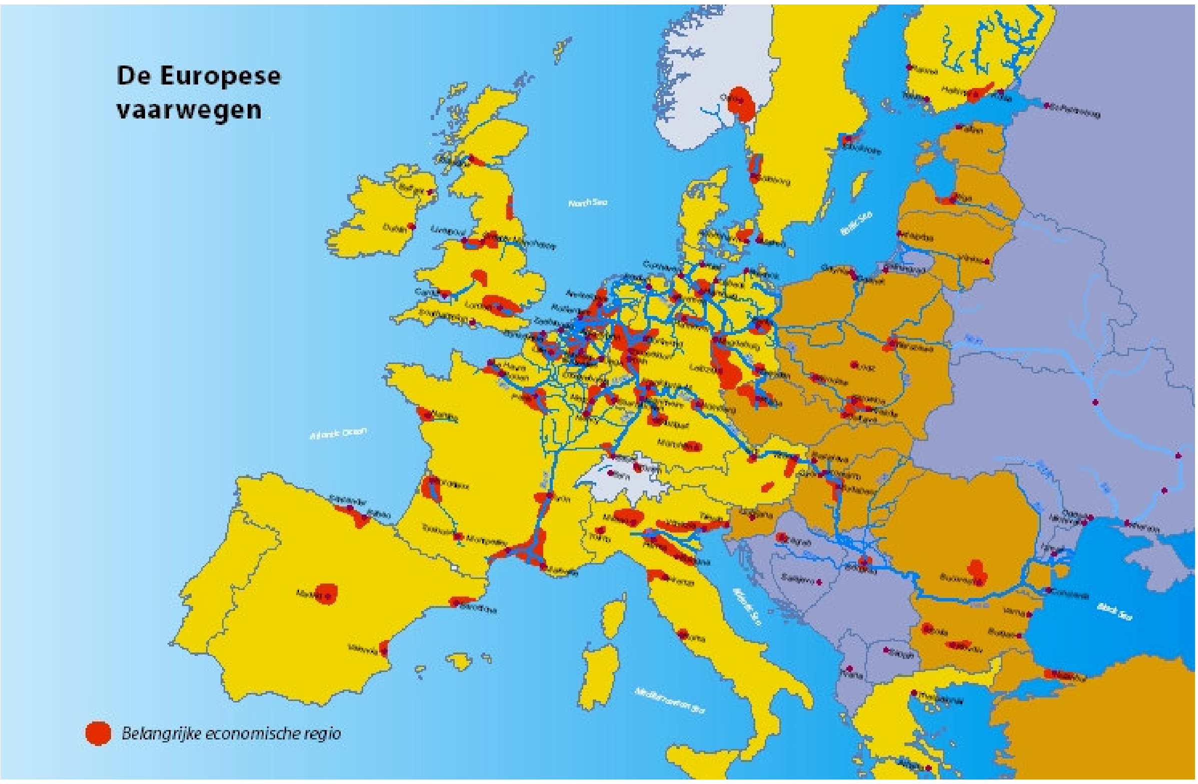


Figure 27. Main economic regions in Europe versus IWT infrastructure
Source: http://www.europa.eu.int/comm/transport/iw/nl/site_map_nl.htm

Congestion and the role of rail transport

Part D Modes and competition has treated how congestion on the road network has in many cases boosted modal shift from road to rail and IWT. A heavily congested road network has the tendency to make IWT a logical choice, even though its cost-efficiency might not be the strongest argument to do so. But let us not forget the ability of rail transport to solve that problem as well. In conclusion, a congested regional road network is a push factor that makes especially small waterways a more attractive modality. But if there is a well-developed rail network than this advantage can be reduced or even nullified.

4.5.4 Characteristics relating to small waterways' use

Current use for goods transport

Current use gives a 'good example'. Companies in the area see that the waterway is being used, actors outside are informed through media. If the SWW features negligible or no use for commercial IWT, then it will be more difficult to realise a modal shift.

Maintenance and management

To professionally use small waterways requires maintenance and management of the waterway. As the use of, especially, small waterways have been declining for decades, in many instances countries have been economising on maintenance and management. Utilisation for commercial transport would involve renewed investment in the navigability of these waterways, and thus considerable costs with unsure coverage. Of course this depends on policies that authorities have had during the time of reduced utilisation. The tradition of IWT in the country or the region also plays a role. Just as well, there are probably numerous waterways that can easily be taken back into use right away.

Recreational navigation

Figure 28. The Göta canal in Sweden: one of the nation's main tourist attractions source: www.ljungsbro.nu/.../ sev%C3%A4rdheter_main.htm

The role of recreational navigation was already touched upon. In some parts of Europe this is a considerable sector of tourism, connected to the local and regional economy, the scenery and the availability of waterways. Many sources argue that a peaceful coexistence is in many cases very well possible, something that was e.g. studied as part of the IMMUNITY project. But the smaller waterways get, the higher the chance is to reach conflict situations, possibly leading to accidents. A main factor is the extended nature of recreation on waterways, which can include anything from motor or sailing boats to jet-skis, rowing boats, canoes and wind-surfboards. In the Netherlands, in some instants authorities are attempting to introduce parallel routes of the main waterways, also with standing mast, to reduce potential conflicts with commercial users of the larger waterways. In fact this would mean that the commercial sector would abandon the SWW as a matter of decision.

4.5.5 Impacts on modal shift potential

We have looked at factors contributing to potential use of Small Waterways, as well as the current use of small waterways (systems) throughout Europe. This section will assess the characteristics as to their importance for current utilisation and modal shift potential.

Characteristics			Importance for current utilisation	Importance in determination of modal shift potential
small waterways	A	Scale	++	+++
	B	Ports and transhipment points	+++	++
	C	Locks	+++	++
	D	Season-related influences	+++	++
their situation	E	Network: Isolated ↔ Integrated	+++	+++
	F	Core economic area ↔ periphery	++	+++
	G	Companies with IWT affinity close-by	+++	+++
	H	Congestion and the role of rail transport	0	+++
their current utilisation	I	Current use for goods transport	-	+
	J	Maintenance and management	-	++
	K	Recreational navigation	-	+

Table 18. Characteristics overview

The table above recapitulates the characteristics as well as an estimation of their importance to develop modal shift potential.

Clearly, detailed analyses of the various individual small waterways or systems of SWWs will reveal the possibilities they offer for modal shift. Such studies, which stand outside the PINE project, would have to look at all of the aspects named in this chapter, determine their importance, draw conclusions and recommendations for that individual case. They will have to take into account all aspects named, of which economic location, companies and port / transhipment sites and the role of road congestion deserve due attention.

4.6 Conclusions

The considerable potential of IWT as a mode, on the pan-European level, (quite literary) narrows down with the scale on which it takes place. This has to do with main characteristics of logistics, including the basic trend of scale enlargement.

This points into the direction of ***not to have too much expectations*** of the abilities of small waterways to solve the problems that higher-scale waterways can solve.

Having realistic expectations of the function of small waterways has several dimensions. First and foremost we have to reckon with the fact that Inland waterway transport owes a great deal of its success to economies of scale and scale enlargement. ***These scale-related advantages of higher-scale IWT, can only in a limited way be transferred to small waterways.*** The same goes for the additional facilities needed, e.g. ports and transhipment points.

With the disadvantages of IWT, one makes the same observation. For example, the main drawback of IWT is the fact that in many cases an additional transhipment movement and / or pre- and endhaulage is needed. This weighs heavily on the cost of the overall transport chain. In the case of SWWs, the cost advantage is already of a thin nature because of the operational cost factors.

The reasons for the past (and, partially, ongoing) decline of small waterways are not easily outstripped, or neutralised, by recent developments boosting IWT on SWWs. Examples include locks and the role of seasonal influences. Aspects like these strongly contribute to inefficiency, making IWT less interesting as a transport modality.

Congestion on the road network plays a main role in modal shift to inland navigation. During the past decade it has made many industries switch to inland waterway transport. As it is more difficult to operate small ships on an efficient (or even cost-covering) basis one could argue that more congestion is needed to make modal shift worthwhile, than in the case of large-scale IWT.

In this part of the PINE project we have shown that a part of the small waterways (systems) will surely be able to contribute to IWT as an attractive modality. As a whole, there is certainly a potential albeit on a modest scale. However, to determine the true perspectives for individual links / systems, individual studies should be carried out to check the link(s) as to indicators and characteristics as identified in this chapter.

4.7 References

1. Mitteleuropäische Wasserstraßen-Karte (Inland Waterways Map). Binnenschifffahrts-Verlag GmbH Duisburg-Ruhrort.

2. Resource Analysis, Technum, Ecory, KU Leuven (2002), Studie naar de ontwikkelings-mogelijkheden van de kleine waterwegen in Vlaanderen inzake Scheepvaart (studie into the navigation possibilities of small waterways in Flanders, by Commission of Vlaams overlegplatform van waterwegbeheerders). Antwerpen: Resource Analysis

3. Buck Consultants International / iris consulting, (2002), Onderzoek in de regio Haacht-Herent-Leuven naar een bedrijvenzone voor zand, grind en aanverwante bouwmaterialen (study in the Haacht-Herent-Leuven region into an industrial area for sand, gravel and related building materials). Brussels: BCI

4. Adviesdienst Verkeer en Vervoer, Directoraat-Generaal Rijkswaterstaat, Ministerie van verkeer en Waterstaat (1999), Toekomstperspectief kleine schepen (future perspectives of small ships). Rotterdam: AVV

5. Adviesdienst Verkeer en Vervoer, Directoraat-Generaal Rijkswaterstaat, Ministerie van verkeer en Waterstaat (1999) Vaarwegen in Nederland.

PINE

Prospects of Inland Navigation within the enlarged Europe

Part F SWOT analyses

Buck Consultants International (The Netherlands)

ProgTrans (Switzerland)

VBD European Development Centre for Inland and Coastal Navigation (Germany)

via donau (Austria)

March 2004

Contents

Chapter 1 Introduction

This part of the PINE Full Final Report contains the SWOT analyses produced as part of the PINE project. Presenting the SWOT analysis is the most efficient way of covering the PINE main findings. This has subsequently been worked out resulting in the conclusions and recommendations in the Final Concise Report (FCR).

In this part we define the strengths, weaknesses, opportunities and threats of inland waterway transport (IWT) systems in Europe, based on the findings and results of the first five Work Packages. The enlargement of the European Union is specifically treated because it will significantly influence the IWT policies of the Commission. The accession countries' IWT infrastructure will provide additional potential for the mode both nationally and internationally.

The following division has been made:

- Supply:
  - Enterprises
  - Human resources
  - Fleets
  - Infrastructure
  - Ports
- Demand: goods categories and logistics chains
- Policy and legislation
- Modes and competition: intermodal and intramodal competition

Each chapter starts with a compact SWOT table. Explaining text sections, in which the strengths, weaknesses, opportunities and threats are further explained, follow it. Throughout the project, one of the main findings is the considerable ***internal variety*** of situations in Inland navigation. This complicates the drawing of straightforward (system-wide and Europe-wide) conclusions. Examples are indicated here by using straight brackets [ ].

Chapter 2 Enterprises

This section deals about enterprises with commercial and economic topics, as well as technical knowledge, the market etc.

Strengths	Weaknesses
- High entrepreneurship and commitment within IWT enterprises	- Many 'one vessel companies' in EU-15, limited supply chain integration - Former state-owned or socialist enterprises have limited market orientation.
Opportunities	**Threats**
- Supply-chain integration and long-term transport contracts - Technical and organisational innovations - Development of a benchmarking system for inland navigation enterprises (including uniform statistical information)	- Differences in the cost structures between western and eastern companies

Figure 1. Enterprises: strengths, weaknesses, opportunities and threats

Strengths

A strength of the European IWT enterprises is linked to the small scale of the companies, generally being characterised by a high degree of entrepreneurship. They are able to offer low prices because of the family character of the enterprise.

Weaknesses

In the main IWT countries of the EU-15, there is a relatively high share of IWT companies with only one vessel (75 – 90%). These 'one-vessel companies' operate in several cases for the same client all year round, but are nevertheless rather vulnerable to price and demand fluctuations.

Fleets of the ***Accession Countries*** used to be owned by large (and often Monopoly) State owned companies. Sometimes the successors of these companies tend to have a limited market orientation.

Opportunities

If a considerable part of the IWT enterprises all over Europe would actively take up logistics trends such as supply chain integration then existing modal shift trends could be sped up. The practice of long-term contracting is already commonplace but should take these innovations into account, in order to encourage the enterprises to further invest in special equipment or specialised / dedicated vessels and thereby realise further cost savings or cover further market niches (e.g. non-stackable swap-bodies).

An opportunity would be the development of a benchmarking system for small inland navigation enterprises (Source: Planco 2003). As part of this the development of a uniform statistical database is crucial.

Figure 2. Large-scale bulk transport
Source : via donau

Threats

Limited differences may continue in the cost structures between western and eastern companies, due (for example) to lower personnel costs of eastern companies and therefore affecting intramodal competition. After a transition period, cost structures will probably align.

Chapter 3 Human Resources

For safe and reliable operation, the availability of well-educated and trained personnel in suitable numbers is crucial.

Strengths	Weaknesses
● Good vocational education/ training ● Good general level of qualification ● Lower personnel costs in East than West (at the same time partly threat for Western companies)	● Lack of national personnel ● Limited harmonisation on social standards ● Shortcomings concerning the knowledge of foreign languages, foreign waterways and economic aspects
Opportunities	**Threats**
● Recruitment of staff from accession (and 3rd) countries ● Reduction in demand for personnel ● Harmonisation of education and improvement of safety/ communication ● Development of sustainable and durable incentives for the employees ● Creation of reliable employment databases	● Lack of personnel ● Lack of harmonisation hinders mutual recognition of river patents

Figure 3. Human resources: strengths, weaknesses, opportunities and threats

Strengths

In general there is a good vocational education / training and good level of qualification within the different qualification degrees of the sector.

In the ***Accession Countries***, personnel costs are (at present) lower than in the West. Despite the fact that this could change, within the EU-25 this could be seen as a threat for the western-European enterprises.

Weaknesses

Currently, there is a lack of nautical personnel, especially in western countries. Therefore, western countries hire personnel from accession countries, but these foreign personnel often have to deal with social problems like social isolation, a low level of social insurance etc. The overall decline of IWT personnel indicates that this could affect the acceding countries as well, especially in the future.

A clear weakness is the unfinished harmonisation of social standards, particularly in the light of the shortage of personnel noted above. This can lead to unacceptable labour circumstances, weakening the sector as a whole.

Against the background of further interactions and traffic exchange between esp. the Danube and Rhine basins, problems could arise with regard to the knowledge of foreign languages and foreign waterways as well as (in all corridors) economic aspects (and in some cases EDP).

Opportunities

At the moment there is a shortage of IWT personnel in the west (opportunity and threat). The lack of personnel might become a bottleneck and hinder the development of inland navigation potential. Possibilities for enlargement of personnel supply can be found in:

- Further migration of personnel from accession countries as well as from third countries such as Russia, Ukraine and Belarus to the present and the future EU-member states
- ‘Side access’ of personnel from other branches to inland navigation, as well as promotion and recruitment, further training and education of young people for example on the lines of the German ‘abi’ programme[1].

Personnel shortage may also be overcome by lower demand for personnel as a result of:

- Further automation of tasks on board
- Larger ship units with in the average lower demand of personnel per cargo unit
- Harmonisation of manning rules in the enlarged EU: in the Accession Countries implementation of these rules will lower personnel demand because of the operation mode being conformed to the EU standard (In the CEEC countries the amount of crew per ship used to be rather high).

A further possibility for the shortage is to develop sustainable incentives for the employees to enter and remain in the sector. This could be done through improved working conditions and salary.

---

[1] Ausbildungsinitiative Binnenschiffahrt (Education Initiative Inland Navigation); a German co-operative IWT education programme

A Europe-wide harmonisation of education requirements and training standards could lead to improved safety and communications (opportunity and threat). This could be done by:

- Education in traffic safety, foreign languages and foreign waterways allows mobility and migration.
- Definition of standards for inland navigation related international communication (e.g. corridor related Inland Navigation codes or '-languages')
- International exchange programs for trainees
- Improvement of economic education and knowledge, e.g. in co-operation with the forwarding and logistic sector
- Development of special education programmes for employees from foreign countries
- Development of special education programmes for employees from other branches
- Development, installation and frequent updating of a reliable database to include employment statistics would help policy makers to tackle human resource problems in IWT.

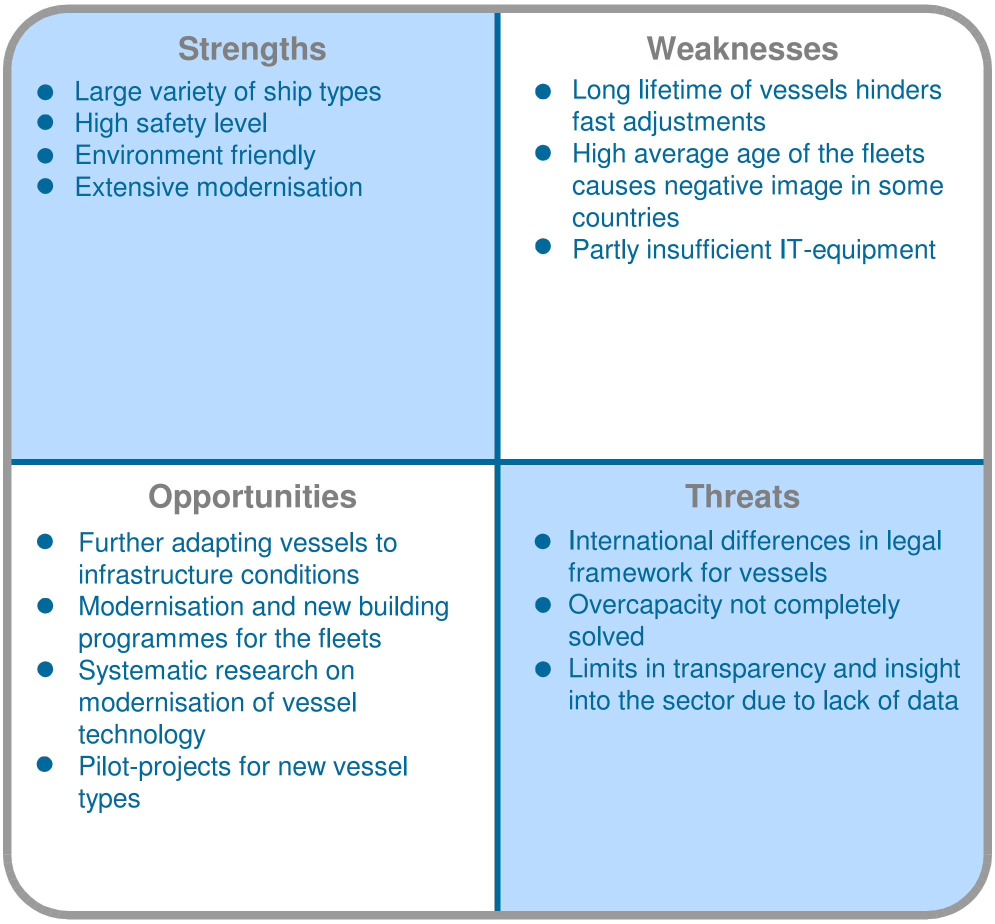
Threats

If the lack of personnel continues (and / or even grows), than this will further complicate the development of the sector as a whole.

Lack of harmonisation in the field of education and qualification hinders the mutual recognition of boatmasters licenses and river patents.

Chapter 4 Fleets

The vessels are part of the system of inland navigation; they are the means of transportation, the ‘driving units’.



Strengths

- Large variety of ship types
- High safety level
- Environment friendly
- Extensive modernisation

Weaknesses

- Long lifetime of vessels hinders fast adjustments
- High average age of the fleets causes negative image in some countries
- Partly insufficient IT-equipment

Opportunities

- Further adapting vessels to infrastructure conditions
- Modernisation and new building programmes for the fleets
- Systematic research on modernisation of vessel technology
- Pilot-projects for new vessel types

Threats

- International differences in legal framework for vessels
- Overcapacity not completely solved
- Limits in transparency and insight into the sector due to lack of data

Figure 4. Fleet: strengths, weaknesses, opportunities and threats

Strengths

Especially on the Rhine, there is a large variety of ship types. The Rhine (and partly also the Seine and Rhone) fleets as well as the Rhine Inspection Regulation (‘RheinSchiffsUntersuchungsOrdnung’ or RheinSchUO) have ‘pathfinder’ or exemplary functions.

IWT has a high safety level and enables environment friendly transport.

Many ships have undergone extended modernisation measures, including ICT equipment.

Weaknesses

The rather long lifetime of vessels hinders fast adjustments. This refers to both size and the adoption of innovative measures and brings disadvantages in competing with other modes, especially trucks (which have a much shorter life). Related to this is the high average age of the fleets. In some countries, e.g. Germany, this causes a negative impact on the image of the modality despite (normally undertaken) modernisation measures.

Another weakness is the inadequate IT-equipment on board of the vessels although the situation has improved during recent years [especially in the Rhine corridor].

Especially for the ***Accession Countries***, lack of compliance with the technical standards required in a foreign corridor or waterway may prohibit operation on these waterways, [particularly on the Rhine]. Lack of information prohibits posing exact figures for all Accession Countries.

Opportunities

Due to limited financial means, infrastructure problems will probably stay in place. In such circumstances, a targeted adaptation of the vessels to the existing infrastructure conditions might strengthen the competitive position of inland navigation (at the same time opportunity and threat).

Shortcomings will arise in the fields of modernisation of the fleets and adaptation to market requirements, due to potential lack of financial means and limited research activities. Targeted financial support could speed up modernisation and systematic research activities on fleet modernisation could strengthen and support the process. Further, selling depreciated (western) vessels to accession countries can open up opportunities for adaptation of the fleets to market requirements (lack of self propelled vessels in the Danube corridor).

As noted in the Planco Report (2003), support for innovative and user-oriented pilot projects in the field of inland navigation could help to develop IWT potential.

Threats

A threat in this respect could be posed by the international differences in legal framework, e.g. regarding to technical and safety standards. Between member states, including Accession States, boatmaster certificates based on Directive 96/50 are mutually recognised. Nevertheless the Rhine regime has in this case not adopted recognition.

There are shortcomings in the fields of modernisation of the fleets and adaptation to market requirements due to potential lack of financial means and limited research activities (at the same time opportunity and threat). The overcapacity issue has not been solved 100%, however the internal variance hinders the extent to which reliable figures can be given.

Lastly, the transparency of the sector and insight into its problems are limited because of a continuing shortage of reliable and comparable fleet data in most of the countries.

Chapter 5 Infrastructure

The inland navigation system's networks and infrastructure comprise waterways, locks, bridges and other structures relevant to the navigation process.

The infrastructure, however, cannot be considered in isolation but must be looked at together with other IWT components, i.e. the enterprises, personnel, know-how, capital, the fleets and the framework conditions in the form of laws, rules and the conditions of competition.

Strengths

- Large capacities of the major waterways
- Good hinterland links

Weaknesses

- Low density of the network in connection with missing links between major waterways
- Bottlenecks limiting seamless transport and ships capacity utilisation
- Water level fluctuations having impacts on reliability and ships capacity utilisation

Opportunities

- Elimination of infrastructure bottlenecks
- Improvement of the capacity/ quality of the infrastructure
- Successful implementation of RIS

Threats

- Limited financial means / biased prioritisation for maintenance measures
- Environmental policy aims put restrictions on transport infrastructure policies
- Weak co-ordination at pan-European level on the improvement of network
- Continued infrastructure limits and bottlenecks reducing the potentials of inland navigation

Figure 5. Infrastructure: strengths, weaknesses, opportunities and threats

Strengths

One of the main strengths of IWT compared to other modes is the availability of capacity on major waterways. Where trucks have congestion and railways always have to deal with slots etc. the IWT system has extended free capacities.

Parts of the Enlarged Europe (EU-25) are well endowed with IWW infrastructure: the Netherlands, Belgium and the northern half of Germany covering large parts of the Rhine, the North-South and a good deal of the East West corridors. The infrastructure network offers good links with the hinterland:

- North Sea - Rhine
- Black Sea - Danube
- Western Mediterranean - Rhone

Figure 6. The Danube through Budapest
Source: via donau

Weaknesses

The density of the IWT network is low compared to the road and railway networks. This affects especially the transport of containers and general cargo. These commodity types need pre- or end hauls in order to perform door-to-door services. Companies with bulk cargo like power plants or chemical plants are often located directly at or in close vicinity of waterways.

The low network density is noticeable among others in missing links. There are inadequate or missing links between major waterways:

- Seine - ARA-ports
- Rhine - Rhone
- Seine - Rhone
- Danube - Elbe

Bottlenecks lead to restrictions in the potential size, draught or air draught of vessels and heavily limit the efficiency and competitiveness of inland navigation. These restrictions sometimes apply to stretches, complete waterways or even network segment and are of a strategic nature. In other cases just it concerns bottlenecks of a local nature. Nevertheless, in most of the cases, they extend their influence not only on the respective waterway or waterways sections, but on the whole transport route. The main missing links and bottlenecks have been listed by the UN-ECE Working Party on Inland Water Transport and are displayed elsewhere in this Final Report (Section 5.4 of Supply part (A)).

Difficult or hardly predictable water level fluctuations on a number of free-flowing river stretches, e.g. Elbe, Oder or Danube also have considerable impacts on reliability, as well as on ships capacity utilisation and thus on the costs of waterway transport. Further, large seasonal variations of nautical conditions occur in the eastern part of the East-West Corridor: some severe winters with ice, water depth fluctuations on free-flowing stretches of the Elbe and Oder and occasionally severe floods.

Large non-uniform deviations in nautical conditions also occur in the southeast corridor along particular stretches of the Danube. These can act as bottlenecks and in combination with limited predictability of water levels limit the competitiveness of IWT.

Opportunities

The improvement of capacity and quality of the infrastructure and the elimination of infrastructure bottlenecks would open further opportunities for both larger vessels as well as seamless transports (at the same time opportunity and threat).

Threats

Financial means for waterway improvements such as new construction measures, elimination of bottlenecks or even maintenance are very limited.

In certain cases mutually opposed goals between environment policy and transportation policy and in some cases dominance of former over transportation and economic policy are hindering badly needed waterway improvements, e.g. the strengthening and upgrading of certain German sections of the Elbe and the Danube.

At the European level, efforts to achieve the improvement of the total network are relatively weak. There is hardly any co-ordination on the (pan-) European level, which is needed to get the most out of the network, which crosses many borders. This will continue to put full profit of IWT’s potential on hold.

Chapter 6 Interfaces: ports and transhipment sites

Interfaces are the points where cargo gets on and off the network. Just as the 'line' infrastructure ports and (other) transhipment sites have in this respect a crucial and multi-dimensional function.

Strengths	Weaknesses
● Trimodality of ports ● Recent development of ports to logistic centres	● Uneven density of the ports / transhipment sites
Opportunities	**Threats**
● Concerted and co-ordinated development of ports and interfaces ● Costs reduction for pre- / endhaulage and transhipment by increased efficiency and / or improved technologies ● Continuation and strengthening of logistic activities and developments	● Different levels of ownership and responsibility potentially result in conflicting interests

Figure 7. Interfaces: strengths, weaknesses, opportunities and threats

Strengths

Most of the ports have integrated IWT with road and rail; some of them (on larger waterways) also cater for river-sea-transport.

Ports have developed from mere locations of transhipment to modern ‘logistic centres’ with high added value, especially in the Rhine corridor and the western parts of the East-West and Danube corridors.

Weaknesses

The density of ports is quite uneven, being very high in the Rhine corridor, whereas in other parts of Europe and especially in the accession countries, it tends to be significantly lower. This also goes for transhipment sites (location on the waterway bank used by industrial company or service operator appointed by the company for transhipment of cargoes transported to and from the site by inland vessel).

