Paper 39 - The Rhine – a small river that became a successful multinational transport system

Gernot PAULI

Central Commission for the Navigation of the Rhine (CCNR), Strasbourg, France

g.pauli@ccr-zkr.org

ABSTRACT: In many parts of the worlds, governments attempt to increase the amount of cargo transported on inland waterways as inland waterway transport (IWT) is regarded as a cost-efficient and environmental friendly mode of transport (EC 2011, UNECE 2011). These attempts have sometimes limited success, in particular, when the waterways run through multiple countries. This paper sets out to explain, what factors are critical for the success of multinational IWT systems using the fluvial navigation system of the Rhine as a case study. The SMART RIVERS Conference seems ideally suited for the presentation of this paper, as this conference brings together experts from different multinational IWT systems and as PIANC promotes the enhancement of waterborne transport infrastructure's economic, environmental and social benefits.

1 INTRODUCTION

With a length of 1300 km, of which 850 are navigable, the Rhine is not among the largest 100 rivers of the world and only the twelfth in Europe. In terms of transport however, it is one of the most important rivers with 330 million tons of cargo and 2 million container (TEU) carried on inland navigation vessels each year, equalling 45 billion tkm (CCNR, EC et al. 2014). What sets the Rhine apart from most other large fluvial navigations systems in the world, in particular from those in China, Russia and the USA, is its multinational character. The navigable part of the Rhine runs through four countries and inland navigation counts for more than 50% of the cross border freight traffic along the Rhine corridor (EC 2014b). Furthermore, the Rhine forms the backbone of an even larger navigation system that connects a number of the most significant industrial centres, urban areas and seaports of six western European countries, namely Belgium, France, Germany, Luxemburg, the Netherlands and Switzerland. This larger system provides for almost 2000 km of highly developed inland waterways. (See **Annex 1**.) This makes the Rhine probably the most successful multinational IWT system in terms of freight volume (See **Annex 2**).

Figure 1: Overview of the fluvial navigation system of the Rhine.

There are larger fluvial systems than the Rhine that lend themselves to navigation, but do not enjoy the same success. This is particularly obvious in the case of the Danube, the other large multinational fluvial navigation system in Europe. Even though the Danube's navigable part is more than twice as long as that of the Rhine and borders on more than twice as many countries, its freight volume is much lower than that of the Rhine. Why then is the Rhine such a successful multinational fluvial navigation system? What are its critical success factors?

2 CRITICAL SUCCESS FACTORS for multinational IWT systems

The term Critical Success Factor (CSF) describes a concept for understanding the prerequisites for success of industries, companies or managers (Bullen and Rockart 1981). In this paper, a CSF is understood as an element that is necessary for a multinational fluvial navigation system to be successful in terms of freight transport.

2.1 *A very good infrastructure for navigation*

The Rhine is naturally not destined for extensive navigation: its average water discharge is rather feeble and the middle part of its watercourse is narrow, windy and dotted with rocks. Nevertheless, the waterway maintains high standards for effective navigation. It has guaranteed fairway dimensions for large vessels and convoys, which are prerequisites for reliable and cost efficient operation of the fleet. (See **Annex 3**.)

Indeed, the cost for freight transport on the Rhine is considerably lower than for transport by rail or road. This applies for bulk goods and even more so for the transport of containers (PLANCO 2007). The latter profits especially from the large air draught of the bridges over the Rhine.

The Rhine's highly developed infrastructure and its good maintenance are the result of a long lasting financial commitment of the riparian states. The development started hundreds of years ago, had its prime in the twentieth century and continues up to present days. Germany and The Netherlands are the riparian countries with the largest geographical share of the Rhine and at the same time the European countries with the highest spending on inland waterways infrastructure investment and maintenance.

The combined spending of these two countries on inland waterways is more than three times as much as that of seven riparian countries of the Danube combined[1].

Modern technologies and River Information Services (RIS) are employed to ensure safe and economical navigation around the clock throughout the year. Electronic reporting for many vessels is mandatory, in particular for those carrying containers. All vessels have to use Inland AIS (Automatic Identification System) and must be equipped with Inland ECDIS (Electronic Chart Display and Information System) or similar systems. The authorities via the internet provide up-to-date notices to skippers in multiple languages. Practically all vessels are equipped with radar allowing navigation also in times of zero visibility.

In spite of the large investments for the development of the Rhine's waterway infrastructure, its quality is limited due to hydrological circumstances. The water level on the Middle Rhine drops to less than 1.9 m for 20 days per year in average. The Rhine has experienced long periods of droughts, which dramatically reduce the carrying capacity of the vessels and therefore the income of the ship-owners. However, technical and operational innovations help minimize these negative effects. Ship-owners increasingly deploy convoys of one self-propelled vessel with one or more push barges. In times of normal water levels, the self-propelled vessel will sail with one barge in front, ensuring a very economical and fuel-efficient operation. At low water levels, when carrying capacity is reduced, one or two barges are added on one side of the convoy. This ensures sufficient transport capacity and earning potential for the ship-owners even in times of low water. In addition, the extension of water level forecast from two to four days provides the skipper with sufficiently reliable information on the water depth for the entire journey at the time of loading of the vessel, allowing the skipper to use the available capacity to the fullest.

