Inland Waterways Transport

Good Practice Manual and Reference Guide

Composed for

The World Bank

Related to the Intensive Training and Exposure Program for Innovations in Inland Waterways

of 19-23 October 2015

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STC-NESTRA

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1. INTRODUCTION AND BACKGROUND

In the week of 19-23 October 2015, an intensive training and exposure program for innovations in inland waterways was organized in the Netherlands, Belgium and Germany for World Bank and IFC staff.

The objectives of the program are:

a) to offer frontline World Bank TTLs and Managers an opportunity to rapidly build capacity in inland waterways transport and gain exposure to modern practices through an intensive and customized program

b) to provide up to date information on the main aspects of inland waterways transport and good practices in the field, so as to:

- elevate and broaden policy dialogue with clients,
- enable teams to assess and develop inland waterways projects,
- adopt a holistic and end-user focused approach to inland waterways projects.

The core of the program is executed in the triangle Rotterdam-Duisburg-Brussels; being the heart of the European inland waterways system (policy making, regulations, operations and flows), and consists of meetings with and visits to policy makers, legislative bodies, waterway managers, port and terminal operators, inland shipping companies, and design institutes and research centers.

The program is built around the following themes: efficient, safe and clean inland waterways transport.

In addition to the exposure program, a succinct and quick reference manual on good practices in inland waterways has been composed. This document provides introductions to the main developments and innovations in the inland waterway sector, in the form of concise concept papers and links and references for further reading.

The quick reference manual relates to the exposure program and contains information based on the site visits and meetings as well as additional materials related to the development of IWT in Europe.

The exposure visit and quick reference manual follow the intensive contacts between STC-NESTRA and the Worldbank in 2014, and is a logical follow-up of the presentation that was given in May 2014 in Washington. Following this presentation and the discussions during and after the visit, it was decided to organize the exposure program, with the aim to introduce the new and existing concepts and visions in developing IWT.

The quick reference manual contains a large number of topics, which can be read as stand-alone pieces. That means that in some cases some overlaps occur between the different parts of the quick reference manual, as they relate to different topics.

2. CONTENTS MANUAL

This quick reference manual is the first one of its kind, and it is the expectation that new parts may be added and text updates and additions and revisions can be made, possibly resulting in a toolkit for IWT in future.

The following topics are included in this good practice manual:

- Policy and strategy - IWT policies, promotional strategies, incentive and promotion programs
- Institutional set up and regulatory issues - role of the Ministry of Transport and related agencies, links between transport and other waterway management issues, international river commissions, public and private parties involvement
- Planning, development and management of inland waterways -planning and design principles, building with nature, room for rivers, management of waterways, links with economic/industrial activity and zoning
- Markets for inland waterways transport and users - markets for IWT, developing business cases, added value of IWT for cargo owners and logistic service providers, IWT competitive position
- Logistics and hinterland connectivity - IWT facilities in ports, hinterland networks, multimodal connections, inland terminals, extended gates, integration of IWT in multimodal corridors
- Infrastructure - waterways, ports, terminals, ship locks, aids to navigation, dredging, embankment protection
- Inland waterways transport operations -the fleet, the companies, crew requirements, IWT economics
- Safety in inland waterways transport -RIS – River information services, traffic control, inspections, calamity abatement and emergency response, safety regions, technical requirements, dangerous goods
- Clean inland waterways transport - emission standards, energy use, fleet improvements and innovations, alternate fuels, waste related to IWT vessels, shore power, green ports
- Solutions for specific waterways and cases - shallow draft vessels, smart terminals, ‘hub & spoke’ logistics
- Financing and exploitation of IWT systems - infrastructure, transport means, role of the banks, cost recovery, support systems for small operators investments
- Capacity building - for staff in waterways authorities, for operators, crews, educational programs, use of simulators

3. IWT POLICY AND STRATEGY

3.1 European Strategy

The general IWT development policies and strategies in Europe are defined by government bodies, such as the EC at international level, the Rhine and Danube Commission, the national governments and dedicated agencies. In addition, the role of industry associations and the benefits of promotion bureaus and the importance of their work regarding the achievement of attracting freight to the IWT sector are important.

3.1.1 General European policies

The European Commission aims at maintaining and reinforcing a strong industrial base for the internal market, as growth in Europe cannot solely depend on the development of services alone. The European Commission aims with dedicated policy measures to support Europe's global leadership in strategic industrial sectors to help bringing back industry's weight in the EU's GDP to 20% by 2020, from less than 16% today. Major industries situated in the EU are competitive partly because of the availability of low transport costs of raw materials by waterway transport. They depend on transport by water to create turnover, employment and profits and give added value to other industries, for instance the chemical, automotive and construction industries. Waterways can also provide the backbone for new circular economy hubs emerging in inland ports. EU's most important waterways crossing cities providing the opportunity to ship finished goods inbound and waste outbound entering the new cycle.

Inland waterway transport (IWT) is characterized by the following intrinsic merits:

- very low direct movement costs;
- low energy consumption, low noise and low carbon footprint;
- safe and secure transport services;
- spare capacity on the network to accommodate growth, negligible congestion on the waterways;
- high transport capacity.

Given the main benefits mentioned above, the European Commission (EC) aims to promote and strengthen the competitive position of IWT in the transport system and to facilitate its integration into the multimodal logistic chain.

"White Paper on Transport"

Since the beginning of the European integration process, the EC has defined the importance of creating a common transport market emphasizing sustainable mobility, following the approach of integrated transport networks under the creation of fair conditions of competition between transport modes. On the European views and objectives regarding the general transport policy are laid down in the so-called White Paper on Transport. Besides general objectives, the White Paper includes specific objectives per modality, also for the stimulation of waterborne transport. The most

recent version of the White Paper was presented by the European Commission in May 2011[1].

The White Paper contains a roadmap to a Single European Transport Area, which is competitive and resource efficient, encompassing: 40 concrete initiatives for the next decade to build a competitive transport system that will increase mobility, remove major barriers in key areas and fuel growth and employment. At the same time, the proposals will dramatically reduce Europe's dependence on imported oil and relates to targeted reduction of carbon emissions in transport by 60% by 2050.

By 2050, other key goals include amongst others a minimum 40% cut in shipping emissions, a 50% shift of medium distance freight journeys from road to rail and waterborne transport, all of which will contribute to a 60% cut in transport emissions by the middle of the century. The European Commission further acknowledges that IWT requires extra support and specific programs have developed to improve IWT and its role in the EU transport system.

The Naiades Programme

Worthwhile mentioning is the Naiades Programme, which is an initiative of the European Commission to enhance the use of inland navigation as part of intermodal freight solutions, in order to create a sustainable, competitive and environmentally friendly European wide transport network.

The Platina 2 project (2013 – 2016), succeeding the successful first Platina project (2008 – 2012), is the European Coordination Action supporting the implementation of the Naiades policy package[2]. During the progress of the Platina I and 2 projects, In order to stimulate IWT, a system of incentive schemes is developed at European and national (Member State) levels. These schemes are categorised in five groups:

Infrastructure – development and improvement of waterways, ports and terminals – planned actions for inland navigation under the existing programs and under the forthcoming instruments of the next multi-annual financial framework for the period 2014-2020 (financial and technical assistance);

[1] For more information: http://ec.europa.eu/transport/themes/strategies/2011_white_paper_en.htm

[2] For more information: http://naiades.info/what-we-do/eu-transport-policy/naiades-ii/

Market – enhance modal shift and door-to-door services – assistance for integrating inland waterways into the multimodal logistic chains; financial incentives for inland navigation;

Fleet – vessel improvements and innovations - measures to reduce emissions (for example by imposing amended emission standards);

Jobs and skills – improve education and training programs – actions aimed at increasing harmonization of standards for professional training and certification.

Information exchange and sharing – bringing together data on infrastructure, fleet, operations and

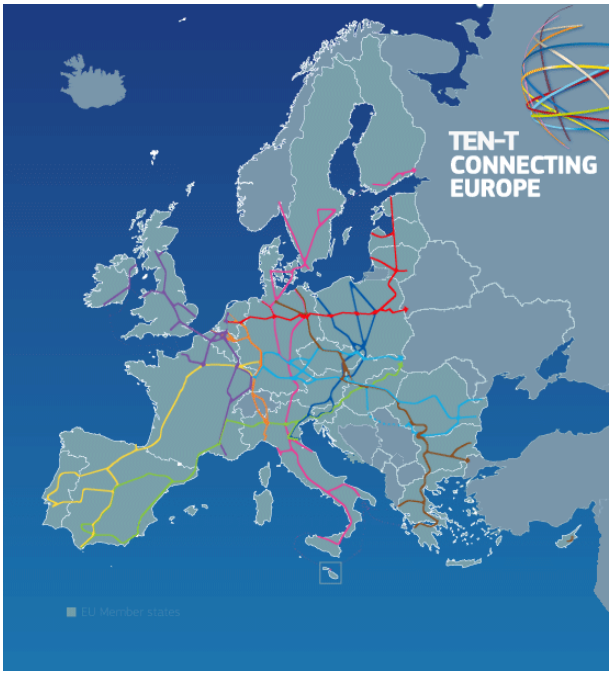
Market – review of the River Information Services policy in order to complete the implementation of RIS.

3.1.2 EU funding for Infrastructure

TEN-T and Connection Europe Facility

In January 2014, the TEN-T Regulation was adopted with the objective of linking the Member States' transport networks and to promote seamless transport chains for both passengers and freight. The TEN-T are trans-European transport networks that shall remove infrastructural bottlenecks, improve functioning of the internal markets and resolve technical barriers such as incompatible standards.

The implementation of TEN-T is financed by the Connecting Europe Facility (CEF). In this Facility, up to €24.05 billion is reserved for TEN-T until 2020. Resources are allocated by Member States and European Commission based on detailed investment working plans focusing on the most important stretches and selecting priority project to be implemented and co-financed by the EU (CEF) in the period 2014-2020.



In relation to waterway transport, further deployment of "River Information Services" and "clean fuel infrastructure" are priority actions. Projects regarding inland waterways and ports have been pre-identified for sections in 7 out of 9 "multimodal corridors", which include studies and works for better navigability, upgrading waterways, locks and multi-modal connections on sections of the European Inland Waterways network.

3.1.3 EU funding for Services

Marco Polo

The main European instrument that aims to shift freight from the road to environmentally friendly modes is the Marco Polo Program. The stated objective is “shifting freight off the road or reduce traffic”. The rationale behind the instrument is that road freight transport

is estimated to grow by 50% in 2030. The specific objective of the Marco Polo program is to reduce road transport by more than 20 billion tonkm/year in EU-27 over the period 2007 – 2013. The focus of the program is solely on business-driven international freight projects (aviation is excluded) carried out by commercial entities. The program is open to transport services only - no research, studies or (core) infrastructure is subsidized with this program.

This program publishes yearly calls for proposals. For the 2010 call € 64 million was available, supporting between 35% and 50% of the eligible project costs depending on the action type.

Five types of actions are can be applied (see Figure 5.8):

- Modal shift actions, which focus on shifting as much freight as economically meaningful under current market conditions from road to short sea shipping, rail and inland waterways. They may be proposing start-up of new services or significantly enhance existing services. They shall be robust, but not necessarily innovative: just shift freight off the road!
- Catalyst actions change the way non-road freight transport is conducted in the Union. Under this type of action, structural market barriers in European freight transport are overcome through a highly innovative concept: causing a real break-through.
- Motorways of the sea actions offer a door-to-door service, which shift freight from long road distances to a combination of short sea shipping and other modes of transport. Actions of this kind are innovative at a European level in terms of logistics, equipment, products and services. Common learning actions enhance knowledge in the freight logistics sector and foster advanced methods of co-operation in the freight market. These actions actively encourage the sharing of knowledge and know-how within the sector.
- Traffic avoidance actions integrate transport into production logistics: reducing freight transport demand by road with a direct impact on emissions. Actions of this type shall be innovative and shall not adversely affect production output and production workforce.
- Common learning actions enhance knowledge in the freight logistics sector and foster advanced methods of co-operation in the freight market. These actions actively encourage the sharing of knowledge and know-how within the sector.

ELAN - European Logistics Advisory Network

The ELAN project is focused on creating modal shift from road to IWT, however suggests a slightly different approach in comparison to the Marco Polo programme. ELAN, a Marco Polo accompanying measure (meaning funded under the Marco Polo Programme), provides support services in the field of IWT by establishing a “pilot network of logistics facilitators.

The aim of ELAN is to boost knowledge of transport users and logistics service providers in order to shift flows to multimodal solutions with a focus on opportunities for IWT.

The ELAN network consists of two groups:

- Logistics specialists at national/regional level at the IWT promotion centers or waterway organizations, which consolidate experience and share best practices on European level;
- Contracted external logistical experts in order to extent capacity of IWT promotion centers to provide additional expertise, know-how and new relations with potential clients of IWT.

3.2 IWT Policy the Netherlands

3.2.1 General Maritime policy

Given the extensive waterway network in the Netherlands and cross border connections, IWT is an obvious choice that is widely accepted to be the safest mode of transport, environmentally friendly and cost-efficient on longer routes. The national policy strategy for IWT is included in the Maritime Strategy 2015 – 2025[3], which is the overall development strategy plan for the maritime cluster with a focus on the following policy areas:

- Human Capital
- Innovation
- Trade
- Accessibility
- Safety and the Environment
- Security and Stability

Given the strong international / cross border component of IWT in the Netherlands cooperation at European level, e.g. to reach a harmonized legislative framework, is a necessity. The international context of the maritime cluster implies that regulations related to technical and job requirements are determined internationally. This applies to inland shipping, where the requirements have been defined in both the EU and CCR.

More the general Maritime Strategy is translated into specific actions for IWT development in the Netherlands, which have a strong coherence with European initiatives and promotion schemes, in order to:

- Work on / with organizations in the inland waterway sector.
- Renew international regulations and strengthening of market observation for inland navigation.
- Better use of and investment in water infrastructure.
- Strengthen the supply chain of goods by inland waterways.
- Modernize crew regulations for inland navigation.
- Raise sustainability performance of inland navigation.
- Raise safety performance of IWT.

[3] The English version of the Maritime Strategy 2015 – 2025 can be found at https://www.government.nl/documents/reports/2015/07/07/the-dutch-maritime-strategy-2015-2025

- Renew technical regulations for inland vessels.
- Work on the EU NAIADES II action program 2014-2020.

In order to stimulate and promote IWT on a national level, the Dutch government, by means of the Ministry of Infrastructure and Environment and related executing agencies, has some (financial) instruments in order. In the next few paragraphs some of these programs, currently implemented or implemented in the past, are shortly described.

3.2.2 National funding instruments

Impulse Dynamic Traffic Management for Waterways

The programme Impulse Dynamic Waterway Traffic Management has, amongst others, studied the possibilities of increasing the appeal of the inland shipping sector. Rijkswaterstaat is the initiator of this programme, in which Dutch government and parties from the logistics chain work together to improve the use of waterways.

In 2010, at the request of the Dutch Government, Rijkswaterstaat initiated the program entitled 'Impulse Dynamic Waterway Traffic Management', also known as IDVV, to meet the anticipated substantial growth in container transport. With the construction of Maasvlakte 2 near Rotterdam the flow of cargo is increasing. Within the programme, public authorities, knowledge institutes, waterway managers, carriers, shippers, ports, terminals and logistics companies cooperate to make better use of the waterways.[4]

Voucher system

In The Netherlands shippers, logistics services providers, etc. can ask for a limited grant with contributes to the implementation of synchromodality in transport networks. Synchromodality is the optimally flexible and sustainable deployment of different modes of transport in a network under the direction of a logistics service provider, so that the customer (shipper or forwarder) is offered an integrated solution for his (inland) transport.

The support programme is mainly focused on proposals that reduce the number of kilometers transport by road, and thus a shift to other modes (IWT, rail or both). Thereby the projects will contribute to the primary goal to reduce the absolute number of CO_2-emissions at the end of 2016. A larger shift will be evaluated with a higher score and thereby has a larger chance to be subsidized. Additionally the replicability and maturity of projects will be evaluated. The proposals will be evaluated by an unbiased Jury according to a score in each category and thereby the proposal with the highest scores will be selected for implementation.

[4] IDVV: The results of the research programme for innovations in Inland Shipping' and the overall report with more than 55 conclusions and suggestions, 'Making a smart transition', can be found here. There results of private initiatives can be found here.

Applicants may also ask for assistance to develop a business plan, for which a logistics consultant is hired to offer assistance. The maximum subsidy is € 200,000 for which co-finance of 50% is requested either in means or in kind.

3.3 Industry representation and promotion

3.3.1 Industry associations

In Europe industry representation and promotion are core elements of sector development. All transport sectors (road, rail and IWT) have mode specific industry representations called associations both on national and on European (and for some sectors also international level). These associations have an important role as an interface between the policy makers / authorities and the commercial operators. The inland waterway transport sector is rather fragmented compared to the other modes however. In recent years more coordination efforts have been made, for instance by the establishment of the European Barge Union which has achieved more substantial influence than the individual national associations that used to act independently.

Promotion of the IWT sector and opportunities is also seen as a core component of sector development. National promotional bureaus and a European bureau carry out a wide range of activities:

- Providing information about IWT services to cargo owners
- Production and distribution of marketing materials
- Organizing marketing events
- Promoting the interests of the sector to the government
- Advisory services for IWT companies

Some examples of European representative associations are:

Inland Navigation Europe (INE): the European platform of national & regional waterway managers and promotion bureaus, which share the deep conviction that moving more goods by water, in EU regions and cities with accessible and navigable rivers and canals, will boost effective and sustainable mobility in Europe (http://www.inlandnavigation.eu/home/);

the **European Federation of Inland Ports** (EFIP): is the official voice of nearly 200 inland ports in 16 countries of the European Union, Switzerland and Ukraine, which highlights and promotes the role of European inland ports as real intermodal nodal points in the transport and logistic chain, combining inland waterway transport with rail, road, and maritime transport (http://www.inlandports.eu/);

The **European Shippers' Council** (ESC): represents the logistic interests of manufacturers, retailers and wholesalers, collectively referred to as shippers, to reach an optimized supply chain, by striving a full liberated European Union transport market that harmonizes issues ranging from freight services to taxation and labor laws to trade facilitation (http://europeanshippers.eu/);

the **'European Liaison Committee of Common Market Forwarders'** (CLECAT): represents the interests of more than 19.000 companies employing in excess of 1.000.000 staff in logistics, freight forwarding and customs services (http://clecat.org/).