Opportunities

The continued provision of competitive waterway port infrastructures as well as good local and regional connections with road and rail can help IWT’s potential.

This requires concerted development of ports and interfaces co-ordinated at local / regional level, comprising:

- Promotion and priority of ‘wet’ (trimodal) transhipment sites versus ‘dry’ bimodal sites within the respective planning procedures
- Infra- and suprastructure
- Local road and railway connections as well as
- The resolution of potentially conflicting town and regional planning interests

In the ports it should be possible to reduce the costs for pre- / endhaulage and transhipment by improved technologies and / or increased efficiency.

The continuation and strengthening of the development process of ports to logistic centres will improve the competitiveness of IWT

Threats

In several cases different levels of ‘responsibility’ and planning for ports potentially results in conflicting interests, as regards

- Waterway infrastructure (usually a national responsibility)
- Port infra- and suprastructure (local / regional responsibility)

- Connections to the local and regional road and railway network (local, regional or national)
- Port 'environment' and town planning, usually local responsibility.

In the ***Accession Countries*** the present port infra- and suprastructure as well as logistic and organisational standards are often the result of the former socialist and centrally planned economic systems. They may therefore be insufficiently geared to modern market requirements where 'bottom-up' flexibility plays a more important role.

Chapter 7 Goods categories and logistics chains

This SWOT deals with the goods and economic sectors that use IWT and provide potentials for the future. Goods that do not lend themselves for (cost-effective) IWT have been left out of the analysis.

Strengths

- Potentials of IWT are closely related to IWT network [Belgium,
- The Netherlands and parts of Germany]
- IWT scale advantages will continue
- Big flows of slow-moving goods: balanced development expected

Weaknesses

- Limited knowledge of logistics chains among IWT actors (supply side)
- Limited knowledge of IWT possibilities among shippers (demand side)

Opportunities

- Increasing level of containerisation
- Development of swap bodies Innovative concepts such as floating inventory concept
- Modal shift approach at company level

Accession country related:

- Containerisation perspectives even higher

Threats

- Fast growing economic sectors often road-oriented: low IWT-affinity
- Bad maintenance infrastructure will continue to hamper growth
- Low cost / benefit margins prevent flexibility of sector [or some subsectors]

Accession country related:

- Development of supply in road transport

Figure 8. Goods categories and logistic chains: strengths, weaknesses, opportunities and threats

The potentials of IWT (demand) are closely related to the subjects mentioned before in the supply part. Sometimes supply and demand come together in this SWOT.

Strengths

The potentials of IWT are closely related to the network density and the amount of ports and transhipment sites. In some areas the network penetrates in the economic core areas like in the Rhine corridor. This means that for economic activities IWW is often ‘in the vicinity’. For the other corridors and parts thereof this is less the case.

The IWT sector has been, and still is, working on modernisation and professionalisation. This has led to the substantial growth of container traffic.

A main characteristic of IWT is scale: one ship can transport the load of tens or even hundreds of trucks. Scale enlargement trends to obtain economies of scale and this will continue in various IWT subsectors.

The segments, in which IWT is traditionally strong, like bulk shipments, will perhaps not continue to grow forever, but they will not decline much either.

Weaknesses

IWT potentials are closely related to the possibilities to use the IWW network. For most of the EU-25, it cannot be said that there are IWWs ‘in the vicinity’. Outside the Netherlands, Belgium and the northern half of Germany, the network has a rather low density. The same goes for ports and transhipment points so IWT plays a role of a different nature in most of the EU-25 than in the ‘core IWT areas’.

On the other hand transhipment points do not always guarantee extra use of IWT. The disadvantage of IWT is that in most cases the transhipment costs together with the pre- and end- haulage are too high. Therefore these costs play a decisive role when it comes to the attractiveness of the mode.

The organisational structure of the IWT sector remains a point of concern at sector level and certainly also at the company level. There will always be a large subsector of owner-operators who in some way will have to modernise their companies and operations.

There is a mutual lack of knowledge between supply and demand. On the supply side, many actors in the IWT sector have little knowledge of logistics or supply chains. Apart from the container sector, there is a polarisation between the highly innovative logistics service providers on the one side, and family-based one-ship skippers on the other side. We have not found that these do not modernise at all, but there are huge differences regarding economic and operational efficiency. On the demand side, there is surely also deficient know-how by the shippers on the opportunities that IWT can offer.

Opportunities

The increase of containerisation is very likely to continue in the coming years, and even decades. This gives IWT the opportunity to introduce itself into new economic sectors.

Everything that is put into various sorts of containers can be transported by IWT, as long as there is infrastructure and the haul is sufficiently long. The container sector and IWT will increasingly 'need each other'. Apart from the container sector, there are perspectives for foodstuffs, metal products, chemicals and machinery. Additional IWT markets might be reached by innovative concepts. A main logistics concept that combines well with IWT is floating inventory.

Modal shift gives opportunities at company level. So far, most programmes shift to multimodal transports (Marco Polo programme) of which IWT is just a part. It is a very good sign that the sector, backed by government funding, is working on innovative pilot-type initiatives. This should be strongly supported since it is the beginning of a more extended use of IWT. However, these initiatives remain pilot projects and have to stand on their own feet after some time.

The position of IWT might grow with the idea of the 'chain director' or 'transport integrator'. In future logistics, a main role will be granted to the party who can oversee the logistic chain. Up till now road transport has a strong position in the logistic chain, but this might be possible for IWT as well.

The European Commission is working on 'getting prices right'. A realistic allocation of the real socio-economic costs of goods transport will have to be established for IWT as well. It is expected that this will only slightly raise rates, since IWT energy use, pollution and congestion sensitivity are rather low. For other modes costs will rise more which will enhance the competitive advantage of IWT.

The following opportunities refer to the ***Accession Countries***:

- For the Accession countries the growth of containerisation is even higher since they start at a lower level. This means that there is more to be attained.
- There are more transhipment sites on water available.
- Many of the industries in the Accession countries have a 'bulk character' whereas in the west they have declined in recent decades.

Threats

The competition with other modes will continue. Road transport grows faster than IWT. This has to do with its greater flexibility and logistic trends like just-in-time deliveries. It is difficult for IWT to respond on these developments. The profit margins of IWT operations are already rather low, which means that there will be little room for flexibility in freight rates and services left.

Rail transport is also a serious threat for IWT potentials, especially in traditional (bulk) sectors and the container sector. In the coming years liberalisation will continue, as well as lowering prices and increasing efficiency. Rail shares some comparative advantages with IWT, but is able to combine this with much higher speeds and shorter lead times. Besides, the rail sector seems better able to take an aggressive stand in the market.

Problems with maintenance of the infrastructure will continue to hamper growth. This is the same for other modes, but for IWT the impact on its competitive power is more serious. Since IWW infrastructure is hardly used for passenger transport, its priority rating suffers in the eyes of transport policy makers.

The following threats refer to the ***Accession Countries***:

- In these countries, the rail sector traditionally has a strong status, which gives them a head start
- Road transport is strongly modernising. With its low costs the CEEC road sector can more easily take an aggressive stand offering more flexibility

Chapter 8 Policy and legislation

This SWOT-analysis deals with the objectives of the European Union for creating a liberalised European inland navigation market, and to ensure this market is a fair and free one by harmonising of legislation. The analysis of all categories of legislation (economic, social, fiscal, transport regulations) is at the European level. An important part of these considerations is formed by the consequences of the enlargement of the European Union.

Strengths

- Liberalised transport operations for international traffic, practically full liberalisation by 2007
- Technical and safety requirements for vessels largely harmonised
- Boatmaster's certificates on Rhine and Danube largely harmonised

Weaknesses

- Restrictions on cabotage for 3rd countries.
- EU-technical vessels regulations outdated.
- EU rules on the size and composition of crews incomplete
- Liability regimes not harmonised on an international level
- Insufficient policy attention and financial means for IWT transport infrastructure.

Opportunities

- Clarify legal situation on the Danube in future revision of the Belgrade Convention
- Update EU-Directive on technical and safety requirements for vessels
- Progress by CCNR and the Danube Commission in recognising boatmaster licences

Threats

- Possible unfair competition following the liberalisation of cabotage
- No final settlement of the problem of working time
- Lack of internationally harmonised liability regimes causes unnecessary litigation and excessive insurance costs.

Figure 9. Policy and legislation: strengths, weaknesses, opportunities and threats

Per category (wherever relevant), a subdivision is made into the following topics:

- Transport rights and market access;
- Technical and safety requirements for vessels;
- Manning requirements and social standards;
- Boatmaster's certificates;

- Liability regimes;
- Transport infrastructure.

Strengths

Transport rights and market access

The current inland waterway markets are largely liberalised and will be fully so by the time the candidate countries join in 2004, with Romania and Bulgaria presumably acceding in 2007.

All of the above implies that the enlargement of the European Union with the candidate countries means that vessels of these countries will attain full access to the EU-waterway network, including the Rhine, as of mid-2004.

Technical and safety requirements for vessels

Technical and safety regulations for transport of dangerous substances have been largely harmonised through the ADN, ADNR and ADND.

Manning requirements and social standards

Harmonised regulation on the Rhine: Chapter 23 of the RVBR determines a rule as regards the minimum size and composition of crews***.***

Weaknesses

Transport rights and market access

The participation by vessels of third countries in bilateral traffic is currently generally discouraged. This limits opportunities for return loads and efficient IWT operations.

Technical and safety requirements for vessels

EU Directive 82 / 714 / EEC was based on the Rhine rules then in force but updating of the Rhine regulations in 1995 left the EU norms outdated.

Technical regulations that are adopted for the European Union are in practice determined only by the five CCNR member countries.

Manning requirements and social standards

The EU rules on the size and composition of crews are not fixed yet.

There is no uniform regime regarding the size and composition of crews exists on the Danube.

A collective European labour agreement does not exist

Liability regimes

Liability rules and contract laws still are mostly based on national regulations, and are therefore not harmonised on an international level. Although this is a problem of civil and commercial law outside the direct area of IWT legislation, it has impacts on the future development of IWT as an intermodal mode of transport.

Transport infrastructure

Six years after the adoption of Decision 1692 / 96 / EC only 20 per cent of the projects planned for 2010 had been completed. Little or no progress in the removal of strategic waterway bottlenecks had been achieved.

This is caused by insufficient policy attention for IWT projects and the problem of financing. National governments which are basically responsible for financing infrastructure cannot be forced to realise construction works, but can be encouraged to do so by financial EU contributions. These require EU policy decisions and legislation.

Boatmaster’s certificates

The requirements imposed on boatmasters in the Rhine and Danube areas are not yet fully harmonised.

Opportunities

Transport rights and market access

The legal situation on the Danube with respect to transport rights needs clarification. The future revision of the Belgrade Convention is an opportunity to do so.

The bilateral restrictions will automatically be superseded by the European transport acquis, which forbids such restrictions in transport rights among Member States.

Technical and safety requirements for vessels

The current revision of the EU Directive 82 / 714 / EEC is needed to bring them in line with the RVBR (Regulation on the Survey of Rhine Vessels) of the CCNR.

Boatmaster’s certificates

The CCNR has made progress in terms of recognition of EU and Danube boatmaster licences and patents.

Upcoming revision of the Belgrade Convention can solve the remaining legal problems.

Threats

Transport rights and market access

The liberalisation of cabotage on the European waterway network calls for flanking measures, e.g. in the area of monitoring and enforcement. Unless liberalisation is accompanied by strict application of technical and manning regulations, there will be a tendency to non-compliance, undermining the aim of a level playing field. Closer co-operation between EC, CCNR and DC is needed in order to prevent unfair competition.

Manning requirements and social standards

Despite the adoption Directive 2000 / 34 / EC laying down minimum requirements for working and rest hours in the transport sector, the problem of working time has not yet been settled satisfactorily at European level for IWT workers. Things have been complicated by the judgement of the European Court of Justice on 9 September 2003[2] stating that time spent in the workplace should be regarded working time. Through lacking harmonisation in this field, control is more difficult because of the differences in national regulation.

Liability regimes

Lack of a harmonised international liability regime causes unnecessary litigation and may raise the insurance costs of transport operations. It therefore acts as a barrier for intermodal transport.

---

[2] Case C-151/02 Jaeger.

Chapter 9 Intermodal and intramodal competition

This SWOT analysis treats competition both between inland waterway transport and other modes ***(Intermodal*** competition) and between inland waterway transport enterprises ***(Intramodal*** competition).

Intermodal competition features tend to dominate in this analysis. However, enhanced intramodal competition in the IWT sector will in turn improve the intermodal competitive position of this sector with rail and road transport.

There are, of course, multiple interactions with the previous SWOT-chapters.

Strengths

Intermodal competition:

- Low average line transport costs (per tkm) for bulk shipments
- Reliable services under predictable weather conditions
- Comparatively high level of transport safety
- Comparatively low external (pollution) costs

Intramodal competition:

- Fully deregulated market
- High share of owner-operators ensures intramodal competition

Weaknesses

Intermodal competition:

- Political preference of rail transport rather than IWT in important European countries
- Limited length of total navigable inland waterways
- Low network density in many areas
- Limited scope for Europe-wide interlinked network
- Low line speed
- Dependence on intermodality for door-to-door services
- Deficits in sector organisation and marketing strategies
- Limited co-operation among operators

Intramodal competition:

- Substantial cost differentials

Opportunities

Intermodal competition:

- Removal of infrastructure bottlenecks
- Implementation of infrastructure links
- Improved transport chains Increasing on-time reliability
- Enhanced intermodality
- Organisational co-operation among chain members

Intramodal competition:

- New communication technologies
- Full harmonisation of regulations and strict enforcement
- Appearance of low-cost competitors from accession countries

Threats

Intermodal competition:

- Truck competition from accession countries
- Priority of investments in road / rail infrastructure

Intramodal competition:

- Entry of low-cost competitors from accession countries

Figure 10. Inter- and intramodal competitive conditions: strengths, weaknesses, opportunities and threats

Strengths

Intermodal competition

In comparison to rail and road transport, IWT usually has the lowest line haul cost (per tonne-kilometre) between inland ports; particularly shipments of bulk products benefit from this advantage[3].

Inland waterway transport services are reliable in terms of meeting established deadlines if and when weather conditions are predictable; this reliability is an important advantage for the transport of all types off goods but especially scheduled container shipments are concerned.

Another aspect of reliability is the high level of safety of inland waterway transport; safety is particularly important for shipments of dangerous goods.

Inland waterway transport in the European Union now operates under fully deregulated market conditions. The rail freight transport sector still being far from complete deregulation, inland waterway transport has obviously a competitive advantage.

IWT causes recognisably the lowest external (pollution) costs among all three inland modes of transport[3].

Intramodal competition

Full market deregulation that is part of the ‘acquis communautaire’ is a precondition for an effective intramodal competition.

The high share of owner-operators in IWT (75 to 90% in the main IWT countries of the EU ensures a high level of intramodal competition since owner-operators are not bound to working hours, their employed workers are.

Weaknesses

Intermodal competition

Political preferences of rail transport rather than IWT in important European countries leading to insufficient attention and financing of IWT projects.

Compared to the existing road and rail infrastructure, the length of navigable inland waterways is rather limited. Many canals were built in the 19th century when inland waterway transport was the most important mode of transport at a time when road transport did not exist and the railways were slowly expanding.

---

[3] It is not possible to give a figure / indication because of varying trip characteristics.

An increasing part of the existing canals and rivers have become obsolete for freight transport since the size / capacity of vessels has continuously increased.

The inland waterway network used today is much less dense and interconnected than are the trunk rail and road networks. Once important links between different regional networks are not operable any more; after World War II, new (line) infrastructures have rarely been implemented because of high investment costs and low economic returns.

Bottlenecks along the existing waterways with reduced dimensions are frequent; they determine the capacity of vessels to operate:

- limited cross sections
- low water sections
- ‘single track’ sections
- limited lock capacities
- low bridge clearance

Commercial speeds of line haulage are lowest: approximately 10 kmh vs. 30 kmh for trucking and combined transport (with transfer of load) and 50 kmh for scheduled through trains.

Door-to-door services of unitised freight using IWT are usually intermodal transport chains requiring trucking at both ends of the trip and suitable transfer facilities. To some extent, this is also the case with bulk cargo.

Navigation on rivers and to a lesser extent on canals is sporadically interrupted because of unpredictable and / or unfavourable navigation weather conditions (low, high water levels, ice).

The organisation of IWT sector activities shows many deficits and lacks a vigorous marketing approach.

Operational co-operation among operators is still a limiting factor.

Intramodal competition

Substantial cost differentials exist in various parts of the network due to differing operating conditions (e.g. [upper] Danube vs. Rhine).

Opportunities

Intermodal competition

The removal of existing bottlenecks and exceptionally the implementation of new key infrastructure links will have a significant impact on intermodal competition of IWT with rail and road transport.

Recent decisions (October 2003) for Union supported Trans-European Transport networks include the following parts of the Rhine and Danube corridors (planned dates for start of operations in brackets):

- Vilshofen-Straubing section on the Danube (2013)
- Rhine-Meuse link with the lock of Lanay as cross-border section (2019)
- Vienna-Bratislava cross-border section (2015)
- Palcovicovo-Mohàcs section (2014)
- Elimination of bottlenecks in Romania and Bulgaria (2011)

In December 2003, the transport ministers unanimously agreed that an inland waterway between the Scheldt river in Belgium / the Netherlands and the Seine in France should be added to the list priority projects to be completed by 2020.

New communication technologies will facilitate the location of cargo and reduce transfer times.

Stackable swap bodies would bring a breakthrough for IWT of intra-European loading units.

More and more services with a sufficient and regular volume of freight can be scheduled reducing transport times.

There are also opportunities for improved transport chains increasing the efficiency of IWT.

There is room for the further increase of on-time reliability by reducing the impact of unpredicted interruptions.

Enhancing the intermodality of IWT will attract further demand to this sector.

Organisational co-operation among chain members that is now developing should also increase IWT's competition power.

Intramodal competition

The equipment of vessels (and cargo) with new communication technologies will create an additional cost advantage, thus fostering competition between IWT operators.

A basic requirement for intramodal competition is the full harmonisation of regulations throughout the Union with monitoring and strict controls of the application of rules and regulations.

Low-cost vessel operators from accession countries will add a new element of intramodal competition, and subsequently of intermodal competition. For the current constellation, this can be a threat, while in the long term it might become an opportunity for the EU25.

Threats

Intermodal competition

Truck competition from low-cost operators in Accession countries appears to be a major threat for IWT, in particular on the Danube and the East-West corridors.

Priority of investments in road and rail infrastructure in the EUs new proposals for TEN-T development and in several countries also on national level is likely to further weaken the competitiveness of the IWT sector.

Intramodal competition

Low-cost vessel operators from Accession countries will inject a new element of intramodal and subsequently of intermodal competition (this is at the same time an opportunity and a threat).

Buck Consultants International
progtrans
VBD
viadonau

PINE

Appendix 1: Inventory of Fleets

Ship's type:

Dry cargo self-propelled river ships

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	1158	971571	456941	839	395	44	ZKR
Germany	D	EU	1028	1198527	516452	1166	502	50	ZKR
France	F	EU	1126	520353	233675	462	208	45	ZKR
Netherlands	NL	EU	3404	3278465	1579760	963	464	47	ZKR
Leading on Rhine			**6716**	**5968916**	**2786828**	**889**	**415**	**47**	
Austria	A	EU	28	33194	24717	1186	883	25	DC
Luxembourg	L	EU	26	26803	13096	1031	504	48	ZKR
Switzerlanc	CH		18	33052	20404	1836	1134	21	ZKR
EU on Rhine + Switzerland			**6788**	**6061965**	**2845045**	**893**	**419**	**46**	
Poland	PL	C04	105	49000	26956	467	257	n.a.	NS2000
Czech Republic	CZ	C04	67	60960	28180	910	421	30	NS2000
Elbe-Oder 2004 candidates			**172**	**109960**	**55136**	**639**	**321**	**n.a.**	
Slovakia	SK	C04	12	18142	10161	1512	847	32	DC
Hungary	H	C04	10	6216	4872	622	487	n.a.	DC
Danube 2004 candidates			**22**	**24358**	**15033**	**1107**	**683**	**n.a.**	
Bulgaria	BG	C07	22	22620	16273	1028	740	27	DC
Romania	RO	C07	32	18082	12048	565	377	22	DC
2007 candidates			**54**	**40702**	**28321**	**754**	**524**	**24**	
All Danube candidates			**76**	**65060**	**43354**	**856**	**570**	**n.a.**	
All leading candidates			**248**	**175020**	**98490**	**706**	**397**	**n.a.**	
Croatia	HR		2	820	917	410	459	18	DC
Serbia/Montenegro	YU		65	61910	21917	952	337	28	NS2000
Ukraine	UA		44	124910	81757	2839	1858	18	DC
Moldova	MOL		3	5365	2176	1788	725	32	DC
Others on Danube			**114**	**193005**	**106767**	**1693**	**937**	**22**	
All cand. + others on Danube			**362**	**368025**	**205257**	**1017**	**567**	**n.a.**	
Finland	FIN	EU	13	2954	3112	227	239	44	NS2000
United Kingdom	GB	EU	118	29858	n.a.	253	n.a.	n.a.	NS1997
Italy	I	EU	1	1200	800	1200	800	35	NS2000
Sweden	S	EU							
Spain	E	EU							
Portugal	P	EU							
Rest of EU			**132**	**34012**	**3912**	**258**	**n.a.**	**n.a.**	
Latvia	LV	C04							
Lithuania	LT	C04							
Rest of candidates			**0**	**0**	**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in CZ: dry + liquid cargo ships togethe

Ship's type: **Dry cargo push barges**

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	146	359903	-	2465	-	23	ZKR
Germany	D	EU	987	891738	-	903	-	22	ZKR
France	F	EU	611	593838	-	972	-	36	ZKR
Netherlands	NL	EU	751	1292402	-	1721	-	25	ZKR
Leading on Rhine			**2495**	**3137881**		**1258**		**26**	
Austria	A	EU	96	163234	-	1700	-	19	DC
Luxembourg	L	EU	2	5660	-	2830	-	25	ZKR
Switzerlanc	CH		0	0	-	0	-	-	ZKR
EU on Rhine + Switzerland			**2593**	**3306775**		**1275**		**26**	
Poland	PL	C04	384	204000	-	531	-	n.a.	NS2000
Czech Republic	CZ	C04			-		-	n.a.	NS2000
Elbe-Oder 2004 candidates			**384**	**204000**		**531**		**n.a.**	
Slovakia	SK	C04	0	0	-	0	-	-	DC
Hungary	H	C04	0	0	-	0	-	-	DC
Danube 2004 candidates			**0**	**0**		**0**		**n.a.**	
Bulgaria	BG	C07	99	165769	-	1674	-	19	DC
Romania	RO	C07	735	1333514	-	1814	-	17	DC
2007 candidates			**834**	**1499283**		**1798**		**17**	
All Danube candidates			**834**	**1499283**		**1798**		**n.a.**	
All leading candidates			**1218**	**1703283**		**1398**		**17**	
Croatia	HR		44	42001	-	955	-	25	DC
Serbia/Montenegro	YU		144	214317	-	1488	-	25	DC + NS
Ukraine	UA		369	493868	-	1338	-	12	DC
Moldova	MOL		0	0	-	0	-	-	DC
Others on Danube			**557**	**750186**		**1347**		**19**	
All cand. + others on Danube			**1775**	**2453469**		**1382**		**18**	
Finland	FIN	EU	2	1812	-	906	-	13	NS2000
United Kingdom	GB	EU	0		-		-		NS1997
Italy	I	EU	12	12000	-	1000	-	25	NS2000
Sweden	S	EU			-		-		
Spain	E	EU			-		-		
Portugal	P	EU			-		-		
Rest of EU			**14**	**13812**		**986,5714286**			
Latvia	LV	C04			-		-		
Lithuania	LT	C04			-		-		
Rest of candidates			**0**	**0**					

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in PL: dry + tank barges together
in CZ: see under dry cargo dumb barge

Ship's type: **Dry cargo towing barges**

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	4	10922	-	2731	-	43	ZKR
Germany	D	EU	75	51516	-	687	-	68	ZKR
France	F	EU	0	0	-	0	-	-	ZKR
Netherlands	NL	EU	150	138296	-	922	-	70	ZKR
Leading on Rhine			**229**	**200734**		**877**		**69**	
Austria	A	EU	43	31939	-	743	-	33	DC
Luxembourg	L	EU	0	0	-	0	-	-	ZKR
Switzerlanc	CH		1	2037	-	2037	-	60	ZKR
EU on Rhine + Switzerland			**273**	**234710**		**860**		**63**	
Poland	PL	C04	492	254000	-	516	-	n.a.	NS2000
Czech Republic	CZ	C04	176	87470	-	497	-	18	NS2000
Elbe-Oder 2004 candidates			**668**	**341470**	**-**	**511**	**-**		
Slovakia	SK	C04	155	248170	-	1601	-	20	DC
Hungary	H	C04	113	52034	-	460	-	n.a.	DC
Danube 2004 candidates			**268**	**300204**		**1120**		**n.a.**	
Bulgaria	BG	C07	113	126791	-	1122	-	32	DC
Romania	RO	C07	696	384810	-	553	-	28	DC
2007 candidates			**809**	**511601**		**632**		**29**	
All Danube candidates			**1077**	**811805**		**754**		**n.a.**	
All leading candidates			**1745**	**1153275**		**661**		**n.a.**	
Croatia	HR		70	29383	-	420	-	36	DC
Serbia/Montenegro	YU		63	41474	-	658	-	38	NS2000
Ukraine	UA		68	112136	-	1649	-	34	DC
Moldova	MOL		9	12424	-	1380	-	26	DC
Others on Danube			**210**	**195417**		**931**		**37**	
All cand. + others on Danube			**1955**	**1348692**		**690**		**n.a.**	
Finland	FIN	EU	28	3309	-	118	-	38	NS2000
United Kingdom	GB	EU	223	58466	-	262	-	n.a.	NS1997
Italy	I	EU	0		-		-		NS2000
Sweden	S	EU			-		-		
Spain	E	EU			-		-		
Portugal	P	EU			-		-		
Rest of EU			**251**	**61775**	**0**	**246**		**n.a.**	
Latvia	LV	C04			-		-		
Lithuania	LT	C04			-		-		
Rest of candidates			**0**	**0**	**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in PL: dry + tank barges together
in CZ: dumb + pushed barges, dry + liquid ca

Ship's type: **Liquid cargo self-propelled river ships** (tankers)

Country	**code**	**status**	**N° of units**	**Total capacity** (tdw)	**Total output** (kW)	**Average capacity** (tdw)	**Average output** (kW)	**Average age** (years)	Data source
Belgium	B	EU	205	242263	108761	1182	531	37	ZKR
Germany	D	EU	305	446262	211918	1463	695	30	ZKR
France	F	EU	70	51414	20736	734	296	42	ZKR
Netherlands	NL	EU	719	721217	370963	1003	516	32	ZKR
Leading on Rhine			**1299**	**1461156**	**712378**	**1125**	**548**	**33**	
Austria	A	EU	4	4036	4333	1009	1083	43	DC
Luxembourg	L	EU	27	47103	23284	1745	862	26	ZKR
Switzerlanc	CH		45	102604	45210	2280	1005	20	ZKR
EU on Rhine + Switzerland			**1375**	**1614899**	**785205**	**1174**	**571**	**32**	
Poland	PL	C04	0						NS2000
Czech Republic	CZ	C04							NS2000
Elbe-Oder 2004 candidates			**0**	**0**	**0**				
Slovakia	SK	C04	0	0	0	-	-	-	DC
Hungary	H	C04	5	6091	4414	1218	883	n.a.	DC
Danube 2004 candidates			**5**	**6091**	**4414**	**1218**	**883**	**n.a.**	
Bulgaria	BG	C07	0	0	0	-	-	-	DC
Romania	RO	C07	5	1723	913	345	183	11	DC
2007 candidates			**5**	**1723**	**913**	**345**	**183**	**11**	
All Danube candidates			**10**	**7814**	**5327**	**781**	**533**	**n.a.**	
All leading candidates			**10**	**7814**	**5327**	**781**	**533**	**n.a.**	
Croatia	HR		2	1657	2121	829	1061	40	DC
Serbia/Montenegro	YU		4	3342	1758	836	440	38	NS2000
Ukraine	UA		0	0	0	-	-	-	DC
Moldova	MOL		0	0	0	-	-	-	DC
Others on Danube			**6**	**4999**	**3879**	**833**	**647**	**37**	
All cand. + others on Danube			**16**	**12813**	**9206**	**801**	**575**		
Finland	FIN	EU	0						NS2000
United Kingdom	GB	EU	55	42846		779			NS1997
Italy	I	EU	1	1000	800	1000	800	35	NS2000
Sweden	S	EU							
Spain	E	EU							
Portugal	P	EU							
Rest of EU			**56**	**43846**	**800**	**783**			
Latvia	LV	C04							
Lithuania	LT	C04							
Rest of candidates			**0**	**0**	**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in CZ: dry + liquid cargo ships(see dry-cargo MS