[1] Average of the years 2004 to 2013; Danube riparian countries Austria, Bulgaria, Croatia, Hungary, Moldova, Romania, Serbia, Slovakia: calculation by the author based on OECD statistic http://stats.oecd.org/Index.aspx?themetreeid=24&datasetcode=ITF_INV-MTN_DATA)

Figure 2: Self-propelled container vessel with three barges at low water level on the Rhine.

The Danube offers potentially much better conditions for inland navigation than the Rhine does, because its average water discharge is three times as large. However, the Danube has not enjoyed such a commitment by its riparian countries for development and maintenance as the Rhine has. In particular, the fairway depth is on many stretches more limited than on the Rhine (EU and NEWADA 2014). This makes freight transport on the Danube unreliable and increases transport cost, preventing the Danube from making use of its potential for IWT (EC 2014c).

2.2 *A well-organised industry with a long-term interest in inland navigation*

It has been decisive for the development of the Rhine to have competent and progressive industry representatives engaged in a structured dialogue with the public authorities in defining policies for the development of Rhine navigation. Since the 19th century, strong links have existed between ship owners, skippers, bankers, technical and legal experts and other professionals, forming a cluster to support a competitive industry. Entrepreneurs drive this industry by continuously developing the Rhine fleet according to logistical needs and technological progress.

In his groundbreaking work on the understanding and role of competition, Michael E. Porter defines clusters as "groups of interconnected firms, suppliers, related industries, and specialized institutions in particular fields that are present in particular locations." He shows, that "clusters not only reduce transaction costs and boost efficiency but improve incentives and create collective assets in the form of information, specialized institutions, and reputation, among others. More importantly, clusters enable innovation and speed productivity growth".(Porter 1998)

Inland navigation companies compete with each other, but generally also with companies of other modes of transport. Therefore, the inland navigation companies must innovate and keep up productivity in order to be economically successful. Being part of inland navigation clusters helps to accomplish this.

Duisburg, situated on the lower Rhine in Germany, is a prime example for an inland navigation cluster. It is home to the largest inland port in Europe, but also to numerous shipping companies, ship and freight brokers, shipyards, equipment manufacturers, training and education institutions (for crew, engineers, economists), specialized banks, research and development institutes focused on IWT, consultants and other companies and institutions active in inland navigation. "Haus Rhein" (The Rhine House) in the port area is the seat of Germany's most important inland navigation industry associations. Similarly, Rotterdam is home to the inland navigation cluster of the Netherlands, probably even surpassing the cluster of Duisburg in size and diversity.

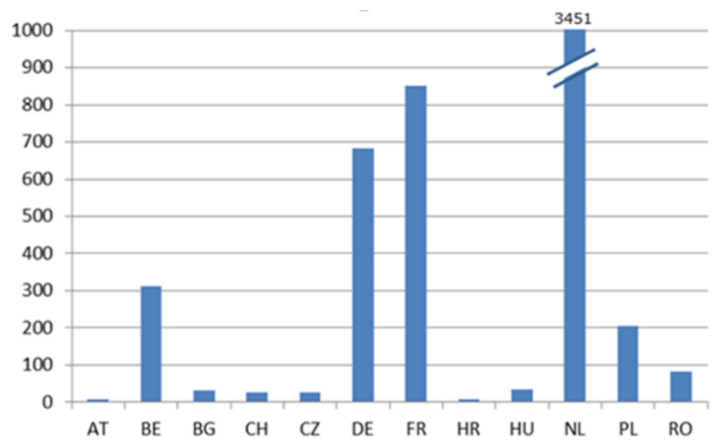


Figure 3: Number of IWT enterprises in European countries (Sierink, Smit et al. 2015).

There are other agglomerations of companies and institutions active in inland navigation in Europe, mostly in the Netherlands as well, in France and in Belgium, as may be concluded from Figure 1. However, their size and diversity is very limited, when compared to Duisburg and Rotterdam. Therefore, one can assume that these agglomerations do not create the benefits attributed to industry clusters and that the companies located in these agglomerations or elsewhere are much less able to compete successfully.

This is of particular importance for those fluvial navigation systems, which do not have a single inland navigation cluster, as their navigation industry is much less likely to compete successfully against other modes of transport.

2.3 Integration of inland navigation in logistical chains

The urban and industrial agglomerations in the Rhine area provide a high demand for transport services. However, a high demand for transport services in general does not automatically translate into freight volume for inland navigation, as not all cargo is equally suited for inland navigation and as inland navigation competes with other modes of transport. However, Rhine navigation does indeed catch a large share of this transport demand and its integration into logistical chains has enabled it to do so.

All along the Rhine, every 20 km on average, public and private ports and terminals constitute links between Rhine navigation and the surrounding economy. They are intermodal platforms providing a great variety of services, in particular transfer of goods from inland navigation vessels to other modes of transport and vice versa. The large seaports are the gateways of Western Europe to the world and the Rhine connects these seaports most efficiently with the hinterland, as **Table 1** indicates. For the port of Rotterdam, the modal share of inland navigation exceeds 40 % (EC 2014b), making it the largest source and destination of the freight transported by the Rhine navigation system.