3.3.2 Vessel Owners Association

A Vessel Owners Association, solely consisting of vessels owners and/or skippers, has the purpose to represent the (collective and individual) social, economic, legal and technical-nautical interests of enterprises, self-employed and business groups and stakeholders in the sector in national and international inland waterway transport.

To actively have a voice in European or national transport / water policies a Vessel Owners Association will typically draft its own agenda with priorities on short, mid and/or long term and may cover topics such as: labour conditions, availability of and requirements to educational & training courses or programmes, environment and safety aspects, economy and market situation, market transparency, needs for financial instruments or subsidies, legislations etc.

Some examples of European associations that represent barge operators are:

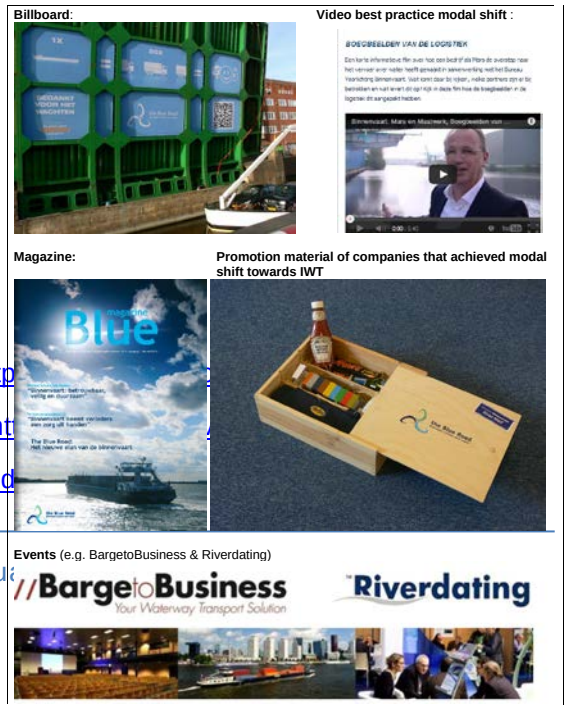
the **European Barge Union** (EBU): to represent the interests of inland navigation on a pan European level and to deal with all questions, arising out of the future development of the inland navigation industry and inland waterway transport (http://www.ebu-uenf.org/);

the **European Skippers organization** (ESO): looks after the interests of the European private inland shipping entrepreneurs on the European level. The ESO-Council is composed of representatives of Belgian, Dutch, French, German and Polish inland waterway transport organizations (http://www.eso-oeb.org/).

3.3.3 IWT Promotion Bureaus

There are a few specialized IWT promotional agencies in Europe, such as Bureau Voorlichting Binnenvaart[5] (the Netherlands) and Promotie Binnenvaart Vlaanderen[6] (Belgium). These agencies are independent organizations that aim to promote and raise awareness of IWT. These organizations depend on funds from third parties obtained through partly from projects (from the national and/or European governmental bodies), but mostly from the support of the industry itself. On an European level, these IWT promotional bureaus are part of Inland Navigation Europe[7] (INE), which acts as a platform for promotion of IWT in Europe.

- The objective of IWT Promotion Bureaus is to promote and raise awareness of IWT, by realizing the following prioritized targets:
- provide businesses with up-to-date IWT information (e.g. information on the conditions and levels of the inland waterways, the facilities, services available, etc.);



[5] Website of Bureau Voorlichting Binnenvaart (BVB): http

[6] Website of Promotie Binnenvaart Vlaanderen (PBV): ht

[7] Website of Inland Navigation Europe (INE): www.inland

- create awareness towards shippers on the potential of inland shipping and the possibilities to move their cargo to IWT;
- create awareness towards governmental bodies (including city planners and economic development parties) of the advantages of this mode of transport (clean, safe and competitive) and the requirements for an efficient inland shipping sector;
- promote IWT as an interesting sector to work in and provide information on the education possibilities.

This is, amongst others, implemented through promotion campaigns is general acceptance and awareness amongst shippers by highlighting the environmentally friendly, safe, competitive and congestion-free characteristics of inland shipping. Promotion campaigns should not only focus on advantages of IWT in existing markets, but also highlight the possibilities in new potential markets. The ultimate goal is to attract more cargo for IWT by means of promoting and realizing modal shift.

The main message of all the awareness and promotional campaigns should be that IWT is a competitive, safe and clean mode of transport, and offers societal benefits. Stakeholders on an international level have achieved this through the following means:

- billboards on ships stating the amount of trucks that is navigating there along the river;
- exhibitions, trade fairs, special events, presentations, guest lectures;
- promotion material (e.g. brochures and leaflets) and press releases (e.g. newspapers, articles, internet, television and radio) on the advantages, strong points and societal benefits of IWT and the funding possibilities available;
- Organisation of meeting partners for business opportunities (Riverdating & Barge to Business events).

4. INSTITUTIONAL & REGULATORY FRAMEWORK

4.1 Institutional frameworks

The institutional frameworks discussed in this document are from the perspective of the European Union and, in particular, from the perspective of the Netherlands.

Within the European Union IWT is governed at four levels:

- Multi-national River Commissions established by International Conventions: the two most important are for the Rhine River and its tributaries (1868) and the Danube River and its tributaries (1948);
- The European Union (EU) through the European Commission;
- Individual European national governments;
- United Nations Economic Commission for Europe (UNECE), which is not an administrative body, (it has no powers of implementation) but which seeks harmonization of IWT navigation and environmental standards across the whole of Europe (including EU and non-EU countries).

4.1.1 River Commissions

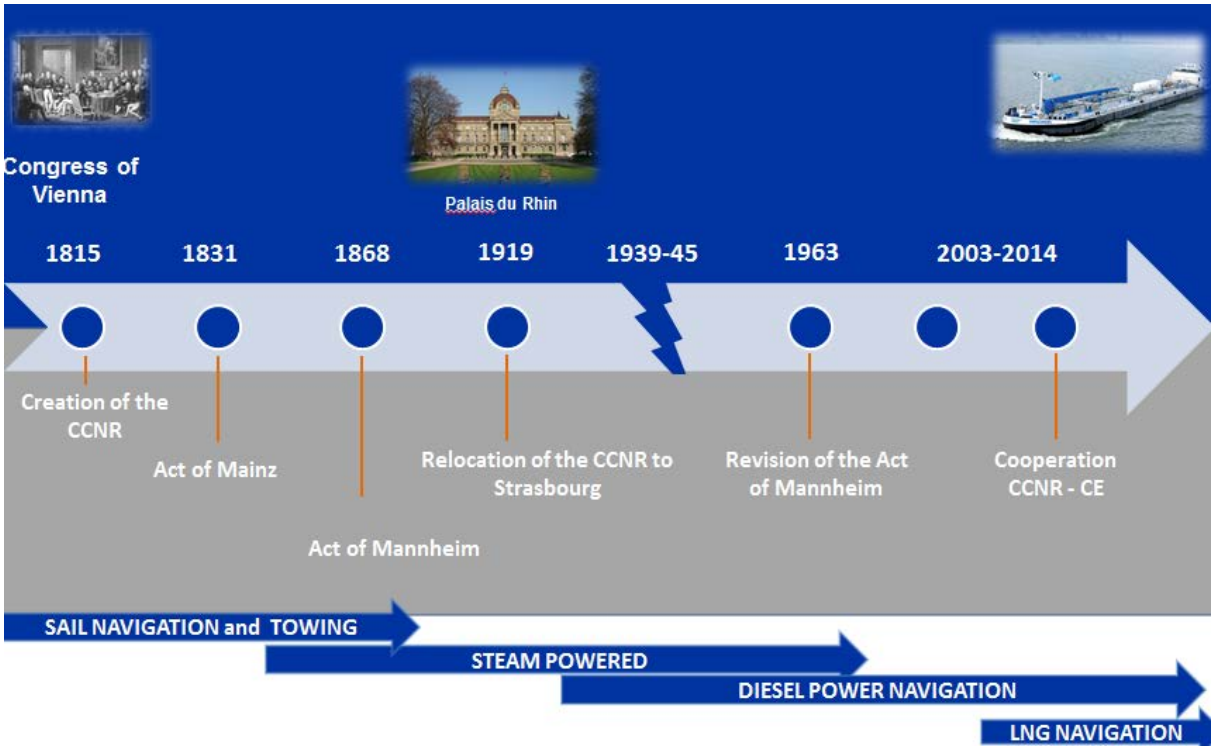
Central Commission for the Navigation of the Rhine

The CCNR's (Central Commission for the Navigation of the Rhine), created in 1815, main objective is to attend to the respect of the principles embodied by the Convention of Mannheim (1868): freedom of navigation, equal treatment of ships of all nations, exemption from any taxes and duties based solely on navigation, absence of physical or administrative obstacles to navigation, commitment to maintain the navigability of the waterway.

In addition, several sub objectives are formulated, such as:

- To ensure the safety of navigation,
- Strive for the unity of the Rhine system,
- Promote the economic prosperity of the Rhine navigation through proposals made by the governments of the member States,
- Deliberate over proposals made by the member States
- Examine any complaint linked to the implementation of the Convention and the enforcement of regulations or measures decided and jointly agreed upon by the riparian governments
- On a social level, the Central Commission administers the Agreement concerning social security of boatmen on the Rhine,
- Finally, the Central Commission fulfils an international role which reaches beyond the Rhine basin.

[Source: http://www.ccr-zkr.org/]



The Danube Commission

The Danube Commission is an international intergovernmental organization, set up by the Convention regarding the regime of navigation on the Danube signed in Belgrade on 18 August 1948. The primary tasks of the Danube Commission activity are provision and development of free navigation on the Danube for the commercial vessels flying the flag of all states in accordance with interests and sovereign rights of the member-states of the Belgrade Convention, as well as strengthening and development of economic and cultural relations of the said states among themselves and with the other countries. The member-states of the Danube Commission are the Republic of Austria, the Republic of Bulgaria, the Republic of Hungary, the Federal Republic of Germany, the Republic of Moldova, the Russian Federation, Romania, the Republic of Serbia, the Slovak Republic, Ukraine and the Republic of Croatia.

[Source: http://www.danubecommission.org/index.php/de_DE/index]

4.1.2 United Nations Economic Commission for Europe (UNECE)

In the area of inland water transport, the United Nations Economic Commission for Europe (UNECE) deals with a wide range of issues, such as:

- Identification and further development of a European network of inland waterways;
- Pan-European rules and signs used on inland waterways;
- Technical requirements for inland vessels;
- Recognition of the boatmasters' certificates;
- River information services;
- Pollution prevention;
- Inland water transport policy, and many more.

This work is accomplished in close cooperation with the European Commission, the River Commissions and other competent international bodies.

This work is accomplished in close cooperation with the European Commission, the River Commissions and other competent international bodies. The UNECE Working Party on Inland Water Transport (SC.3) is an intergovernmental body which ensures maintenance of relevant legal agreements, such as the European Agreement on Main Inland Waterways of International Importance (AGN). It also adopts UNECE resolutions on the inland water transport issues listed above. SC.3 meets once a year. The Working Party on the Standardization of Technical Safety Requirements in Inland Navigation (SC.3/WP.3) assists the Working Party on Inland Water Transport in preparing amendments to pan-Europeans technical and safety requirements for inland navigation, such as the European Code for Inland Waterways (CEVNI) and the Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels (Resolution No.61). SC.3/WP.3 usually meets twice a year in early spring and summer to prepare the annual session of SC.3.

[Source: http://www.unece.org/trans/main/sc3/sc3_about.html]

4.1.3 Member State level: example the Netherlands

On Member State level, each Member State has the authority to structure its waterway management and define its policies and strategies. As an example the case for the Netherlands is presented here. In this country the Ministry of Infrastructure and Environment is responsible for IWT policies and waterway management. The Ministry states its responsibilities and ambitions as follows: “Broadly speaking, the Ministry of Infrastructure and Environment consists of three sections: policy, implementation and inspection”. In addition, the ministry has several support agencies to ensure that the top political and civil service layers as well as the employees are able to perform their work. In the policy section, three Directorates-General are concerned with developing policy in the areas of mobility, water management, aviation and maritime affairs.

The Inspectorate for Transport, Public Works and Water Management oversees compliance with statutory regulations by private individuals and companies. The Royal Netherlands Meteorological Institute (KNMI) gathers information on the weather, climate and seismology and performs research.

The Directorate-General of Public Works and Water Management, the VenW Inspectorate and the KNMI are agencies of the ministry.

The Ministry of Transport, Public Works and Water Management ensures that the physical basis, the foundations of the Netherlands, is solid and that we can move quickly and easily so that we can live and work in safety. In this way, VenW contributes to a dynamic and sustainable society.

[Source: http://www.rijkswaterstaat.nl/english/index.aspx]

4.2 Regulatory Framework

4.2.1 EU Directives

Vessel requirements

The European Directive 2006/87/EC lays down technical requirements for inland waterway vessels. It is designed to lay down a high level of safety standards for shipping on the Rhine. To achieve this, it provides for the introduction of a Community certificate for inland waterway vessels in each Member State, to be issued by the competent authorities. The Directive applies to vessels of a length of 20 meters or more and a volume of at least 100 m3. It also applies to floating equipment, tugs and pushers, and vessels intended for passenger transport carrying more than 12 passengers in addition to the crew. Ferries, naval vessels and warships are excluded from its scope of application.

Vessels operating on Community waterways must also carry a Community certificate. Where they operate in zone R, they must have either a Community certificate or a certificate issued in accordance with the Revised Convention for Rhine Navigation. Community certificates are to be issued following a technical inspection carried out prior to the craft being put into service and intended to check whether it complies with the technical requirements laid down in the Directive. Community certificates may be issued by the competent authorities of any Member State. It must draw up a list of its competent authorities and notify them to the European Commission. E.g. in The Netherlands the inspection body has recognized Classification Societies to carry out inspections and to issue certificates, such as: Bureau Veritas, Lloyd's Register, DNV GL, etc.

Regarding emissions of NOx and PM, new inland vessel engines fall under stage IIIA of Directive 2004/26/EC New and more stringent stage IV standards under Directive 2004/26/EC are in preparation. Directive 2004/26/EC however leaves the majority of older vessels unaffected for the moment.

Crew requirements

When considering crew requirements, a distinction is be made between requirements for boatmasters and "ordinary" crew members. The minimum age for a boatmaster to enter the IWT workforce is 21, whilst anyone above the age of 16, which possesses the required skills and training, can become an ordinary crew member. Good hearing and eyesight are two of the most important faculties for boatmasters and their crew members, therefore, pre-employment and routine checks are required.

When it comes to training and certification of crew members across Europe, slight differences are notices between Member States. Training and certification are now being harmonized through such initiatives as the Standards of Training and Certification in Inland Navigation (STCIN) introduced by the IWT educational network, Education in Inland Navigation (EDINNA).

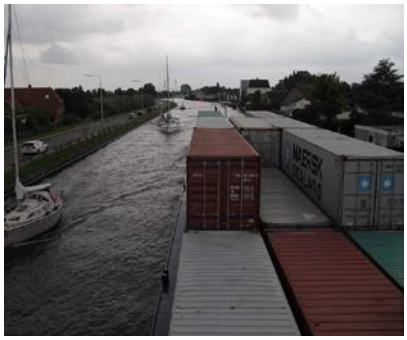
4.2.2 Member State level: example the Netherlands

Inland shipping act

Since 1 July 2009 the Inland shipping act is effectuated in the Netherlands. The Act consists of the implementation of the European Directive 2006/87/EC (see above) and also encompasses three additional regulations, namely: the Inland Transport regulation, Labor and Manning regulation and the Inland Vessel regulation.

The Inland shipping act is related to international (or European) regulations, especially for vessels and / or operators that navigation on international rivers such as the Rhine and the Danube.

Inland Waterways Police Regulations



Waterways, especially in the Netherlands, can be busy since they are used by both commercial and recreational vessels. Rules have been made to ensure safety on the water, and each captain must know th ese rules, which are included in the Inland Waterways Police Regulations (BPR).

In order to realize more situational awareness and joint responsibility amongst skippers, the project “Sail Together” was started to promotes a safe, cooperative use of the waterways by commercial and recreational vessels. There are ten 'Junction booklets', which describe the most important waterway junctions in each region in The Netherlands, which contain maps showing the safest and fastest way to navigate through these junctions.

The brochure ‘Sail Together!’ contains the most important navigation rules, some advice and a number of practical tips for safe sailing. Other brochures are e.g.:

- Rules for speed boats;
- Safety on board;
- Passing of locks;
- Communication on the water.

The brochures (in English) and additional information can be found on the www.safeboating.eu

Monitoring and inspection of inland vessels

From the perspective of operators in the field of IWT, it is important to be aware of the aspects that are subject to monitoring by the Inspection, types of inspection and possible consequences in case of non-compliance. In line with the responsibilities of the Dutch Inspection body, the following aspects are being monitored, thereby taking the national Inland Shipping Act, DG transport Act and Labor Act based on European regulations, into account:

- Ships construction and interior;
- Goods and passengers;
- Crew qualifications and working times;

- Loading/unloading (dis)embarking.
- The following types of inspection can be distinguished:
- Horizontal supervision (by closing enforcement agreements);
- System supervision (by conducting audits);
- Reality-checks (by conducting audits and object as well as administration checks at shipping companies).

The Inspection closes enforcement agreements with well-performing (large) businesses that comply with the rules and regulations. Aspects are taken into account in these agreements are amongst others the quality of safety management systems, the duty to report self-identified non-compliance and the way the Inspection acts in this regard, the number-of reality checks.

Currently, the concept of horizontal supervision is mainly implemented in The Netherlands. International implementation of this concept would be beneficial for the market sector given that the hinder for businesses as result of inspections will be reduced.

Incident registration and analysis

In the Netherlands the Dutch Safety Board is authorized to carry out investigations into incidents on the Dutch inland waterways that involve inland vessels. The Board not only investigates individual incidents but also performs special investigations. These special investigations examine and analyse multiple incidents that are connected in some way. These investigations examine one or more common safety issues that played a role in these related accidents.

The investigation is performed by the Board's own in-house investigators, who are assisted by external specialists where necessary.

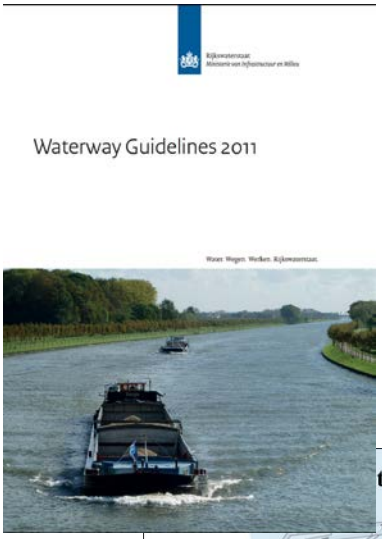
5. PLANNING OF INLAND WATERWAYS

As described in Chapter 4, the Directorate-General of Public Works and Water Management (Rijkswaterstaat, RWS) ensures that the policy of the Ministry of Infrastructure & Environment is implemented. Rijkswaterstaat manages the national waterway, which entails responsibility for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. This includes the main road network, the main waterway network and water systems.