Ship's type: **Tank towing barges**

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	0	0	-	0	-	-	ZKR
Germany	D	EU	12	3899	-	325	-	40	ZKR
France	F	EU	0	0	-	0	-	-	ZKR
Netherlands	NL	EU	9	2530	-	281	-	51	ZKR
Leading on Rhine			**21**	**6429**		**306**		**45**	
Austria	A	EU	0	0	-	0	-	-	DC
Luxembourg	L	EU	0	0	-	0	-	-	ZKR
Switzerlanc	CH		0	0	-	0	-	-	ZKR
EU on Rhine + Switzerland			**21**	**6429**		**306**		**454**	
Poland	PL	C04	0		-		-		NS2000
Czech Republic	CZ	C04	0		-		-		NS2000
Elbe-Oder 2004 candidates			**0**	**0**					
Slovakia	SK	C04	47	61559	-	1310	-	32	DC
Hungary	H	C04	23	32283	-	1404	-	n.a.	DC
Danube 2004 candidates			**70**	**93842**		**1341**		**n.a.**	
Bulgaria	BG	C07	10	10574	-	1057	-	33	DC
Romania	RO	C07	96	39799	-	415	-	37	DC
2007 candidates			**106**	**50373**		**475**		**37**	
All Danube candidates			**176**	**144215**		**819**		**n.a**	
All leading candidates			**176**	**144215**		**819**		**n.a.**	
Croatia	HR		26	25755	-	991	-	46	DC
Serbia/Montenegro	YU		28	30125	-	1076	-	41	NS2000
Ukraine	UA		50	61250	-	1225	-	36	DC
Moldova	MOL		0	0	-	0	-	-	DC
Others on Danube			**104**	**117130**		**1126**		**39**	
All cand. + others on Danube			**280**	**261345**		**933**		**n.a.**	
Finland	FIN	EU	0		-		-		NS2000
United Kingdom	GB	EU	24	17330	-	722	-		NS1997
Italy	I	EU	0		-		-		NS2000
Sweden	S	EU			-		-		
Spain	E	EU			-		-		
Portugal	P	EU			-		-		
Rest of EU			**24**	**17330**					
Latvia	LV	C04			-		-		
Lithuania	LT	C04			-		-		
Rest of candidates			**0**	**0**					

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in PL: dry + tank barges together
in CZ: see under dry cargo dumb barge

Ship's type: **Tank push barges**

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	8	9144	-	1143	-	38	ZKR
Germany	D	EU	41	55352	-	1350	-	24	ZKR
France	F	EU	64	90823	-	1419	-	34	ZKR
Netherlands	NL	EU	49	80666	-	1646	-	25	ZKR
Leading on Rhine			**162**	**235985**		**1457**		**29**	
Austria	A	EU	n.a.		-		-		DC
Luxembourg	L	EU	2	8444	-	4222	-	20	ZKR
Switzerlanc	CH		0	0	-	0	-	-	ZKR
EU on Rhine + Switzerland			**164**	**244429**		**1490**		**29**	
Poland	PL	C04	0		-		-		NS2000
Czech Republic	CZ	C04	0		-		-		NS2000
Elbe-Oder 2004 candidates			**0**						
Slovakia	SK	C04	n.a.		-		-		DC
Hungary	H	C04	n.a.		-		-		DC
Danube 2004 candidates			**0**						
Bulgaria	BG	C07	n.a.		-		-		DC
Romania	RO	C07	n.a.		-		-		DC
2007 candidates			**n.a.**						
All Danube candidates			**n.a.**						
All leading candidates			**n.a.**						
Croatia	HR		n.a.		-		-		DC
Serbia/Montenegro	YU		48	73054	-	1522	-	33	NS2000
Ukraine	UA		n.a.		-		-		DC
Moldova	MOL		n.a.		-		-		DC
Others on Danube			**48**						
All cand. + others on Danube			**48**						
Finland	FIN	EU	0				-		NS2000
United Kingdom	GB	EU	0				-		NS1997
Italy	I	EU	20	25000		1250	-	15	NS2000
Sweden	S	EU					-		
Spain	E	EU					-		
Portugal	P	EU					-		
Rest of EU			**20**		**0**				
Latvia	LV	C04					-		
Lithuania	LT	C04					-		
Rest of candidates			**0**		**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in PL: dry + tank barges together
in CZ: see under dry cargo dumb barge

Ship's type: **River tugs** (for towing barges)

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	21	-	5819	-	277	n.a.	ZKR
Germany	D	EU	163	-	33776	-	207	56	ZKR
France	F	EU	3	-	835	-	278	43	ZKR
Netherlands	NL	EU	546	-	119435	-	219	52	ZKR
Leading on Rhine			**733**		**159865**		**218**	**n.a.**	
Austria	A	EU	6	-	2786	-	464	35	DC
Luxembourg	L	EU	9	-	5011	-	557	64	ZKR
Switzerland	CH		1	-	368	-	368	60	ZKR
EU on Rhine + Switzerland			**749**		**168030**		**224**	**n.a.**	
Poland	PL	C04	9	-	1615	-	179	n.a.	NS2000
Czech Republic	CZ	C04	105	-	35010	-	333	23	NS2000
Elbe-Oder 2004 candidates			**114**		**36625**		**321**	**n.a.**	
Slovakia	SK	C04	2	-	256	-	128	45	DC
Hungary	H	C04	14	-	5722	-	409	n.a.	DC
Danube 2004 candidates			**16**		**5978**		**374**	**n.a.**	
Bulgaria	BG	C07	28	-	11481	-	410	38	DC
Romania	RO	C07	365	-	96880	-	265	32	DC
2007 candidates			**393**		**108361**		**276**	**32**	
All Danube candidates			**409**		**114339**		**280**	**n.a.**	
All leading candidates			**523**		**150964**		**289**	**n.a.**	
Croatia	HR		36	-	9531	-	265	34	DC
Serbia/Montenegro	YU		66	-	17702	-	268	39	NS2000
Ukraine	UA		9	-	6930	-	770	35	DC
Moldova	MOL		0	-	0	-	0	-	DC
Others on Danube			**111**		**34163**		**308**	**37**	
All cand. + others on Danube			**634**		**185127**		**292**		
Finland	FIN	EU	28	-	8082	-	289	54	NS2000
United Kingdom	GB	EU	69	-	24120	-	350	n.a.	NS1997
Italy	I	EU	0	-		-			NS2000
Sweden	S	EU		-		-			
Spain	E	EU		-		-			
Portugal	P	EU		-		-			
Rest of EU			**97**		**32202**		**332**	**n.a.**	
Latvia	LV	C04		-		-			
Lithuania	LT	C04		-		-			
Rest of candidates			**0**		**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

in CZ: tugs and pushers togethe

in GB: tugs and pushers together

Ship's type: **River pusher-tugs** (equipped for towing and for pushing barges)

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU		-		-			ZKR
Germany	D	EU		-		-			ZKR
France	F	EU		-		-			ZKR
Netherlands	NL	EU		-		-			ZKR
Leading on Rhine			**0**		**0**		**n.a.**	**n.a.**	
Austria	A	EU	0	-	0	-	n.a.	n.a.	DC
Luxembourg	L	EU		-		-			ZKR
Switzerlanc	CH			-		-			ZKR
EU on Rhine + Switzerland			**0**		**0**				
Poland	PL	C04		-		-			NS2000
Czech Republic	CZ	C04		-		-			NS2000
Elbe-Oder 2004 candidates									
Slovakia	SK	C04		-		-			DC
Hungary	H	C04	1	-	1470	-	1470	n.a.	DC
Danube 2004 candidates			**1**		**1470**		**1470**	**n.a.**	
Bulgaria	BG	C07	9	-	3180	-	353	n.a.	DC
Romania	RO	C07	54	-	27036	-	1470	19	DC
2007 candidates			**63**		**30216**		**480**		
All Danube candidates			**64**		**31686**		**495**		
All leading candidates			**64**		**31686**		**495**		
Croatia	HR		0	-	0	-	n.a.	n.a.	DC
Serbia/Montenegro	YU		0	-	0	-	n.a.	n.a.	NS2000
Ukraine	UA		46	-	68096	-	1480	35	DC
Moldova	MOL		1	-	220	-	220	15	DC
Others on Danube			**47**		**68316**		**1454**	**35**	
All cand. + others on Danube			**111**		**100002**		**901**		
Finland	FIN	EU	2	-	2021	-	1011	20	NS2000
United Kingdom	GB	EU	-	-	-	-	-	-	NS1997
Italy	I	EU		-		-			NS2000
Sweden	S	EU		-		-			
Spain	E	EU		-		-			
Portugal	P	EU		-		-			
Rest of EU			**2**		**2021**				
Latvia	LV	C04		-		-			
Lithuania	LT	C04		-		-			
Rest of candidates			**0**		**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004

C07 - candidate to join the Union in 2007

EU - European Union Member state

DC - Danube Commission

ZKR - Central Commission for the Rhine Navigation

NS - National Statistics (Sources)

in CZ: tugs and pushers togethe

in GB: tugs and pushers together

Ship's type: **River pushboats** (for pushing barges)

Country	code	status	N° of units	Total capacity (tdw)	Total output (kW)	Average capacity (tdw)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	59	-	33517	-	568	n.a.	ZKR
Germany	D	EU	286	-	107041	-	374	32	ZKR
France	F	EU	196	-	91481	-	467	51	ZKR
Netherlands	NL	EU	549	-	241795	-	440	46	ZKR
Leading on Rhine			**1090**		**473834**		**435**	**n.a.**	
Austria	A	EU	13	-	12223	-	940	36	DC
Luxembourg	L	EU	11	-	12598	-	1145	23	ZKR
Switzerlanc	CH		7	-	5444	-	368	36	ZKR
EU on Rhine + Switzerland			**1121**		**504099**		**450**	**n.a.**	
Poland	PL	C04	236	-	67387	-	286	n.a.	NS2000
Czech Republic	CZ	C04	20	-	n.a.	-	n.a.	n.a.	NS2000
Elbe-Oder 2004 candidates			**256**		**67387**		**263**	**n.a.**	
Slovakia	SK	C04	34	-	36398	-	1071	18	DC
Hungary	H	C04	16	-	15400	-	963	n.a.	DC
Danube 2004 candidates			**50**		**51798**		**1036**	**n.a.**	
Bulgaria	BG	C07	22	-	30102	-	1368	20	DC
Romania	RO	C07	124	-	213570	-	1722	14	DC
2007 candidates			**146**		**243672**		**1669**	**15**	
All Danube candidates			**196**		**295470**		**1508**	**n.a.**	
All leading candidates			**452**		**362857**		**803**	**n.a.**	
Croatia	HR		10	-	5915	-	592	19	DC
Serbia/Montenegro	YU		45	-	43285	-	962	28	DC + NS
Ukraine	UA		21	-	41508	-	1977	19	DC
Moldova	MOL		0	-	0	-	0	n.a.	DC
Others on Danube			**76**		**90708**		**1194**	**24**	
All cand. + others on Danube			**528**		**453565**		**859**	**n.a.**	
Finland	FIN	EU	0	-		-			NS2000
United Kingdom	GB	EU	-	-	-	-	-	-	NS1997
Italy	I	EU	11		12000		1091	25	NS2000
Sweden	S	EU		-		-			
Spain	E	EU		-		-			
Portugal	P	EU		-		-			
Rest of EU			**11**		**12000**				
Latvia	LV	C04		-		-			
Lithuania	LT	C04		-		-			
Rest of candidates			**0**		**0**				

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

20 pushers of a total of 105 tugs and pusher

in GB: tugs and pushers together

Ship's type: **River passenger ships**

Country	code	status	N° of units	Total capacity (persons)	Total output (kW)	Average capacity (persons)	Average output (kW)	Average age (years)	Data source
Belgium	B	EU	153	n.a.	23606	n.a.	154	n.a.	ZKR
Germany	D	EU	1007	204644	234389	203	233		ZKR
France	F	EU							
Netherlands	NL	EU	834	48885	159919	59	192		ZKR
Leading on Rhine			**1994**	**253529**	**417914**	**127**	**210**	**n.a.**	
Austria	A	EU							
Luxembourg	L	EU	6	1550	3257	258	543		ZKR
Switzerland	CH		39	6782	40637	174	1042		ZKR
EU on Rhine + Switzerland			**2039**	**261861**	**461808**	**128**	**226**	**n.a.**	
Poland	PL	C04	76						NS2000
Czech Republic	CZ	C04	67	8597	n.a.	128	n.a.	n.a.	NS2000
Elbe-Oder 2004 candidates			**143**						
Slovakia	SK	C04							
Hungary	H	C04							
Danube 2004 candidates									
Bulgaria	BG	C07							
Romania	RO	C07							
2007 candidates									
All Danube candidates									
All leading candidates									
Croatia	HR								
Serbia/Montenegro	YU		5	598	991	120	198	26	NS2000
Ukraine	UA								
Moldova	MOL								
Others on Danube									
All cand. + others on Danube									
Finland	FIN	EU	107	9930	21116	93	197	48	NS2000
United Kingdom	GB	EU	n.a.						
Italy	I	EU	18	2300	n.a.	128		25	NS2000
Sweden	S	EU							
Spain	E	EU							
Portugal	P	EU							
Rest of EU			**125**						
Latvia	LV	C04							
Lithuania	LT	C04							
Rest of candidates									

Used abbreviations:

C04 - candidate to join the Union in 2004
C07 - candidate to join the Union in 2007
EU - European Union Member state
DC - Danube Commission
ZKR - Central Commission for the Rhine Navigation
NS - National Statistics (Sources)

Buck Consultants International
progtrans
VBD
viadonau

PINE

Appendix 2
Cost structure of the fleets

1. Definition of the reference ships

According to the aforementioned statements and the need to make a reasonable and pragmatic selection several representative ships will be determined which are important for both the intermodal and the intramodal competition. The selection concentrates on dry cargo vessels, as they represent the major part of the fleets. Moreover, the settlement on similar ship types guarantees a comparability of the results. Main emphasis is given to those examples and comparisons, which are of high interest for the intramodal competition. Therefore, the selection mainly refers to self propelled vessels since they are most relevant for intramodal competition. For the Danube corridor additionally a pushed train has been selected due to the prevailing importance of this technology on the Danube. Cost structures for the selected ship types will then be analysed taking into consideration different circumstances as explained in detail in chapter 4.4.

The following vessels will be looked at:

- single self-propelled vessel of so-called “Europe”-size (license for the Rhine corridor or parts of the North-South corridor)
  L x B x T = 80 x 9.5 x 2.5 m, dead-weight[1] about 1280 t at 2.5 m draught; 750 KW, operation within the Rhine corridor, East-West-corridor (German part) and within parts of the North-South-corridor; operation within the Danube corridor possible, too

- single self-propelled vessel, type „Labe“ (license for the Czech Republic)
  L x B x T = 80 x 9.3 x 2.4 m, dead-weight about 1190 t at 2.4 m draught; 420 KW, operation on the river Elbe (with draught restrictions), the German canal network as well as on the river Rhine, e.g. within hinterland traffic between Rotterdam and the Czech Republic or Germany

- single self-propelled vessel of “Europe”-size (license for the Danube corridor)
  L x B x T = 80 x 9.5 x 2.5 m, dead-weight about 1280 t at 2.5 m draught; 750 KW, operation within Rhine and Danube corridor

- single self-propelled vessel, GMS-type, "large cargo motor ship" (license for the Rhine corridor)
  L x B x T = 110 x 11.4 x 3.5 m, dead-weight about 2850 t at 3.5 m draught; 1200 KW, operation within the Rhine corridor, operation within Danube corridor possible too

---

[1] In practice, also the term “load capacity” is used. In some cases different definitions are used for these terms. In this context “dead weight” is used as “total carrying capacity”, covering load capacity as well as fuel, water, stocks etc.. The term “load capacity” mostly refers to the so called “payload”, which excludes fuel, water, stocks etc.

- pushed train (license for the Danube corridor)
  L x B x T = 153 x 22 x 2.5 m, four “Danube-Europe IIb” barges,
  dead-weight about 6000 t at 2.5 m draught; 1700 KW,
  push boat length (not included) about 35 m, operation within the Danube corridor only.

Impact of ship size, capacity utilisation ratio and transport distance

A significant impact on inland vessel transport costs is to be attributed to the following factors:

- the rate of capacity utilisation,
- suitable ship types (ship size) and
- transport distance.

Irrespective of the ship type and size, it is obvious that costs per transported unit drop with an increasing rate of capacity utilisation, since total costs do largely not depend on the transport volume.

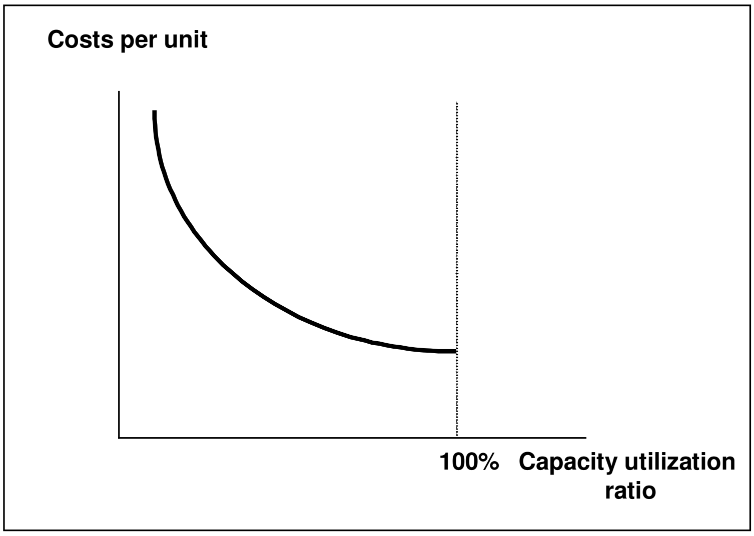


Figure 1. Relation between costs and capacity utilisation ratio

There are, however, close relations between the possible capacity utilisation ratio and the corresponding conditions as e.g. available transport volume and available draught. Often, limits of one or even both factors avoid advantageous, high capacity utilisation ratios. Further analyses, esp. on the interactions between the available draught and the capacity utilisation ratio are made in SWP 5.3.

As long as there is an appropriate transport volume and a suitable waterway infrastructure which does not limit the draught of the vessel, the operation of larger ships is advantageous (concave rise in fixed standby costs with dropping operating costs). This is illustrated in the following diagram.

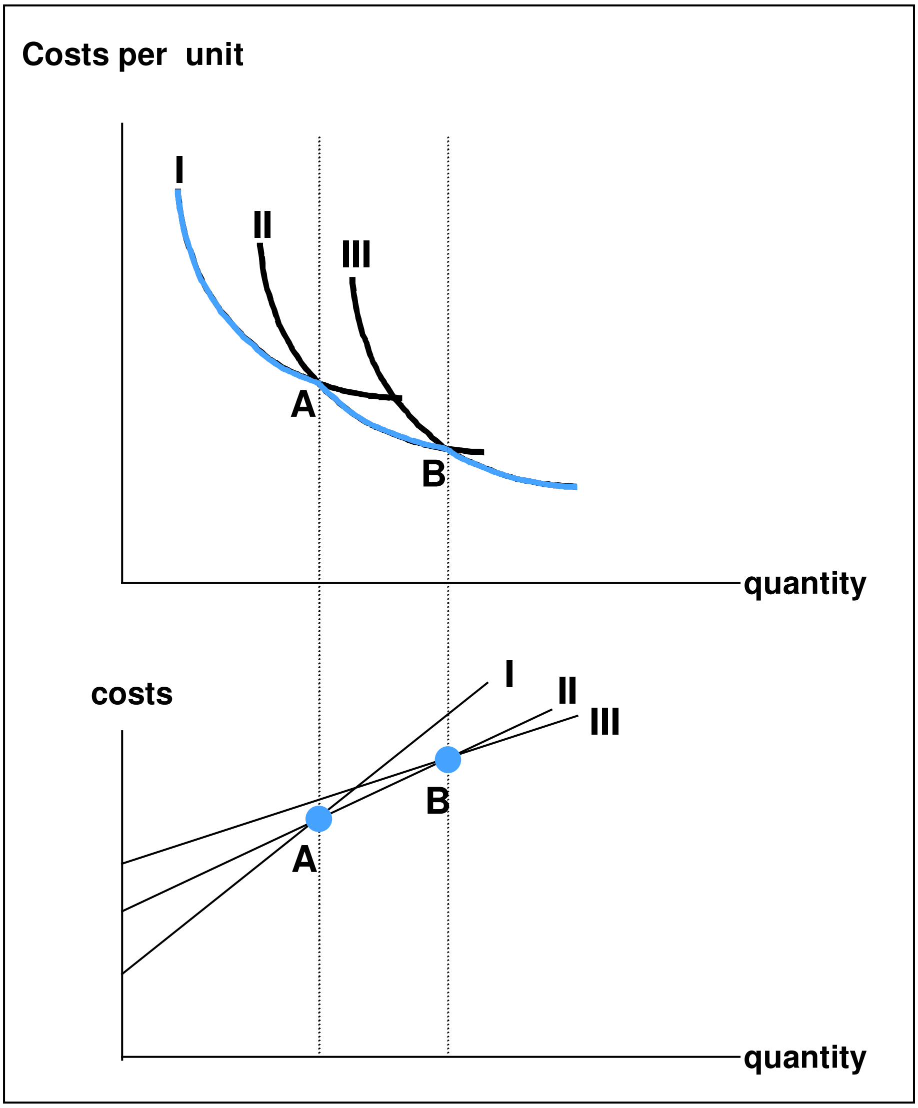


Figure 2. Relation between costs and ship size

Explanations:

Up to the transport volume A, type I operates at the lowest costs per unit. Between the volume range A and B type II is the best one and in case of a larger transport volume type III should be preferred.

At the same time the importance of infrastructure policy and the necessity of suitable infrastructure can be demonstrated. As long as the requirement for an appropriate transport volume is met the operation of larger ships and an increased carrying capacity result in a reduction of waterborne transport costs and consequently to a higher competitiveness towards other transport alternatives.

The influence of the distance on the ship related costs is illustrated in the diagram below. Considering low distances, the costs per unit are high in order to decrease with growing distances. The background for this effect are different distance-related ratios between the operating time and the non-operating time (e.g. loading/unloading) of a vessel[2].

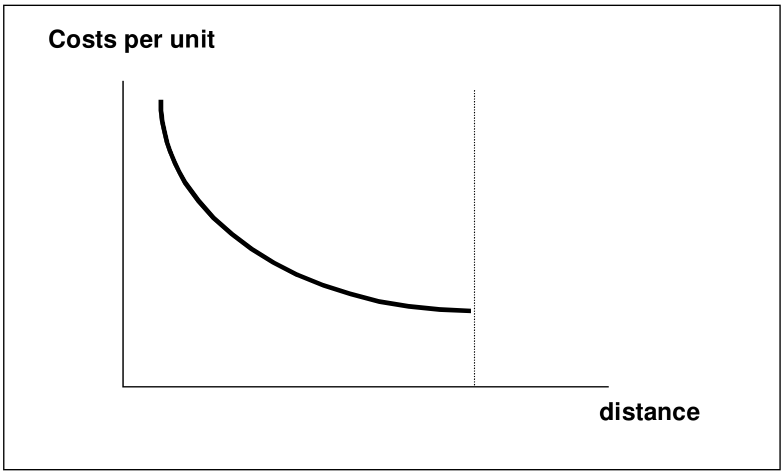


Figure 3. Relation between distance and costs

Standby costs

1.1.1 "Europe"-ship (Rhine)

At first the relevant ship characteristics as well as the conditions influencing costs are to be defined for a selected "Europe"-type ship, licensed for the Rhine corridor or for the northern part of the North-South corridor. For this purpose the following assumptions are made:

Operator structure, mode of operation and operating time

Vessels of that size are notably operated by independent ship owners, mainly within the Rhine corridor or the northern part of the North-South corridor. It is usual to operate in daily navigation A1 mode according to the Inspection Regulations for Vessels navigating on the Rhine (RheinSchUO) which means an operating time of up to 14 hours per day. 300 days of operation per year will be the basis for further calculations.

---

[2] This effect will be even larger, if the non distance related costs (e.g. transhipment, pre- and endhaulage etc.) are included.

Personnel costs and social payments

Personnel costs including social payments are subject to varying circumstances and ranges. Parameters like the ship operators, mode of operation, ship size as well as nationality of the crewmembers play a decisive role. At first, the minimum crew number and their qualification considering ship size, operating area and mode of operation should be found out. The Regulations for Vessels navigating on the Rhine (RheinSchUO) clearly stipulate the minimal crew number on board and their qualification. As far as wages are concerned, it is more difficult to identify reliable figures. As a result, it has to be taken into account whether the crewmembers are of national or foreign nationality (for example German, Polish or Czech) and likewise whether a shipping company or an independent owner is operating the vessel. Especially, in case of an independent owner the range of staff costs proves to be extremely high.

Independent owners often operate their vessels in form of a family business, which means with the help of relatives, for examples their partners. A comparability of personnel costs might be more complicated in those cases because the employment of skipper and family varies in its intensity. For example, the partner could take over the part of an able seaman or a helmsman. Husband and wife together are able to operate a “Europe” ship for 14 hours. In many cases however, only one member of the family works aboard and employs additional crewmembers. Both variants are going to be analysed since they often exist in reality.

Likewise, these crew combinations differently influence staff costs. While employed crewmembers are paid wages and social payments at usual market terms ship owner and the accompanying members of the family partly receive comparatively lower wages. The lower limit of personnel costs including social payments for an independent ship owner and his accompanying family members (mode of operation A1, which means an operating time of 14 hours per day) amounts to about € 50,000 to 60,000 / year according to information on part of this branch. However, “serious” calculations consider € 65,000 / year. Here the basis is € 60,000 / year (variant 1A). As regards the alternative “independent owner without accompanying members of the family, but with an employed able seaman” a lower limit of about € 85,000 to 90,000 is considered and for “serious” calculations approx. € 100,000 to 105,000. This study is based on € 95,000/ year (variant 1B). Within the Netherlands these costs partly fall below the given amounts.

In addition to the indicated figures, a labour reserve has to be considered to cover days out of service due to illness, holiday and leisure time. For independent owners an additional factor of about 1.1 to 1.2 will be estimated, here exemplary 1.15 is taken for calculation purposes.

A lack of domestic personnel causes the employment of more and more foreign crewmembers above all from Poland and the Czech Republic (see SWP 2.4). The wages and social expenses for foreign crewmembers are different from case to case. On account of the high number of missing crewmembers wages for an employment, e.g. in Germany, in many cases are only slightly lower compared to those paid for domestic personnel and do even reach the western level now and then. The same applies to social payments, which are almost as high as for German personnel. The advantages for the Czech and Polish staff do not refer to lower wages but rather to an often better motivation in relation to the national personnel. This study therefore allows for the same costs for the crewmembers on western ships irrespective of whether they come from the western part of Europe or Poland and the Czech Republic.