Rank	Port	Country	IWT System	Cargo volume (mil. tons, 2014)	Modal share IWT (2013)
1	Rotterdam	Netherlands	Rhine	444,7	43 %
2	Antwerp	Belgium	Rhine	199,0	41 % (2014)
5	Amsterdam	Netherlands	Rhine	97,8	60 %
…					
15	Constanta	Romania	Danube	55,6	23 %

Table 1: European Seaports, by cargo volume (EC 2014a, EC 2014b, EC 2014c, Antwerp Port Authority 2015, Port of Rotterdam Authority 2015)

Freight transport on inland waterways can be monomodal, such as the transport of gravel from gravel pits to concrete factories and chemical products between chemical factories. However, this type of transport has only a limited economic potential. Multimodal transports offer a much larger transport market for inland navigation, in particular in combination with maritime transport. Raw materials are typically transported in bulk from their sources to ports on other continents. Inland navigation can complement the logistical chain by delivering the raw material from the maritime port to the end-users. A telling example is iron ore and coal from overseas sources arriving in Rotterdam or other nearby maritime ports, which are transported from there by inland navigation to steelworks in Duisburg, 60,000 to 80,000 tons, each day all year round. The ITF Transport Outlook 2015 forecasts an increase of freight volumes on the important maritime routes of some 300 % until 2050 and a fourfold increase in seaports freight turnover (OECD/ITF 2014). If inland navigation in a particular fluvial system is able to provide necessary hinterland connections for maritime routes, it will enjoy potentially similar increases in freight volumes.

The most sophisticated logistical chains, of which inland navigation is part of, involve the transport of containerized goods. It is the fastest growing freight sector of Rhine navigation, compensating for the decline of transport of other goods. Most often, these containers are transported from or to terminals in the seaports. The port of Rotterdam aims at a modal share of inland navigation in the transport of containers of 45 %.

Market segment	Share in %	
	2002	2013
Dry bulk	68	67
Liquid bulk	27	25
Containers	5	8

Table 2: Individual market segment shares of transport volume on the Rhine (CCNR, EC et al. 2014).

In comparison, the potential for the integration of Danube navigation’s in logistical chains seems to be limited, even though the river connects many more countries than the Rhine does:

- The ports on the Danube are not only smaller than the Rhine ports, there are also only half as many in relation to the length of the river.
- Constanta, the most important port with maritime traffic in the Danube region, has a freight throughput equalling roughly a tenth of the throughput of Rotterdam and the modal share of inland navigation is half of that of Rotterdam.
- There is only very limited transport of containers on the Danube.

2.4 A dedicated supranational organisation

Since 1815, the Central Commission for the Navigation of the Rhine (CCNR) has been the forum for coordination and decision-making in all international matters concerning Rhine navigation. Freedom of navigation, equal treatment of waterway users and prosperity for the navigation industry are its guiding principles. The CCNR was given legal powers, which it has used to develop a comprehensive and continuously updated set of regulations for Rhine navigation. They have become the blue print for the regulation of inland navigation in Europe and beyond.

Freedom of navigation and equal treatment of waterway users allows and stimulates (cross-border) competition. In general, competition is seen as a driver for innovation and as an effective instrument to keep costs for consumers low. Indeed, there is a strong competition in Rhine navigation, manifest in the number of companies operating on the Rhine. Rhine navigation is acknowledged as offering lower transport cost than competing modes and it is at the forefront of innovation, as examples from the preceding sections of the paper show.

In principle, the CCNR regulations ensure safety, whereby all elements of the navigation system are addressed. In recent years, environmental protection has become an important objective of these regulations. These regulations are demanding and lead to additional expenditures for the ship-owners, such as additional investment cost for the design and equipment of the vessels or higher salaries for trained personnel.

However, at the same time, the regulations and their enforcement ensure safety and ease of navigation. The number and impact of accidents remains low, the traffic flows smoothly and pollutions has reached low levels. Furthermore, regulations stimulate innovation and ship-owners find ways to fulfil the safety requirements in the most efficient way possible.

In his book *The Competitive Advantage of Nations* Michael E. Porter famously “advocates new, constructive, and actionable roles for government, old distinctions between *laissez-faire* and prosperity. This implies a minimalist government role in some areas (e.g., trade barriers, pricing) and an activist role in others (e.g. ensuring vigorous competition, providing high-quality education and training). … Governments must strive to improve the business environment in many ways. It must not, however, limit competition or ease standards for safety and environmental impact. Such “help” actually retards competitiveness by stunting innovation and slowing productivity improvement.” (Porter 1998). This aptly describes the role of river commissions, as they are the governments of multi-national fluvial navigation systems.

Engagement with important stakeholders is of great importance for any regulatory work, including that of river commissions:

- Regulators, even in inland navigation, work in a fast-changing political, economic, social, technological and ecological context. Stakeholders often have a better understanding of the context and know regulatory subjects better than the regulator does; at least they know best the impacts of regulation.
- Working with stakeholders helps regulators to better understand the risks of envisaged regulations.
- Stakeholders that are involved in the development of regulation are more likely to support its implementation.