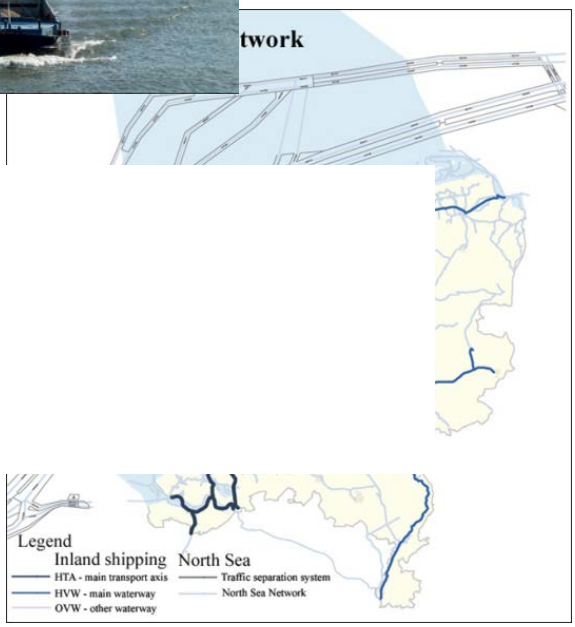
Besides making sure all of the Netherlands keeps dry feet, has sufficient clean water and can call on reliable and useful information, smooth and safe transport by water are other ways of using water are the key ingredients of integrated water management for Rijkswaterstaat.

5.1 Dutch Waterway Guidelines

The Dutch waterway network is the densest in Europe. About 6000 kilometers of rivers and canals, many of the latter serving drainage as well as navigation, form a complex system serving all parts of the country. The main commercial waterways (Class IV and higher), with a total length of 1,600 kilometer, account for about 40% of international freight movements in the Netherlands and 20% of domestic freight. The main network is state-owned and operated by Rijkswaterstaat. Smaller waterways are managed by many different provincial authorities or drainage boards.



Smaller regional waterways are managed on provincial level by decentralized authorities. The National Directive for Waterways lays down the design criteria for e.g. waterway sections, locks, bridges and inner harbours, buoys markings, signposting and so on.



- 1,600 kilometres of rivers and canals
- 6,100 kilometres of shipping routes on open water
- 80 shipping locks
- 420 bridges

5.2 Waterway management

For the management and maintenance of the main waterway network, about € 7.3bn is budgeted until 2028. This entails an annual budget deviating between € 425m – 510m, which is allocated and contracted by means Service Level Agreements (SLA) for a period of 4 years. These SLA guarantee the availability of a waterway corridor in terms of depth, width, maximum delay at locks, etc. during a minimum percentage of total time per year. Such long term SLA offer contractors better conditions for innovations in working methods and equipment as well as in financial engineering.

The investments in the upgrading of the national waterway network amount to € 250m per year. Upgrading comprises modernizing and/or enlarging the locks, adaptation of the transverse section and/or longitudinal profile of the waterway etc. The total scope of the upgrading of course depends on the total freight volumes transported, the expected developments of the fleet and economic developments and expected modal shift.

As for now, inland navigation is economically feasible at distances starting at 40 to 60 km in case origin and destination of the freight is located alongside a waterway. In case additional overland transport is necessary, inland navigation is feasible at distances greater than 150 km.

Furthermore, the modal split may be influenced by measures of other administrations. E.g. the Rotterdam Port Authority, aiming at less traffic congestion in the port area, is implementing a strategy to increase the inland navigational share to 45% of the hinterland transport. In spatial planning the regional administrations take care to allocate industrial plots alongside waterways to companies that will profit from using inland navigation.

It goes without saying that all policies and long term targets are being established in an interactive planning procedure that allows all stakeholders to participate in the decision making process. Stakeholders being the shippers, the skippers organization, Ministry of Transport, regional administrations, municipalities, port authorities and port operators, the interested public, ecologists, etc. The sometimes cumbersome process of interactive planning leads to broad public support for the decisions taken in the end.

5.2.1 Good Practices of Integrated Waterway management

Functions of waterway systems

Freight transport and passenger transport are only one of the functions that a lake, river or canal can have. Other important functions of waterways are[8]:

- Tourism (recreational crafts, recreational areas, fishing);
- Water management (flood protection, agricultural irrigation, water supply for industries and water consumption);
- Living, landscape and wildlife: ecosystem with wildlife habitats, nature conservation, development of attractive real estate, housing boats, river islands;

[8] Source: Platina 2

- Hydroelectric: energy production by means of dams.

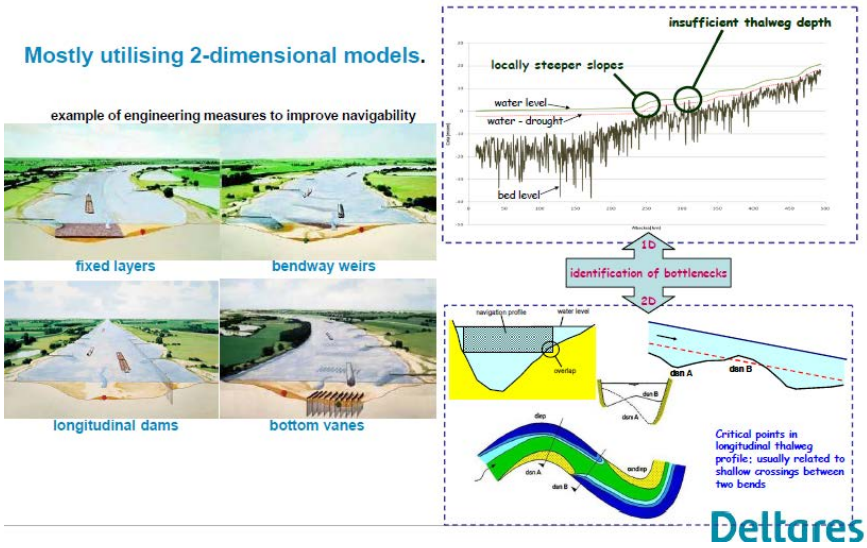
The development of IWT infrastructure cannot be based on freight transport developments only. Taking other functions of waterways into account (ecology, flood protection, recreation) including the spin-offs for overall industrial and economic development, often generates win-win situation for stakeholders involved. Such an integrated approach is successful for a number of projects in Europe, such as East of Vienna along the Danube River. The project aimed and obtained higher water levels during dry periods with lower flow velocities, mitigating the strong erosion of river banks causing the removal of rip-rap bank protection and the formation of a natural sand bank for better ecological conditions. Improving the navigational situation while preserving the typical flora and fauna of the Danube Floodplain National Park[9].

For additional good practices in particular related to integrated approached in ecological terms, is referred to the 'Good practice manual of Platina I'[10]. Additional research on this topic is currently addressed in Platina 2 where a new Good Practice Manual on sustainable inland waterway management will be prepared.

DELTARES

Deltares is a renowned institute in the Netherlands for a.o. consultation and research of issues related to the subjects described above and further in this chapter. Their expertise, in this case specifically for waterway management), is as follows:

- River water levels and bed morphology;
- Dredging and sediment management plans for the optimal management of waterways;
- Operational predictions of water depths allowing for the optimal utilization of ship cargo capacity;
- The impact of propeller flows on bed and bank materials, and on structures;
- Optimizing the design of locks and dams.



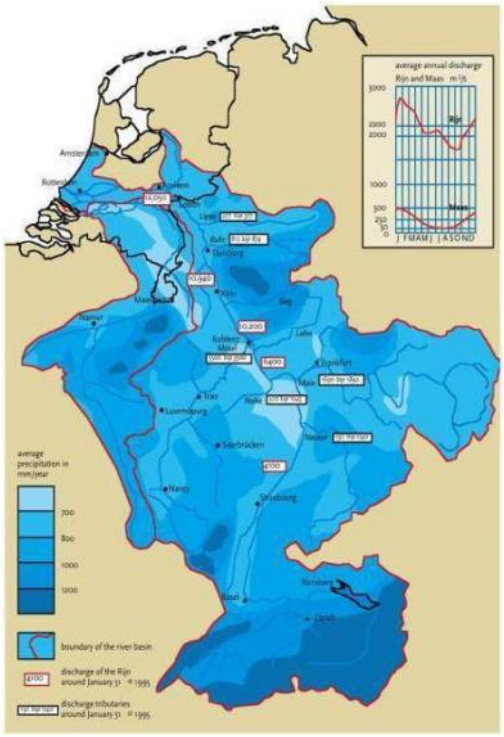
[9] For more information see: http://www.donau.bmvit.gv.at/en/

[10] See: link to Platina IWT planning Manual

5.2.2 Climate change resilience

Long term impact of weather forecasts

Extreme weather events relevant to inland waterway transport are low-water events (drought), high water events (floods) and ice occurrence. Of less importance are wind gusts and reduced visibility. Until 2050 it is not expected that low-water events become significantly severer on the Rhine as well as the Upper Danube. On the Lower Danube some impact of drought in association with increased summer heat might appear, demanding however dedicated research. Related to high-water events no reliable statement with respect to increase of discharge and frequency of occurrence can be given. However, chances of floods on inland waterways will remain important also in the future related to probabilistic design of flood protection. For distant future (2071-2100), the costs of inland waterway transport are projected to increase more significantly in Danube and Rhine waterways due to adverse impacts of climate change.[11]



"Room for the rivers"

Although no significant structural effect due to climate change are expected on the short term in the Rhine-Main-Danube region, high discharge waves can cause severe damage to human life and urbanized and industrial areas. For The Netherlands high discharge waves on the Rhine and Meuse would occur during high discharge on the rivers in combination with high discharge on the tributaries due to precipitation upstream and insufficient permeability of soil (frozen during Winter periods / highly saturated soils due to long periods of precipitation). These combinations occurred in the Rhine delta in 1993 and 1995, when floods devastated regions surrounding the delta. In the neighboring vicinity of the Rhine and Meuse over 200,000 people were evacuated. Reason for The Netherlands to start the project "Ruimte voor de Rivier", "Room for the River" (in English), is to draft an integrated spatial plan with the main objectives of flood protection, master landscaping and the improvement of overall environmental

[11] Source EU research: www.ecconet.eu & Move-it Guidebook IWT

conditions". Completion of a package of 34 projects, which encompasses placing and moving of dykes, depoldering, creating and increasing the depth of flood channels, reducing the height of groins, removing obstacles, and the construction of a "Green River" which would serve as a flood bypass. This will result in increasing safety levels against river flooding[12].

5.2.3 Capital investments to increase fairway depths or invest innovative solutions

Deeping waterways for more efficient navigation

From many perspectives it is a necessity for inland waterway network is well maintained to allow sufficient draught for efficient transport goods via inland vessels. The improvement of the waterway infrastructure quality can reduce air pollutants and greenhouse gas emissions, as the removal of infrastructural bottlenecks and the maintenance of waterways (e.g. dredging) increases the possible load rate of a vessel and allows larger vessels to sail and to benefit from economies of scale. By increasing the load factor and transporting cargo more efficiently, the fuel consumption as well as the emissions per loading unit is reduced. Moreover during dry/low water periods the impacts of lack in maintenance become very clear, which could induce a negative modal shift. Additionally in low water, usually, higher levels of fuel consumption are required to attain the same velocities (due to higher resistance). Well maintained waterways are therefore not only important for enabling the economic efficiency of transport but also for the fuel consumption and the environmental performance. In Europe the TEN-T corridor network also includes a comprehensive network of inland waterways which is targeted to comply with CEMT-IV[13] dimensions and beyond, including a minimum waterway depth of 2.5 meter, to be part of the TEN-T Core Network[14].

Obviously in order to reduce bottlenecks and especially draught limitation, maintenance and capital dredging is needed to increase draught and clearance for safe passage under fixed bridges. However capital and maintenance dredging is expensive. Under the first PLATINA project, European programme to stimulate and strengthen inland waterway transport, dredging expenses on the Rhine corridor were estimated to be more than 1 billion euro to develop a targeted policy of a usable fairway with a depth of 2.8 meter.

Alternatives for deepening waterways

The policy in Europe of increasing waterway dimensions to allow for continuously enlargement of scale is slowly changing. Still for economic and more ecologic operation of inland navigation more draught on inland waterways in Europe is required, but alternatively innovative vessels are designed and tested with limited draughts and adjusted hulls, propulsion and engines, to sail more efficiently in comparison with

[12] For more information see: http://www.ruimtevoorderivier.nl/english

[13] Member States of the European Union agreed on the CEMT-classification of the Inland Waterways in 1992. This agreement standardized the dimension on the fairway (see: link to additional information on classification of European waterways)

[14] See also: http://ec.europa.eu/transport/themes/infrastructure/index_en.htm

currently operated vessels, due lower fuel consumptions (thus reducing emissions levels) against the equal or improved loading capacities.

Take for example the COVADEM initiative[15]. In case of high water on the rivers, there is limited space under the bridges. And depending on the weight carried, the vessel lies either deep or less deep in the water. Such a situation requires proper planning: how will the water level in the rivers evolve and how many layers of containers can be carried so that the vessel can still pass easily under bridges? At low water, the reverse is true: the vessel should not lie too deep in the water. Moreover, more fuel is consumed if there is relatively little water under the keel.

The Covadem project (cooperative navigable depth measurement) ensures that, in future, a large number of shipmasters will be able to continuously transmit their sonar soundings, position (and also preferably, fuel consumption) during navigation. Based on all these measurements, it will be possible to compile a proper profile of the current navigable depth of all European waterways. Furthermore, with advanced modelling, the navigable depth can be predicted a few days ahead.

Additional alternatives are related to innovative vessel designs, specifically low draught vessels. Some examples have been included in Chapter 11.

Working with Nature[16]

Working with Nature is an integrated process which involves working to identify and exploit win-win solutions which respect nature and are acceptable to both project proponents and environmental stakeholders. It is a philosophy which needs to be applied early in a project when flexibility is still possible. By adopting a determined and proactive approach from conception through to project completion, opportunities can be maximised and - importantly - frustrations, delays and associated extra costs can be reduced.

Whilst the requirement to consider the potential environmental impacts of proposed projects for ports, navigation or associated infrastructure is well-established, the process of so doing is often complicated and difficult. If the design concept for a project has progressed before environmental issues are considered, the environmental impact assessment necessarily becomes an exercise in mitigation or damage limitation, potentially resulting in sub-optimal solutions and missed opportunities.

Working with Nature requires that a fully integrated approach be taken as soon as the project objectives are known – i.e. before the initial design is developed. It encourages consideration of how the project objectives can be achieved given the particular, site-specific characteristics of the ecosystem.

Working with Nature is about more than avoiding or mitigating the environmental impacts of a pre-defined design. Rather, it sets out to identify ways of achieving the project objectives by working with natural processes to deliver environmental protection, restoration or enhancement outcomes.

Fundamentally, therefore, Working with Nature means doing things in a different order:

[15] For more information see: http://www.covadem.eu/en/

[16] This text is based on Pianc's Position Paper Working With Nature

- establish project need and objectives;
- understand the environment;
- make meaningful use of stakeholder engagement to identify possible win-win opportunities;
- prepare initial project proposals/design to benefit navigation *and* nature;

Working with Nature thus requires a subtle but important evolution in the way we approach project development. We need to move towards an approach which:

- focuses on achieving the project objectives in an ecosystem context rather than assessing the consequences of a predefined project design;
- focuses on identifying win-win solutions rather than simply minimising ecological harm.

Working with Nature considers the project objectives firstly from the perspective of the natural system rather than from the perspective of technical design.

Working with Nature will undoubtedly pose significant challenges - in gaining acceptance of the concept and in ensuring that we have the scientific knowledge and understanding necessary to realise the potential benefits, whilst at the same time ensuring compliance with the ever-increasing national and international legislation and regulations. Nonetheless, it is important to recognise that significant progress has been made in a number of relevant areas over the past two decades, for example:

- we have achieved some important advances in technology, science and understanding, in modelling and design as well as in ecosystem functioning;
- we are starting to progress beyond documenting the natural state to understanding and predicting system dynamics;
- we are becoming better equipped to recognise and deal with uncertainty;
- we understand the importance of balancing economic, social, technical and environmental parameters, and of exploring the full range of potential solutions;
- we make more use of effective stakeholder engagement in contributing to a truly sustainable outcome.

Working with Nature represents a real opportunity for all future navigation-related developments. PIANC acknowledges that a concerted effort will be required to raise awareness of the concept and the benefits it offers. All parties potentially involved in development projects will need to be engaged in the transition: port and navigation authorities, governments and regulators, project developers, local communities, and environmental stakeholders. Some will undoubtedly find it difficult to accept or will be reluctant to accept the new way of thinking. Perseverance and patience will be vital. PIANC is convinced that Working with Nature is essential to future, sustainable, port and navigation development.

Whilst technical and scientific knowledge and understanding has improved significantly over recent years, this does not mean that we have all the answers. Working with Nature requires an understanding of dynamic natural ecosystems. In some cases we already have a reasonable understanding, in others we do not. Although some research into ecosystem dynamics and cause-and-effect relationships is ongoing, more is needed. Data

must be collected. Modelling tools need further development and verification. But these gaps in knowledge and understanding should not be used as an excuse to defer attempts to put Working with Nature into practice.

Many recent marine and inland water infrastructure projects have been delayed as a result of administrative procedures. Environmental regulations are not typically designed to stimulate development and innovation: indeed the relative lack of flexibility in the application of much environmental regulation could prove to be counter-productive insofar as the aims of Working with Nature are concerned. It will therefore become increasingly important to look to the intention of the legislation rather than taking a prescriptive approach to its implementation. A transition from a philosophy of 'control' to one of 'management' is needed and the cultural differences between ecologists, civil engineers, planners and politicians similarly need to be addressed if 'Working with Nature' is to be embraced. Although these are real problems, they are not insurmountable.

Numerous research projects over recent years have highlighted the significant contribution aquatic ecosystems make to human economic well-being: e.g. water resources, nutrient cycling, food production, flood defence, recreation and tourism. The growth in world population, its increasing needs and the challenges of climate change are putting the natural environment under ever-increasing pressure. Notwithstanding the significant progress made in recent years, the current approach to assessing environmental impacts - no matter how well it is applied - typically results in an environmental loss. The approach is not, therefore, sustainable.