Compared to Poland and the Czech Republic personnel from the Danube corridor can only be met on western vessels to a lower extent. Details on staff costs are not available for those cases but their trend should be below that of the aforementioned eastern countries. This is particularly valid the more the country of origin is located downstream the Danube[3]. As this variant has been of minor importance up to now it will be disregarded[4].

Maintenance/Repair, depreciation, interests

Ships of that type and size were mainly built from the 30th to the 70th of the last century. But not only is the age of the vessels decisive when assessing their general and technical condition because it just relates to the date of licensing. Inland vessels are rather durable assets whose operating life might, to some extent, be similar to that of properties. Likewise various components of the ship as well as of properties have to be changed or replaced by new modern parts to ensure an up-to-date technology. For example, the main engine will often be replaced after 20 years by a new more efficient one with lower emissions. Within the operating life of a vessel this might happen repeatedly. Bow thrusters, improving the manoeuvrability and the safety of a vessel are an example of new technology, which can be applied later. Frequently only the ship’s hull corresponds with the original vessel after 50 or 80 years.

It is absolutely conceivable that e.g. a 20 year old vessel, which operates regularly but whose components have not been substituted at all, might be in a worse condition than a 40 year old one of the same type the components of which (such as main engine or propeller) had been replaced or modernised at regular intervals. In many cases however, ships of that type running within the western region have been equipped with an elevating wheelhouse or bow thrusters. The propulsion output normally amounts to between 700 and 800 kW.

Age, equipment and condition of a ship are influencing among others the costs of depreciation as well as maintenance and repair. Normally, interactions between these two factors exist. Depreciation costs of a new vessel seem to be comparatively high and those for maintenance and repair low; for old vessels an inverse ratio is valid.

---

[3] The increasing linguistic and communication problems for this personnel will be dealt with in SWP 2.4.

[4] An additional variant for the personnel costs is applied by some shipping lines. They register their personnel that work on German vessels (for example of German origin) with a service company in Luxembourg in order to reduce the level of social payments. As independent ship owners prevail within the Rhine corridor this combination is disregarded too.

As far as the Rhine corridor is concerned, exemplary average rates of the actual costs of a group of German vessels will be taken for 2001[5]. For ships of that size and age € 27 per ton dead-weight and year are spent on average as regards maintenance and repair[6] and about € 23 concerning depreciation. As to the ship considered, this equals to about 34,500 or 29,500 €/a, respectively. Attention has to be given to the fact that mainly the costs for maintenance and repair may vary for different years depending on the kind and extent of the envisaged repairs.

The determination of interests is also based on the above-mentioned source. As a result, interests are estimated on average at about € 8 per ton dead-weight and year amounting to approx. annually € 10,000 for the vessel.

Insurance

Several parameters influence the insurance costs above all the kind of insurance (hull, liability, cargo) and the amount of the insurance (level of cover). Therefore figures might vary depending on the country and the variant. Again the cost structure for the mentioned group of German ships will be applied. In this connection insurance costs are given at about € 13 per ton dead-weight and year on average which means about annually € 17,000 for the ship.

Variant		**staff [€/year]**	**maintenance/ repair [€/year]**	**depre-ciation [€/year]**	**interest [€/year]**	**insurance [€/year]**	**TOTAL per vessel [€/year]**	**TOTAL per tdw [€/year]**
1 A	Skipper (independent ship owner) + 1 member of family	69,000	34,500	29,500	10,000	17,000	160,000	125
1 B	Skipper (independent ship owner) + 1 employee	109,000	34,500	29,500	10,000	17,000	200,000	156

Table 1. Standby costs „Europe“-type ship (registration within the Rhine corridor or parts of the North-South corridor)

---

[5] Source: Overview cost structure of selected German vessels of independent ship owners, to be found in: Planco "Potential and future of German inland navigation ", 2. interim report, Essen 2003

[6] The ratio of costs for maintenance/repair towards those for depreciation outlines the „structural increase in the percentage of old ships“ within a part of the German fleet.

Total costs per ship thus amount to about € 160,000 per year for the variant 1A. Related to one ton dead-weight (tdw) this equals to about € 125 per year. For the variant 1B the according figures run to about 200,000 and € 156 per year.

1.1.1 Ship of type "Labe", licensed for the Czech Republic

The Czech ship type "Labe" mainly runs as already mentioned before on the river Elbe but also within the German canal network including hinterland traffic between Rotterdam and Germany as well as the Czech Republic. Since her capacity almost corresponds to that of the Western European vessel and the operation areas overlap cost structures in relation to the western vessel are significant.

Czech statistics contain in all 67 self-propelled ships with dead-weight of between 650 and 1500 t. Of those, some estimated 40-50 units might belong to the "Europe"-type ship. On the other hand, the international Rhine fleet counts more than 1619 ships of such type resulting in a ratio of 2.3%.

The German fleet outside the Rhine area, i.e. (apart from the German part of the Danube region) above all within the East-West corridor, comprises approximately a few hundred units of such type. Compared to the aforementioned 40-50 Czech vessels, in this case a stronger intramodal competition exists.

Although the number of this type of vessels within the Czech Republic and the German part of the East-West corridor is rather small it is obvious that the intramodal competition rather occurs between those two groups ***within*** the East-West corridor than between the Czech ships and the International Rhine fleet.

Operator structure, mode of operation and operating time

It is assumed that this vessel is operated by a Czech shipping company[7]. Like for the German ship a mode of operation of 14 hours is chosen. The operating season is also estimated at 300 days per year (in case of exclusive operation on the river Elbe this time would be limited by draught restrictions to about 250 days).

Staff costs and social payments

This Czech ship sails with a crew typical for that type which consists of two teams of three crewmembers each. They change once per month meaning that one team is working while the other stays at home. Within 30 days à 14 hours the crew stays on board about 420

---

[7] Source of the following cost estimation for the ship of type „Labe“: Karel Horyna, Czech Republic

hours[8]. This way they earn their wages for both the running month and the month free of work plus 100 hours overtime. As a result, personnel costs including social payments come up to € 4,500 per month (both teams). The surcharge, which covers days out of service, holiday, etc. arising for independent owners will not be applied for this calculation. Instead it is quite usual to pay travel expenses/daily allowances for the staff exchange/employment abroad which are to be considered with € 1,500 per month. Spread out on the whole year wages arise for 12 months, travel expenses/daily allowances for 10 months, resulting in total costs of about € 69,000 per year.

Maintenance/Repair, Depreciation and Interest

The age of the ships is estimated at 25 years on average. About 10% of the fleet had been modernised and equipped with new main engines and bow thrusters; propulsion output is on average 420 kW. Costs for maintenance and repairs[9] are estimated at about € 1,500 per month. As a result, costs of € 18,000 per year come about. As regards costs of capital there is no information available on depreciation and interests; at present Czech banks do not offer to finance ships. The monthly leasing rates are however known and will substitute the two other items. They amount to about € 5,000 per month and cause annual costs of € 60,000 per year.

Insurance

As far as insurance is concerned, hull insurance and liability insurance which (required within the Czech Republic) form the basis. They both are estimated at € 750 per month on average accumulating to about € 9,000 per year.

The costs for all items per ship amount to about € 156,000 per year. Related to one ton dead-weight (tdw) this equals to about € 131 per year.

---

8 Depending on the point of view, there are different opinions on the question, if the time on board completely or only partly should be considered as working time. Despite of different views, in this case this time has been considered as working time according to the practice at the respective Czech company.

[9] Reference year 2002, repairs were carried out within the Czech Republic. After the sale of the shipyards (at the end of 2002) repairs will be organized when required, which means less repairs are carried out. (This implies a higher failure risk or a dropping reliability, respectively, on a both short- or long term basis).

	Variant	Personnel [€/year]	Maintenan./ Repair [€/year]	Depreciation and Interest [€/year]	Insurance [€/year]	TOTAL per vessel [€/year]	TOTAL per tdw. [€/year]
2	2 teams (3 pers. each, 30 days shift)	69,000	18,000	60,000	9,000	156,000	131

Table 2. Standby costs „Labe“-type ship (license for the Czech Republic)

1.1.2 Ship of “Europe”-size (Danube)

Regarding the ship of “Europe”-size with license for the Danube corridor different circumstances are to be considered. First of all those vessels should be listed which are already registered within the Danube corridor. Their number is rather limited however. 12 and 13 ships, respectively, are registered within Austria, Bulgaria and Romania, additional 6 within Slovakia and 15 within Serbia (there are no figures available for Hungary), added up to about 59 units of the size 1000-1550 tdw[10]. Compared to this figure, the Rhine fleet consists of 1619 ships of that type and size.

Technical equipment of these vessels is in many cases equivalent of the western standard for the ships of such type and size. Many ships do comply with the requirements set up for the operation within the Rhine area, e.g. regarding propulsion output, manoeuvrability, stopping ability, etc. Presumably about 30 of the mentioned 59 ships are concerned which would equal to just below 2% of the Rhine fleet.

Operator structure, mode of operation and operating time

In times of socialism regime inland navigation within the Danube countries was the task of the state owned shipping lines. Today, many of these companies, like the national economies as a whole, find themselves in a transition process from planned to free market economy causing a continuous changing of circumstances and structures. In some cases the shipping lines (either still state owned or already taken into private ownership) still operate in similar or slightly modified (management) structures. In other cases, new and more efficient management and operation structures occur.

With regard to the forthcoming EU-enlargement to the east, different options regarding company and management structures are possible. It can be assumed that in the future independent shipowners enter the market, introducing modern and more cost-effective operation structures, leading e.g. to lower management costs. Another option would be the

---

[10] Possible inaccuracies within the statistics which means not operating vessels could not be considered.

establishing of joint ventures using western vessels and management structures combined with personnel from the east.

On the other hand in the future (after accession to the European Union) a further increase of personnel costs, approaching towards the western level, is expected to occur in the accession countries. Although there are good arguments for these effects to get real, presently it must be left open how far and to which extent these developments will take place. Since both developments have opposite tendencies (cost decrease by lean and efficient company structures on the one hand, and cost increase due to increasing personnel costs on the other hand) they at least partly might compensate each other.

Therefore, it has to be kept in mind that the following cost data just outline the momentary situation. Variations might occur due to the described changes of circumstances and structures.

Data of single vessels from Slovakian and Hungarian companies form the bases of this variant. The nautical season is estimated at about 300 days per year.

Personnel costs and social payments

Wage levels in Hungary and Slovakia are - with reference to one person - almost identical though personnel costs for one crew in Hungary exceed (due to a probably higher number of crewmembers) those of a Slovakian crew. Without analysing crew numbers in details an average value for both countries simplifies the presentation (see aforementioned Planco study) which is given at € 40 per tdw and year. Consequently, costs of the complete vessels amount to about € 51,000 per year .

Maintenance/repair, depreciation and interests

Once again, the specific average costs of a Slovakian and a Hungarian vessel according to the aforementioned source are laid down. They amount to € 14 and € 34 per tdw and year for maintenance/repair and depreciation; for the ship as a whole the costs are about € 18,000 and € 43,500 per year. Concerning interests there is no information available. As an approximation the respective figure from the Rhine vessel (€ 10,000 per year) has been assumed.

Insurance

Insurance costs rise to € 4 per tdw and year on average based on the Hungarian and Slovakian ships. so that the costs per vessel reach about € 5,000 per year.

	Variant	Personnel [€/year]	Maintenance/ Repair [€/year]	Depre-ciation [€/year]	Interests [€/year]	Insurance [€/year]	TOTAL per vessel [€/year]	TOTAL per tdw [€/year]
3	Eastern companies with Europe type ships from the east	51,000	18,000	43,500	10,000	5,000	127,500	99

Table 3. Standby costs „Europe“-type ship (license for the Danube corridor)

1.1.3 GMS-type, "Large cargo motor ship" (Rhine)

The number of this vessel type, licensed for the Rhine corridor, has steadily grown on the river Rhine over recent decades. They transport bulk cargo as well as containers being able to stack 4 containers abreast (total capacity for 4 layers about 200 TEU). At a draught of 3.50 m they have dead-weight of about 2850 t. Their propulsion output has been adapted to the hydrodynamic conditions for navigation on the Rhine and normally amounts to between 1000-1200 kW, for pushed trains up to 1600 kW; as reference value 1200 kW are considered here. The majority of these vessels are well equipped with for example bow thrusters, elevating wheelhouse, etc.

Operator structure, mode of operation and operating time

Different modes of operation can be applied aboard this type of vessel. Basically, ships with high capital intensity should be operated intensely. This concerns ships such as tankers as well as quite new vessels. These ships tend to a continuous operation (mode B, 24 hours per day), than to mode of operation A1/daily navigation (14 hours per day). Vessels, which transport containers, often operate in the continuous mode as well. For the operation on the river Rhine the Regulations for vessels operating on the Rhine claim 4 or 5 crewmembers, respectively, two skippers, one helmsman with Rhine patent and one able seaman or two skippers, one helmsman and two able seamen. On the other hand, mode A1/daily navigation requires only one skipper, one helmsman and one able seaman. For the semi-continuous mode of navigation A2 (18 hours per day) 2 skippers, one able seaman as well as one trainee are necessary.

Particularly new ships, intended to operate in continuous mode are basically equipped with the necessary number of sleeping accommodations for the additional personnel. Many ships however, are not able to operate in continuous mode. Its cause is to be found in the missing of appropriate accommodation for the additional crew member and in a lack of qualified personnel which is difficult to find (see SWP 2.4) and thus rather expensive. For this reason the “medium” mode of operation A2 (up to 18 hours per day) is applied as an example which is not that personnel-intensive. The estimated operating time per year amounts to 320 days[11]. Likewise, a private ownership is assumed since it can often be met within the Rhine corridor.

Personnel costs and social payments

On the assumption of different variants the analysis of the personnel costs is carried out in the same manner as for the “Europe” vessel. Variant 4A foresees an independent ship owner including one accompanying family member (one skipper and one able seaman).The second skipper and able seaman work as employees. Personnel costs including social payments are estimated at about € 140,000 per year. Within variant 4Bn the accompanying family member is substituted by an additional employee. Personnel cost including social payments are figured up at about € 175,000 per year.

On account of longer operating times and days compared to the “Europe” type vessel, the correcting factor is estimated here exemplary 1.2 (instead of 1.15).

Maintenance/Repair, Depreciation and Interests

Like for the “Europe” vessel, costs for maintenance and repair, depreciation as well as interests are taken on the basis of actual costs for a group of suitable ships. Average values for a group of German and Dutch vessels deriving from the cost plan of the aforementioned Planco study will be considered. Maintenance and repair are calculated at about € 18, depreciation at about € 40 and interests at about € 6 per tdw and year. As a result, costs for the ship as a whole accumulate to about € 51,000 per year for maintenance and repair, about € 114,000 per year for depreciation and about € 17,000 for interests.

Insurance

The determination of the insurance costs is also based on the aforementioned cost plan. Insurance costs are indicated at about € 10.5 per tdw and year amounting to about € 30,000/year for the whole ship.

---

[11] The assumptions of operation mode A2 (up to 18 hours/day instead of 14) and sailing season of 320 days/year (instead of 300) are made in order to demonstrate calculation as close to reality as possible. On the other hand distortions between the different variants might arise from these assumptions. For this reason further calculations have been made for the variants 4 A/B, based on mode A1 (14 hours/day) and 300 days/year sailing season. In this case, firstly the standby costs/day decrease caused by lower crew members, but due to the shorter sailing time per day the number of days in operation – related to a certain transport task - grows. Related to the analysed transport example the individual costs (€/t) are almost equal to those shown in table 7 below (see chapter 4.5, operating costs), the differences amount to only 1-3%. Hence, no further differenciation on this topic has been made.

	Variant	Personnel [€/year]	Mainte-nance./ Repair [€/year]	Depre-ciation [€/year]	Interests [€/year]	Insurance [€/year]	TOTAL per vessel [€/year]	TOTAL per ton tdw [€/year]
4 A	Shipper (independent owner) + 1 member of family + 2 employees	168,000	51,000	114,000	17,000	30,000	380,000	133
4 B	Shipper (independent owner) + 3 employees	210,000	51,000	114,000	17,000	30,000	422,000	148

Table 4. Standby costs for the GMS-type, „Large cargo motor ship" (license for the Rhine corridor)

The total costs per vessel amount for the variant 4A to about € 380,000 per year. Related to one ton dead-weight this equals to about € 133 per year and for the variant 4B comparative figures are about € 422,000 per year and € 148 per year, respectively.

1.1.4 Danube pushed train

Pushed trains represent the most important ships along the Danube and take up the major part within the fleets. One Romanian pushed train with a dead-weight of about 6,000 t and a propulsion output of 1,700 kW is considered within this study. Unlike the other single self propelled vessels, types "Europe" and "large cargo motor ship", this pushed train will not operate within different corridors, but only along the Danube.

There is no information as regards operator structure, operating mode and operating time. Therefore, a shipping company operation prevailing within the Danube area is assumed. An estimated nautical season of about 300 days per year and a continuous navigation mode (24 hours per day) are applied[12]. Costs do also go back to the a.m. Planco study. As the conversion to another ship size is omitted, here total costs of the individual items instead of specific costs per tdw will be looked at directly. Since costs for interests are not given in this case, as an approximation the average percentage of the previous examples (5.5% of total costs) has been adopted.

---

[12] The continuous navigation mode is oftenly used on the Danube, esp. in case of long-distance transports. In case of daytime operation mode (up to 14 hours/day) the standby costs/day would be reduced due to lower crew members while on the other hand the days of operation and hence the operation costs related to a certain transport task would grow according to the footnote under chapter 4.4.4.

	Variant	Personnel [€/year]	Mainte-nance/ Repair [€/year]	Depre-ciation [€/year]	Interests [€/year]	Insurance [€/year]	TOTAL per vessel [€/year]	TOTAL per tdw [€/year]
5	Danube pushed train (license for Romania)	30´000	15´000	104´000	9´000	7´000	165´000	27,5

Table 5. Standby costs „Danube pushed train“ (license for Romania)

Total costs per vessel and year amount to about € 165,000, converted to one ton dead-weight this equals to about € 27.5. Compared to the previous variants this amount is explicitly low which is mainly caused by two factors, namely the size effect on the one hand and the fairly low cost level within Romania on the other. The fact that the pushed train with dead-weight of 6000 t is able to transport twice the quantity of the “large cargo motor ship” and five times more than the “Europe”-type ship explicitly underlines the size effect.

As to the second aspect, it can be pointed out that the wage level in Romania is only about one third of the Hungarian or Slovakian and less than one tenth of that within the countries of the Rhine corridor. Likewise, insurance costs are very low; related to one ton dead-weight they fall below the level of Hungary and Slovakia and come up to one tenth of the costs within the countries of the Rhine corridor. The same applies to costs for maintenance and repair particularly, in relation to the dead-weight of the pushed convoy. On the one hand the system related moderate costs regarding the large unit and on the other the favourable age of only about 14 years of the Romanian pushed trains contribute to this situation. Only specific costs for depreciation seem to have the size of those within other countries.

1.1.2 Overall view on standby costs

Results of the preceding calculations are compiled within the following table. Apart from the already mentioned total costs per year and ship and the total costs per year and tdw, total costs per day are being turned out. The overall view clarifies cost advantages of the “Europe”-type ship with license for the Czech Republic (variant 2) and above all with license for the Danube corridor (variants 3A and 3B) towards the license for the Rhine corridor (variants 1A and 1B). The “large cargo motor ship” is, related to the ship as a whole, much more expensive than the previous variants. With reference to the dead-weight however, the order of magnitude is almost the same as of the “Europe”-type ship. The Danube pushed train is characterised by low costs related to the ship size and per ton dead-weight, respectively.

	Variant	Standby costs per year (ship) [€/ a]	Standby costs per year and tdw [€/ a/ t]	Standby costs per day (ship) [€/ d]
1A	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 member of family	160´000	(1280 t) 125	(300 d) 533
1B	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 employee	200´000	(1280 t) 156	(300 d) 667
2	Europe-type ship lic. f. Czech Republic; 2 teams (3 pers. each, 30 days shift)	156´000	(1190 t) 131	(300 d) 520
3	Europe-type ship lic. f. Danube corridor; eastern company with ships from the east	127´500	(1280 t) 99	(300 d) 425
4A	Large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 1 member of family + 2 employees	380´000	(2850 t) 133	(320 d) 1188
4B	large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 3 employees	422´000	(2850 t) 148	(320 d) 1319
5	pushed train Danube (license in Romania)	165´000	(6000 t) 27,5	(300 d) 550

Table 6. Overview on standby costs

Though this overall view allows for a first assessment it remains incomplete however as this calculation does not yet contain the operating cost. This will be analysed within the next step.

1.2 Operating costs and total costs

1.1.5 Approach

As already mentioned, operating costs will be determined in a simplified way with the help of the average fuel consumption, the fuel price as well as a surcharge for lubricants. While the installed main engine output varies for the different ships standard, equal assumptions are made as to the other parameters in order to prevent a distortion of the results. The following assumptions are being made:

▪ medium rate of capacity utilisation of main engine[13]	60%
▪ specific consumption of main engine	0.2 kg/kWh
▪ density of fuel	0.835 kg/l
▪ price of fuel[14]	0.2 €/l
▪ surcharge for lubricant (added to fuel costs)	3%
▪ surcharge for shipping company management costs or provisions respectively[15]	15%

Operating costs are explained with the help of a simple example which serves for demonstration purpose:

A transport with a running time of 72 hours is assumed[16]. For the mode daily navigation (14 hours per day, variants 1A, 1B, 2, 3A) this corresponds to an operating time of about 5.14 days. In case of the mode semi-continuous navigation (18 hours per day, variants 4A and 4B) 4 days, for continuous mode (variant 5) 3 days would be necessary. Times for loading and unloading of the vessel as well as waiting times depend on the existing conditions.

---

[13] According to the characteristic of the respective stretch (or mixture of different stretches) the rate of capacity utilisation of the main engine differs severely, on canals it might fall below 30%, on free flowing rivers with a high stream flow it could nearly reach 100% (upstream). A standard value of 60% will be applied here.

[14] Fuel price varies more or less not only among the different areas but also as far as time periods are concerned. So, prices within sea port are often lower than within hinterland. For the purpose of an intramodal comparison only those circumstances will be considered in which ships run within the same operating area (such as vessels of the Rhine fleet and the Danube fleet within the Rhine corridor), so that the same price covers both cases. Thus, the same price will be taken for all variants, i.e. the presently valid level of 0.2 €/l. This procedure will help to avoid a distortion of the calculation resulting from possibly differing national prices.

15 In several cases shipping companies calculate a surcharge for management costs on the operation costs. The amount of these surcharges differs from case to case. Independent shipowners usually can avoid or at least reduce this cost position. They, however usually pay a provision fee for acquisition of transport orders. This position often amounts to a similar size. In other cases it is usual, not to add these surcharges on the operation costs, but on the standby costs. For simplification reason and to avoid distortions, here the surcharges have been calculated to 15% of the operation costs in all cases.

16 For simplification reasons, in this transport example in all cases the same speed and distance has been assumed.

Normally, they tend to be longer within the east than in the west. For simplification reasons, they are estimated at 1 day for the Europe type vessels and 2 days for the large cargo motor ship (since this vessel is able to carry about 2 x as much as the Europe type vessel) . With regard to the Danube pushed train, which is able to carry more than 2 times as much as the large cargo motor ship, 4 days of loading / unloading time will be applied. . All other conditions remain stable (unmodified). In the following the operating costs will be determined for the different variants.

1.2.1 Overall view on operating costs and total costs

From the sum of the standby- and operating costs total costs emerge; here shown with the help of the aforementioned example. Total costs will be distributed to the cargo volume resulting in costs per ton. Further, three different rates of capacity utilisation[17] will be considered and analysed which means 90%, 70% and 50%. The results of the calculation are shown in table 7 below .

---

[17] The rate of capacity utilisation refers to the weight capacity, not to the TEU- or volume capacity. In practice different rates of capacity utilisation depending on the existing conditions will be met.

	Variant	Standby costs [€]	Operating costs [€]	Total costs [€]	Individual costs [€/ t] at a rate of capacity utilization of 90%	70%	50%
1A	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 member of family	3´273	1´838	5´111	(1152 t) 4.44	(896 t) 5.70	(640 t) 7.99
1B	Europe-type ship lic. f. Rhine corridor; skipper (independent owner) + 1 employee	4´095	1´838	5´933	(1152 t) 5.15	(896 t) 6.62	(640 t) 9.27
2	Europe-type ship lic. f. Czech Republic; 2 teams (3 pers. each, 30 days shift)	3´193	1´027	4´220	(1071 t) 3.94	(833 t) 5.07	(595 t) 7.09
3	Europe-type ship lic. f. Danube corridor; eastern company with existing ships from the east	2´610	1´838	4´448	(1152 t) 3.86	(896 t) 4.96	(640 t) 6.95
4A	large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 1 member of family + 2 employees	7´238	2´948	10´076	(2565 t) 3.93	(1995 t) 5.05	(1425 t) 7.07
4B	large cargo mot. sh. lic. f. Rhine corridor; skipper (independent owner) + 3 employees	7´914	2´948	10´862	(2565 t) 4.23	(1995 t) 5.44	(1425 t) 7.62
5	pushed train Danube (license in Romania)	3´850	4´167	8´017	(5400 t) 1.48	(4200 t) 1.91	(3000 t) 2.67

Table 7. Total and individual costs (related to the analysed transport example, see chapter 4.5.1)

The following conclusions can be taken from this table:

Registration effect

The “Registration effect” covers those consequences resulting from the registration of a ship within a corridor with its specific circumstances (e.g. level of wages). This effect will not be distorted if ships of the same type and size are compared. The registration effect mainly relates to the intramodal competition among different fleets and nations.

The comparison of the variants 1A/B and 3 shows that in case of the “Europe”-type ship a license for the Danube corridor (variant 3) is more favourable in terms of costs than for the Rhine corridor (variants 1A/B). Lower costs for personnel and for insurance within the Danube corridor cause this advantage. Costs for maintenance/repair and depreciation are almost the same.

Likewise, cost advantages appear in case of ship registration within the Czech Republic (variant 2) compared to a license for the Rhine corridor or the German part of the East-West-corridor, respectively, however, to a slightly lower extent than for variant 3. Costs for insurance are – like within the Danube corridor – below those existing for a ship within the Rhine corridor. Costs for maintenance/repair are slightly lower than for the aforementioned western vessel. However, cost advantages arise by the minor propulsion output, which is reflected within the moderate operating costs.

Size effect

The “size effect” describes the situation outlined within Figure 2. With rising ship size specific costs fall on the same conditions and vice versa. This statement is valid irrespective of corridors and can basically even be applied to vessels of other sizes (which are not analysed here).

The comparison of the variants 1A/B and 4A/B clarifies that on same circumstances (license for the Rhine corridor) and despite of clearly higher total costs the larger cargo motor ship (variant 4A/B) shows lower individual costs than the “Europe”-type vessel (variant 1A/B).

The cost advantage resulting from the size effect is – related to this example - in terms of value almost the same as the advantage by the registration effect (license “Europe”-type vessel for the Danube corridor, variant 3 towards license “Europe”-type ship for the Rhine corridor, variant 1A/B). From another point of view it is obvious that the “Europe”-type ship with license for the Danube corridor despite of her small size realises just as favourable costs as the “large cargo motor ship” with license for the Rhine corridor.

When comparing the Danube pushed train with the “Europe”-type ship the size effect will be explicitly obvious. In doing so it has to be kept in mind that in this case a “registration effect” will occur within the Danube corridor, as a registration of the “Europe”-type vessel has been assumed for Slovakia and Hungary, respectively, and regarding the pushed train within Romania.