The CCNR has habitually engaged its stakeholders, in particular ship-owners. Already in 1848, the CCNR invited the ship-owners to discuss with them first Rhine Police Regulations. Today, the CCNR has officially recognized some 20 trade associations and other non-governmental organisations representing private entities involved in inland navigation, ranging from ship-owners to the chemical industries, whose products are carried on inland waterways.

The recognition forms the basis for the engagement of these stakeholders, which extends from establishing the CCNR’s work programme to its decision making on navigation regulations.

Historically the most important and today still most intensive engagement is that of the ship-owners. The demand of the CCNR for engagement has shaped the development of the European inland navigation industry associations: Most of the members of these associations are located in the CCNR member states, as are the secretariats of these associations; and the inland navigation industry of all CCNR member states is represented in these associations. (See **Annex 4**.)

However, stakeholder engagement must be forward looking and keep pace with the changing political, economic, social, technological and ecological context, which the river commissions work in. In particular, the engagement of stakeholders supporting social and environmental objectives, such as trade unions and environmental NGOs, has to be intensified.

Competition, trade associations and stakeholder engagement are features of western, liberal societies with market-based economies. Countries following the principles of socialist societies with planned economies do not develop these characteristics. Today all riparian countries of the Danube are members of the EU or strive to become one in the future. However, most of them have a common history of belonging to the so-called Eastern Bloc, the communist states of Eastern Europe. This history may explain today’s comparably weak competition between shipping companies on the Danube, its weak trade associations and the lack of stakeholder engagement. It certainly explains the characteristics of the present day Danube Commission, which are very different from those of the CCNR, in particular the limited emphasis on competition and the absence of regulatory powers. This comparison makes it clear, that having a dedicated supranational organisation with certain characteristics as governing body is critical for the economic success of multinational fluvial navigation systems.

2.5 Protection of the environment

The Rhine navigable waterway system is largely the result of human actions. In the past, development has often been ecologically blind and as a result, caused severe damage. Today, decisions concerning the management and improvement of the infrastructure are preceded by careful environmental impact assessments. These are carried out in close cooperation with all stakeholders and in accordance with environmental legislation of the EU and the CCNR member states.

The shipping industry in the Rhine area is well aware that the application of legal requirements for infrastructure development is not sufficient. Inland navigation is only one of several water uses and it must engage in the protection of the fluvial ecosystems and the environment in general.

There are good reasons for this engagement and its further strengthening:

- Inland navigation needs a strong political backing, not least for further infrastructure development. The economic output of inland navigation is small, compared to other modes of transport, and it does not play an important role in the lives of citizens. Therefore, it has a much lower political weight than competing transport modes. Without the perceived ecological advantage, politicians are not compelled to advocate for inland navigation development.
- Rivers and lakes are very dear to many people. If inland navigation damages rivers or lakes, people will resent inland navigation and in particular, its further development, as numerous citizen movements against inland navigation development projects show.
- Environmental protection policies are incorporating more and more the “polluter pays” principle. This principle makes the pollution-producing party responsible for compensating the damage done to the natural environment. This principle has received strong support by the Organisation for Economic Co-operation and Development (OECD) and the European Union (EU). If inland navigation wants to keep its production cost low, it must protect the environment.

-

- Environmental protection is increasingly becoming a decision criteria in the private sector, in particular in companies, which have adopted the principles of Corporate Social Responsibility (CSR). These companies take into account the effects that their actions have on the environment, including the effects of their supply chains. Therefore, these companies prefer to have their goods transported by inland navigation, if this is less harmful for the environment than other modes of transport.

Inland navigation in a particular fluvial system may even be called upon to take on more cargo and thereby help to minimise environmental problems of other modes of transport. With the tremendous increase of freight arriving in or departing from seaports, road and rail networks will be overloaded and noise and pollutant emissions will reach unacceptable levels. Using inland navigation instead will take pressure from these networks and the environment and provide additional benefits such as reduced waiting times and transport cost (OECD/ITF 2014). For this reason, the ports of Rotterdam and Antwerp already have relevant policies in place and the modal share of Rhine navigation in container hinterland transport of these ports is increasing remarkably.

Other engagement of Rhine navigation in recent years has let to tangible progress in the protection of the environment. The vessels use clean fuel, basically free of sulphur. Ship waste is systematically collected on board and handled in waste treatment facilities. The financing of the waste collection and treatment is based on the polluter pays principle. Intentional or unintentional pollution of the aquatic environment has been greatly reduced due to strict regulations and improved government oversight. The shipping industry actively supports government activities of the CCNR, the EU and member states to further reduce pollutant emissions from inland navigation engines, e.g. by using LNG as fuel.

On the Danube, the situation is very different. Many vessels still use fuel with high sulphur content. Systematic collection and treatment of ship waste is not implemented yet. Oversight on water pollution is patchy. Engagement of governments and companies in reduction of pollutant emissions is generally weak or absent altogether. This situation coincides with a strong resistance against waterway infrastructure development by citizen movements and very weak government engagement for inland navigation in a number of riparian countries.

The comparison of navigation on the Rhine and Danube, regarding the protection of the environment allows the conclusion that protection of the environment by inland navigation is more than just "nice to have". It is critical for the success of inland navigation. This is true for national waterways, but may be more so for international and multinational waterways, as negligence of environmental protection in one riparian country influences the image of inland navigation in other countries.