In the meantime, this growth translates into a global increase in trade and the associated need for new and/or more efficient waterborne transport infrastructure continues. We therefore need to use our improved knowledge and experience to begin to look at things differently - to facilitate the delivery of better environmental protection and/or enhancement alongside economic development; to reduce delays and frustrations; and to explore opportunities to provide local communities with much-needed amenity areas, recreational resources and improved landscapes.

Working with, rather than against, natural processes can result in less expensive and more sustainable solutions. Utilising natural processes rather than artificial means can offer viable, cost-effective long-term options. For example retaining dredged sediment within the estuarine system helps to sustain mudflats and salt marshes, and thus reduces the cost of flood defence maintenance. Exploring opportunities to use dredged material for beach nourishment is another well-established 'win-win' management option.

Finally, PIANC recognises that the current emphasis on sustainable development means that other organisations or initiatives broadly share the Working with Nature philosophy. For example, the Building with Nature programme3 focuses on the development of guidelines and tools for eco-dynamic development and design. The programme aims to demonstrate that it is possible to develop infrastructure while creating opportunities for nature at the same time. Links to this and other initiatives and useful references are shown on the PIANC Working with Nature website (www.pianc.org/workingwithnature.php).

Working with Nature does not mean that we no longer achieve our development objectives: rather it ensures that these objectives are satisfied in a mutually beneficial way. Developing and delivering such win-win initiatives will take more innovation and

imagination in some cases than in others, but PIANC is convinced that the rewards of Working with Nature extend far beyond the natural environment. PIANC's sister organisations CEDA (Central Dredging Association) and IADC (International Association of Dredging Companies) also support and endorse the Working with Nature principles.

6. IWT MARKETS

6.1 Transported volumes in Europe

According to European statistics 532 million tonnes of cargo were transported in 2013 by IWT (EU28)17, which led to a freight turnover of more than 152 billion tkm. Of the total volume transported, approximately 67% is transported within or through the Netherlands. Other EU Member States with a high share of goods transported by IWT are: Germany (40%), Belgium (36%) and France (13%). Oil and chemical products (liquid cargo), coals and ores and construction materials (sand and gravel) have the largest share in the transported tonnage in Europe.

Geographically, the majority of the cargo flows is transported on the Rhine corridor (68%)[18], the North-South axis between Netherlands and France accounts for 16% of the cargo transported, the Danube corridor for 14% and the remaining 2% consists of East-West transport between Germany and Poland. An overview of how the 532 million tonnes of cargo is distributed over the European waterways is given in the figure[19] below.

[17] See: Eurostat - transport by type of good

[18] NEA, et al. (2011). Medium and Long Term perspective of IWT for the EU

[19] Source: Data PLATINA Deliverable 5.5 (2010) & Google maps, adapted by STC

6.2 IWT Market Segments[20]

6.2.1 Transport for coal fired power plants

Characteristics

Power generation in particular requires reliable coal delivery from seaports. Therefore, often coal shuttles with dedicated vessels are operated. They continuously supply large coal volumes from seaports and directly return without payload for the next coal shipment. The decision to choose IWT for coal transport is cost-driven, so that shippers have an incentive to use large dry bulk ship configurations realizing significant economies of scale. Large push convoys consisting of a push boat and up to six barges, carry coal from seaports to destinations along the Rhine such as Duisburg. These convoys provide capacities of up to 18 ,000 tons and result in an extensive decrease of transport costs. Smaller trains with two barges supply power plants within domestic markets. Push convoys with vessels and up to two pushed barges as well as large self-propelled vessels are other alternatives.

Decreasing waterway dimensions and fairway depths between seaports and plants limits the size and load of ships for direct delivery. Transshipment and use of adjusted ships and loads may be an option. Larger ship configurations on sections with more favorable waterway dimensions allow more extensive cost reductions. For instance, in the German canal network adjacent to the Rhine the maximum small pushed trains with two barges or consisting of one vessel and one barge are allowed. However, power generators usually choose direct deliveries from seaports with smaller ships. Barge-barge transshipment often applies jointly with interim coal storage in inland terminals. Coal is mostly transshipped to rail at these terminals for plants without suitable waterway access.

Supply chain organisation

Coal logistic concepts of currently constructed plants along the German canal network show the relevance of customized solutions with respect to local conditions. Long-term agreements/contracts between plant operators, such as shippers and shipping lines are required to allow investments in adjusted ships. Logistic concepts include direct deliveries and avoid transshipments. Some customers, who choose to organize the supply chains themselves, use the spot market to attract vessel capacity. However, in most cases vessels operate under long term contracts, which are concluded between the customer on the one side and groupings of operators or large brokers on the other side of the market. Push convoys deliver to one plant. Low transport costs are an important factor for decisions on plant location and ship configuration. Furthermore, dedicated storage facilities in seaports and ships running continuously ensure a reliable coal supply.

[20] Source: Platina report D 1.5:Analysis of Possibilities to Enhance Market Transparency and Synergistic Actions

6.2.2 Transport of coal, ore and metal products for the steel industry

Characteristics

Regular barge transports supply steel plants with raw materials. Often dedicated vessels run shuttle operations to ensure a reliable supply. Large ships carry bulky commodities to ensure low transport costs per unit. The largest ships operate along the Rhine between ZARA-ports and Duisburg. Push convoys with six barges carry up to 17 000 tonnes of iron ore. Waterway capabilities limit ship size and load on other sections of the waterway network. Depending on conditions, smaller pushed trains with about a 4 000 tonne capacity and self-propelled vessels with about a 2 500 tonne capacity are used on waterways adjacent to the Rhine.

Self-propelled vessels dominate the transport of break-bulk products. Ship size varies depending on size of consignments and waterway conditions. Small-sized vessels transport a significant share of steel industry products carried on inland waterways to customers at lower class waterways.

Supply chain organisation

Shippers use facilities in seaports and inland ports to store raw materials. Steel producers hold additional buffers on site at plants. In general, the strategic transport decisions depend on the location of steel plants and on the input source. Multimodal hinterland chains with transshipment from inland navigation to railway are an option and often such transshipments are connected with buffering raw materials in inland ports.

Steel producers are central actors in the supply chain and they decide on sourcing of inputs. A plant supply of inputs is already considered when planning. The organisation of chains depends on their sourcing strategy. If purchasing inputs directly at the source, the producers are usually involved in transport decisions. In contrast, traders might organize shipments of commodities. Apart from that, steel producers may outsource transport decisions.

In any case, the requirements of steel producers determine the modal choice. Customized logistic concepts are developed for regular standardized shipments of raw materials. Logistic concepts include sources, modes, frequency and shipment size as well as storage of raw materials.

As in other industries, the reliability of input flows is very important in the steel industry. A reliable input flow including buffers is one condition to avoid costly production stops. Among modes with sufficient reliability, cost dominates decisions on transport of inputs. As outlined regarding the coal supply of power plants, waterway conditions determine reliability and cost of inland navigation. IWT is very well positioned for input flows of the steel industry due to affinity of bulk commodities. Good links and direct waterway access of steel plants contribute to cost-efficiency of IWT. Plants without access to waterways and weakening waterway conditions distant to seaports give rise to integration of IWT in intermodal chains. Although for both transport of coals and ores, on some connections IWT has to compete to rail transport. The cost position of IWT relative to rail transport varies from case to case.

In particular, transport of raw materials is a large market for IWT. Transport volumes are related to production volumes of plants supplied by waterways. In competition with

railways, low cost is a factor to choose IWT, provided there is reliable waterway connection and access near the plant. Among modes, IWT is the best and most able to accommodate the large bulk volumes. A reduction of steel related IWT of raw materials is likely related to a shift of production to non-European plants. Supply of raw materials from Ukraine and Russia are expected to gain importance. In many instances this type of IWT activity is strongly connected to the (planning of) infrastructure projects. IWT has a lower share in transport of steel products. Due to usually smaller batches and many destinations distant to waterways, these transports have a lower affinity to IWT. Rail transport is therefore mainly used for the distribution over Europe of heavy steel products (e.g. coils). For locations that are near waterways however, the heavy weight and bulkiness of goods could be a reason to choose IWT.

6.2.3 Liquid bulk transport for the petroleum and chemical industry

Characteristics

IWT related to mineral oil products and chemical industry is mostly the regular transport of raw materials. Shippers usually contract capacities in the long term. Logistic concepts often include dedicated ships for regular supply of particular commodities. Cost intensive cleaning of tanks, often required before carrying other commodities, is a reason for commodity-specific ships. IWT is adjusted to conditions such as the volumes required and the storage available. Shuttles from seaports or between plants without return freight dominate. However, depending on supply chain characteristics return freight may be available and ship routing is adjusted to these freight flows. An example is a circle routing with subsequent transports.

Tank ships dominate in the chemical industry with its large share of liquid bulks. Large tank ships are used for bulk commodities shipped in large volumes such as mineral oil products. Along the main corridors with corresponding capabilities capacities above 3 500 tons ensure low costs per unit. On other waterways, smaller units adjusted to local capabilities are used. In general, shippers require ships with less capacity for smaller consignments. Ships with separate small-sized tanks for different commodities are an alternative. Furthermore, special tanks may be required due to the characteristics of the commodities. This applies in particular to gases, which account for a large share of IWT in the chemical industry. The prohibitive cleaning costs of tanks before carrying different commodities, tends to be dedicated to smaller tanks.

Double-hull tank ships are required for the transport of chemicals on waterways. An additional hull reduces the tank capacity of ships and increases the empty draught of vessels, which influences the price during periods of low water. Tank ships of a larger size are required to suit capacity requirements and allow comparable levels of cost reduction.

Supply chain organisation

Petroleum and chemical industry supply chains are interrelated and both include large liquid bulk flows. In the petroleum industry, crude oil imports arrive in seaports and are transported to refineries. Refineries either supply large consumers such as chemical plants or depots for further distribution with mineral oil products. A share of crude oil supplies is transported by pipeline. IWT accounts for a large share of other bulk transports depending on the location of the refinery and destination. Commodities have

an affinity with IWT and plants within the petroleum and chemical industry are often located near water. Smaller mineral oil consumers are usually supplied from depots by road transport. Several plants within the chemical industry are large consumers supplied directly with mineral oil.

The chemical industry includes producers of base chemicals and special chemicals. They use mineral oil and chemical raw materials in production. Furthermore, semi-finished products are used as inputs to produce high-value chemicals. The interdependency of chemical production is one reason for the emergence of large chemical plants including different productions. A large share of raw materials is imported via seaports. Pipelines transport a significant volume of bulk. IWT relies in particular on wet connections for a large share of remaining bulk transports. While raw materials tend to be shipped in large volumes suitable for IWT the batch, size usually decreases along the supply chain towards finished products. The batch size of base chemicals is larger compared to special chemicals. Overall, products including a wide range of commodities and different degrees of vertical integration within the chemical industry make supply chains and related transports rather individual. However, all plants require the regular supply of large volumes of raw materials.

The most relevant actors for supply chain decisions are mineral oil product suppliers, producers in the chemical industry and end users of chemicals. They decide on product flows in production and distribution and corresponding transports. Decisions are determined by the requirements of production processes in the chemical and related industries. Relevant requirements arise on the supply and demand side of commodities. Furthermore, traders of mineral oil products and other chemicals decide on transport. Shippers' requirements (e.g. EBIS) are binding for brokers, who are assigned to organize transport along supply chains. The chemical industry outsources a large share of logistic activities to external providers.

The organisation of supply chains in the complex chemical industry is a challenging task. Producers require reliable transport of raw materials and semi-finished products to ensure continuous production. Frequent navigational restrictions could reduce reliability of IWT below acceptable levels. Storage along the chain and on site at plants reduces adverse impacts (e.g. on transport delays). However, emerging floating storage concepts tend to decrease a plant's reserves. They depend on the reliability of IWT.

Sufficient reliability provided, cost is the most important factor in transport decisions within the chemical industry. This applies in particular to large volumes of inputs. Relevance of inland navigation for particular transport flows depends on waterway access at origins and destinations as well as waterway connections. Corresponding to product flows connections with seaports and between plants are important. Availability of product pipelines negatively affects the share of IWT on particular liquid bulk routes. If a pipeline connection is available, it is superior to inland navigation for transporting liquid bulk transports. IWT is regarded as reliable despite restrictions such as changing water levels of rivers. Although changing water levels of rivers may limit payload, IWT of liquid bulk commodities achieves cost advantages in particular on wet connections when compared to railway and road transport. Furthermore, fairway depth and bridge clearance may limit ship size and cost advantage of IWT. The cost advantage is, depending on tank ship capacity, up to 50% on a typical liquid bulk route between Antwerp and Ludwigshafen.

Restrictions for the transport of dangerous goods by railway and road are another reason to choose IWT as a large share of goods in the chemical industry is classified as dangerous. The relevance of speed for transport decisions increases with the finishing of products along the supply chain. Packed chemicals account for a larger share among finished products. Furthermore, increasing volumes of chemicals are shipped in containers. Road and railway transport dominate transport of packed chemicals, while IWT accounts for a small share of volumes.

6.2.4 Container transport

Characteristics

The position of IWT along corridors depends on corresponding seaports as well as waterway conditions and inland terminal density in their hinterland. Strong seaports, good waterway links and a high quality network of inland terminals lead to above average IWT shares in the hinterland of Western seaports.

Liner services usually carry containers by inland waterways and in particular, between seaports and hinterland terminals shipping lines operate regularly scheduled services. These services carry containers from different shippers (merchant and carriers haulage). Large ships allow cost reduction and make IWT more competitive. However, waterway capabilities and sufficient demand are required for the operation of large ships. Waterway dimensions and in particular bridge clearance determines capacity. With respect to cost reduction, usually three-tier container transport on waterways is required to achieve cost levels competitive with railway and road transport. However, some two-tier container services are in operation. The Rhine corridor accommodates high capacity container transport. Depending on the section of the waterway up to six tiers are permitted.

Along the Danube pushed trains with four barges are regarded as optimum for future container transport. Three tiers yield a capacity of 576 TEU. In the hinterland of the Constanta port, four tiers are theoretically possible for transports to Belgrade. The number of maximum container levels decreases to three on the Danube further to the West, for example in Austria and Bavaria, due to bridge clearance. Additionally limited water levels on the Danube affect the loading capacity of vessels.

Supply chain organisation

Overseas containers are, especially along the River Rhine, transported into the hinterland by IWT. Containers are predominantly loaded with small sized consumer goods imported or destined for export. In the origin region, either single shippers with sufficient volumes dispatch loaded containers or logistic enterprises (for example inland terminal operators) consolidate LCL (Less than Container Load). In destination regions, wholesalers and large retailers receiving FCL (Full Container Load) usually deconsolidate containers. Apart from that, logistic providers deconsolidate container shipments and distribute consumer goods. With the growing logistic efficiency of IWT, container transport increases continuously on waterways in seaports in the hinterland. However, road and railway transport still dominate in this market segment. A major share of container transport on inland waterways is a component of long intermodal transport chains passing terminals for instance inland ports. Container transport accounts for a large share of sea-river transport. Sea transport directly from and to inland ports avoids transshipments of containers in seaports.

A wide range of actors such as suppliers, importers and retailers determine global shipping decisions. Shippers dispatch a different number of individual consignments with a limited batch size. In particular, shippers with few shipments outsource transport organisation to forwarders and logistic service providers. In general, third parties have a strong influence on global supply chains of consumer goods. They operate global container networks and provide door-to-door transport. A large number of different shippers use such networks. In the seaport hinterland transport maritime shipping lines have a strong influence (e.g. Maersk, CMA CGM, MSC). They decide on what containers are shipped under carrier's haulage. Costs are less relevant for modal choice in container transport, as costs are very low in relation to the high value of consumer goods. However, hinterland transport accounts for a large share of cost in the door-to-door intercontinental container transport. Therefore, costs of IWT and related transshipments are an important factor. This applies in particular to maritime shipping lines deciding on container hinterland transport ('carrier haulage). This intercontinental container cargo transport by IWT is generally not time-critical. Many import goods from Asia for example stay on deep-sea vessels for a few weeks (e.g. transport from Shanghai to Rotterdam takes approximately 28 days).

The container capacity of ships determines competitiveness of IWT in terms of cost. Capacity of particular ships depends on the number of container levels possible. Bridge clearance is a limiting factor. Low clearance reduces tiers and may lead to non-competitive cost levels per container.

IWT has a significant cost advantage on typical container routes. IWT is more than 40% cheaper compared to other modes between Rotterdam and Duisburg employing high capacity ships of Jowi-class or coupled convoys. The cost advantage further upstream, i.e. between Rotterdam and Basel, is also considerable when operating coupled convoys, although when pre-/end haulage distances to shippers increase rail transport becomes an interesting alternative. However, considering limited pre-/end haulage IWT remains cost leader also due to better access to the large number of different terminals in the seaports compared to rail.

Quality aspects are becoming more and more important in container transport. Relevant criteria in this respect are reliability, speed and flexibility of modes. Relevance of reliability becomes apparent, as container shippers often back transports by other modes to ensure in-time delivery. Container transport on waterways is very reliable. Congestion is no issue on waterways and changing waterway levels are usually not that critical for container ships. However, congestion in the seaports occurs frequently, which causes additional costs due to the increase of waiting times for vessels for loading/unloading.

In particular, in the continental cargo market the limited speed of IWT may increase the time to market of goods to above acceptable levels as these chains are used to the speeds of road haulage and rail. However, unloaded containers are usually not that time critical and they have an affinity to IWT. The waterway network limits spatial flexibility of IWT. Flexibility in terms of time is provided with regular liner services connecting seaports and inland ports. A growing inland terminal network and more frequencies of container lines improve flexibility for container shippers using IWT. In particular, container transport demands the implementation of information and communication technologies in IWT in order to optimize port processes and load rates of vessels.

6.2.5 Transport of agribulk

Characteristics

Mainly dry cargo motor vessels are used to transport the products in the agribulk-market but occasionally push barges may also be used. Generally, the smaller and medium-sized motor cargo vessels specialize in the agribulk supply chains. The vessels, therefore, often do not require the maximum dimensions of the waterways.

Most of the IWT services are demanded via spot markets although some cargo flows are transported under longer-term contracts. In general, transport volume developments in this sector are quite stable and are not really influenced by the economic climate. Often more important drivers are the weather, which influences the size of the harvest (e.g. grain), the size of the livestock and changes in the size of the population.