While the size effect will remain unchanged, the registration effect might decrease on midterm horizon due to alignment tendencies in cost structures of western and eastern companies.

Rate of capacity utilisation effect

The comparison of the rates of capacity utilisation stresses, to which high extent individual costs increase with dropping capacity utilisation rates, e.g. caused by limited draught (see explanation for the aforementioned Figure 1). For this example the difference in costs between the rates of capacity utilisation of 50% and 90% is clearly higher than the aforementioned size effect between the variants 1A/B and 4A/B and the registration effect; therefore the capacity utilisation effect is the dominant one in this example.

Appendix 3: Inventory of waterways

1. United Kingdom

Inland navigation in United Kingdom has a very long tradition. Even before the invention of steam engine numerous navigable canals were constructed. With the mass introduction of railways in the mid of 19th century the inland navigation abruptly lost on commercial importance. Nowadays, the dense network of canals with very restricted dimensions which do not match since long time ago the needs of transportation market is mostly rehabilitated for recreational use. Proportionally only a very small share of waterways retains their importance for commercial cargo navigation.

The main inland waterways with considerable cargo transport volumes are maritime stretches of bigger rivers like Thames up to London (Tower Bridge), Mersey as an access to the Port of Liverpool, and estuaries of Severn, Ouse (Yorkshire, Goole) and Clyde (Glasgow). To this group belongs also the Manchester Ship Canal enabling sea-going vessels to reach the Port of Manchester.

At over 320 kilometres in total length the river Severn is amongst the most significant, natural river waterways in Britain. The river flows through some of England's major historic towns and cities. The navigable waterway from the sea side starts in commercial port of Sharpness (near Bristol) and leads over Gloucester up to Stourport.

River Ouse in Yorkshire (there is the river bearing identical name in Norfolk) is navigable for cargo transports in its lower stretch with annual volume of about 350.000 tons of goods.

Britain's premier waterway, the Grand Union connects London and Birmingham. The main line is 215 kilometres long, with arms to Paddington, Slough, Wendover, Aylesbury and Northampton. Once upon a time the canal was one of the most prosperous waterways in the country, formed through the amalgamation of 11 different canal companies. Today the canal plays an increasingly important role for leisure, providing opportunities for boating, walking, fishing, watersports, nature study, art and photography. Its virtue is its diversity, with a wide variety of landscapes, wildlife, architecture, historic craft and events.

Grand Truck (Trent & Mersey) Canal was opened in 1777. The canal proved immediately successful, carrying huge tonnages, with all manner of different types of cargo. With numerous branches and junctions, the canal soon became known as 'The Grand Truck Canal'. Today, the canal's great length and proximity to both towns and open countryside make it extremely popular. It also forms part of two circular canal routes: the Cheshire Ring and Four Counties Ring.

Union Canal and Caledonian Canal are located in Scotland.

According to the position of inland navigation nowadays, the United Kingdom might be classified in the category of countries with low IWT profile.

#	Name		Class		Length	Breadth[1]	Draught	Height	N° of locks	Remark
			IWT	R/S	(km)	(m)	(m)	(m)		
1	**Mersey**	Maritime sector		3	27	26.5	8.5	-	3	Maritime canal for larger sea-going ships
2	**Manchester Ship Canal**		VIa	3	58	23.3	7.8	21.3	5	Larger sea-going ships
3	**Severn**	Sharpness-Gloucester	III		27	9.1	2.7	32.0	2	
		Gloucester-Worcester	I		48	6.4		7.5	2	
		Worcester-Stourport	0		21	5.8	1.5	6.1	3	
4	**Thames**	Maritime sector		3	116		4.3			Tidal Thames with access of sea-going vessels
		T.Bridge-Teddington	Va		32	11.4	3.2			
		Teddington-Oxford	0		158	4.0	1.0	2.3	33	Capacity of the ship up to ~ 150 tdw
5	**Trent**	Nottingham-Cromwell Lock	I		46	5.3	1.5	3.8	8	Capacity of the ship up to ~ 200 tdw
		Cromwell Lock - Gainsborough	II		50	8.0	1.6		0	Capacity of the ship up to ~ 700 tdw
		Gainsborough – Trent Falls	III		34	11.4	4.5		0	Coasters up to ~ 1700 tdw
6	**Grand Union Canal**		0		215	3.7	1.0	2.3	180	Links London and Birmingham
7	**Grand Truck Canal**		0		160	2.1		1.7	79	Links Chester and Nottingham
8	**Aire & Calder Canal**		II		55	6.1	2.5	3.6	12	Ships of up to 700 tdw, link between Goole and Leeds
9	**New Junction Canal**		0		9	3.3		3.3	1	

Continue to next page

---

[1] Of the vessel

The United Kingdom– continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
10	**Ouse**	Goole-Selby	III		26	9.5	2.4	15.2	0	Tidal stretch, up to 3 LASH barges
		York-Selby	I		31	7.0	1.5	5.9	1	
11	**Union Canal**	Edinburgh-Falkirk	0		50	3.8	0.8	2.7		Including Forth & Clyde Canal
		Falkirk-Glasgow	0		62	6.0	1.6	3.0		
12	**Caledonian Canal**		II				3.7	35.0	0	Links Fort William and Inverness
13	**Leeds & Liverpool Canal**		0		204	4.3		2.4	91	

---

[1] Of the vessel

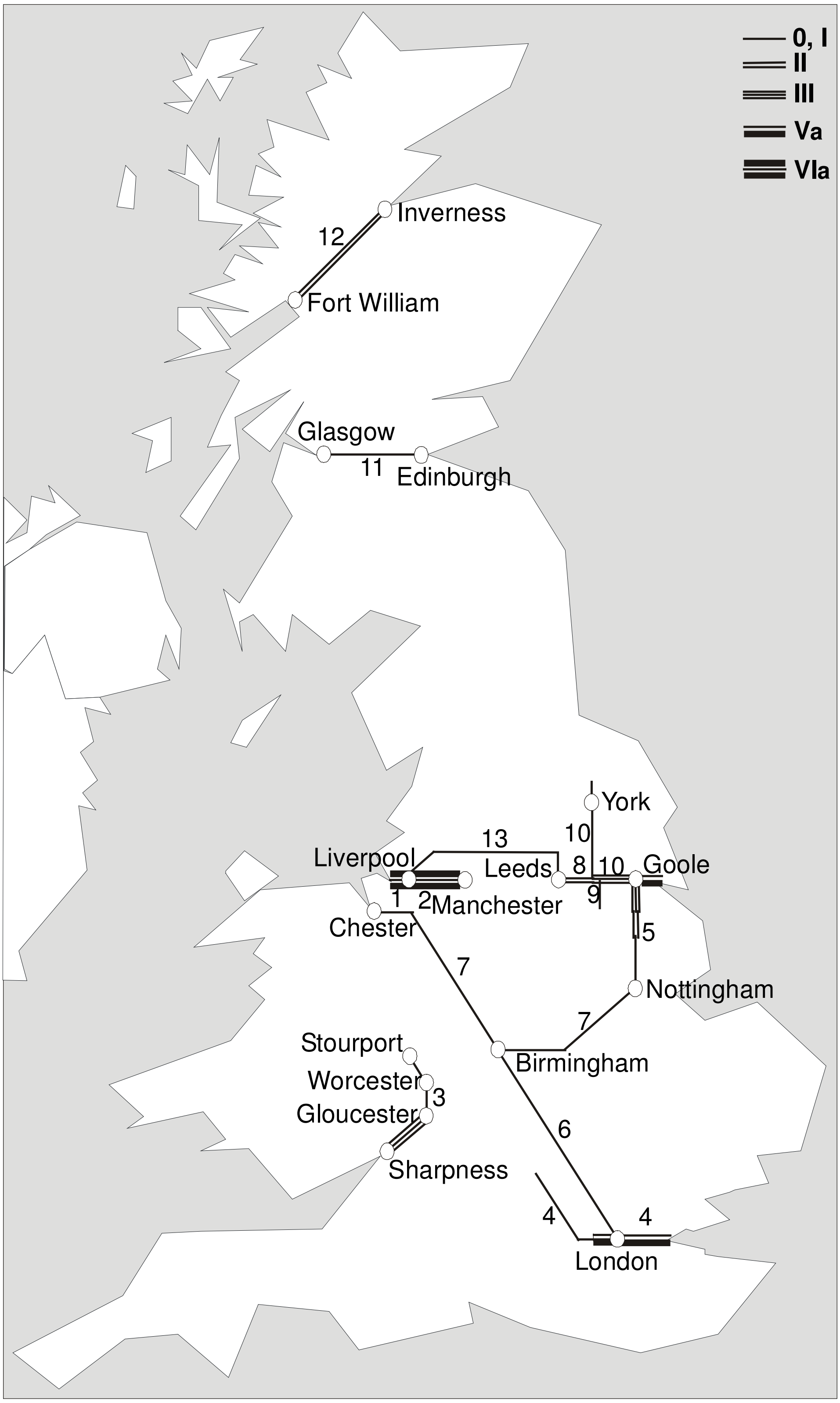


Fig. A1.1: Inland waterways in United Kingdom

2. The Netherlands, Belgium, northern part of France

With a total length of 5046 km meaning in average 123 length kilometres of waterways per 1000 square km of the land territory, the Netherlands is the country with by far the highest waterway network density in Europe. The second ranked is Belgium with 47 km/1000 sq. km. These two countries together with neighbouring Germany and France have densest network of inland waterways in Europe and represent the group of four EU countries with the highest IWT profile. Basic data are given in the following table.

German Rhein changes its name into Boven Rijn after passing the German-Dutch border at Lobith. Neder Rijn is the northern branch of the Rhine river diverging from main fairway at km 867. Southern (main) branch from that point downstream is named Waal.

Neder Rijn in the Table includes also Pannerdensch Kanal.

River Maas (waterway #14) includes Julianakanaal, Bergsche Maas and Amer (the entire stretch from Maastricht to Lage Zwaluwe).

#	**Name**	**Class**		**Length** (km)	**Breadth**[1] (m)	**Draught** (m)	**Height** (m)	**N° of locks**	**Remark**
		IWT	R/S						
1	**Boven Rijn**	VIc	2	10	34.3	3.5	9.1	0	Renamed Rhine after passing in the NL
2	**Neder Rijn**	Vb		60	17.7	3.5	9.1	2	Parallel waterway to the Rhine main arm
3	**Waal**	VIc	2	85	34.3	3.5	9.1	0	Renamed segment of the Rhine in the Netherlands
4	**Amsterdam-Rijnkanal**	VIb		97	22.8	4.0	9.1	4	

continued on next page

---

[1] allowed breadth of pushed train

The Netherlands, Belgium, northern part of France – continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
5	**Boven Merwede**		VIc	2	9	34.3	4.2		0	Renamed segment of the Rhine in the Netherlands
	Beneden Merwede		VIc	2	15	34.3	3.8	9.1	0	Renamed segment of the Rhine in the Netherlands
6	**Oude Maas**		VIc	3	31	34.3	8.8	42.5	0	Renamed segment of the Rhine in the Netherlands
7	**Lekkanaal**									
8	**Lek**		VIa			17.7	3.5	9.1	1	Parallel waterway to the Rhine main arm
9	**Noord**							12.6	0	
10	**Nieuwe Maas**							9.3	0	Parallel waterway to the Rhine main arm
11	**Nieuwe Merwede**							11.3	0	Parallel waterway to the Rhine main arm
12	**Dordsche Kil, Holl. Diep**					22.8				Link from Rhine to Schelde river
13	**Schelde-Rijnverbindung**		VIb		40	22.8	4.0	9.1	2	
14	**Maas**		Va		230	11.4	3.0	6.7	8	from Belgian border to Dordrecht
15	**Albert Canal**		VIa	1	129	15.4	5.0	6.7	6	
16	**Antwerpen-Brussels**		VIa		50	14.0	4.2	5.9	2	
17	**Meuse**	Givet - Namur	Va		45	11.4	2.5	6.3	10	
		Namur-Liege	Va		69	15.4	3.2		4	
18	**Charleroi-Brussels Canal**		IV		68	9.5	2.5		12	
19	**Gent-Terneuzen Canal**		VIb		34	22.8	6.0		1	
20	**Gent-Osten. Canal**	Ostende-Brugge	Vb						2	Gent-Oostende Canal
		Brugge-Gent	IV						2	
21	**Dunkerque-Lille**		Va		189	11.4	3.0	4.5	14	Dunkerque Escaut
22	**Seine**	Montreau-Paris	Va		95	11.4	2.8	5.5	11	
		Paris-Rouen	Vb	1	242	11.4	3.5	6.0	7	Locks with more chambers
		Rouen - Le Havre	VIb	3	105	22.8	5.5	-	0	

continued on next page

---

[1] allowed breadth of pushed train

The Netherlands, Belgium, northern part of France – continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
23	**Brugge-Zeebrugge Canal**		VIb	3					1	
24	**Lys**	Gent-Deinze	Va			11.4	2.5	4.5	1	Between Lille in France and Gent in Belgium
		Deinze-Lille	IV			9.5	2.5		6	
25	**Oise**		Vb		100	11.4	2.5	5.25	8	
26	**Canal du Nord**		II		95	5.25	2.4	4.28	19	Between Oise and Canal de Aire
27	**Yonne**		I		108	8.0	1.8	4.4	21	
28	**Marne**		I		215	7.6	1.8	4.43	8	
29	**Sambre**		IV			9.5	2.5		7	Namur-Charleroi Waterway
30	**Terneuzen-Antwerpen**			3						Seaway
31	**Wesel-Datteln-Kanal**		Vb		60	11.4	2.8	6.5	6	waterway #8 on map N°3
32	**Rhein**		VIc	2	179	34.3	2.5	9.1	0	waterway #1 on map N°3
33	**Geldersche IJssel**		Va		136	11.4	1.7	10.8	0	waterway #17 on map N°3
34	**Twenthe Kanal**		IV		50	9.7	2.6	7.3	3	waterway #15 on map N°3
35	**Brussels - Gent Canal**		IV							
			Va							
			VIa			14.0	4.2	5.9	2	Part of the Antwerpen-Brussels Canal
36	**Schelde**		VIa							Southern part of the river, upstream Gent
37	**Escaut**		IV			9.5	2.5	4.5	3	Elevator Strepy-Thieu near Mons for ~1350 tdw ships
38	**Sensee**		Va			11.4	2.5		8	Bauvin-Valentiennes
39	**Canal du Centre**		IV			9.5	2.5		5	
40	**Canal de la Nethe**		Iv			9.5	2.5		2	
41	**Canal de Louvain**		II						5	
42	**Somme**		I						10	

---

[1] allowed breadth of pushed train

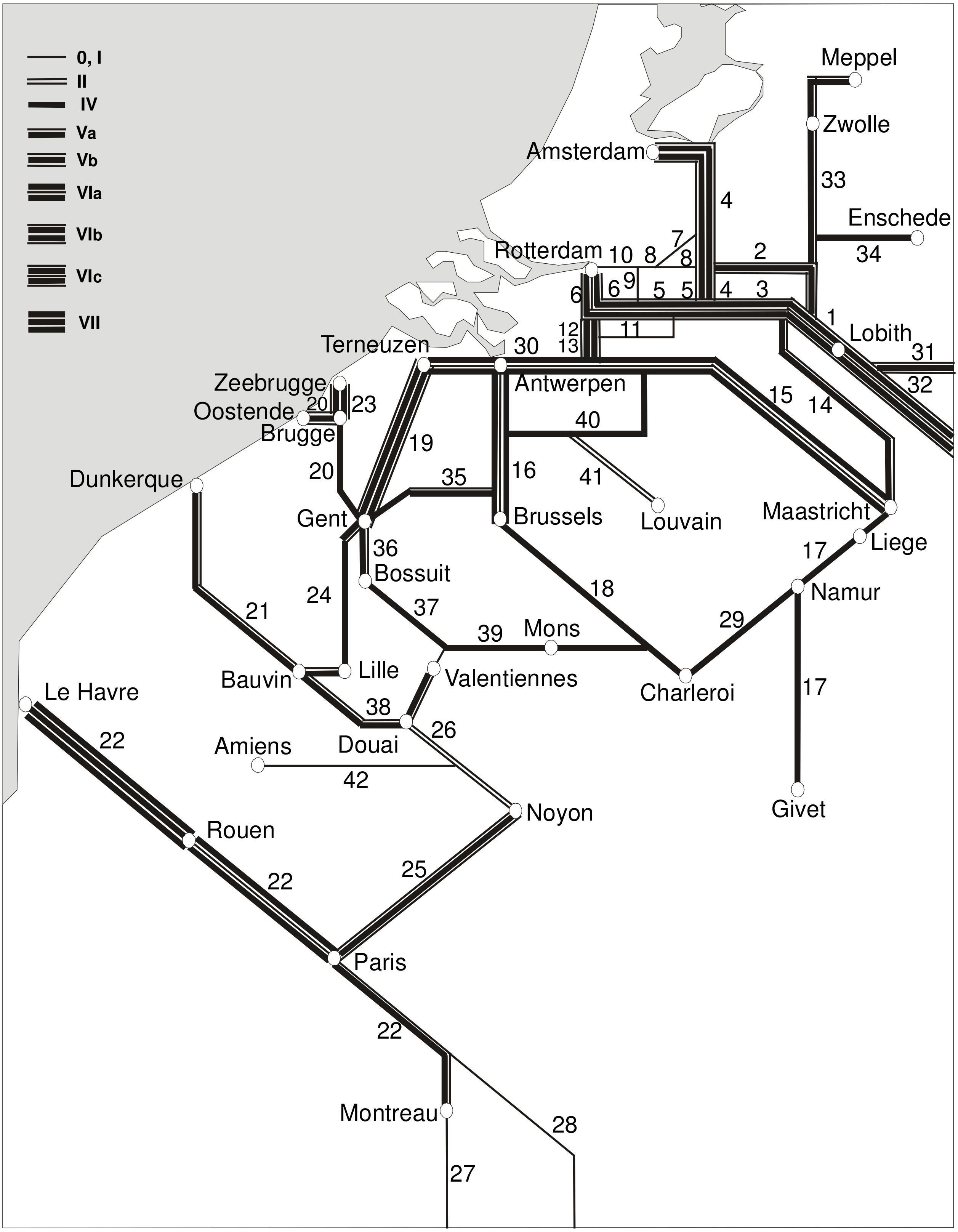


Fig. A1.2: Inland waterways in The Netherlands, Belgium and the northern part of France

2a. Selection of the most important waterways in the Netherlands

#	Name	Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
		IWT	R/S						
1a	**Boven Rijn**	VIc	2	3,5	22,8/34,2	4.5	-	0	From Lobith (border) to Pannerden
1b	**Waal**	VIc	2	85,1	22,8/34,2	4.5	17.2	0	From Pannerden to Gorinchem
1c	**Boven + Beneden Merwede**	VIc	2	22,7	22,8/34,2	4.4	11.6	0	From Gorinchem to Dordrecht
1d	**Noord**	VIc	2	8,7	22,8/34,2	4.4	12.9	0	From Dordrecht to Krimpen a/d Lek
2a	**Pannerdensch Kanaal**	Va		11,0	17,0	4.5	21.1	0	From Pannerden to Arnhem
2b	**Neder Rijn**	Va		48,6	17,0	4.5	13.2	2	From Arnhem to Wijk bij Duurstede
2c	**Lek**	Via	2	59,0	22,8/12,0	4.5	15.5	0	From Wijk bij Duurstede to Krimpen a/d Lek
3	**Nieuwe Mass**	Vib	2	46,3	23,0	4.5	12.3	0	From Krimpen a/d Lek to Vlaardingen
4	**Oude Maas**	VIc		30,8	25,0	8,8	11.4	0	From Dordrecht to Vlaardingen
5a	**Hartel Kanaal**	Vic		23.7	22,8/34,2	4.5	10.0	0	From Spijkenisse to Maasvlakte
5b	**Dordtsche Kil**	Vic	3	9,1	25,0	7,8	-	0	From Moerdijk to Dordrecht
6	**Amsterdam-Rijnkanal**	VIb		64,1	23,0	4,0	9,0	3	From Amsterdam to Tiel
7	**Noordzee-Kanaal**	Vib	3	34,5	42,0	13,1	-	1	From IJmuiden to Amsterdam
8	**Zaan**	Va		21,0	11,5	2,7	-	1	From Amsterdam to Alkmaardermeer
9	**Amsterdam-Lemmer Link via Harinxma locks**	Vb		80,8	17,5	3,5	-	3	From Amsterdam to Lemmer (southern route; there is also a northern route via Krabbersgat locks)
10a	**Prinses Margriet Kanaal**	IV		87,6	10,5	2,6	5.4	3	Including van Starkenborgh Kanaal; from Lemmer to Groningen; being upgraded now!
10b	**Eemskanaal**	Va		26,4	13,0	4,5	5.4	1	From Groningen to Delfzijl; being upgraded now!

Continued on next page

---

[1] allowed breadth of pushed train

Selection of the most important waterways in the Netherlands

Continued from previous page

#	Name	Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
		IWT	R/S						
11	**Zwarte Water/Meppelerdiep**	IV		25,3	11,5	3,0	-	0	From Ketelmeer to Meppel
12	**Gelderse IJssel**	Va		134,8	12,0	4.5	10.9	0	From Arnhem to Ketelmeer
13	**Zuthphen-Enschede Kanaal**	IV		49,8	11,5/9,75	2,8/2,6	6.3	3	From Zutphen to Enschede
14	**Zijkanaal naaar Almelo**	Va		15,6	9,75	2,5	6.4	0	From Almelo to Zuthphen-Enschede Kanaal
15	**Hollandsche Ijssel**	Ya		18,9	11,5	2,7	8.5	1	From Rotterdam to Gouda (this stretch)
16	**Maas-Waal Kanaal**	Vb		13,4	14,0	3,0	9.9	2	From Nijmegen to Mook
17	**Maas/Julianakanaal**	Va		231,4	14,0/13,5	3,0/3,5	6.3	10	From Moerdijk to Maastricht/Belgian border
18	**Zuid-Willemsvaart**	II		66,8	7,2	1,9	5.2	13	From ‘s-Hertogenbosch to Nederweert
19	**Schelde-Rijnverbindung**	VIb	3	67,4	23,0	4,0	9.1	3	Down to Antwerp (in NL rom St Philipsland to Belgian border)
20	**Grevelingen**	VIa		10,5	23,0	4,75	-	1	Just a stretch (part) of the waterway
21	**Kanaal door Zuid-Beveland**	VIb		32,1	23,0	4,0	4.8	1	From Oosterschelde to Westerschelde
22	**Westerschelde**	Sea	3	46,0	23,0	4,0	-	1	from Gent-Terneuzen Canal to Rijn-Schelde link
23	**Gent-Terneuzen Kanaal**	VIb		29,7	22.8	4,0	-	1	From Belgian border to Terneuzen
24a	**Nieuwe Merwede**	VIc		18,5	22,8	4.5	-	0	From Gorinchem to Moerdijk
24b	**Hollandsch Diep**	Vic	3	13,8	25,0	7,8	10.2	0	From Moerdijk to Grevelingen
25	**Wessem-Nederweert Kanaal**	II		16,3	7,2	2,1	5.0	1	Link between Maas and Zuid-Willemsvaart

---

[1] allowed breadth of pushed train

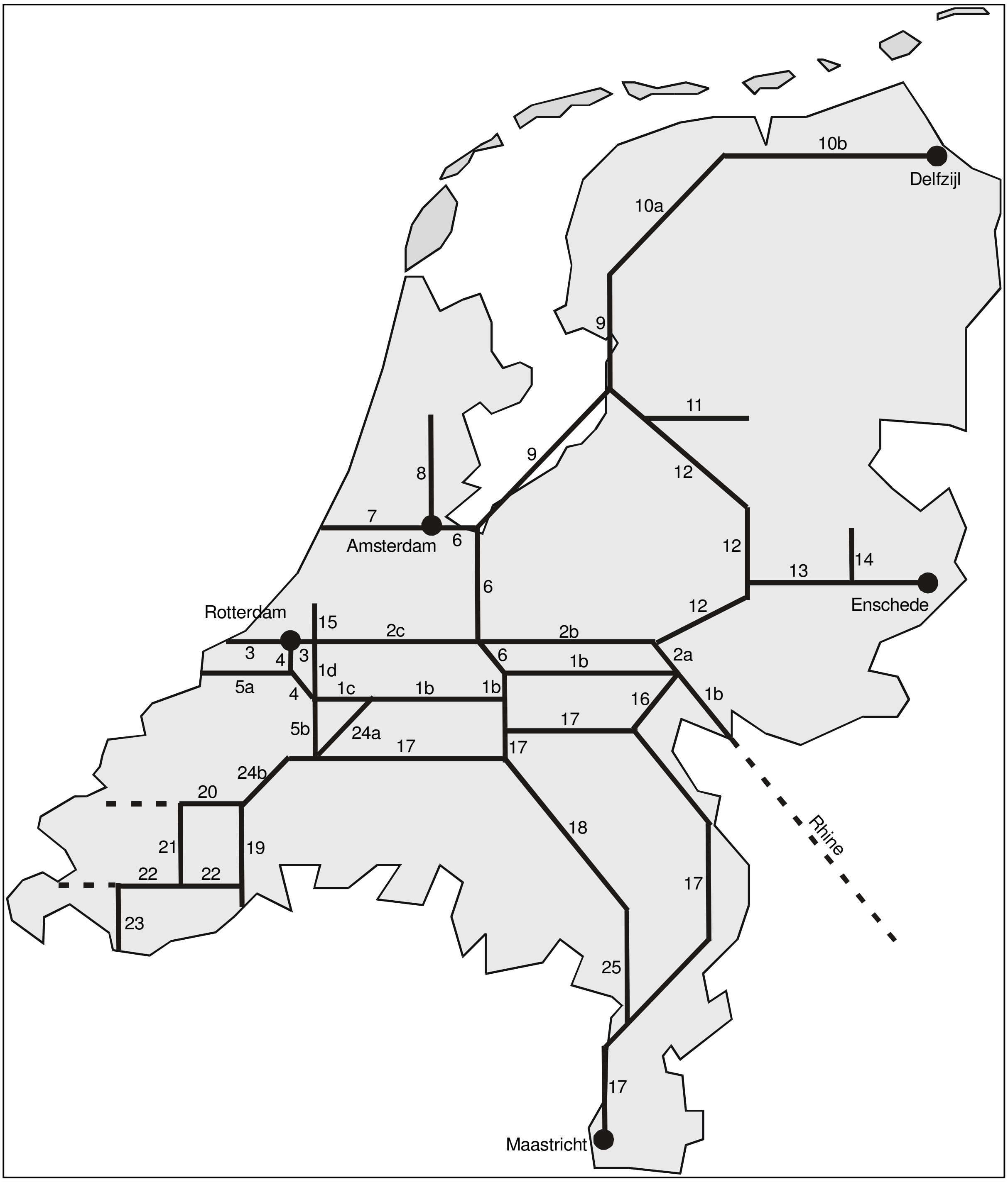


Fig. A1.2a: Selected inland waterways in the Netherlands

3. Germany (Rhein confluence), Luxembourg, Switzerland, part of France

The improvements of Dortmund-Ems-Canal are under work and expect to be accomplished till 2007. Then the entire length of 225 km between Dortmund and the Ems river will be upgraded to ECE class Vb with guaranteed draught of 2.8 m.