3 CONCLUSIONS

This paper applies the concept of Critical Success Factors (CSF) in the context of multinational IWT systems and identifies five CSF for such systems:

1) *A very good infrastructure for navigation,*
2) *A well-organised industry with a long-term interest in inland navigation,*
3) *Integration of inland navigation in logistical chains,*
4) *A dedicated supranational organisation, ensuring competition as well as setting high safety and environmental standards,*
5) *Protection of the environment.*

The usefulness and the quality of this undertaking may be questioned. Indeed, there is already intensive research on the development of IWT in general and on specific navigation systems or waterways in particular. However, the author of this paper did not encounter research that tried to explain development potential of multinational IWT systems with a combined analysis of IWT infrastructure, IWT industries, IWT governance and IWT integration in logistical chains. This paper is trying to close this gap based on a clear conceptual framework.

Instead of using the concept of CSF, the prerequisites for long-term success of multinational IWT systems may be determined by applying the concept of sustainable transport systems[2].

[2] "A sustainable transportation system is one that: allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations; is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; and limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level,

This concept is generally accepted and well researched. It is based on a clear definition (CST 2005) and indicators were developed, which help to analysis the sustainability of a transport system, meaning the potential for functioning over a long period. Indeed, the author of this paper has undertaken such an analysis and he concluded, taking again the IWT system of the Rhine as an example, that inland navigation scores generally high on sustainability criteria, but that it still has to overcome certain deficiencies (Pauli 2010). However, the analysis was complex and detailed, and therefore difficult to understand and to communicate. Furthermore, the analysis did not establish a relationship with transport volume and did not answer the question, how inland navigation systems may attract large freight volumes. Ideally, the application of the two concepts may complement each other: The CSF may enable an analysis of the development potential of an IWT system and the application of the concept of sustainable transport systems may indicate, whether the IWT system is sustainable.

The author of the paper freely admits, that the CSF for multinational IWT systems have not been identified as a result of scientific research, but are rather based on the experience and observations of a practitioner in the field. Hence, the subject may benefit from further research, possibly applying the concept of CSF to a range of navigation systems and developing a more stringent definition for the term "success". The concept may even apply to all fluvial systems, be they national or international.

Nevertheless, the CSF identified in this paper may be useful for decision makers in national governments, river commissions or other international organisations, who are involved in the development of multinational fluvial navigation systems. They may determine, whether the system for which decisions are to be taken fulfil these CSF. If not, measures need to be identified and taken, which ensure that these CSF are eventually in place and the associated requirements are met. If this is impossible, the expectations regarding the development goals for the IWT system need to be lowered.

reuses and recycles its components, and minimizes the use of land and the production of noise."

REFERENCES

Antwerp Port Authority (2015). 2015 Facts & Figures. Antwerp, Antwerp Port Authority.
Bullen, C. V. and J. F. Rockart (1981). A primer on critical success factors. CISR No. 69, Sloan WP No. 1220-81. Cambridge, Massachusetts Center for Information Systems Research, Sloan School of Management, Massachusetts Institute of Technology.
CCNR, EC and Panteia (2014). The Inland Navigation Market in 2013 and perspective for 2014/2015. Market Observation. Strasbourg.
CST (2005). Defining Sustainable Transportation. Winnipeg, The Centre for Sustainable Transportation.
EC (2011). White Paper 'Roadmap to a single European transport area — Towards a competitive and resource-efficient transport system'. E. Commission. Luxembourg, Publications Office of the European Union.
EC (2014a). North Sea – Baltic Core Network Corridor Study - Final Report. Brussels, European Commission.
EC (2014b). Rhine-Alpine Core Network Corridor Study – Final Report. Brussels, European Commission.
EC (2014c). Rhine-Danube Core Network Corridor Study – Final Report. Brussels, European Commission.
EU and NEWADA (2014). Fairway Rehabilitation and Maintenance Master Plan – Danube and its navigable tributaries, EU Strategy for the Danube Region, Priority Area 1a – To improve mobility and multimodality: inland waterways
NEWADA duo project.
OECD/ITF (2014). ITF Transport Outlook 2015. Paris, OECD.
Pauli, G. (2010). "Sustainable transport: A case study of Rhine navigation." Natural Resources Forum **34**: 18.

PLANCO (2007). Verkehrswirtschaftlicher und ökologischer Vergleich der Verkehrsträger Straße, Bahn und Wasserstraße; Schlussbericht. Magdeburg, PLANCO Consulting GmbH, Essen, Bundesanstalt für Gewässerkunde, Koblenz.
Port of Rotterdam Authority (2015). Port Statistics. Rotterdam, Port of Rotterdam Authority.
Porter, M. E. (1998). The Competitive Advantage of Nations New York, The Free Press.
Sierink, H.-E., R. Smit, M. Quispel, S. van Putten, R. v. Liere, H. Visser, W. v. d. Geest, J. Rusche and F. Spiess (2015). Analysis of Possibilities to Enhance Market Transparency and Synergistic Actions. Brussels.
UNECE (2011). White Paper on Efficient and Sustainable Inland Water Transport in Europe. New York and Geneva, United Nations Economic Commission for Europe.