In the future, it can also be expected that more and more agricultural bulk products will be used for the production of energy and bio fuels to replace fossil fuels. This is expected to create a gradually increasing transport demand for IWT. This will, in addition, increase the dependence of this sector on development in the general economy. This type of product will then be transported by liquid cargo motor vessels.

Supply chain organisation

Looking at the composition of animal bulk products transported one could distinguish four distinct supply chains/ sub-segments in the market: Animal feed, Grains/Wheat, Fertilizers and Oil seeds.

Animal feed customers are often large co-operations of farmers and the final consumer here is of course cattle breeding farms. IWT is primarily used in the transport from seaports to large agricultural co-operations. The animal feed generally does not originate in seaport areas but is shipped to these from overseas. Road freight transport companies usually do the final distribution in the supply to cattle breeding farms.

The final consumers in the supply chains of grains are both farmers (cattle feed) and the food processing industry. As can be seen, sourcing within the continent is more important in this supply chain than the animal feed market.

Fertilizers are produced by the agro-chemical industry. Raw materials (e.g. phosphates) are shipped to these companies by sea. IWT is being used for hinterland transport to plants or to agricultural co-operations from where farms are being supplied. The type of farmer is grows crops.

Oil seeds are used by some chemical plants and to a lesser extent the food processing industry. Many vegetable oils are used to make soaps or other skin products, candles, perfumes and other cosmetic products. This is also a flow, which is strongly related to seaports

6.2.6 Transport for the construction industry

Characteristics

For the transport of raw materials to construction industry plants, usually small, medium and large vessels are use. For example, concrete plants are often located along smaller waterways, as they depend on the benefits of lower transport costs by IWT and secondly

are required to be close to their clients/service due to limitations to the specific nature of their products (e.g. limited transport range in urban areas of concrete trucks). Obviously when plants are located along rivers or in ports accessible to large vessels, the shipper can benefit from even lower freight rates in comparison to other modes.

In the transport to/from large infrastructure projects both small and medium-sized, motor vessels are used with the occasional push barge. Because the locations of construction sites vary over the course of time, different vessel types might be useful in different projects. In the market segment of transport of river or sea sand, however, a substantial number of specific IWT vessels operate that are also used in the process of mining/pumping up the sand. Those vessels, which are active primarily in the Netherlands and Belgium, are characteristic for this particular IWT market segment. Generally, this type of transport is not time-critical and can be planned and scheduled.

Supply chain organisation

The supply chains of material (mainly gravel) from mining/win locations to production plants, which manufacture specific materials for construction, are comparatively simple and the geographic patterns are fixed. Most plants are located close to waterways and the market share of IWT in this supply chain is very significant in countries with a dense waterway network (e.g. the Netherlands). The IWT services required in this particular market segment are frequently contracted via the spot market although a sizeable part of the transport volumes is also channelled through the term market or by means of internal contracts for own account transport. Some of the raw material trading and production companies have their own fleet of vessels to ensure transport capacity.

The supply chain of sand to infrastructure projects or large housing projects is more complex because those projects will not necessarily be located close to waterways. Although the destinations for the time being are fixed in the longer term, this market does not have fixed destinations. In many instances this type of IWT activity is strongly connected to the (planning of the) infrastructure project itself and therefore, the marketing and pricing of the transport flows is primarily realised in long term contracts with the contractor of the infrastructure project or the builder of the project.

6.2.7 Expectations and requirements for the future

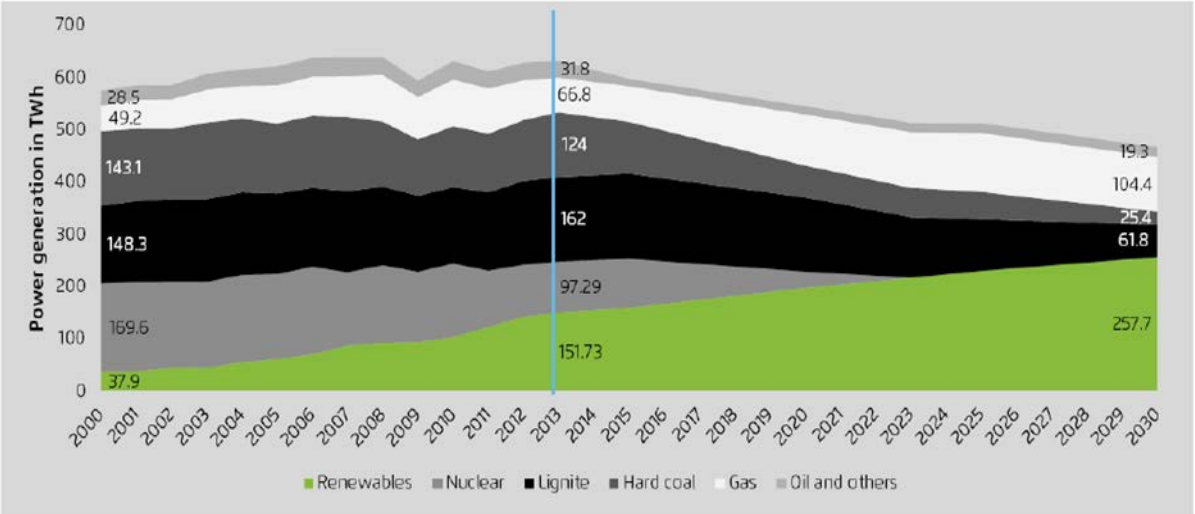
Coal fired power plants

The transport of coal transport via IWT mainly takes place between seaports in the ARA-region and coal-fired power plants in Germany. Between 2010-2013 electricity generation lost from the closed nuclear plants (43 TWh from 2010-2013) was expected to be compensated by coal-fired power plants, however instead it was more than compensated for by the increase in renewable electricity (47 TWh 2010-2103). The increase in the proportion of electricity generated from coal (3.6 percentage points between 2010 and 2013) was the same as the reduction of electricity from gas burning. Germany also exported a record amount of electricity in 2013 (33 TWh) .

In the short term (until 2016), the transport of coal via IWT is expected to remain stable or show a small growth, due to additional coal-fired power generation capacity in Germany. In the medium and longer term (until 2030) the demand for coal is expected to decline, since the share of coal generated electricity will have to decline from 45% to 19% for Germany to meet the 2030 climate target. This is expected to be compensated

by electricity generated by renewables and gas (see figure below). Therefore, the expected small growth of coal transport by IWT in Europa will most likely be a temporary phenomenon, in the long term, coal transport by IWT for coal-fired power plants expected to decline considerably.

See the expected declining demand for the transport of coal when relating this to the prospective development of energy scenarios of the German federal government in the graph below.



Source: Agora

Transport of coal, ore and metal products for the steel industry

In 2013, the steel demand in the EU was 27 % below the pre-crisis level; in 2014, the steel market in Europe is rather weak also due to severe competition from the steel industry in Asia (China, India, and Japan). IWT plays an important role especially for the import of raw materials, ore for steel production and coal to power the steel industry. The next few years the World Steel Association expects a moderate growth of 2-3% for the EU28, which will also increase the transport of raw materials slightly. In the longer term, the survival of the European steel industry is rather uncertain. Restructuring of the steel industry will be necessary to improve the competitiveness on the world market and this restructuring will lower production levels. This may also cause the EU steel production in Western Europe to relocate their own steel production to other (Middle and Eastern European) countries and steel import flow is expected to occur. As stated before regarding semi-finished steel products, IWT especially has to compete with rail transport.

Liquid bulk transport for the petroleum and chemical industry

The liquid bulk market segment is currently the most important market segment for IWT, since 26% of the total volume transported by IWT concerns liquid bulk. The suitability to accommodate extensive volumes of liquid bulk commodities in the hinterland of seaports with reliable waterway connections is one factor to choose IWT. In general, railway and pipeline transport are alternatives for the transport of large volumes. Lower costs are an advantage of IWT. Moreover, safety with respect to rather low external risks of dangerous goods contributes to the choice of IWT.

Future development of oil consumption and related transport will be influenced by oil price, efficiency and the availability of alternative fuels and energies. Political developments in oil producing countries will increasingly become a factor as well. The growing scarcity of oil will increase the efforts to improve efficiency and find alternatives suitable for large-scale use. In the long-term, the LNG market for bunkering is expected to become a booming market. LNG for bunkering is expected to increase to 20-30% in the period 2025-2030.

Another growing transport trend, which could lead to an increase of IWT transport concerns biofuels, which is a liquid energy source (bio ethanol and biodiesel), produced out of raw materials being agricultural crops and residues. The European chemical industry expects an average growth of 1-2% per annum until 2020. However, European plants increasingly have to compete with plants in the Middle East and especially Asia.

Container transport

The growth in the transport of containerised cargo in inland waterways declined during the economic downturn, but is now showing a strong revival to attain pre-crisis levels. It is expected that container transport will further increase in the near future and the in the longer term. A significant driving force is the modal split commitment made by various seaport authorities (Rotterdam in particular) for the future transport to/from the port. Additionally IWT may also benefit from new cargo flows using existing and extensive hinterland container transport services for maritime containers across Europe, for instance for the transport of continental cargo.

Transport of agribulk

The agribulk sector (cereals, seeds, fertilizers, ingredients for feed, etc.) is quite stable and is not really influenced by the economic climate. More important is the weather, which influences the size of the harvest (e.g. grain). On the short/medium term a (very) modest growth of transport volumes is expected in this market., although transportation by barge will have to meet with increasing requirements regarding food security concerns (e.g. GMP). Relevant for the long-term demand volume are the size of the livestock industry and the size of the population, whereas the size of the population in Europe is expected to decrease in the future.

Moreover, irrespective of this decline, fertilizer volumes will decrease because of environmental restrictions. While the general trend is strongly negative for this market segment, it is expected that more and more agricultural bulk products will be used for the production of energy and bio fuels to replace fossil fuels. This trend is expected to generate an increasing transport demand for IWT. In case IWT develops a prominent role in the transportation of biomass, the overall transport of performance in the agribulk segment will grow considerably. In comparison to some other agricultural commodities, the demand for biomass is not expected to be subjected to seasonal influences. Plants running on biomass have to be kept operational.

Transport for the construction industry

This market segment is strongly related to development plans for infrastructure and housing, therefore freight volumes will depend on the development and composition of the population in the future and the level of welfare. In the short-term, transport levels may increase slightly, but in the medium and long term trends are negative. It expected

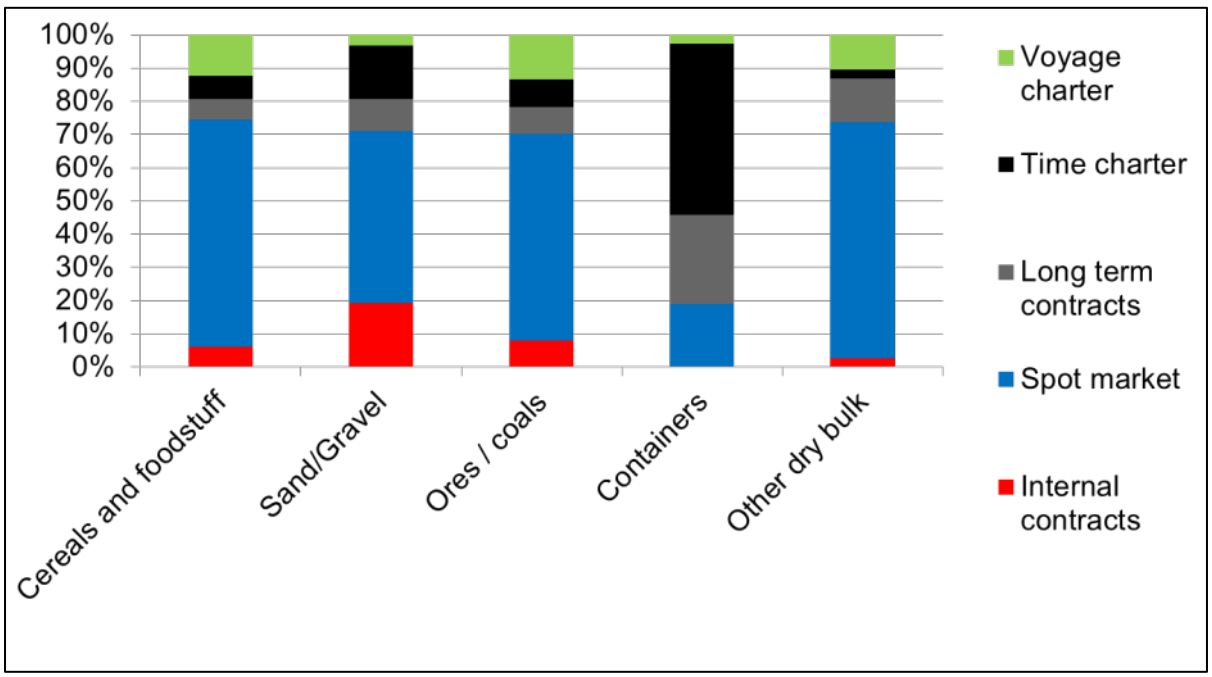
that the IWT freight volumes will follow this negative trend. Additionally supply chains may alter due to advanced environmental requirements at extraction sites. This implies a shift of transshipment from inland ports to seaports. However, IWT will remain the most cost effective mode to transport this cargo especially for construction industries located along waterways.

6.2 IWT market structure

6.2.1 Supply side of IWT

The supply side of the IWT market in Western Europe is strongly fragmented and dominated by micro-sized (family) enterprises owning/operating only one vessel. About 5,700 European enterprises are primarily focused on operational management of their vessels (12,800 units) often relying on more or less 86 ship brokers and cooperatives and 135 shipping lines, who represent 250 shippers and logistics service providers, to match supply to transport demand. There is a big difference between the primary market (shippers – brokers, cooperatives and big shipping lines) and the secondary market (brokers, cooperatives and big shipping lines – shipowner/operators). As a result, the brokers have a good view of the market situation while the individual shipowners have much less information and therefore a relatively weak position to negotiate prices and conditions.

The figure below gives an overview of the volatility in the market from the perspective of the barge operator, since around 60% of the cargo (for except the container market) is acquired on the spot market.



In contrast to the market in Western Europe, single shipowner/operators owners on the Danube are rather exceptional. The IWT market on the Danube is dominated by large, often (previously) state owned, enterprises of which, according to Eurostat statistics, a high percentage owns 20 vessels or more which carry out 90% of the total transport on the Danube (commonly push convoys). Larger companies such as shipping lines also

operate in Western Europe, in particular in the transport of large container and tanker vessels or push convoys operating on a 24/7 basis.

6.2.2 IWT Operations

This market segment is strongly related to development plans for infrastructure and housing, therefore freight volumes will depend on the development and composition of the population in the future and the level of welfare. In the short-term, transport levels may increase slightly, but in the medium and long term trends are negative. It expected that the IWT freight volumes will follow this negative trend. Additionally supply chains may alter due to advanced environmental requirements at extraction sites. This implies a shift of transshipment from inland ports to seaports. However, IWT will remain the most cost effective mode to transport this cargo especially for construction industries located along waterways.

Inland waterways usually have a major role in the transport between the seaport and destinations in the hinterland of the seaport in order to facilitate international import and export flows. Examples here are the transport of containerized goods where inland waterways links the maritime deep-sea connections with distribution centers and production facilities in the hinterland. Other examples are the import flows of oil products from refineries, the import of coal and ores for energy and steel production plans. However inland waterways can also have a major role in transports on the continent such the intra-regional or local transport of sand and gravel and agricultural products.

The operational models that are used depend on several elements:

- Volume
- Transport distance
- Possible vessel dimensions and service hours of locks and bridges

In order to reduce the transport costs, usually the largest type of vessel is selected for the operation if there is sufficient cargo in a direct “point-to-point” system. The point-to-point system is most economical if there is a high volume of transport in both directions. For example for transport of bulk materials on larger waterways often push barges and coupled convoys are used that are operated in a 24/7 operational model to use the assets to the maximum. In such operational models the push convoys have the advantage that the push boat can be decoupled from the barges, which allows the boat and its crew to minimize the (inactive) dwell time in ports while the barges are loaded/unloaded (pool system). For example in the USA the push convoys are very large and are operated in a hub-and-spoke system where barges are sorted by destination on several interconnections in the network.

However, in case the volumes are smaller and more fragmented, smaller motorvessels are used or consolidation takes place via inland terminals or by means of visiting several terminals in order to fill the vessel with sufficient cargo (load factor). For example for the transport of agricultural transport of grains harvested in the North of France, small canal vessels of 350 tons are used to transport the agricultural goods to processing plants. These vessels are operated in weekday operation, maximum 14 hours per day since also the waterway network is usually closed during the night and during weekends.

For transport of liquid cargo, the tanker vessels have a number of separated tanks which allows the vessels to carry different products for different clients and to apply an operational model based on a roundtrip along a number of ports for loading/unloading.

Another important issue to take into account is also the requirements for the cargo hold. Often the cargo hold needs to be cleaned first in order to be able to load another type of product because of the quality requirements. In order to avoid expensive costs and time needed for cleaning and inspection, many barges are used in a dedicated manner for a specific type of product. This however does result in more empty sailing, but in the end this is a cheaper operation, in particular if the transport distances are small.

The longer the transport distance, the more interest there is to have a descend load factor of the vessel. As a result, on longer journeys the vessel operators will try to find return load in order to minimize costs and to be able to provide competitive rates to their clients. As a result of imbalances between import and export flows, it can be seen that there can be significant differences between the level of rates between the direction. For example on the Rhine, the market for bulk cargo is mainly driven by imports via the seaports such as Antwerp, Rotterdam and Amsterdam. As there is much less export of bulk cargo from Germany, the market price for inbound transport (upstream) is much higher compared to the market price for outbound cargo (downstream).

A more complex operational model can be seen in the market of containerized transport. The containers for the deepsea vessels have to be distributed or sources from a range of different locations in the hinterland of the seaport. In Europe many inland terminals have been developed in the last 25 years in order to provide the link between the customer and the waterways. Traditionally each terminal has their own barge service applying a ‘Full barge load” operation.