The abbreviated names of particular waterways have the following meanings:

- RHK – Rhein-Herne-Kanal
- WDK – Wesel-Datteln-Kanal
- ESK – Elbe-Seitenkanal (Elbe Lateral Canal)
- MLK – Mittelland-Kanal
- DHK – Datteln-Hamm-Kanal
- DEK – Dortmund-Ems-Kanal
- KüK – Küstenkanal (Coastal Canal)

#	Name		Class		Length (km)	Breadth[1] (m)	Draught[2] (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Rhein**	Rheinfelden – Augst	Va		7	11.4	3.2	6.0	1	Guaranteed draught
		Augst – Basel	Vb		11	11.4	3.2	7.1	1	Guaranteed draught
		Basel – Straßburg	VIb		129	22.8	3.2	7.0	8	Draught depending on water level
		Straßburg – Karlsruhe	VIb		67	22.8	2.1	9.1	2	
		Karlsruhe - Budenheim	VIb		145	34.3	2.1	9.1	0	3 barges abreast downstream
		Budenheim –Bad Salzig	VIb		56	34.3	1.9	9.1	0	3 barges abreast downstream
		Bad Salzig – Köln	VIc		122	34.3	2.1	9.1	0	3 barges abreast downstream
		Köln – Dutch border	VIc	2	179	34.3	2.5	9.1	0	downstream km 865 see map N°2

continued on next page

---

[1] allowed breadth of pushed train

[2] guaranteed draught at a very low water level

Germany (Rhein confluence), Luxembourg, Switzerland, part of France – continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
2	**Neckar**	Rhein - Plochingen	Va		203	11.4	2.5	5.5	27	Maximal capacity ~ 1800 tdw
3	**Main**	Rhein – km 130	Vb		130	11.4	2.8	4.4	12	downstream km 38 B<14 m
		Km 130 – Bamberg	Va		253	11.4	2.5	4.8	23	waterway #1 at map N°10
4	**Mosel**	Koblenz– French border	Vb		242	11.4	2.5	6.0	12	Critical bridge at Koblenz
		French border - Nancy	Vb		152	11.4	2.7	2.9	16	French section, the river renamed Moselle
5	**Saar**	Mosel - Dillingen	Vb		60	11.4	2.7	5.3	4	
		Dillingen-Saarbrücken	I		31	5.1	1.7	5.3	1	Section under improvement to Vb
6	**Lahn**	Wetzlar - Rhine	0		125	5.2	1.4	2.9	20	Excursion vessels only
7	**RHK**	Duisburg – km 25	Vb		25	11.4	2.8	4.5	3	Rhine-Herne Canal
		Km 25 - DEK	IV		21	9.5	2.5	4.5	1	
8	**WDK**	Wesel - DEK	Vb		60	11.4	2.8	6.5	6	Wesel-Datteln Canal, double chamber locks
9	**DHK**	DEK - Hamm	IV		47	9.5	2.5	4.0	2	Dortmund-Hamm Canal
10	**DEK**	Dortmund - WDK	Vb		21	11.4	2.8	5.25	1	Dortmund-Ems Canal, Lock and elevator
		WDK - MLK	IV		87	9.5	2.5	5.25	1	3 chambers at Münster
		MLK - Papenburg	IV		117	9.5	2.5	5.25	15	
11	**Ems**	Papenburg - Emden	Vb		68					Maritime sektor
12	**MLK**	DEK - ESK	Vb		234	11.4	2.7	5.25	1	Mittelland-Kanal, waterway #2 at map N°4
13	**KüK**	Küstenkanal	IV		70	11.4	2.5	4.5	1	waterway #7 at map N°4

continued on next page

---

[1] allowed breadth of ship or pushed train

Germany (Rhein confluence), Luxembourg, Switzerland, part of France – continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
14	**Neder Rijn**	Millingen-Lek	Vb		60			9.1	2	waterway #2 at map N°2
15	**Twenthe Kanal**		IV		50	9.7	2.6	7.3	3	
16	**Ruhr**	Duisburg-Mühlheim	Va		12	12.0	2.8	6.5	2	
17	**IJssel**	Arnheim - IIsselmeer	Va		136	11.4		10.8	0	Geldersche IJssel
18	**Marne-Rhein Canal**		I		290	5.05	1.8	3.5	151	
19	**Maas**		Va		230	11.4	3.0	6.7	8	waterway #14 at map N°2
20	**Albert Canal**		VIa	1	129	15.4	5.0	6.7	6	waterway #15 at map N°2
21	**Meuse**	Namur-Liege	IV		69	15.4	3.2		4	waterway #17 at map N°2
22	**Rhone-Rhein Canal**		I		270	5.1	1.8	3.5	119	

---

[1] allowed breadth of ship or pushed train

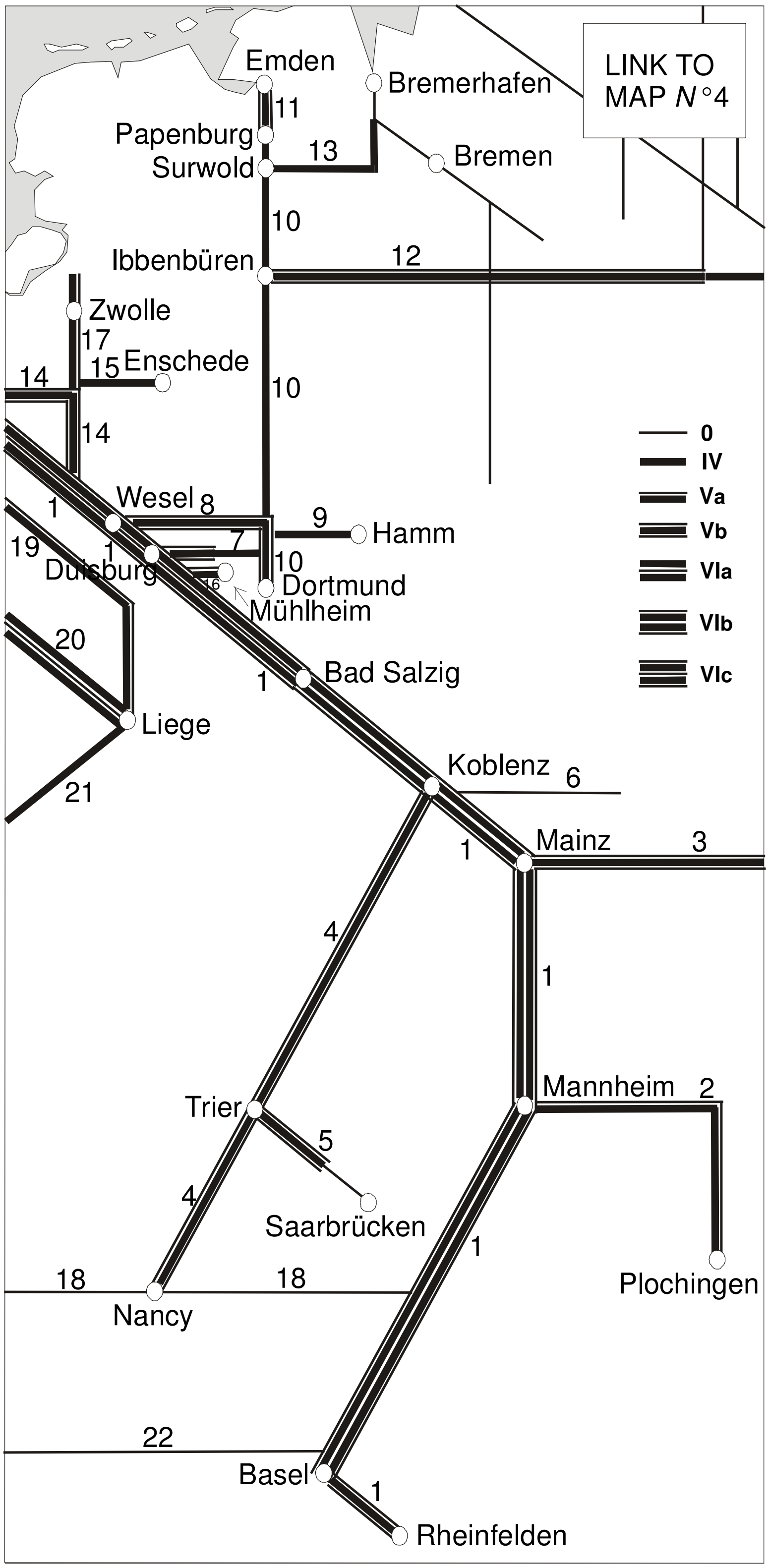


Fig. A1.3: Inland waterways in Germany (Rhine confluence), Luxembourg, Switzerland and the part of France

4. Germany (Elbe confluence), Czech Republic

Considerable differences in approximate deadweight in column “Remark” for vessels on the waterways having the same ECE class notation might appear due to air draught limitations. Namely, some waterways have lower class notation only due to the strict air draught limits. For instance the KüK would have class Va instead of IV if only air draught would be increased from existing 4.5 m to prescribed least 5.25 m. Otherwise, the large inland vessels of a length of up to 102 m and breadth of up to 11.4 m having a draught of up to 2.5 m i.e. vessels fully satisfying the Va standards are allowed.

The abbreviated names of particular waterways have the following meanings:

- MLK – Mittellandkanal (Midland Canal)
- NOK – Nord-Ostsee-Kanal (North Sea – Baltic Canal)
- ESK – Elbe-Seitenkanal (Elbe Lateral Canal)
- ELK – Elbe-Lübeck-Kanal
- KüK – Küstenkanal (Coastal Canal)
- EHK – Elbe-Havel-Kanal
- HOW – Havel-Oder-Wasserstraße (Havel-Oder Waterway)
- SOW – Spree-Oder-Wasserstraße (Spree-Oder Waterway)
- MHW – Muritz-Havel-Wasserstraße
- MEW – Muritz-Elde-Wasserstraße
- UHW – Untere Havel Wasserstraße (Lower Havel Waterway)
- OHW – Obere Havel Wasserstraße (Upper Havel Waterway)
- StW – Stör Wasserstraße
- TeK - Teltowkanal

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Elbe**	Chvaletice – Melnik	IV		102	11.4	1.8	3.7	15	Assessed capacity ~ 800 tdw
		Melnik–Schöna	Va		106	11.4	2.2	6.1	6	Assessed capacity ~ 1500 tdw
		Schöna – km 57	Va		57	14	1.4	4.8	0	Allowable draught at >240 days
		Km 57 – km 276	Va		219	14	1.4	4.5	0	Allowable draught at >240 days
		Km 276 – km 569	Va		293	14	1.6	5.0	0	Allowable draught at >240 days
		Km 569 – km 615	VIb		46	22.8	5.3	4.9	1	Pushed trains up to ~6000 tdw
		Km 615 – North Sea	VIb	3	112		8.0	51.0	0	Large sea-going ships
2	**K**	DEK - ESK	Vb		234	11.4	2.7	5.3	1	Assessed capacity ~ 3400 tdw
		ESK – Elbe	IV		91	11.4	2.0	6.4	1	Assessed capacity ~ 950 tdw, (lock under const.)
3	**Weser**	Münden – km 354	IV		354	12.3		4.3	7	Assessed capacity ~ 950 tdw
		Km 354 - Bremen	Vb		18	12.4			1	Assessed capacity ~ 3400 tdw
		Bremen - North Sea	VIb	3	85				0	Pushed trains up to ~6000 tdw
4	**NOK**	North Sea - Baltic		3	100	42	14	42	2	Very large sea-going ships, not used by inland ships
5	**ESK**	Elbe-Seitenkanal	Vb		115	11.4	2.7	5.3	2	Assessed capacity ~ 3400 tdw
6	**ELK**	Elbe-Lübeck-Kanal	IV		62	11.4	2.0	4.6	7	Assessed capacity ~ 900 tdw
7	**KüK**	Küstenkanal	IV		70	11.4	2.5	4.5	1	Assessed capacity ~ 1800 tdw, air draught limit
8	**EHK**	Elbe-Havel-Kanal	IV		57	11.4	1.9	4.3	3	Assessed capacity ~ 800 tdw
9	**HOW**	Havel-Oder-Waterway	IV		93	10	1.8	4.3	5	Assessed capacity ~ 900 tdw
10	**SOW**	Spree-Oder-Waterway	III		125	9.6	1.8	4.0	7	Assessed capacity ~ 900 tdw
11	**MHW**	Müritz-Havel-Waterway	I		32	5.2	1.4		4	Assessed capacity ~ 100 tdw
12	**MEW**	Müritz-Elde-Waterway	I		180	5.2	1.4		17	Assessed capacity ~ 100 tdw

continued on next page

---

[1] allowed breadth of ship or pushed train

Germany (Elbe confluence), Czech Republic – continued

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
13	**Peene**	Malchin – Demmin	III		31	8.2	1.8	5.3	0	Assessed capacity ~ 600 tdw
		Demmin – Baltic Sea	IV		72	9.5	2.5	4.3	0	Assessed capacity ~ 1300 tdw
14	**UHW**	Untere Havel-Waterway	III		149	9.0	2.0	3.6	6	Assessed capacity ~ 900 tdw
15	**Saale**	Halle - Barby	IV		87	9.5		4.3	5	Assessed capacity ~ 800 tdw (at 1.8 m draught)
16	**Vltava**	Prag - Melnik	IV		92	10.6	1.8	4.2	10	Assessed capacity ~ 800 tdw
17	**enau**	Lüneburg-Fahrenholz	I		18	6.2	0.9		2	Assessed capacity ~ 50 tdw
		Fahrenholz - Elbe	III		11	9.0		7.2	1	Assessed capacity ~ 400 tdw
18	**Aller**		II		117	9.5		4.0	4	Assessed capacity ~ 300 tdw
19	**Trave**	ELK - Lübeck	IV		6	9.5	2.0		0	Assessed capacity ~ 900 tdw
		Lübeck – Baltic Sea	VIb	3	21	24	8.0		0	Sea-going ships
20	**OHW**	HOW-Neustrelitz	I		94	5.2	1.4		11	Assessed capacity ~ 100 tdw
21	**StW**	MEW - Schwerin	I		45	5.2	1.4		1	Assessed capacity ~ 100 tdw
22	**TeK**	Teltowkanal	IV		38	9.0	2.0	4.4	1	Assessed capacity ~ 900 tdw

---

[1] allowed breadth of ship or pushed train

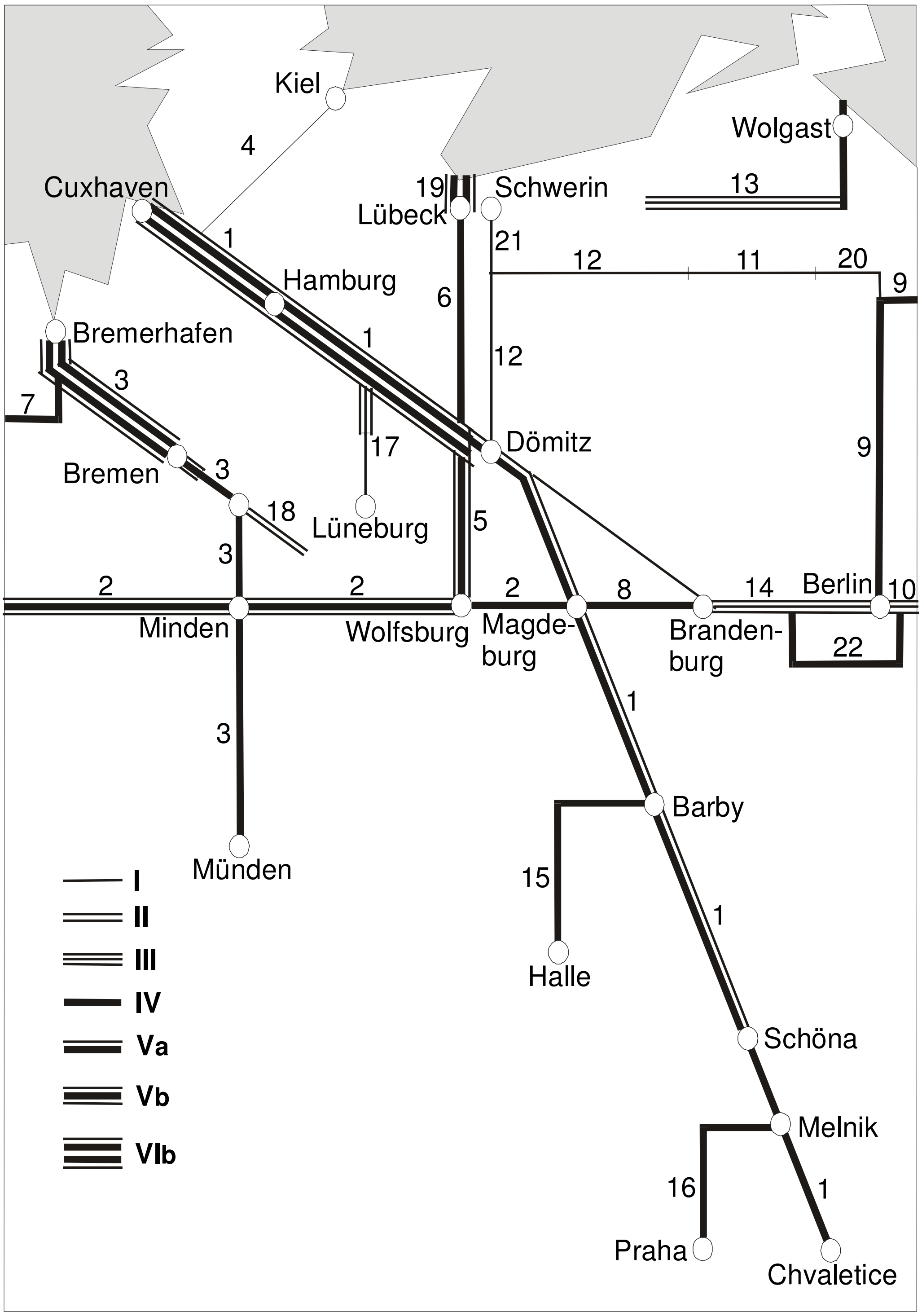


Fig. A1.4: Inland waterways in Germany (Elbe confluence) and Czech Republic

5. Germany (Oder confluence), Poland

Due to the ice restrictions an average annual navigational season on Wisla lasts about 260 days. The section between Krakow and Warszawa has numerous local draught restrictions and therefore is not used for commercial navigation.
River Oder is canalised in its upper stretch but the low air draught is the very limiting factor. Navigation is restricted to daytime only due to the lack of proper navigational aids.
The Oder-Wisla Waterway connects Wisla and Oder. The navigable link to Belarus is theoretically provided over the river Bug but due to unfavourable river bed morphology and difficult dredging this waterway is not in use nowadays.

#	**Name**		**Class**		**Length** (km)	**Breadth**[1] (m)	**Draught** (m)	**Height** (m)	**N° of locks**	**Remark**
			IWT	R/S						
1	**Wisla**	Krakow – Warszawa	I							Out of use
		Warszawa – km771	I		251				0	Assessed capacity less than 200 tdw
		km771 – km 909	II		137		2.2	2.8	0	Extreme local shallows
		km909 – km 941	IV		33		2.5	4.5	0	Assessed capacity ~ 1300 tdw
		km941-Gdansk	Vb		18	12	4.5		1	Assessed capacity ~ 3300 tdw
2	**Oder**	Kozle – Brzeg Dolny	III		183	9.6	1.8	3.3	6	Difficult meanders
		B.Dolny - Kostrzyn	II		335	9.0	1.3	6.4	0	Assessed capacity ~ 250 tdw
		Kostrzyn - Szczecin	III		122		1.8	6.3	0	Assessed capacity ~ 900 tdw
		Szczec. - Swinoujscie	Vb	3	64		10.5		0	Length restrictions < 210 m
3	**Oder-Wisla Waterway**	Warta – Netze -	II		68	9.0		2.8	0	Assessed capacity < 400 tdw
		Bydgoski Canal	II			9.0		3.6	22	Assessed capacity < 400 tdw
4	**Bug**	Link to Belarus								Out of use
5	**SOW**	Spree-Oder-Waterway	III		125	9.6	1.8	4.0	7	~ 900 tdw
6	**HOW**	Havel-Oder-Waterway	IV		93	10	1.8	4.3	5	~ 900 tdw

---

[1] allowed breadth of ship or pushed train

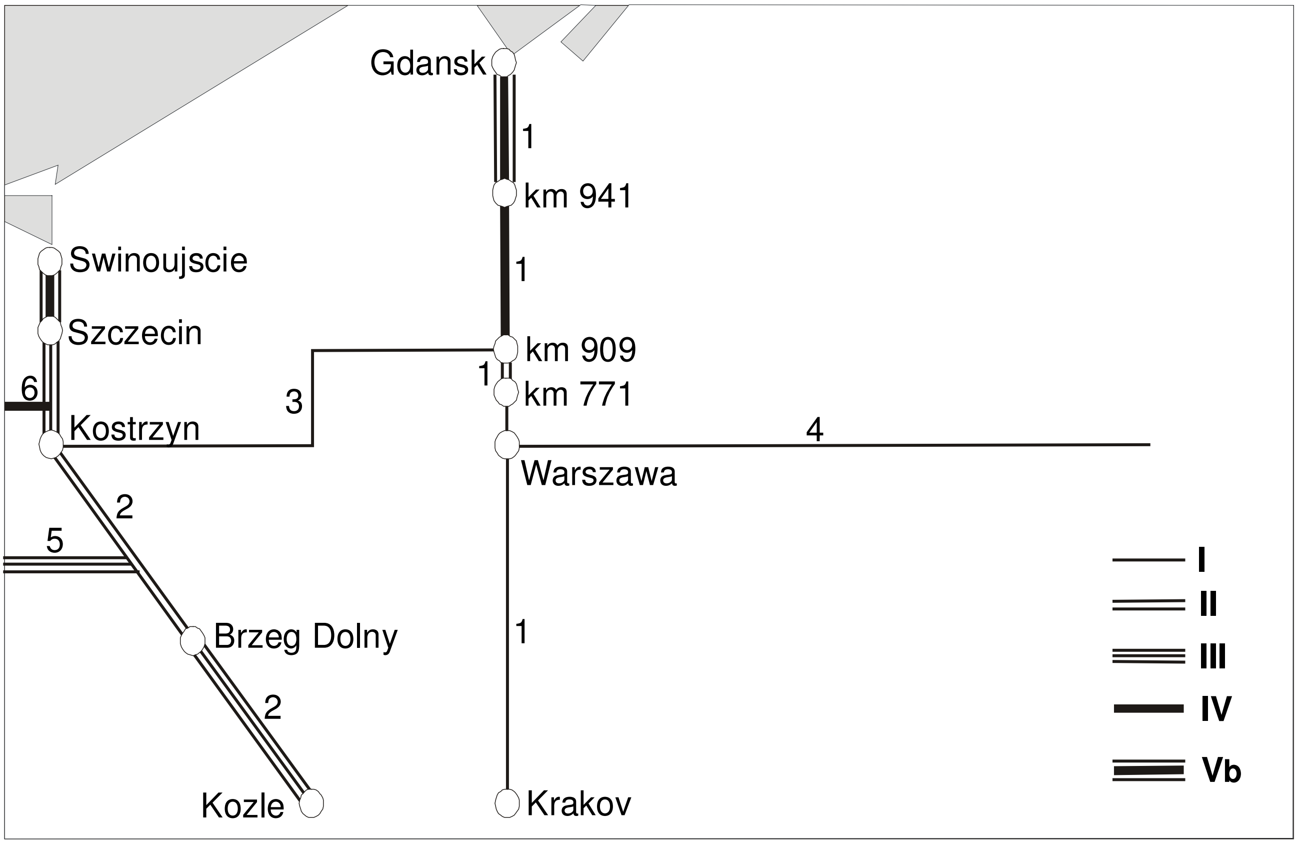


Fig. A1.5: Inland waterways in Germany (Oder confluence) and Poland

6. Sweden

Swedish inland waterways consist of numerous lakes and linking canals. Except Trollhätte Canal linking the Lake Vänern and Södertalje Canal linking the Lake Mälaren to the North and Baltic Sea respectively, all other canals and lakes are exclusively dedicated to tourist traffic.

Smaller non-classified canals (class “0”) were primarily built and used for cargo transport until the mid of twentieth century. Since then only regular or charter passenger traffic (tourist cruising) takes place in restricted period of the year (during summer months only). Göta Canal is one of Sweden’s biggest tourist attractions with more than one million visitors annually. Due to severe winter conditions recreational use is restricted to only four summer months.

#	Name	Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
		IWT	R/S						
1	**Trollhäte Canal**	IV	1	82	13.2	5.4	27.0	6	Cargo and passenger shipping
2	**Lake Vänern**	IV	1		13.2	5.4		0	Several destinations
3	**Göta Canal**	0		189	7.0	2.8	22.0	58	Tourist cruising only
4	**Kinda Canal**	0		79	4.5	1.5	3.1	15	Tourist cruising only
5	**Södertalje Canal**	VIa	2	6	17.0	6.8	34.0	1	No ice restrictions, short sea services
6	**Lake Mälaren**	VIa	2			6.8			Intensive short sea services
7	**Strömsholms Canal**	0		117	5.0	1.4	2.5	26	Tourist cruising only
8	**Hjälmare Canal**	0		12	7.0	2.0		9	Tourist cruising only
9	**Bergslag Canal**	0		64	3.6	1.2	2.1	6	No access to other ww

---

[1] allowed breadth of ship

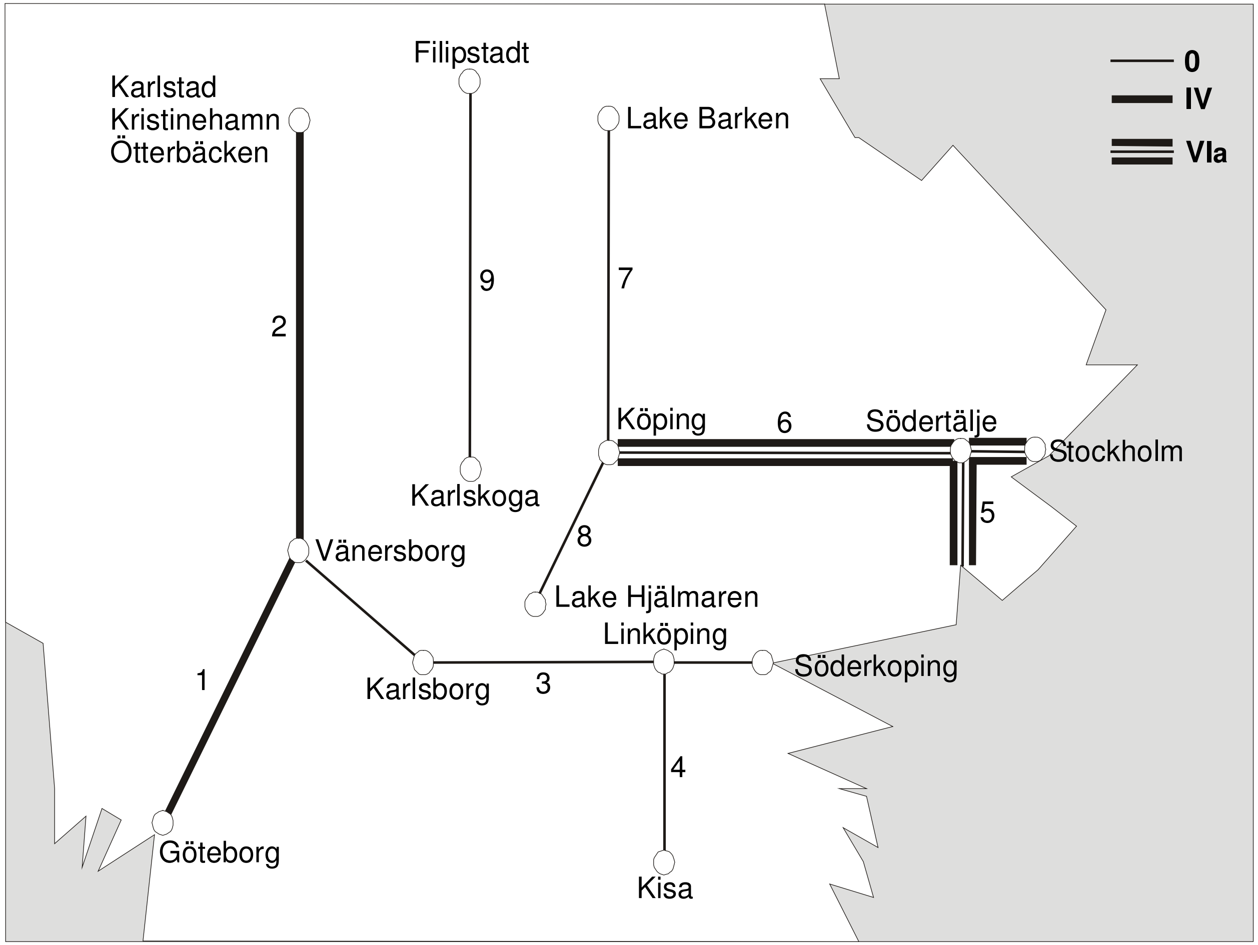


Fig. A1.6: Inland waterways in Sweden

7. Finland

Finish inland waterways are actually numerous lakes mutually connected into a navigable network.