Annex 1

Important inland waterways in the Rhine area and their main characteristics

Waterway	Length (km)	CEMT Category	Fairway depth (m)	Bridge height (m) (lowest above highest navigable water level)	Cargo (tons / year)	Container (TEU / year)
Rhine	885				332 mil.	2.000.000
High		Va	2,25	5,10		
Upper D/F		VIb	3,00	7,0		800.000
Upper D		VIb	1,90 – 2,10	9,10	193,5 mil.	
Middle		VIc (from km 564)	2,10 – 2,80	9,10		1.200.000
Lower		VIc	2,80	9,10		2.000.000
Delta					138,5 mil.	
Waal		VIc	2,80	9,00		
Leek						
Neckar	200	Va	2,80	6,00	6,3 mil.	27.000
Main	390			(6,00)	16,7 mil.	76.000
Upper part		Vb (from km 174)	2,90	4,85		
Lower part		Va (to km 384)	2,50	6,20		
Mosel	390	Vb	3,00	6,00	14 mil.	6.000
Rhein-Herne-Kanal	45	Vb (IV)	4,00 (3,50)	4,50	13 mil.	2.000
Wesel-Datteln-Kanal	60	Vb	4,00	4,50	18,6 mil.	3.000
Amsterdam-Rhine-Canal	71	VIb	4,00	9,05	73 mil.	66.000
Schelde-Rijn Connection	38	VIc	4,00	9,10	115 mil.	1.399.000
Donau	2412					20.000
Obere		V b – VI c	1,70 – 2,90	2,50	5,0 mil.	
Mittlere		VI b - VII	1,90 – 3,50	10,40	5,0 mil.	
Untere		VII	1,50 – 3,50	20,40	18,1 mil.	

This table is meant for general information only. Latest available data.

<u>Sources:</u>
„Europäische Binnenschifffahrt, Marktbeobachtung 2014“, Zentralkommission für die Rheinschifffahrt, Straßburg
„Verkehrsbericht 2013“, Generaldirektion für Wasserstraßen und Schifffahrt Außenstelle Süd, Würzburg 2014
„Verkehrsbericht 2013, Rheinstromgebiet“, Generaldirektion für Wasserstraßen und Schifffahrt Außenstelle Südwest, Mainz 2014
„Verkehrsbericht 2013, Niederrhein und westdeutsches Kanalnetz “, Generaldirektion für Wasserstraßen und Schifffahrt Außenstellen West, Münster 2014
„Marktbeobachtung der Donauschifffahrt: Bilanz für das Jahr 2014“, Donaukommission, Budapest 2015
www.elwis.de, Binnenwasserstraßen der Bundesrepublik Deutschland
Verwaltungsvorschrift der Wasser- und Schifffahrtsverwaltung des Bundes (VV-WSV) 1103, Teil 4 - Zuordnung der dem allgemeinen Verkehrs dienenden Binnenwasserstraßen des Bundes zu den Wasserstraßenklassen, Bundesministerium für Verkehr und digitale Infrastruktur, Bonn 2015
www.danubecommission.org, Brücken an der Donau; www.unece.org, Blue Book Database
North Sea – Baltic Core Network Corridor Study - Final Report, European Commission, Brussels, 2014
Data provided by Rijkswaterstaat
Analysis of the EU Combined Transport, KombiConsult et al., European Commission, Brussels, 2015

Annex 2

Important multinational fluvial navigation systems[3]