6.2.3 Collaboration and market transparency

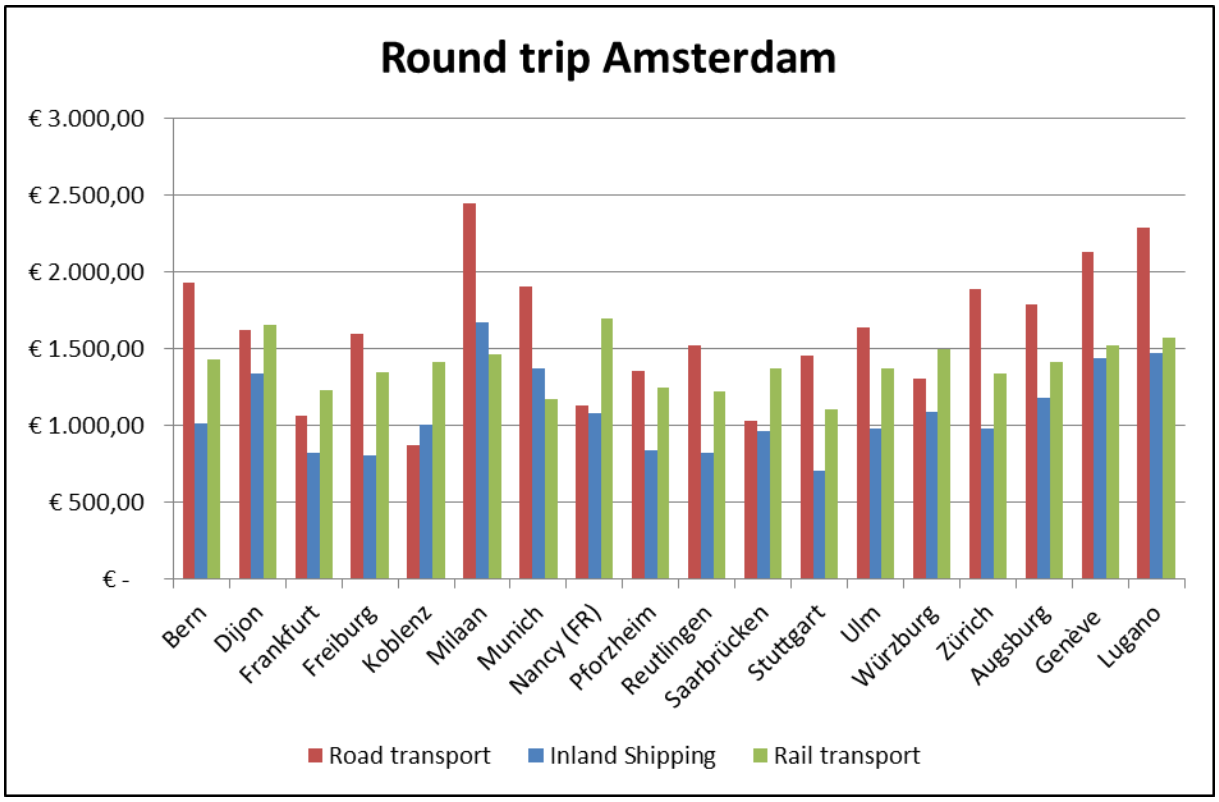
On European level a lot of attention is given to look at possible synergetic actions and improvement of market transparency from the viewpoint of the vessel operators/owners. This could be achieved by means of improved transport capacity management (efficiency) and expansion in the services providing one-stop-shop logistic solutions in order to improve integration of Inland Waterway Transport (IWT) in supply chains. This concerns collaboration between shipowners and brokers in order to reach economies of scale that allow the expansion of services by means of offering storage and transshipment operations as well as intensified collaboration with other modes of transport.

From a socio-economic viewpoint, there are a number of arguments in favor of collaboration instead of individual and fragmented operations. Collaboration between shipowner/operators is believed to be more efficient and because of the focus on more long-term contracts and stable relationships with shippers and brokers. This contributes towards stability in the market. It also contributes to market transparency as the number of economic operators is consolidated into larger entities. The increase of scale of organisation can also contribute to a better ability of IWT to provide multimodal logistic services. Economies of scale and more multimodal operations reduce internal transport costs as well as externalities such as congestion on roads, noise and greenhouse gas emissions.

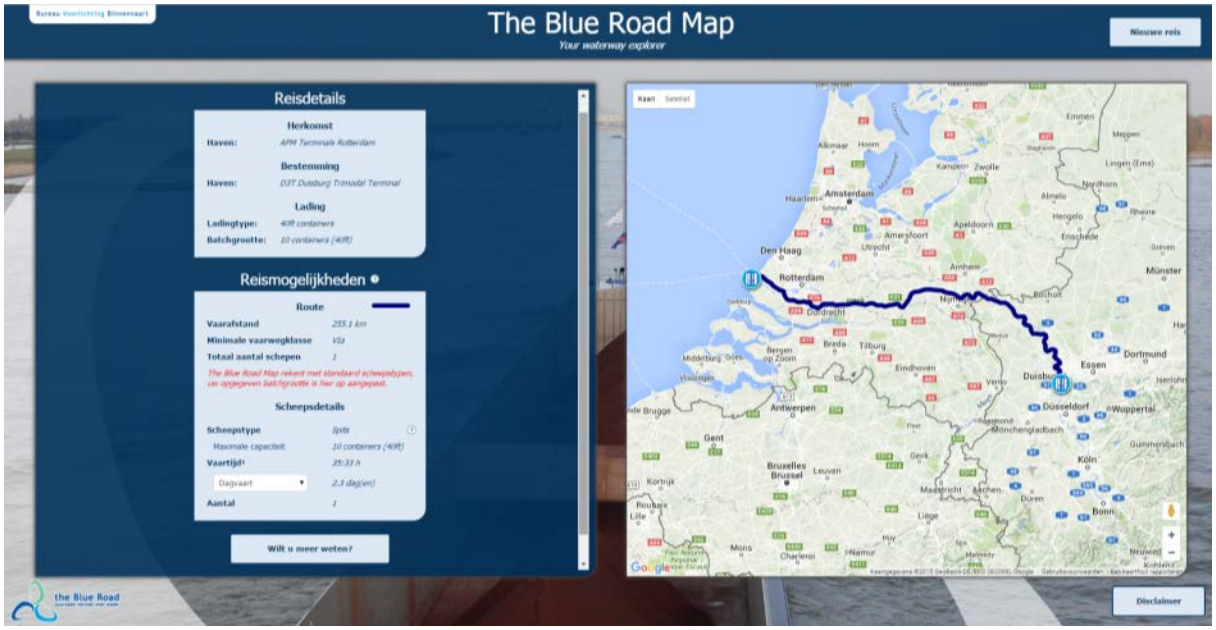
6.3 Developing business cases

The development of business case is mainly the responsibility of IWT promotion bureaus, by enhancing awareness of IWT solutions amongst shippers as already briefly explained in chapter 3.3.3. Promotion bureaus are able to give shippers more insight in the benefits of transporting goods using inland shipping directly, or more topical by means of intermodal transport (containers being transported via IWT on the long haul, using road transport for pre- and end haulage).

Promotion bureaus also consider new market potential. For example, in Europe continental containerized goods are mostly transported in Full Truck Loads (FTL's). In order to attract more cargo, and look for specific market potential, a comparative analysis was made to consider both Inland Shipping and Rail transport (in an intermodal transport chain) as alternative for direct trucking. As an example the case for continental container transport, making use of 45 ft. pallet wide containers, is given below.



Furthermore in order to create more awareness amongst shippers to transport goods via IWT, tools are designed to inform shippers about specific solutions: http://www.blueroadmap.nl (in Dutch).


The Blue Road Map
Your waterway explorer
Nieuwe reis
Reisdetails
Herkomst
Haven:
APM Terminals Rotterdam
Bestemming
Haven:
DIT Duisburg Trimodal Terminal
Lading
Ladingtype:
40ft containers
Batchgrootte:
10 containers (40ft)
Reismogelijkheden
Route
Vaarafstand
255.1 km
Minimale vaarwegklasse
Va
Totaal aantal schepen
1
The Blue Road Map rekent met standaard scheepstypen, uw opgegeven batchgrootte is hier op aangepast.
Scheepsdetails
Scheepstype
Spits
Maximale capaciteit
10 containers (40ft)
Vaartijd¹
35:33 h
Dagvaart
2.3 dag(en)
Aantal
1
Wilt u meer weten?
Kaart
Satelliet
Rotterdam
Den Haag
Amsterdam
Dordrecht
Antwerpen
Duisburg
Essen
Düsseldorf
Dortmund
Köln
Bonn
Disclaimer

7. LOGISTICS AND HINTERLAND CONNECTIVITY

7.1 Multimodal logistics and transport corridors

An important element of logistics and hinterland connectivity to consider is the link between the multimodal facilities and the location of economic zones and industrial areas. Logistic and economic zones more and more are connected through multimodal transport corridors which are planned, and developed from in an integrated manner, and with governance over the corridor. Inland ports and extended gates are important elements in this new development, by functioning as facilitator for multimodal connections and as platform for the region. There are several good examples on how this development was taken up in other countries, and the exposure program included several of these regions. In and outside the EU multimodal transport corridors are developed, where new governance models are being applied.

7.2 Multimodal transport

The concept of multi- and synchromodal corridors is relatively new, but in more and more countries, the authorities see the concept as a possibility to achieve big improvements in the logistics and transport between the seaports and the hinterland, but also for land transport corridors to other countries, and within large countries. The multi- and synchromodal corridor concept looks at transportation from an integrated perspective: what are the overall transport requirements on a corridor that can be met by a combination of transport modes. A corridor in this case is a connection between the hinterland and the port outlet, from a trade and logistics point of view, or between land locked regions. A corridor manager overlooks the alternatives and finds smart solutions. This can mean investing in a new transport alternative, if this leads to a better logistic end solution, while efficiently using the scarce resources.

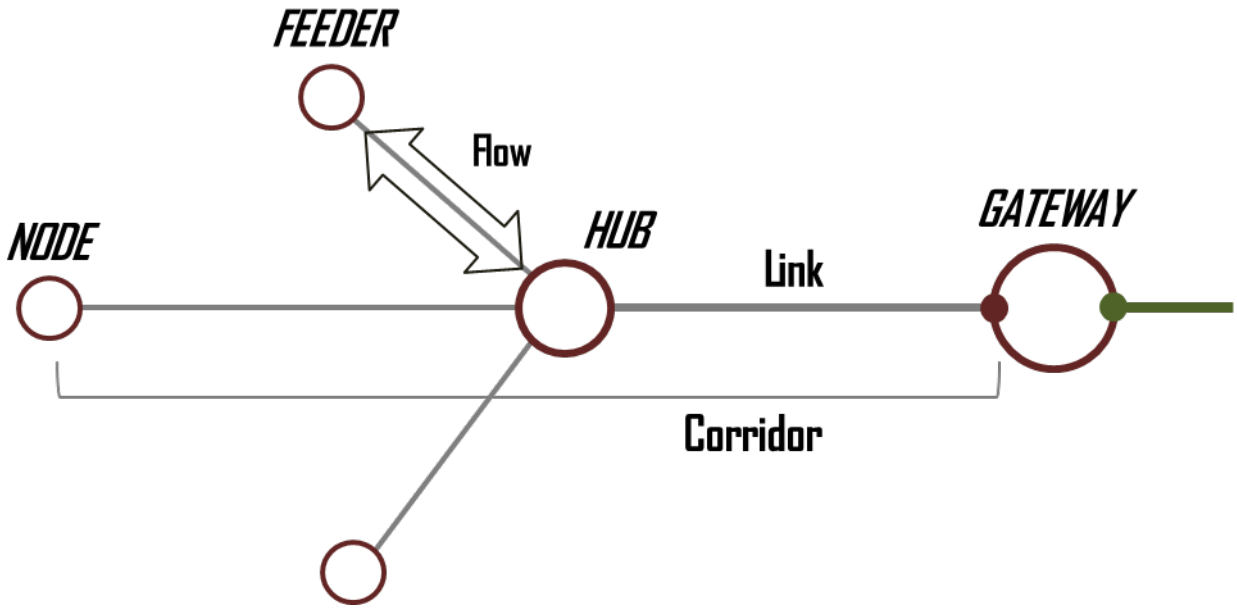
In most countries and regions, the multimodal transport network is (still) a patchwork of single modal networks of roads, railways, waterways, airports and seaports. These modal networks might be of high quality and well developed, this does not guarantee smooth and seamless connections and logistic operations. Realizing efficient supply chains in practice is hampered by especially:

- the cross border or cross region infrastructures;
- the technical interoperability;
- the integration of different transport modes.

Efficient multimodal transport systems, which require high volumes of cargo and close coordination and facilitation, will normally develop faster in parts of these networks that connect high volume generating areas, with destination areas, or international nodes such as seaports. In addition, the bundling of cargo, active or not, will concentrate the volume even more, combining different origin-destination flows into large bundles of goods that follow high capacity pathways. This is a self-enforcing mechanism, since high volume of cargo will result in cheaper transport solutions, higher efficiency and more reliability, and experimentation with multimodal concepts. This in turn attracts more cargo streams.

As a result, transport networks often consist of dominant paths, or corridors. These can run in parallel, or cross each other, or be entirely unrelated or interconnected. These corridors not only function as a focal point for infrastructure investment, transport planning and operations, but also, more and more, as the center point for governance and policymaking.

Central point in the approach is that a corridor is considered as a whole, and that the different elements have seamless connections. Not only does it deal with the flow of goods, also the flow of information needed to control and direct the goods flow is included. For the management of a corridor so-called control towers can be developed. A control tower is a business process outsourcing service that has control on the design, arrangements and/or operations of one or more chains for one or more customers. In this way a corridor can be designed in the most efficient way, and therefore we can speak of a smart corridor (see figure below for typical elements, nodes and links, in a multimodal transport corridor concept).



The concept of multimodal transport corridors is promoted in many countries and regions, but especially in the European Union, the multimodal transport corridor concept has been developed as a useful and necessary tool in defining and developing the new Trans European Transport Corridor Network (TEN-T). The methodology that was developed here is such, that it can easily be adopted and applied in other regions and countries.

This chapter describes the methodology behind the new multimodal transport corridors, gives a number of examples, and outlines the concept of synchromodality. The multimodal zone, normally created around larger inland ports, is a key element, and a number of good practices are described.

7.3 Representations of multimodal transport

Multimodal transport is a blanket term, that can have a lot of different meanings. As a result, there are also many different definitions of different forms of multimodal transport. These definitions in themselves are not so relevant (because they tend to

change over time), but it is important to realize that there are different representations of multimodal transport that exist, and can even be used in combination with each other. This sector will list a number of these representations.

Combined transport[21]. Combined transport has a considerable history in Europe, and other parts of the world, as a solution for long haul transport by trucks. The strength of trucking is not long haul transport, but the flexibility in pre- and end-haulage in origin and destination. The long haul, often several thousands of kilometers, can be done by another transport means. On routes where the end points are not well developed, it can be advantageous to transport not just the cargo, but the entire truck. This combination of transport by carrying a truck or trailer on a train or barge is called combined transport. Other terms, sometimes for technically slightly different concepts, are piggy back transport, or Hückepack transport. The main requirement for this transport type is the availability of loading and unloading where trucks can be driven onto the train or barge, or the availability of cranes. In the latter case, the trailers need to be reinforced to be able to lift them.

Intermodal transport[22]. This term is being used to refer to transport chains, where different modes are used one after the other, and where a unit load device is employed. In many cases, this unit load device is a container, or a swap body. The unit load device facilitates easy and fast transfer of the cargo from one mode of transport to another.

Multimodal transport[23]. While we use the term multimodal transport as a generic term for all forms of transport that include different modes, there is also a more specific definition. This definition refers to the situation where transport using different modes is executed under a single transport contract. This is very common in ocean transport, where the bill of lading (B/L) covers an ocean leg and a hinterland leg, and in air transport, where the airway bill can also cover the air transport leg and a hinterland leg. This mechanism is often used to get more flexibility to choose the ports of call, and to offer extended services to customers by transporting the cargo to a location closer to their door.

Co-modal transport[24]. The European Union has had a strong focus on intermodal transport for a long time (see definition 2.). In practice, however, due to the serial structure of intermodal transport solutions, they describe restricted set of transport solutions that exist in practice. Businesses turn out to be more creative in offering complex transport solutions, that also employ different modes of transport in parallel.

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[21] The UNECE and the European Commission have a slightly more general definition, that also covers intermodal transport. In their definition, combined transport can be unaccompanied intermodal transport, if it is only the trailer, and accompanied intermodal transport, if the traction unit is also transported.

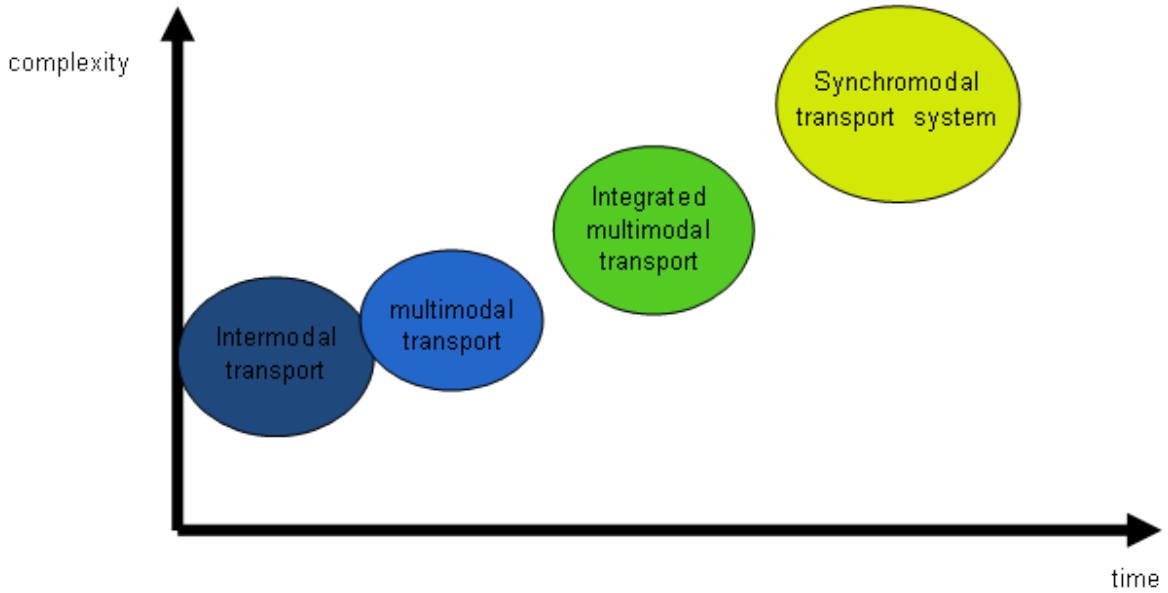
[22] ECE/FAL Recommendation No.19 “Code for Modes of Transport”

[23] United Nations Convention on International Multimodal Transport of Goods

[24] This definition is due to several research projects funded by the European Commission. It is in use since 2006

This means that on a specific route, and where geographical circumstances allow this, trucking, rail and barge transport may be offered at the same time. Other possibilities also exist, such as the parallel use of trucking and short sea shipping. The key issue for co-modality is the possibility to split a cargo stream into different flows that each have characteristics that match a certain mode. A simple example is splitting a cargo flow into a part that has to be moved quickly, and a part that does not have to move quickly.