The Saimaa Canal connects the Lake of Saimaa with the Gulf of Finland since 1968. The last 19.6 km of Canal is traced through the Russian territory upon the agreement concluded between Finland and the Soviet Union under which the portions of the Canal lying in Russia were leased to Finland.

Vessels having a draught of 3.9 m or are not allowed to exceed the speed of 9 km/h. For vessels with lesser draught the speed limit gradually rises up to 18 km/h.

Passage is permitted for merchant vessels of all flags. No exceptional documents are required for the vessels or their crews other than those in accordance with standard international navigation rules. All the vessels with more than 25 m in length have to use a pilot when proceeding through the Canal.

#	Name	Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
		IWT	R/S						
1	**Saimaa Canal**		1	43	13.2	4.35	24.5	8	Assessed capacity ~ 2800 tdw 5 months with ice
2	**Lake Saima Deep Canals**	Va	1	478 (total length)	13.2	4.2	24.5	2	Assessed capacity ~ 2800 tdw, 5 months with ice in average navigable 9.5 months for ships reinforced for navigation in ice
3	**Lake Pielinen Canal**	IV		169	11.8	2.4	12	3	Assessed capacity ~ 1300 tdw 5 months with ice
4	**IJsalmi Canal**	Va		103	11.8	2.4	12	2	Assessed capacity ~ 1800 tdw, 5 months with ice

---

[1] allowed breadth of ship

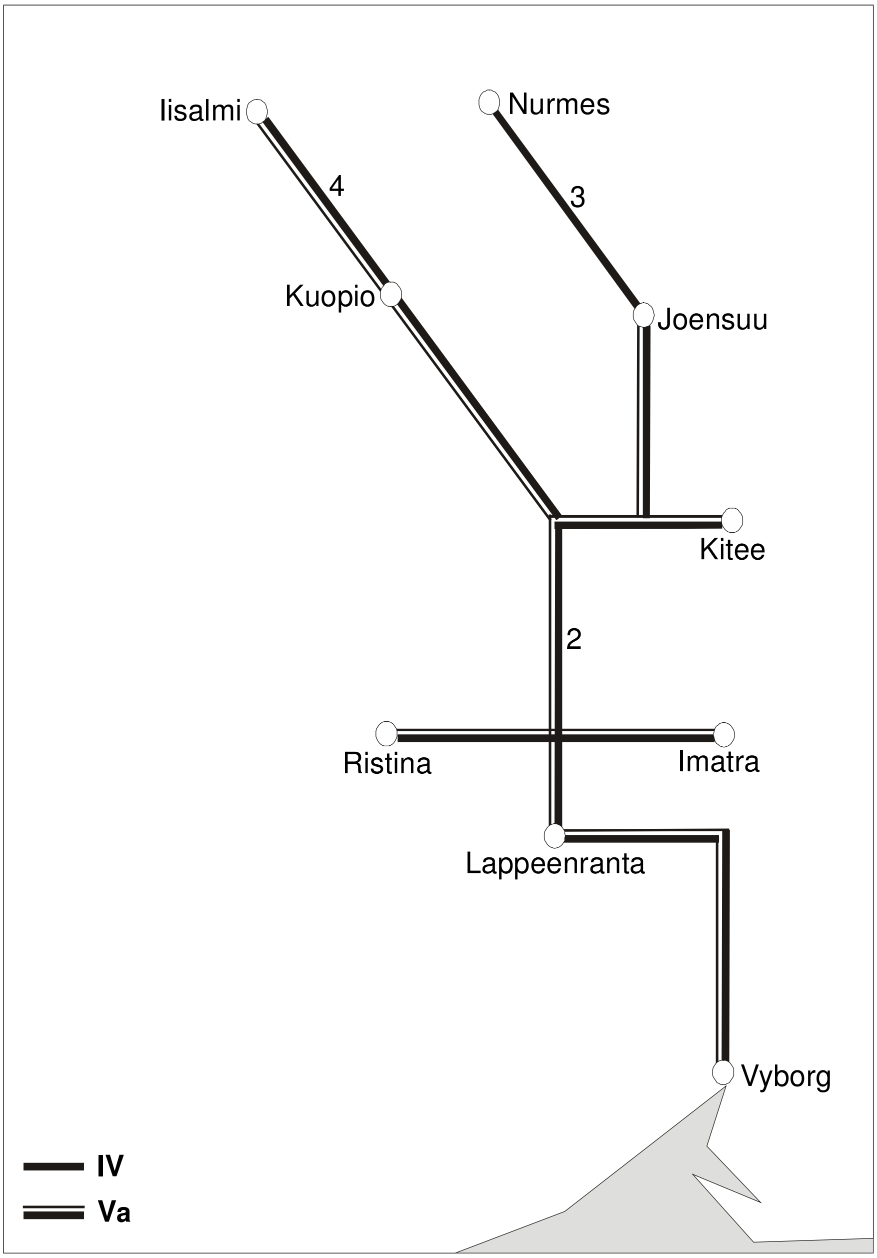


Fig. A1.7: Inland waterways in Finland

8. Latvia and Lithuania

Lower Nemunas includes the corresponding river stretch and 55 km of the sheltered Kuronian Bay towards the Baltic seaport of Klaipeda. Upstream Lithuania's capital Kaunas the Nemunas river is cut-off by the hydropower plant dam without lock. Otherwise the river would be navigable for commercial vessels for another 101 km upstream. There is no service during wintertime.

River Daugava in Latvia is navigable only for sea and river/sea vessels in its short maritime stretch between the Baltic Sea and the Port of Riga. East of Riga hydropower plants and dams without locks do not allow inland navigation.

#	**Name**		**Class**		**Length** (km)	**Breadth**[1] (m)	**Draught** (m)	**Height** (m)	**N° of locks**	**Remark**
			IWT	R/S						
1	**Daugava**			3	12		7.5		0	Restrictions due to 4 months with ice
2	**Nemunas**	lower	IV		190	10	1.5	9	0	Assessed capacity per vessel ~ 600 tdw
		upper	III		87	8	1.2	9.2	0	Assessed capacity per ship ~ 350 tdw

---

[1] allowed breadth of ship

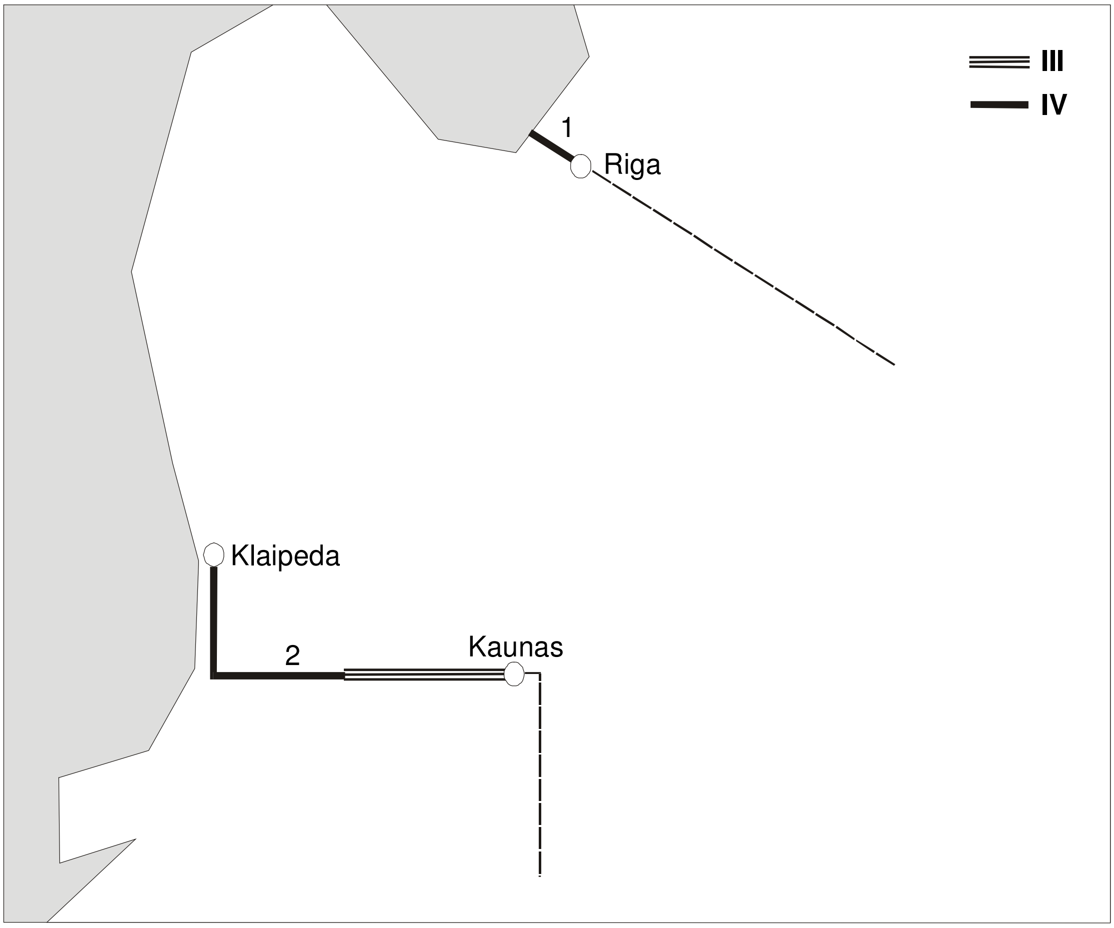


Fig. A1.8: Inland waterways in Latvia and Lithuania

9. France

#	Name		Class		Length	Breadth[1]	Draught	Height	N° of locks	Remark
			IWT	R/S	(km)	(m)	(m)	(m)		
1	**Rhone**	Upper Rhone	0		70	-	-	-	3	
		Lower Rhone	Vb/VI	1	310	11.4	3.0	6.3	13	River-sea ships with ~1300 tdw capacity
2	**Loire**	BoucheMaine-Nantes	I		85	12.5	0.9-3.5	4.5	0	
		Nantes – St. Nazaire	IV		68	34.2	4.7	-	0	
3	**Garonne**		IV		137	15.0	1.8	6.5	0	
4	**Canal de Midi**		0		337	5.0	1.5	3.3	65	
5	**Saone**		IV		227	11.4	1.8	6.0	23	
6	**Rhone-Rhein Canal**		I		270	5.1	1.8	3.5	119	waterway #22 at map N°3
7	**Canal de Bourgogne**		I		242	5.0	1.4	3.5	189	
8	**Yonne**		I		108	8.0	1.8	4.4	21	waterway #27 at map N°2
9	**Marne-Rhein Canal**		I		290	5.05	1.8	3.5	151	waterway #18 at map N°3
10	**Marne**		II		215	7.6	1.8	4.4	8	waterway #28 at map N°2
11	**Seine**	Montreau-Paris	Va		95	11.4	2.8	5.5	11	waterway #22 at map N°2
		Paris-Rouen	Vb	1	242	11.4	3.5	6.0	7	waterway #22 at map N°2
12	**Oise**		Vb		100	11.4	2.5	5.25	8	waterway #25 at map N°2

---

[1] allowed breadth of ship

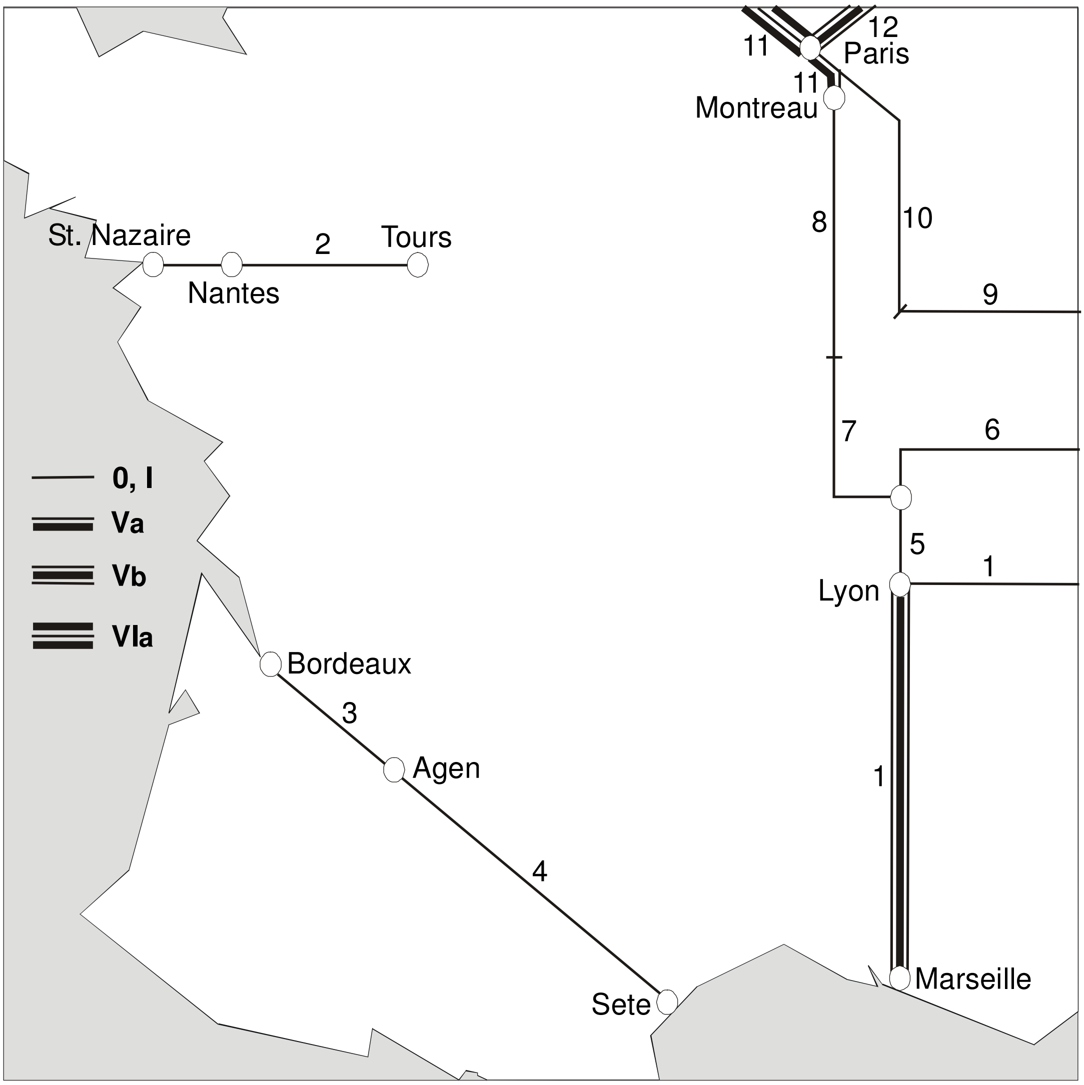


Fig. A1.9: Inland waterways in France

10. Germany (Danube confluence), Austria, Slovakia, Hungary, Croatia, western part of Serbia

The Danube becomes navigable for small vessels at Ulm, 2588 km from the mouth into the Black Sea at Sulina. The section between Ulm and Kelheim has the ECE class 0, i.e. it is navigable for small ships having a deadweight less than 250 tons.

The most expressed nautical bottleneck on the upper course of the Danube River is the Straubing-Vilshofen section with seasonal very shallow waters and narrow fairway and with numerous spots (nowadays approximately 40 sites along the 70 km long stretch) where due to safety reasons the by-passing of two vessels is not recommended. In so-called “Wachau” sector between Danube km 2038 and 2008 the uniform water depth of 2.8 m is reduced to 2.3 m. Along the Wachau sector, downstream the Freudenau lock at Vienna towards Bratislava and downstream the Gabcikovo lock towards Budapest seasonal shallow water periods, usually during summer months, could last several weeks.

Downstream Budapest the Danube is principally navigable for river/sea vessels, however, with reasonable restrictions in regard to water depth (usually more than 3.5 m) and bridge clearance at Novi Sad (6.82 m at high water level).
Intensive cargo traffic on Drava river in Croatia takes place only between the port of Osijek and the mouth into Danube at km 1383.

River Sava is characterised by very high meandering coefficient (almost 2) and numerous shallows, especially in the upper river course.

River Tisa (Serbian, Croatian, *Tisza* in Hungarian) provides pretty favourable nautical conditions in its lower and middle course in Serbia (negligible slope of only about 40 mm per km) with average annual duration of navigational season of about 320 days.

River Begej as well the Becej-Bogojevo, Vrbas-Bezdan and Novi Sad- Savino Selo canals (and few others with ECE classes II or I not listed here) belong to the relatively dense network of navigable waterways in northern part of Serbia, the so-called “Danube-Tisa-Danube navigation and watering system”. Even though more than one half of these waterways correspond to the ECE class IV all have only regional importance, among others due to the national legislation.

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Main**	km 130 – Bamberg	Va		253	11.4	2.7	4.8	24	waterway #3 at map N°3
2	**MDK**	Bamberg – Kehlheim	Vb		171	11.4	2.7	6.0	16	
3	**Danube**	Kelheim – Regensburg	Vb		35	11.4	2.7	5.9	2	
		Regensburg - Straubing	VIb		57	22.8	2.7	5.8	2	
		Straubing - Vilshofen	VIa		70	22.8	1.7	4.7	0	One-way traffic on many spots, main Danube bottleneck
		Vilshofen – Bratislava	Vib		383	22.8	2.7	6.0	11	2.3 m depth at km 2038-2008
		Bratislava – Novi Sad	Vic		608	33.4	1.9	6.7	1	Periodically local shallows
		Novi Sad – Belgrade	VII	2	88	33.4	5.0	19.0	0	Further Danube downstream at map N°11
4	**Drava**	Km 198 – km 68	II		130	6.6	1.4	3.0	0	Border between Hungary and Croatia
		Km 68 – Osijek	III		46	8.2	1.9	4.0	0	
		Osijek – Danube	IV		22	9.5	2.5	5.3	0	
5	**Sava**	Sisak – Samac	III		281	8.2	2.0	4.0	0	Since recently international river (SLO, HR, BIH, SER)
		Samac – Belgrade	Va		306	11.4	2.5		0	Last about 200 km before the mouth flows through SER
6	**Tisa**	Vasarosnameny-Tisazalök	II		177	7.0	2.5		0	Hungarian sector
		Tiszalök-Danube	IV		519	9.5	2.5		3	Stable nautical conditions, international (H, SER)
7	**Begej**	Tisa – km 35	IV		35	11.0	2.5	5.6	1	Waterway N°5 at map N° A1.11
8	**Becej-Bogojevo-Canal**		IV		90	11,0	2.5	6.2	3	
9	**Vrbas-Bezdan-Canal**		II		81	7.5	2.5	5.6	3	
10	**Novi Sad- Savino Selo-Canal**		IV		39	11.0	2.8	12.0	1	
11	**Vah**		IV		45	9.5	2.5		0	

---

[1] allowed breadth of ship or pushed train

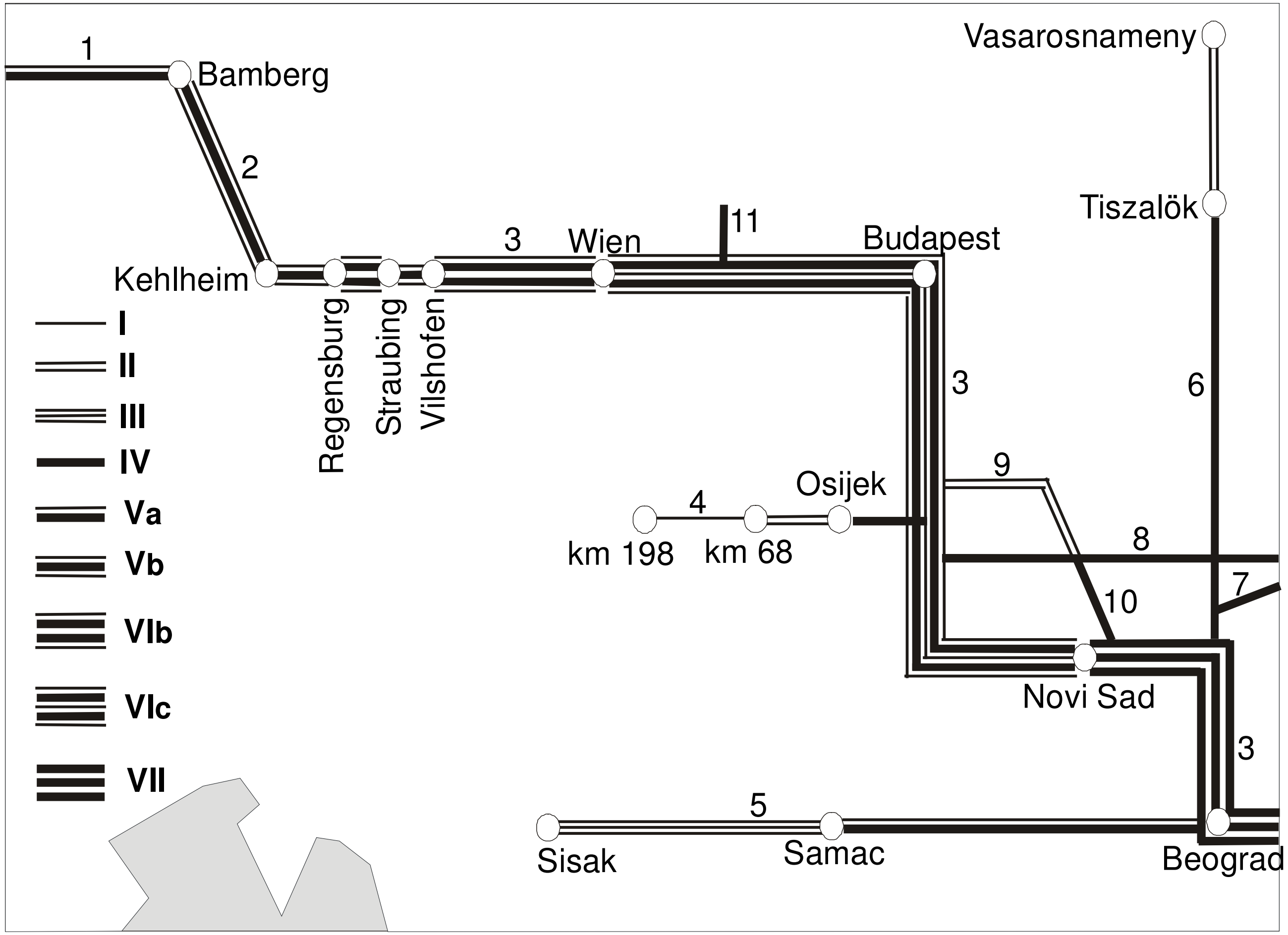


Fig. A1.10: Inland waterways in Germany (Danube confluence), Austria, Slovakia, Hungary, Croatia and the western part of Serbia

11. Eastern part of Serbia, Romania, Bulgaria, Moldova, part of Ukraine

The stretch between Belgrade (entrance in the Port of Belgrade at Danube km 1167) and the lock Iron Gates II (Danube km 864) has a pretty deep and wide fairway in comparison to the usual inland waterways standards. As far as the stream flow rate is considerably low due to the influence of Iron Gates I water reservoir the nautical conditions are favourable. Downstream Iron Gates II periodical relatively short-lasting (few days annually) local shallows with even less than 2.0 m depth might appear, usually during the summer months. Downstream the river km 346 the Danube branches into two navigable arms which merge again at river km 240. At the moment there are only 9 bridges crossing the Danube between Belgrade and the mouth at Sulina over a length of 1167 km. All these bridges have the clearance above the high water level of at least 10 m (except the bridge at Pancevo near the Port of Belgrade with 9.1 m air clearance).

Downstream river km 170 (Port of Braila) the Danube is navigable for sea-going ships (maritime sector) entering the river over the Sulina Canal. River-sea vessels of up to about 4000 tdw are able to navigate along the whole river stretch from Sulina up to Belgrade and further upstream (with draught depending on the actual fairway depth on critical spots).

The Becej-Bogojevo Canal and Palanka-Becej Canal mutually connect rivers Danube and Tisa in the northern part of Serbia as the so-called “Danube-Tisa-Danube Canal” (see also map N° A1.10). These canals together with rivers Begej and Tamis belong to the dense network of smaller regional navigable waterways with a total length of about 600 km. At all 338 km of these canals have an ECE class IV, 215 km are of a class III or II and the rest of about 50 km are either of class I or 0.

The Danube-Black Sea Canal connects the Danube river at km 300 (measured from the mouth at Sulina) with the deep sea Port of Constanta. The White Gate (Romanian *Poarta Alba*)– Midia Canal is the side branch of the main Canal.

The northern branch of the Danube delta named Chilia Arm is international waterway between the Danube main course and the Ukrainian Port of Izmail over the length of 23 km. Farther downstream towards the mouth into the Black Sea at Ust Dunaisk this branch belongs to the Ukrainian national waterways. The Chilia Arm in Ukraine has a total length of 116 km.

The river Prut has regional importance for Moldova only.

The southern navigable branch of Danube (St. George Arm) is of negligible commercial importance and is used only for occasional transports of construction materials by smaller barges.

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Danube**	Belgrade – Iron Gates	VII	2	300	33.4	5.0	9.1	2	Nautically the most favourable Danube section
		Iron Gates - Cernavoda	VII	2	563	33.4	3.5	9.1	0	Periodically local shallows
		Cernavoda - Braila	VII	2	130	33.4	3.5	15.2	0	
		Braila – Sulina Arm	VII	3	108	33.4	7.3	-	0	Sea-going hips up to ~10000 tdw
		Sulina Canal	Vb	3	70	22.8	7.3	-	0	Access to the Black Sea
2	**Becej-Bogojevo-Canal**		IV		90	11.0	2.5	6.2	3	Waterway #9 at map N°10
3	**Palanka-Becej-Canal**		IV		147	11.0	2.5	5.6	3	Link to Tisa river from the lower Danube
4	**Tamis**	Danube – Pancevo	IV		3	11.0	2.5		0	Link to the Port of Pancevo
		Pancevo -	0							
5	**Begej**	Tisa – km 35	IV		35	11.0	2.5	5.6	1	
		km 35 – km 64	III		29	9.5	2.0	5.4	2	
6	**Danube-Black Sea Canal**		VIb	2	64	22.8	5.5	17.0	2	Access to the Seaport of Constanta
7	**White Gate – Midia Canal**		Va	1	27	11.4	3.8	13.5	2	Access to the Seaport of Midia
8	**Prut**		II				2.0		0	Negligible regional commercial use
9	**Danube**	Chilia Arm[2]	VII	3	23	33.4	5.5		0	International WW to Ismail
10	**Danube**	St. George Arm	III			11.4	2.0		0	Negligible commercial use

---

[1] allowed breadth of ship or pushed train

[2] Total length of the Chilia Arm, northest of three branches in the Danube Delta, is 116 km. International waterway Danube extends from the junction point of Chilia Arm at Danube km 79.17 (measured from the mouth at Sulina) to the Port of Ismail, just for the next 23 km. The rest of the Chilia Branch towards the mouth at Ust Dunaisk is the Ukrainian national waterway.