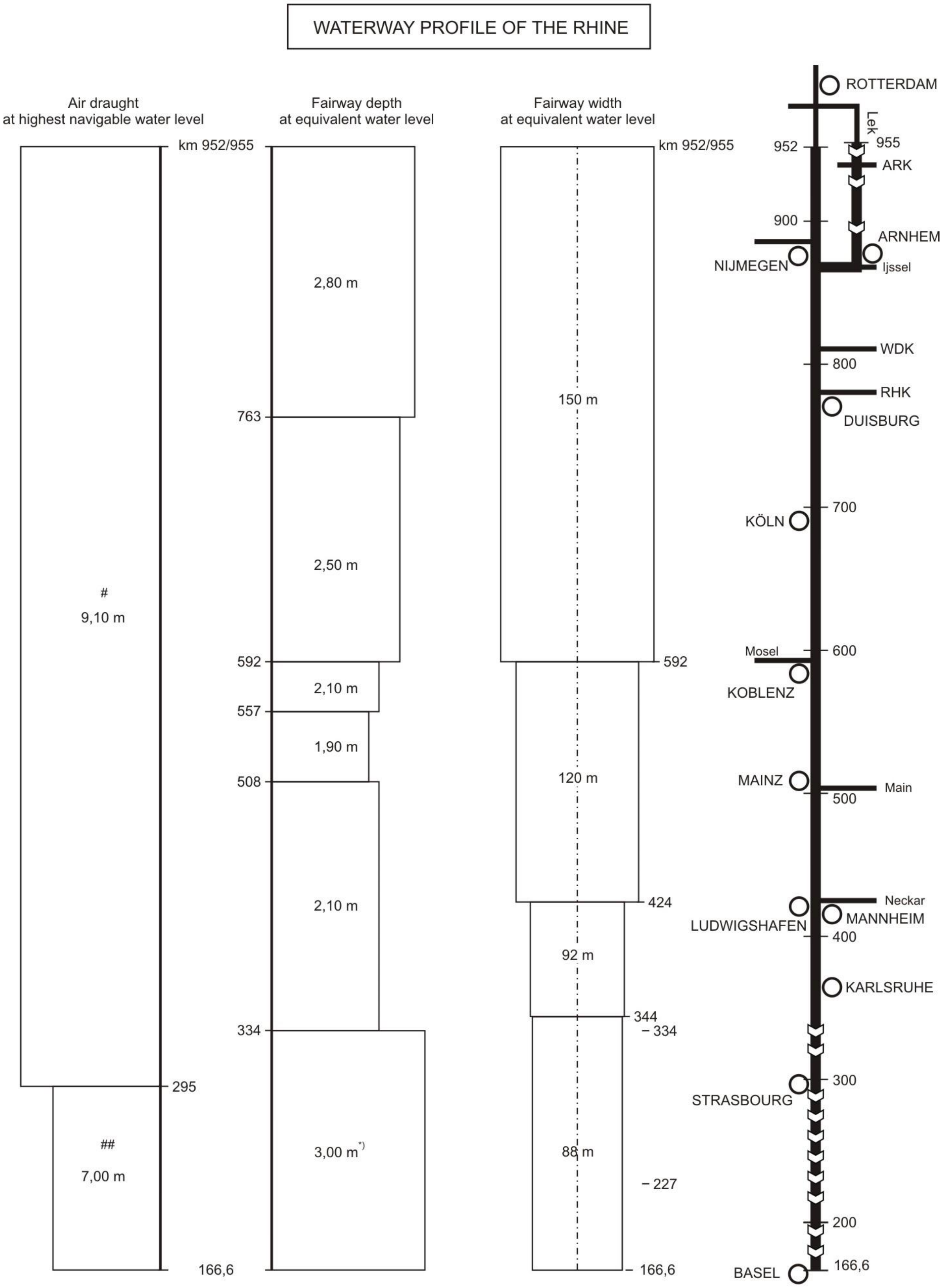
Rank[4]	River	Length (km)	Drainage area (km^2)	Average discharge (m^3/s)	Outflow	Countries in the drainage basin	Freight volume
1.	Nile	6.650 (6.853)	3.254.555	5.100	Mediterranean	Ethiopia, Eritrea, Sudan, Uganda, Tanzania, Kenya, Rwanda, Burundi, Egypt, Democratic Republic of the Congo, South Sudan	Mainly touristic (only 1% of goods transport), about 3.000.000 tons/year
2.	Amazon	6.400 (6.992)	7.050.000	219.000	Atlantic Ocean	Brazil, Peru, Bolivia, Colombia, Ecuador, Venezuela, Guyana	45.000.000 tons/year but the potential of the system could reach about 180.000.000 tons/year (according ANTAQ)
8.	Paraná – Río de la Plata	4.880	2.582.672	18.000	Río de la Plata	Brazil, Argentina, Paraguay, Bolivia, Uruguay	About 20.000.000 tons/year (for Paraná/Paraguay)
9.	Congo	4.700	3.680.000	41.800	Atlantic Ocean	Democratic Republic of the Congo, Central African Republic, Angola, Republic of the Congo, Tanzania, Cameroon, Zambia, Burundi, Rwanda	/
12.	Mekong	4.350	810.000	16.000	South China Sea	China, Myanmar, Laos, Thailand, Cambodia, Vietnam	More than 3.000.000 tons/year (containers included)
14.	Niger	4.200	2.090.000	9.570	Gulf of Guinea	Nigeria, Mali, Niger, Algeria, Guinea, Cameroon, Burkina Faso, Côte d'Ivoire, Benin, Chad	/

[3] Only rivers whose river basins are located in more than two countries and for which significant IWT activities or the existing of international river commission are known are listed
[4] Ranking according to river length

Rank	River	Length (km)	Drainage area (km^2)	Average discharge (m^3/s)	Outflow	Countries in the drainage basin	Freight volume
29.	Brahmaputra	2.948	1.730.000	19.200	Ganges	India, China, Nepal, Bangladesh, Bhutan	About 70.000.000 tons/year (in India in total)
30.	Danube	2.888	817.000	7.130	Black Sea	Romania, Hungary, Austria, Serbia, Germany, Slovakia, Bulgaria, Croatia, Moldova	About 40.000.000 tons/year
34.	Ganges	2.620	907.000	12.037	Bay of Bengal	India, Bangladesh, Nepal, China	About 70.000.000 tons/year (in India in total)
38.	Paraguay	2.549	900.000	4.300	Paraná	Brazil, Paraguay, Bolivia, Argentina	About 20.000.000 tons/year (for Paraná/Paraguay)
58.	Orinoco	2.101	1.380.000	33.000	Atlantic Ocean	Venezuela, Colombia, Guyana	/
75.	Senegal	1.641	419.659		Atlantic Ocean	Guinea, Senegal, Mali, Mauritania	/
76.	Uruguay	1.610	370.000		Atlantic Ocean	Uruguay, Argentina, Brazil	
125.	Rhine	1.233	198.735	2.330	North Sea	Germany, France, Switzerland, Netherlands, Austria, Liechtenstein, Italy, Belgium, Luxembourg	330.000.000 tons/year