These different representations of multimodal transport are interrelated in the sense that they represent different stages of complexity. This is represented in the following figure.



In summary, the different multimodal transport solutions can be characterized by the key determining factors in the definitions:

- Combination of modes, requiring special loading and unloading solutions,
- The use of loading units to facilitate transfer of cargo between modes,
- A single contract to cover transport by multiple modes,
- Distinguishing different needs and requirements within large volume cargo flows that can be met with different transport modes.

These factors form an important part of the requirement set for multimodal transport solutions.

7.4 Synchromodal transport

Synchromodal transport, or synchromodality is a term coined in the Netherlands as part of the development of a vision for the position of the Netherlands as the world's leading logistics hub. The term is now used worldwide as the ideal representation of the multimodal transport concept. Synchromodality is the coordination between and within chains at the level of infrastructure, services and transport, such that, given the aggregated demand for transport, the right mode is used at any time.[25]

[25] TNO 2011, Final report Implementation Roadmap Synchromodal Transport Systeem

In principle, the optimal use of infrastructure a transport means is an ambition that underlies all multimodal transport concept development. However, in practice, many bottlenecks remain that hamper the efficient integration and synchronization of transport that is part of the vision of synchromodality. These bottlenecks exist at the three levels of the transport system that are referred to in the definition: infrastructure, transport services and the execution of transportation.

At the infrastructure level, apart from missing links in the infrastructure for single modes, the main bottlenecks are at the level of transfer nodes or terminals. In a synchromodal transport system, all transfers of cargo between modes should be seamless, efficient and cheap. This is facilitated by having terminals, preferably connecting more than two modes, in the right location, with the right cargo handling facilities, and the right level of capacity.

At the transport services level, a bottleneck is often the lack of services offered for the various modes. Truck transportation is often possible on any combination of origin and destination, but rail and barge services are only offered if there is a sufficient volume of cargo, and a potentially profitable business for a transport operator. Related to this pre-requisite, another bottleneck can be the lack of coordination of cargo generation, which means that, while the cargo is there, transport needs are not coordinated, and the resulting transport demand is scattered and fragmented. A common solution in many parts of the world is that cargo owners and shippers will develop their own dedicated transport solutions, which are often not open to other market parties, and may be restricted in scope, geography and capacity. The fact that this situation exists is in itself a bottleneck, since it may take a long time to convince the cargo owners to participate in other transport solutions.

At the transport operations level, bottlenecks impact transport performance: transit time, price levels, probability of delay, high degree of damage or loss of cargo, overall reliability. Bottlenecks may be physical (locks, bridges, shallow water), operational (poor quality equipment, or low quality transport operations), organisational (lack of communication, unclear responsibilities), commercial (strong focus on costs and prices), legal (lack of clear contracts or proper legal framework).

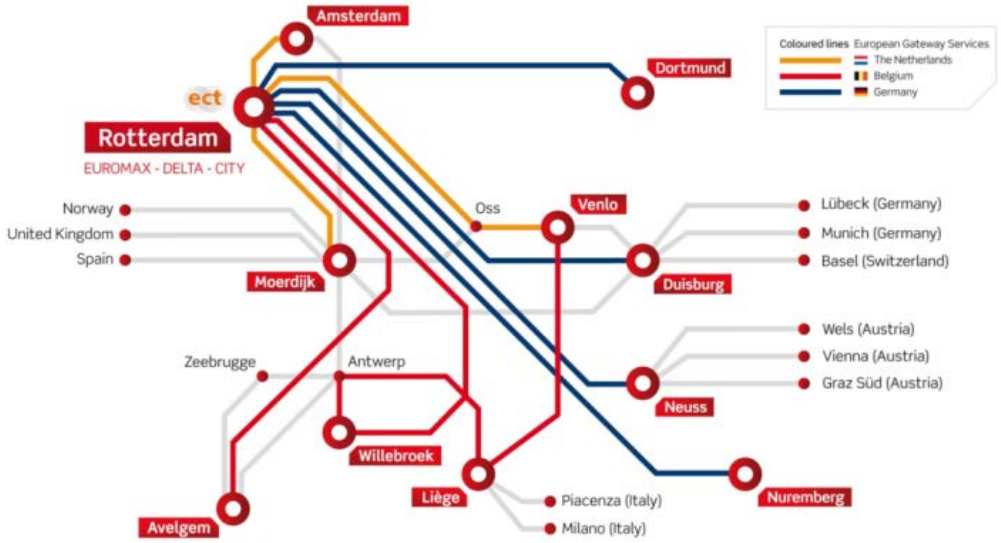
Synchromodality, with its ambition of flexible integration of transport modes, differs from regular multimodal transport because of the focus on the additional requirements for flexible integration. In a regular multimodal transport solution, the operational characteristics of the modes, the mode-specific legal frameworks, and the preference of the cargo owners still play an important role. As a result, the integration that is achieved is not complete, and often the result of a lot of manual work ‘behind the scenes’.

Synchromodality’s additional requirements are:

- Optimal operational flexibility in the transport system
- Active bundling of cargo
- Monitoring and control on the performance of the transport system
- An overall system approach to transport planning

Optimal operational flexibility means that switching from one mode to another, either because it is planned, or ad-hoc as a result of a calamity, is not impeded at all. The only remaining activity that still takes time is the physical transfer of the cargo, but this time can be planned and taken into account in the lead time calculation.

The figure below gives an overview of European Gateway Services, which is an example of a synchromodal network.



Active bundling of cargo is important because any complex multimodal transport solution requires substantial volumes of cargo, that are synchronized in terms of time, conditions and place. Active bundling means that there is a specific party that pro-actively aims to bundle cargo from different shippers in a certain region. This can be, for instance, an industry association, a commercial company, or a government department.

The additional requirements of operational flexibility and bundling of cargo often demand timely and accurate information on transport performance, regional cargo offers, available capacity, and so on. In addition, flexibility also requires information on the occurrence of calamities and other causes of delay, preferably before they happen. Therefore, monitoring and control is an important requirement for synchromodality.

Finally, the integrated operation of multiple modes, multiple infrastructure networks, correctly capacitated nodes, information requirements and bundling of cargo demands a coherent vision from the start. Therefore, transport planning has to move towards an overall systems level approach.

7.5 The development of the Trans European Transport Network

In the previous paragraphs the concept of synchromodality and multimodal transport corridors were described. The EU transport strategy is described in two main documents: EU 2020 Strategy (2010) and the White Paper on Transport (2011). The main points of this strategy can be summarised as:

- An integrated approach to optimize the efficiency of the transport system and transport organization;
- Making transport and transport systems seamless;
- Keeping transport competitive;
- Improve safety, reduce energy consumption and environmental impact;

- Improving competitiveness of environmentally friendly modes of transport;
- Creating integrated transport networks used by two or more modes of transport.

The ambition of the EU is that two levels of multimodal networks are created, a so-called Comprehensive Network and the Core Network TEN-T. The comprehensive network is to be completed by the year 2050. It comprises a comprehensive network of routes, feeding into the core network at regional and national level. This network is largely financed by the Member States itself, with in some cases EU transport and regional funding.

The Core Network is the TEN-T, the Trans European Transport Network. It is estimated that some €500 billion is needed to complete TEN-T Core Network by 2030, of which €250 billion for the removal of the main bottlenecks up to 2020. Financing partly comes from the EU budget, but also from the private sector and local and national governments. New financing schemes are developed that work as a 'multiplier', for example the EU (or the implementing European Investment Bank) gives guarantees for certain investment loans to private banks.

The new policy sets out a much smaller and more tightly defined transport network for Europe. Its aim is to focus spending on a smaller number of projects where real EU added value can be realised. Member States will also face more rigorous requirements in terms of common specifications which will work cross-border, and legal obligations actually to complete the project.

The specific impact of this new policy is an accelerated implementation of the trans-European transport Core Network corridors that will favour more adequate transport infrastructure coverage of the Union, modal-shift, co-modality and synchromodality. Innovative information and management systems, that are part of the network, provide support for logistic functions, inter-modal integration and sustainable operation in order to establish competitive transport chains, according to the needs of the users. And the efficiency of the transport system will be improved, with an important reduction of congestion and travel times.

This approach is fundamentally different from the approach that was followed in the past:

From:	*To:*
• a funding instrument	• a planning instrument with linked budget
• single layer network and priority projects	• dual layer network (core + comprehensive network)
• bottom-up approach	• top-down + bottom-up mixed approach
• stand alone program	• coordinated program
• modal networks	• multimodal network

For every priority corridor, a structured approach is followed, leading to a work-plan with proposed measures and funding: a blueprint for the multimodal corridor.

The plan of approach for drafting the blueprint for a corridor consists of the following activities:

a) identification of all relevant stakeholders on the corridor (public, private)
b) summary of all relevant studies on the different corridor sections or routes and the main findings
c) a description of the core corridor infrastructure characteristics, such as:
    - infrastructure characteristics (current and planned)
    - bottlenecks and missing links
    - the intermodal nodes (ports, railroad terminals, logistic centres) and their connections within the corridor
    - relevant traffic management systems along the corridor
d) logistic characteristics, such as:
    - freight flows (current and forecasted)
    - logistic performance indicators
e) multimodal transport market analysis, containing:
    - alternatives available on the corridor
    - mode choice, route choice and the factors behind
    - possibilities for multimodal improvements
f) work-plan and implementation plan, containing:
    - plan for the removal of physical, technical, operational and administrative barriers between and within transport modes and for the enhancement of efficient multimodal transport and services
    - an assessment of risks and the identification of measures to be taken in order to mitigate negative environmental impacts
    - the estimated investments
g) possible incentives needed
h) the governance model

As an instrument for implementation of the core network, the Multimodal Corridor concept has been defined. A multimodal corridor covers at least three modes and three countries, they are to be financed through CEF. Nine corridors have been identified. The EU has organised the corridor projects using the following the following governance system:

- A European “Corridor Coordinator” (to support the implementation of the core network);
- A consultative “Corridor Forum” (to assist the EU coordinator) ;
- A multi-annual corridor development plan.

7.6 Changing functions of the inland ports

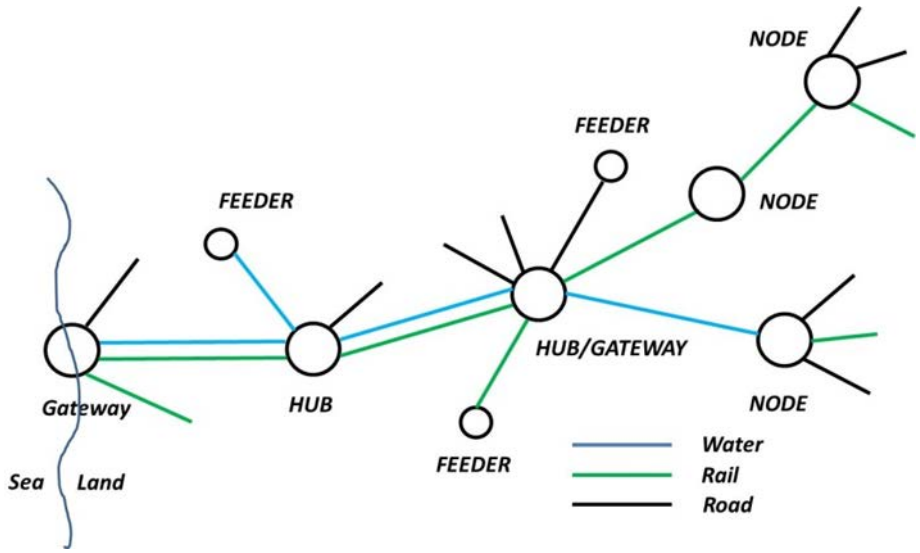
The inland ports play a crucial role in the multimodal transport chains as they provide transfer points to other modes and are connected with logistics centres, industrial areas, agricultural areas or large consumer markets such as metropolitan areas. Especially the links, preferably as short as possible to minimise last mile transport by truck, with the economic and industrial activities are important elements in the inland ports planning

process. We can conclude that the roles of inland ports are fundamentally changing and the following roles that inland ports can play are identified, some of these can be combined:

- Multimodal hub on the Transport Corridors:
  - Interface between the maritime and land modes of transport (rail, road and inland waterways transport).
  - Extended gates of the major seaports.
- Platform for the regional economy
- Interface between long distance transport and local logistics:
  - Sustainable city logistics and use of small waterways
  - Cargo bundling, innovation and smart solutions

It is important to realise that in a modern multimodal transport system, using the advantages of synchromodality, the mode of transport becomes less important, as seamless connections between the modes exist. Considering the various roles of inland ports, the possibilities for increased multimodal transport and bundling of cargo will be different. These different roles can be performed at several positions in the network, and in combination.

The various roles of inland ports in multimodal corridors is illustrated in the graph below.

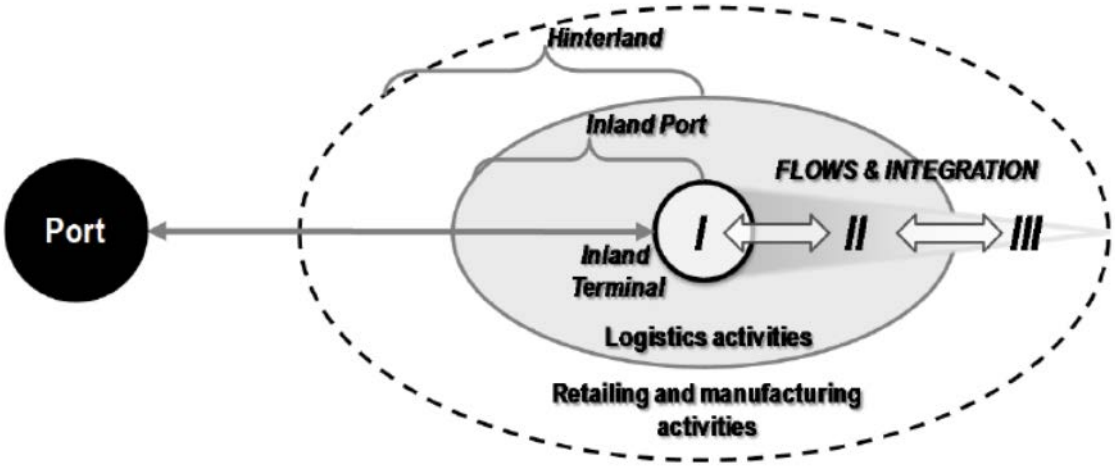


The graph illustrates that in principle all combinations of modes are possible, but of course in practice this is influenced by the trade-off between transport cost and transhipment cost. The larger the volume, the easier it becomes to create multimodal corridors with intermediate transhipments. In order to develop more multimodal transport the challenge is to bundle cargo in such a way that massive flows are created on the links of the corridors. This is realised by creating cargo generating and attracting

activities in the surroundings of the nodes (inland ports), and by piggybacking continental flows on the massive maritime oriented flows.

Inland ports are fitting within a regional economic geography by linking a region to global supply chains. Over this issue, a study[26] uses a three tier system to represent the functional relations between an intermodal terminal and its hinterland (region), particularly within a port authority. This model can be readily applied to inland ports with the first tier representing the terminal itself, notably in terms of volume, capacity and performance. The second tier relates to the logistics activities around the inland terminal, often by means of a geographic clustering of logistic companies. The third tier represents an array of retailing and manufacturing activities in the hinterland where inputs or outputs are handled or managed by the logistics activities of the second tier[27].

Figure 5.6: The position of the modern inland port and its functions

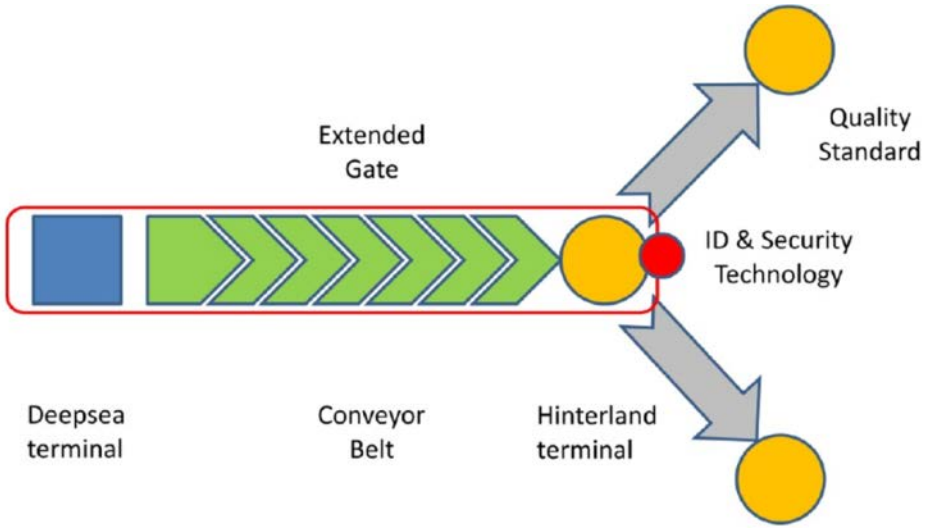


Finally we would like to introduce the concept of extended gates as a way to even better integrate the inland port with the seaport or with other gateways. The extended gate can be seen as a full integration between gateway and inland port, where activities in the supply chain can be carried out at any place in the chain. The relation between the gateway and the inland port is illustrated in the next graph where it has taken the form of a conveyor belt.

See below for the visualization of Extended Gate.

[26] Wakeman, T. (2008) "Marine Transportation of International Freight for the Northeast Corridor", in Anticipating 2025 in Northeast Corridor Transportation: Aerial, Highway, Marine, and Rail Technologies & Linkages, Institute of Public Administration, Public Policy Forum, University of Delaware, Newark, DE. Pages 38-59.

[27] Functions and Actors of Inland Ports: European and North American Dynamics, Jean-Paul Rodrigue, Jean Debrie, Antoine Fremont, Elisabeth Gouvernal (Journal of Transport Geography, Volume 18, Issue 4, July 2010, Pages 519–529)



7.7 Examples of Integrated Logistic Zones and Multimodal Ports

The aspect of multimodal transport, corridors and integrated logistic zones and inland ports was introduced as an additional element in these policy notes, as a direct result of the study tour to Europe.