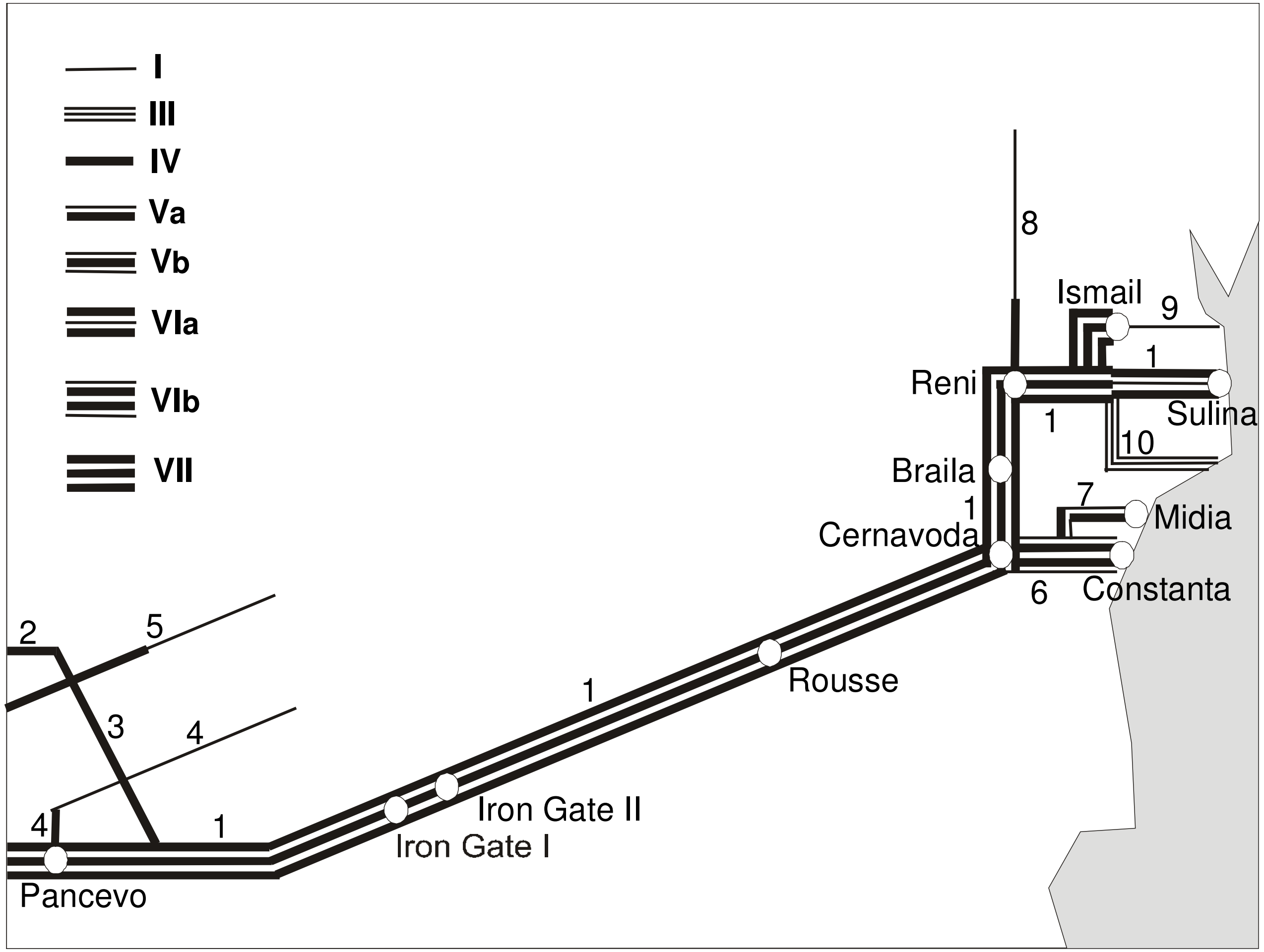


Fig. A1.11: Inland waterways in eastern part of Serbia, Romania, Bulgaria, Moldova and the part of Ukraine

12. Italy

River Po is characterised with low stream flow rates (0.6 – 0.8 m/s) and large amplitude of water level variations. According to the systematic survey the minimal fairway depth of 2.5 m is exceeded on about 220 days a year. Thereby some 40 critical spots (shallows) have been identified along the 300 km stretch between estuary and linking canal to the Port of Cremona.

The upper range of the Po river, between Pavia and Cremona, is used nowadays just for recreational purposes. After completion of the lock near Serafini the section to Piacenza (35 km upstream Cremona) will become navigable for larger river ships.

Ferrara Waterway linking the Port of Ferrara with Adriatic at Porto Garibaldi has large number of bridges (27 bridges along some 70 km long stretch) with very low clearance and on some places very narrow span too (only 11.5 m at two bridges).

Po-Brondolo Waterway leads to the Port of Chioggia as the principal gate to the Adriatic Sea and further along the coast through the Venetian Lagoon to Monfalcone. The stretch between Chioggia and Monfalcone is used mostly by excursion vessels and recreational boats.

Cremona – Milano Canal is operational between the Port of Cremona and Pizzighettone. The remaining stretch to southern reaches of Milano in a length of about 50 km and 5 locks is under construction.

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Po**	Pavia – Link to Cremona	Va		98	10.0	1.5	7.0	1	No commercial use, recreation only
		Cremona – Canal Bianco	Va		129	11.4	1.8	7.0	0	
		Canal Bianco - Ferrara	Va		71	11.4	1.8	7.0	0	
		Ferrara – Foce Po Grande	Va		92	11.4	2.0	7.0	0	No exit to the sea
2	**Po di Levante**		Va		19	11.4	2.5	7.0	1	High sedimentation
3	**Ferrara Waterway**									
		Ferrara - Volpagliaro	IV		30	10.0	3.0	4.0	1	Small cross section
		Volpagliaro – Valle Lepri	IV		28	10.0	3.0	3.9	1	
		Valle Lepri – Porto Garibaldi	IV		12	10.0	3.5	7.0	1	
4	**Po-Brondolo Waterway**		Va		19	9.5	3.0	4.7	3	To the port of Chioggia
5	**Cremona – Milano Canal**		Va		15	11.4	3.0	6.5	2	In use up to Pizzighettone
6	**Fissero Tartaro Canalbianco**		IV		117	10.0	2.5	5.4	5	Including San Leone

---

[1] allowed breadth of ship or pushed train

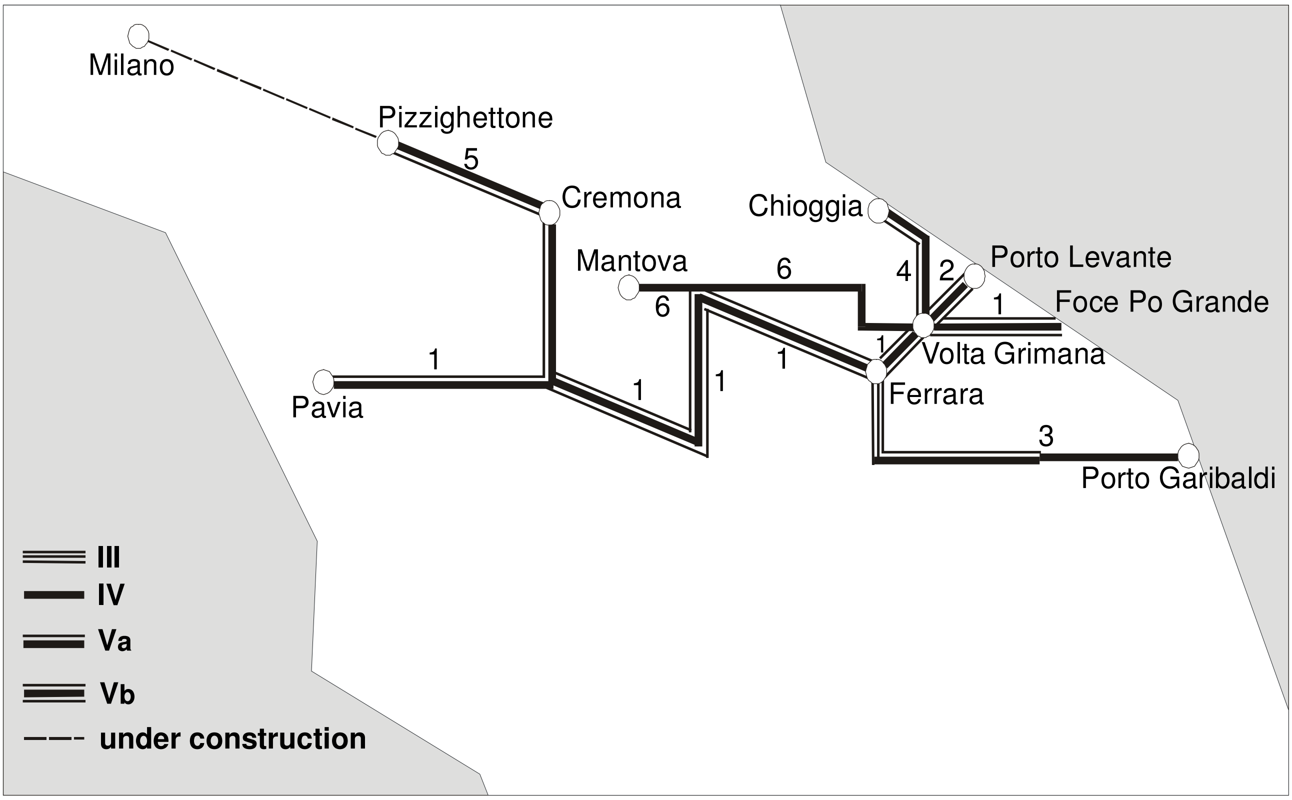


Fig. A1.12: Inland waterways in Italy

13. Spain, Portugal

All rivers on Iberian Peninsula are characterised by very high flow variations. The rivers flowing into Atlantic (Duero, Tejo, Guadiana, Guadalquivir) are navigable for sea-going vessels in their lower courses or just in estuary range (Duero). Commercial inland navigation does not exist or appears just occasionally.

Ebro is the only bigger river flowing into Mediterranean. In recent years (since 1992) the construction works took place and the lower range is nowadays enabled for the navigation of smaller passenger vessels. The estuary is not regulated for navigation and there is no navigable access to the sea.

#	Name		Class		Length (km)	Breadth[1] (m)	Draught (m)	Height (m)	N° of locks	Remark
			IWT	R/S						
1	**Duero**		0	1	211	11.4	3.9	7.5	5	For smaller ships navigable further up to Salamanca
2	**Tejo**	Estuary - Alverca		3	40					Large sea-going ships
		Alverca - Santarem		1	60					Maritime sector
		Santarem - Abrantes	0		120					Small river ships
3	**Guadiana**	Villa Real - Pomara		1	52					Small sea-going ships
		Pomara - Mertola	0		15					Small river ships
4	**Guadalquivir**			3	54					Sea-going ships with draught less than 5.2 m
5	**Ebro**	Amposta - Tortosa	1		15		2.0		0	Negligible commercial use of ships of up to ~ 200 tdw
		Tortosa – Mora d'Ebre	0		76		1.5		1	Recreational use only
		Mora d'Ebre – Riba-Roja	0		20		1.0		1	Recreational use only

---

[1] allowed breadth of ship

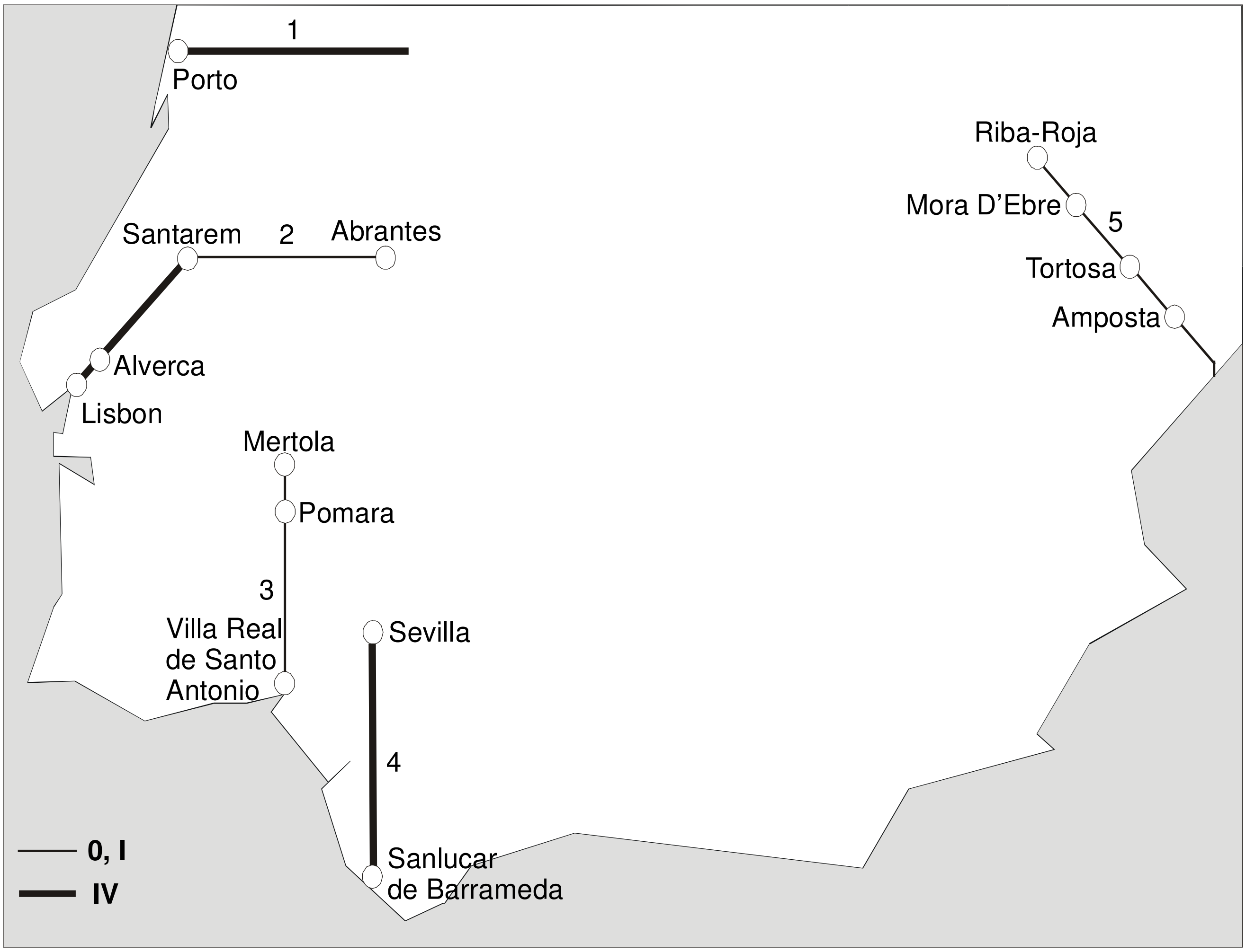


Fig. A1.13: Inland waterways in Spain and Portugal

Appendix 4: Analysis of Ports

Conventional Inland Ports

Corridor	Port	Country	1	2	3	4	5	6	7	8=7/6	9=1/(6+7)	10=1/4	11=1/5	12=5/4	13	14
Rhine	Basel	CH	8546	S	RRR	7000	65	200000	250000	1,3	19,0	1221	131	0,93	H	
	Nijmegen	NL	1149	S	RRR	165	2	n.a.	n.a.	n.a.	n.a.	6964	575	1,21	H	
	Stuttgart	D	3022	S	RRR	5600	43	141000	183000	1,3	9,3	540	70	0,77	H	H
	Meppel	NL	n.a.	n.a.	RRR	1750	3	38000	30000	0,8	n.a.	n.a.	n.a.	0,17	H	
	Mertert	Lux	2058	R	RRR	2093	8	133600	11540	0,1	14,2	983	257	0,38	n.a.	n.a.
	Average indicators for the Rhine Corridor									**0,7**	**14,2**	**2427**	**258**	**0,69**		
South-East	Lom	BG	1500	S	RRR	1482	27	60200	9468	0,2	21,5	1012	56	1,82	L	L
	Orsova	RO	118	F	R	500	6	16000	1600	0,1	6,7	236	20	1,20	L	L
	Pancevo	SER	300	S	RRR	760	3	100000	32000	0,3	2,3	395	100	0,39	L	L
	Vukovar	CRO	55	R	RRR	300	3	12000	2500	0,2	3,8	183	18	1,00	n.a.	n.a.
	Budap.-Csepel	H	4001	R	RRR	5600	26	72000	86000	1,2	25,3	714	154	0,46	H	H
	Bratislava	SK	2512	R	RRR	2540	23	79100	26400	0,3	23,8	989	109	0,91	M	M
	Enns-Ennsdorf	A	928	R	RRR	1000	3	35000	40000	1,1	12,4	928	309	0,30	n.a.	n.a.
	Average indicators for the South-East Corridor									**0,5**	**13,7**	**637**	**109**	**0,87**		
West-East	Aken	D	239	S	RRR	800	4	20000	1000	0,1	11,4	299	60	0,50	n.a.	n.a.
	Decin	CZ	540	F	RRR	1800	9	12300	4000	0,3	33,1	300	60	0,50	n.a.	n.a.
	Magdeburg	D	3276	S	RRR	4963	7	88000	5700	0,1	35,0	660	468	0,14	n.a.	n.a.
	Wroclaw Municipal Port	PL	525	S	RRR	2570	8	41230	14000	0,3	9,5	204	66	0,31	n.a.	n.a.
	Average indicators for the West-East Corridor									**0,2**	**22,3**	**366**	**164**	**0,36**		
N-South																
	Charleroi	B	5571	R	RRR	6935						803			H	
	Average indicators for the North-South Corridor											**803**				
Rest	Cremona	I	444	R	RRR	650	1	n.a.	n.a.	n.a.	n.a.	683	444	0,15	n.a.	n.a.

1 Total annual turnover in 1000 tons
2 Turnover trend in the last decade: R = rising, S = stagnating, F = falling
3 Multimodality potential: R = road, RR = railway, RRR = trimodal
4 Total length of piers in metres
5 Number of portal cranes
6 Open storage area in square metres
7 Covered storage area in square metres
8 Good structure indicator (ratio between covered and open storage area)
9 Storage load indicator (ratio between total annual turnover and total storage area) - in tons per square metre
10 Pier load indicator (ratio between total annual turnover and total length of piers) - in tons per length metre and year
11 Crane load indicator (ratio between total annual turnover and number of portal cranes) - in 1000 tons per crane and year
12 Crane density indicator (ratio between number of portal cranes and total length of piers) - in cranes per 100 meter length
13 Versatility of services: H = high, M = moderate, L = low, n.a. = data input not indicative
14 Versatility of commodity categories: H = high, M = moderate, L = low, n.a. = data input not indicative

River-Sea Ports

Corridor	Port	Country	1	2	3	4	5	6	7	8=7/6	9=1/(6+7)	10=1/4	11=1/5	12=5/4	13	14
Rhine	Liege	B	20602	R	RRR	22000	110		145000	n.a.	142,1	936	187	0,50	H	H
	Duisburg	D	36300	S	RRR	17000	128	439900	370000	0,8	44,8	2135	284	0,75	H	H
	Average indicators for the Rhine Corridor:									**0,8**	**44,8**	**1536**	**236**	**0,63**		
S-East	Galati	RO	8098	S	RRR	1800	47	61365	4500	0,1	122,9	4499	172	2,61	L	L
	Rousse	BG	1650	S	RRR	3000	30	135200	25100	0,2	10,3	550	55	1,00	M	M
	Average indicators for the South-East Corridor:									**0,2**	**66,6**	**2525**	**114**	**1,81**		
W-East	Szczecin	PL	18875	R	RRR	19500	150	540000	202000	0,4	25,4	968	126	0,77	H	H
	Average indicators for the West-East Corridor:									**0,4**	**25,4**	**968**	**126**	**0,77**		
N-South	Lyon	F	10000	R	RRR	9000			25000			1111	n.a.	n.a.	H	H
	Paris-Genn.	F	20000	n.a.	RRR	12000		140000	62000	0,4	99,0	1667	n.a.	n.a.	H	H
	Average indicators for the North-South Corridor									**0,4**	**99,0**	**1389**				
Rest	Joensuu	FIN	452	R	R	370	0	25000	18000	0,7	10,5	1222	n.a.	0,00	n.a.	n.a.
	Vaesteras	S	n.a.	n.a.	RRR	2350	n.a.	290000	48000	0,2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Goole	UK	2711	R	RRR	4800	28	470000	55000	0,1	5,2	565	97	0,58	H	H
	Average indicators for the R/S Ports outside the main IWT Corridors:									**0,3**	**7,9**	**1458**	**97**	**0,58**		

1 Total annual turnover in 1000 tons
2 Turnover trend in the last decade: R = rising, S = stagnating, F = falling
3 Multimodality potential: R = road, RR = railway, RRR = trimodal
4 Total length of piers in metres
5 Number of portal cranes
6 Open storage area in square metres
7 Covered storage area in square metres
8 Good structure indicator (ratio between covered and open storage area)
9 Storage load indicator (ratio between total annual turnover and total storage area) - in tons per square metre
10 Pier load indicator (ratio between total annual turnover and total length of piers) - in tons per length metre and year
11 Crane load indicator (ratio between total annual turnover and number of portal cranes) - in 1000 tons per crane and year
12 Crane density indicator (ratio between number of portal cranes and total length of piers) - in cranes per 100 meter length
13 Versatility of services: H = high, M = moderate, L = low, n.a. = data input not indicative
14 Versatility of commodity categories: H = high, M = moderate, L = low, n.a. = data input not indicative

Deepsea Ports

Corridor	Port	Country	1	2	3	4	5	6	7	8=7/6	9=1/(6+7)	10=1/4	11=1/5	12=5/4	13	14
Rhine	Rotterdam	NL	322000	S	RRR	80000	291	n.a.	22142000	n.a.	n.a.	4025	1107	0,36	H	H

IWT share of turnover (%)	32	Containers total (TEU/year)	6100000
General cargo (1000 t/year)	21730	Containers per IWT (TEU/year)	1190000
Dry bulk (1000 t/year)	59544	Trend in container figures	R
Liquid bulk (1000 t/year)	20156		

Corridor	Port	Country	1	2	3	4	5	6	7	8=7/6	9=1/(6+7)	10=1/4	11=1/5	12=5/4	13	14
S-East	Constanta	RO	42369	S	RRR	28520	194	1210000	363000	0,3	26,9	1486	218	0,68	H	H

IWT share of turnover (%)	24	Containers total (TEU/year)	83000
General cargo IWT (1000 t/year)	912	Containers per IWT (TEU/year)	n.a.
Dry bulk IWT (1000 t/year)	9193	Trend in container figures	R
Liquid bulk IWT (1000 t/year)	72		

Inland Ports with special function

Ro-Ro service for heavy road vehicles (semitrailers) on the Danube between Germany and Bulgaria

Corridor	Port	Country	1	2	3	4	5	6	7	8=7/6	9=1/(6+7)	10=1/4	11=1/5	12=5/4	13	14
S-East	Passau	D	60	R	RRR	200	0	34000	0	0,0	1,8	300	n.a.	0,00	n.a.	n.a.
S-East	Vidin	BG	728	S	RRR	1640	3	28000	0	0,0	26,0	444	243	0,18	n.a.	n.a.

1 Total annual turnover in 1000 tons
2 Turnover trend in the last decade: R = rising, S = stagnating, F = falling
3 Multimodality potential: R = road, RR = railway, RRR = trimodal
4 Total length of piers in metres
5 Number of portal cranes
6 Open storage area in square metres
7 Covered storage area in square metres
8 Good structure indicator (ratio between covered and open storage area)
9 Storage load indicator (ratio between total annual turnover and total storage area) - in tons per square metre
10 Pier load indicator (ratio between total annual turnover and total length of piers) - in tons per length metre and year
11 Crane load indicator (ratio between total annual turnover and number of portal cranes) - in 1000 tons per crane and year
12 Crane density indicator (ratio between number of portal cranes and total length of piers) - in cranes per 100 meter length
13 Versatility of services: H = high, M = moderate, L = low, n.a. = data input not indicative
14 Versatility of commodity categories: H = high, M = moderate, L = low, n.a. = data input not indicative

Buck
Consultants
International

progtrans

VBD

viadonau

PINE

Appendix 5: Relevant RIS standards

Appendix: relevant RIS standards

- Guidelines and Recommendations for River Information Services, PIANC, 2002
- Guidelines and Criteria for Vessel Traffic Services in Inland Waters (Inland VTS Guidelines (worldwide), IALA Recommendation V-120, June 2001
- Regional Arrangement Concerning the Radiotelephone Service on Inland Waterways (Europe), Basel, 2000
- Inland ECDIS Standard of the Commission for the Navigation on the Rhine, 2001
- Harmonised Commodity Description and Coding System of the ECO (worldwide)
- UN Code for Trade and Transport Locations (UN/LOCODE) (worldwide)
- UN / EDIFACT Standard, UNTDID (worldwide)
- Standardised UNECE Vocabulary for Radio Connections in Inland Navigation (Europe), 1997
- IMO Resolution MSC.74(69) Annex 3, Recommendation on performance standards for AIS
- Draft Revision of Recommendation ITU-R M1371, April 2001-06-29 Technical Characteristics for a Universal Shipborne Automatic Identification System, using Time Division Multiple Access in the VHF Maritime Band
- IEC 61993 Part 2, CVD 2001, Class A Shipborne Installation of the Universal Shipborne Automatic Identification System (AIS) using VHF TDMA techniques
- Draft IALA Guidelines on the AIS System 2001
- IMO Compendium on Facilitation and Electronic Business, 2001
- IMO International Maritime Dangerous Goods Code (IMDG)
- UNECE Trade data elements directory UNTDED with volume III: Compendium of Trade Facilitation Recommendations
- UN/CEFACT Recommendation No. 28 Codes for Types of Means of Transport

Contact details

DG-TREN

Contact person	***Mr Rolf Dieter***
Postal address	Rue de la Loi 200 B - 1049 Brussels Belgium
Visiting address	Rue De Mot 28 B - 1040 Bruxelles Belgium
telephone: fax: e-mail:	+32 2 296 82 69 +32 2 295 21 65 rolf.dieter@cec.eu.int

Buck Consultants International BV (BCI)

Contact person	***Mr Sander Kooijman***
Postal address	P.O. Box 1456 NL - 6501 BL Nijmegen The Netherlands
Visiting address	Kerkenbos 10-31 NL - 6546 BB Nijmegen The Netherlands
telephone: fax: e-mail:	+31 24 379 0222 +31 24 379 0120 sander.kooijman@bciglobal.com

ProgTrans AG

Contact person	***Mrs Maja Helms***
Postal address & Visiting address	Gerbergasse 4 CH - 4001 Basel Switzerland
telephone: fax: e-mail:	+41 61 560 3512 +41 61 560 35 01 maja.helms@protrans.com

VBD
Europäisches Entwicklungszentrum für Binnen- und Küstenschiffahrt

Contact person	***Mr Berthold Holtmann***
Postal address	Postfach 10 13 49 D - 47013 Duisburg Germany
Visiting address	Oststraße 77 - 77a D - 47057 Duisburg Germany
telephone: fax: e-mail:	+49 203 99 36 90 +49 203 36 13 73 holtmann@vbd.uni-duisburg.de

via donau
Entwicklungsgesellschaft mbH fur Telematik und Donauschifffahrt

Contact person	***Mr Manfred Seitz***
Postal address & visiting address	Donau-City-Strasse 1 A - 1220 Vienna Austria
telephone: fax: e-mail:	+43 1 595 48 96 0 +43 1 595 48 96 19 seitz@via-donau.org