Source: https://en.wikipedia.org/wiki/List_of_rivers_by_length; http://www.wwinn.org/

Annex 3



*) Guaranteed water depth

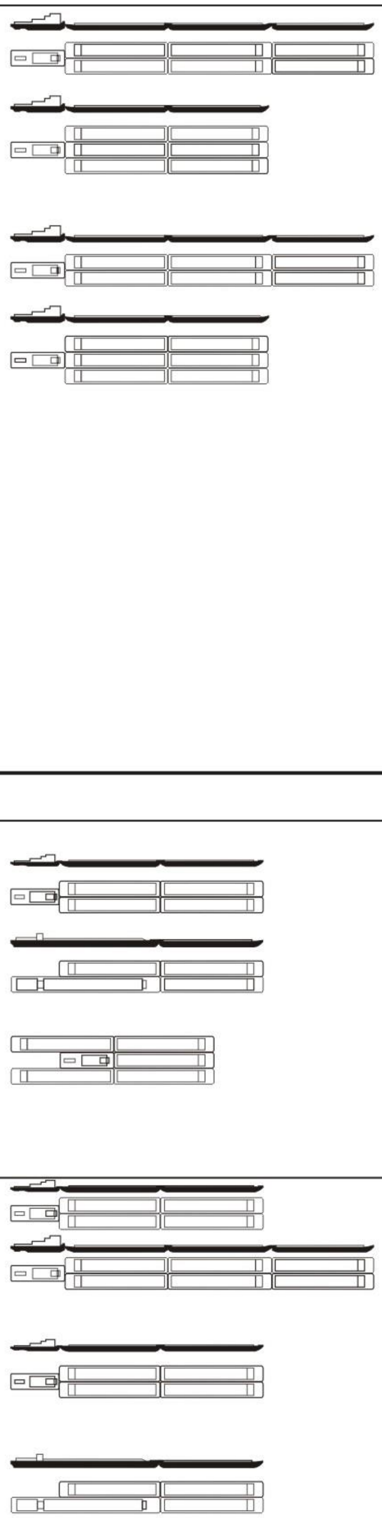
\# 1. At the Josef-Kardinal-Frings-Brücke (Südbrücke Düsseldorf, Rhine km 737,10) the air draught of the bridge at HNWL is 8,61 m.
2. At the Kniebrücke Düsseldorf (Rhine km 743,57) the air draught of the bridge at HNWL is 8,82 m.
3. At the road bridge Rheinhausen - Duisburg-Hochfeld (Rhine km 775,29) the air draught at HNWL is 8,88 m.
4. At the road bridge Bonn-Beuel (Kennedy-Brücke Bonn, Rhine km 654,94) the air draught of 9,10 m above HNWL is only available over a width of 115 m.
5. At the road bridge Köln-Deutz (Rhine km 687,93) the air draught of 9,10 m above HNWL is only available over a width of 94 m.

\## At the Europabrücke (Rhine km 293,48) the air draught of the bridge at HNWL is 6,79 m.

Simplified representation of the maximum dimensions of vessels and pushed convoys
(For binding dimensions see Chapter 11 Police Regulations for the Navigation of the Rhine)

km	Vessels Length [m]	Vessels Width [m]		Pushed convoys Length [m]	Pushed convoys Width [m]	
	135	22,8	Waal	269,5	22,90	B
	135	17,7	Lek[2]	110,0	17,70	
	135	22,8	Waal	193,0	34,35	T
	135	17,7	Lek[2]	186,5	11,45	
867,5						
				269,5	22,90	B
	135	22,8				
				193,0	34,35	T
564,3						
	135[3]	22,8		B 186,5 T 116,5	22,90	
540,2						
				193,0	22,90	
	135	22,8		153,0	34,35	
359,8						
	135	22,8		193,0	22,90	
334,0						
	135	22,8		270,0	22,90	
287,4						
	135	22,8[4]				
				183,0	22,80[4]	

Formation[1]



1) The formation for the Lek is not represented due to space limitations.
2) Larger dimensions apply from the Lek channel (km 949,40) to Krimpen (km 989,20).
3) At certain water levels 110.
4) Smaller dimensions apply in case of closure of certain lock chambers.
B: Upstream navigation T: Downstream navigation.

Annex 4

Representation of national ship-owners associations in European ship-owners associations

Country / national association	Member State of the CCNR	Member State of the Danube Commission	European Barge Union (EBU)	European Skippers Organisation (ESO)
Austria		X	X	
Belgium	X		X	X
Bulgaria		X		
Croatia		X		
Czech Republic			X	
France	X		X	X
Germany	X	X	X	X
Hungary				
Luxembourg			X	
Moldova		X		
Netherlands	X		X	X
Poland				X
Romania		X	X	
Russia		X		
Serbia		X		
Slovakia		X		
Switzerland	X		X	
Ukraine		X		

Source: http://www.ebu-uenf.org , http://www.eso-oeb.org