Visits were made to amongst other the logistic regions of Venlo and Duisburg, which are two examples of inland ports which have developed into logistic zones where all modes are present in direct combinations, offering the advantages of the extended gates and having introduced the synchromodal services concept.

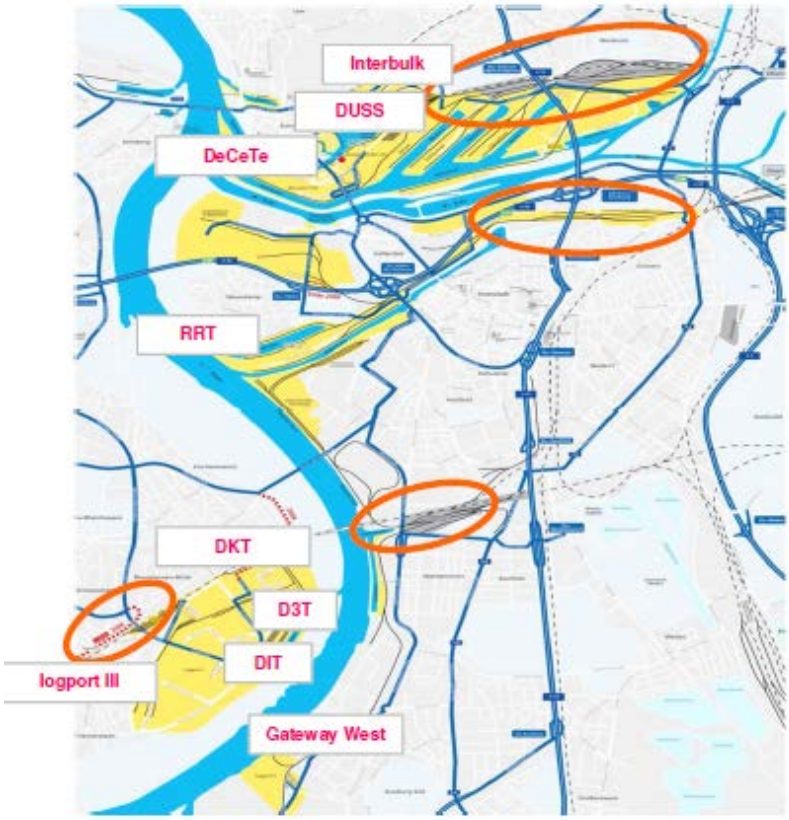
The logistic region of Venlo is a large complex of industry, logistics companies, multimodal terminals, with a certain specialisation in agricultural products, but certainly not limited to that. Between the port of Rotterdam and the inland terminal so called synchromodal services are offered for example by European Gateway Services. So-called “Trade Ports” are set up where as much as possible all functions are integrated and in its direct vicinity. The region has, by combining all these functions, attracted a large number of logistic enterprises using this are as its central warehousing and distribution point for a much larger region, in some cases even the whole European Union.

An aerial view of the inland trimodal port of Venlo is given below.

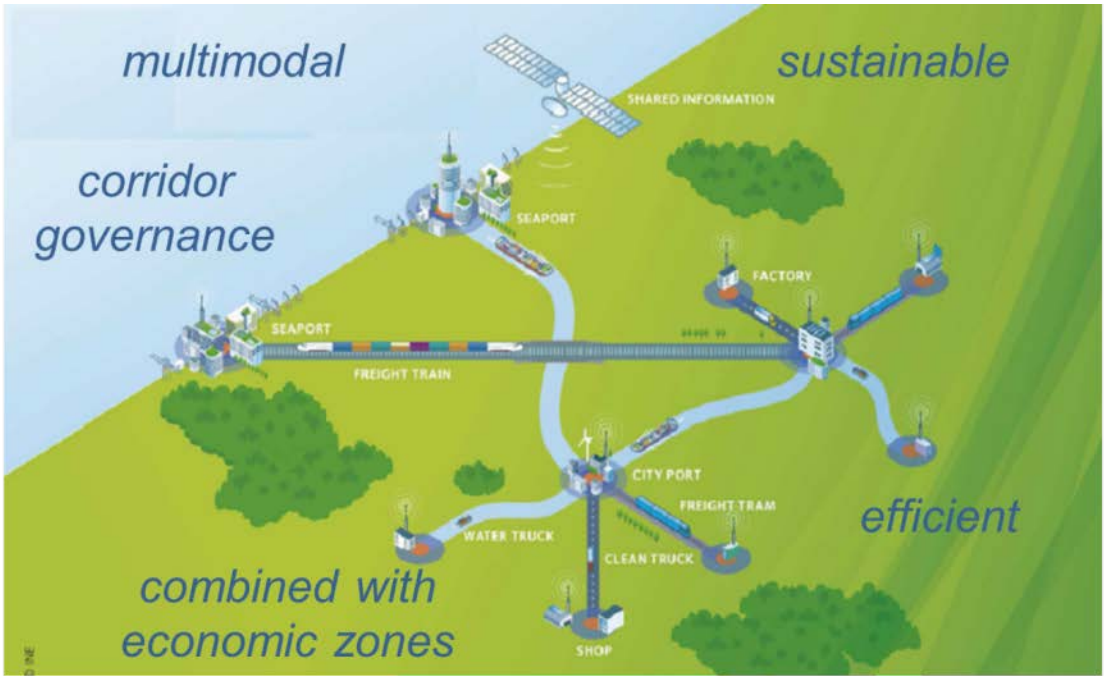
The port of Duisburg, Duisport, carries the tittle ‘Largest inland port of the world’, and is an impressive complex of multimodal terminals, industrial activities and logistic zones, with frequent and seamless connections with seaports such as Rotterdam and Antwerp, and the European consumer and production regions. And since the creation of the Eurasian landbridge Duisburg serves as a terminal on the railway link with all parts of China including Chongqing. Duisburg is probably the best example where successful transformations of old industrial areas into high end quality multimodal logistic zones using the extended gate concept, has taken place.

Especially Logport, a recent redevelopment of an old steel plant into a new logistic site is interesting, and it shows that by physically integrating multimodal facilities, this acts as a catalyst in attracting other logistics activities, leading to ever increasing bundling possibilities of cargo flows.

Some illustrative photos of facilities at Duisport are given below, as well as the locations of multimodal facilities.



To conclude this chapter, the following figure is used to illustrate the vision of future multimodal networks and transport corridors.



8. SAFETY

8.1 General monitoring of waterways

IWT safety and security issues are discussed in the River Commissions of the Rhine (CCNR) and the Danube (DC), which are monitored by the UNECE Working Party on Inland Water Transport (SC.3). Mechanisms to enhance safety and security in IWT are the “European Code for Inland Waterways” (CEVNI, often based on regulations provided by CCNR and DC) for safety of navigation; technical prescriptions for inland vessels and guidelines on “River Information Services” (RIS) and other uses of ICT to increase safety and efficiency on inland waterways.

The Rhine Commissions also lays down regulations for safety, security and environmental issues related to inland shipping. Typically these regulations, such as the CEVNI (mentioned above) are inspired on these regulations, whereas many of its provisions are identical or equivalent.

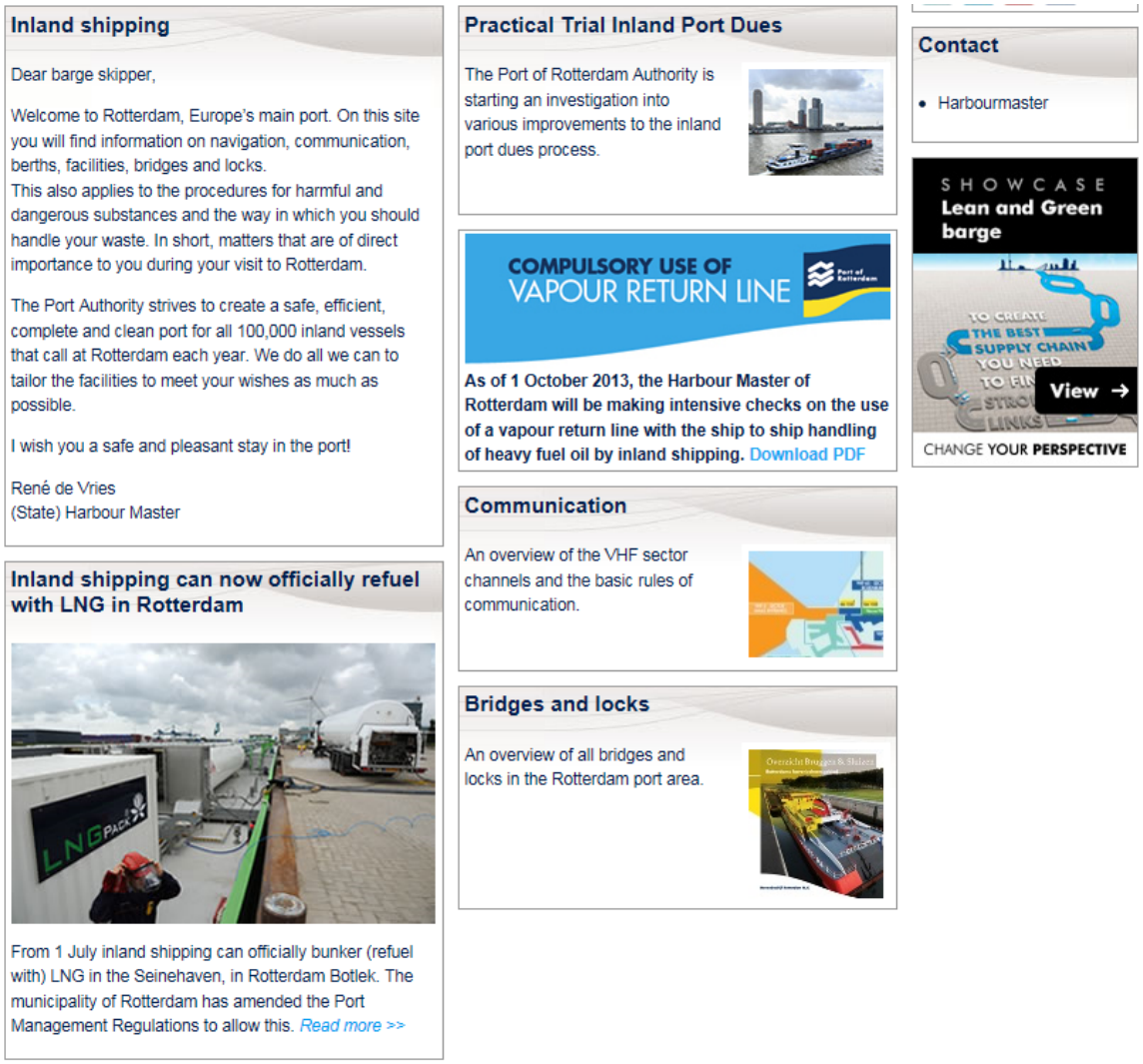
The vessels and convoys have to display the proper lights and markings, this according the police regulations. These police regulations also settle_the rules for meeting (from opposite directions), crossing, overtaking and berthing of vessels as well as the waterway signs, the allowed dimensions of vessels and convoys and the water protection against pollution. The observance of the rules by the navigation companies during sailing are supervised by the national water polices of the Rhine riparian states.

8.2 Waterway services

In order to create a safe, efficient, complete and clean port, port authorities of sea ports or large inland port in Europe have (basic) rules and procedures for e.g. communication, port operations in case of dangerous and noxious goods, taking berth and use of facilities, guidelines for waste disposal, information on bridges and locks and inland port dues. In case of the Port of Rotterdam where about 100,000 inland vessels call the port each year, the website is supplied via their website[28]. Additionally on the website of the Port of Rotterdam a checklist can be found to verify whether the inland vessel and/or cargo needs to be reported.

On overview of the waterway services as presented on the website of the Port of Rotterdam is given below.

[28] See also: http://www.portofrotterdam.com/en/Shipping/inland-shipping/Pages/default.aspx



8.4 European RIS policy

Monitoring vessels on the waterways in the EU and most other developed waterway basins is done by a combination of means. The overall system of River Information Services, or RIS, is a system that was set up by the European Commission, with involvement of the CCNR, PIANC (World Association for Waterborne Transport Infrastructure, Permanent International Association for Navigation Congresses) etc. More and more it is becoming a worldwide standard. An EU framework directive (EC/2005/44) provides minimum requirements to enable crossborder compatibility of national systems. Comprehensive and international guidelines for RIS are developed to harmonise the existing standards for particular river information systems and services within a common framework.

The harmonization of existing standards serves the objectives of implementing RIS services across Europe, namely: enhancement of inland navigation safety in ports and rivers; provide local and regional traffic information for safety monitoring on tactical as well as strategic level; optimise the resource management of the waterborne transport chain by enabling information exchange between vessels, lock and bridges, terminals and ports; providing information on the status of fairways and providing traffic and transport information for an efficient calamity abatement process. Numerous services relevant to

RIS are already sustained, particularly: radiotelephone, traffic posts, Internet, Inland ECDIS (Electronic Digital data Information Services), AIS (Automatic Identification System) and NtS (Notices to Skippers).

A specific element of RIS, is to increase traffic management services which aims to optimise the use of the infrastructure as well as facilitating safe navigation. Currently, the "VTS centres" (vessel traffic service centres) are designed and constructed to bring enhanced safety and efficiency of vessel traffic into practice. In the Netherlands a Traffic Management support system for inland shipping (VOS) is introduced, where hull data, travel and cargo information and current position information of vessels (supplied by AIS) will be combined and used as an important source of information during incidents on Dutch waterways. Additionally, VOS will be used as an efficient planning tool for locks and bridges and also for forecasting of traffic at locks, bridges and traffic posts. This opens new possibilities like corridor management and voyage planning, VOS will be introduced at 10 traffic posts, more than 80 locks and 90 bridges. Locks and bridges are currently operated at regional levels, whereas traffic posts are located at or in the vicinity of critical fairway sections (e.g. crossings of fairways) and additionally patrol vessels are also governed to monitor fairway sections locally.

8.5 Requirements for transport of special cargoes

Inland waterways transport is generally considered as the safest mode of transport, and for that reason the transport of dangerous cargoes by inland waterways is heavily promoted in many countries.

In the Netherlands for example, about half of the transport of dangerous cargoes is done by inland waterway transport. Of course it is of the greatest importance that the transport and handling of dangerous cargoes takes place under safe and secure conditions, thereby minimizing the risk to the society and the environment.

The most important types of dangerous goods transported all over the world are oil and oil products. The Port of Rotterdam in the Netherlands has a lion share in oil transport due to its location at the mouth of the river Rhine. In 2005 180 million tons of dangerous goods were transported in and through the Netherlands annually, of which 60% by pipeline, 35% by IWT and 5% by rail and road. The increase of dangerous goods transport over the last ten years is estimated at 35-40%.

8.5.1 Current policy and guidelines

Inland waterways transport is generally considered as the safest mode of transport, and for that reason the transport of dangerous cargoes by inland waterways is heavily promoted in many countries. In the Netherlands for example, about half of the transport of dangerous cargoes is done by inland waterway transport. Of course it is of the greatest importance that the transport and handling of dangerous cargoes takes place under safe and secure conditions, thereby minimizing the risk to the society and the environment. Dangerous cargo transport on the waterways can take the form of liquid bulk in tanker vessels, or solid dangerous goods, mainly transported in containers. It should be noted that in future also coal may be considered as dangerous cargoes, and special regulations may apply (according recent discussions in UNECE).

Handling and transport of dangerous goods (DG) by various modes of transport has been the object of intensive international and national regulation and administration procedures. Examples of such codes and regulations are the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), 2013 and the IMO Dangerous Goods code applicable to sea transport and cargo handling terminals, 2002. All dangerous goods regulations and codes are based on the dangerous goods classification which is accepted worldwide. Division 1.1 contains substances, which have a mass explosion hazard; the substances of Division 1.2 have a projection hazard, but not a mass explosion hazard; Division 1.3 have a fire hazard and a minor projection hazard, while the substances of Division 1.4 present only a slight risk of explosion.

From the side of the authorities special regulations are drafted for the transport of dangerous cargoes, in addition to the normal regulations. Also barge operators have to take specific additional measures when they are transporting dangerous cargoes. The legal system covers amongst others the vessel requirements, crew requirements, facilities for dangerous cargoes, safety management systems, and emergency response plans.

8.5.2 Vessel requirements for transportation of dangerous cargo

In Europe for the transport of dangerous cargoes, a Community Certificate is required, with special notification to the construction requirements in the ADN. Through the system of construction and equipment requirements, the tanker vessel receives a list of commodities and products that may be transported with that vessel. This list is given by the Classification Bureau that does the final certification of the vessel in the field of classification certification. Based on this certification, the vessel receives a “Certificate for the Transport of Dangerous Cargoes “from the Shipping Inspectorate of the Ministry of Transport. Vessels have to be built under the supervision of classification bureaus such as Veritas, Lloyds and Germanischer Lloyd.

8.5.3 Crew requirements

At present high requirements are put on crew on board of vessels carrying dangerous cargoes. This was different a few decades ago, and this situation is actually the case in many countries outside the EU. The “Certificate Dangerous Cargoes“ requires a written course in a training institute. Participating in the examination is only possible when all written training material is delivered to the training institute. A five day vocational training programme is possible, presence sheets are required in order to be admitted to the examination. For the transport of gas and chemical products, a specific ADN Certificate for this type of transport is required. The education requirements are included in the ADN, meaning that they are identical in all European member countries.

8.5.4 Emergency response system

Accidents in waterway transportation of dangerous goods are abrupt, rapid and very harmful. In order to enhance the efficiency of emergency response and reduce the damage of relevant accidents to the minimal level, a complete emergency management system should be properly established.

A proper emergency response system should address the following issues:

- Hazards to health;
- Risks of fire or explosion;
- Immediate precautions following an incident or accident;
- Immediate methods for handling fires;
- Initial procedures for handling spills;
- Preliminary first aid measures.
- Risk management, analysis and incident investigation

Especially for dangerous cargoes it is important to monitor and inspect the vessels and the crew. In the Netherlands, the system of risk analysis is a major factor in determining where inspections should take place, and where special attention would be needed. Then scarce resources can be used in an optimal manner and actual risks can be minimized.

The Dutch risk management system is based on the concept of Personal Risk (chance of one in a million per year that a personal incident occurs due to transport related incidents) and a similar Groups Risk. The system incorporates: Transportation as it relates to external risks, Accident and incident registration, River Information Services. Alongside the rivers and canals hazard zones have been defined: Red corridor (width 40 m), Black corridor (width 25 m) and Green corridor (no hazard zone).

The Transport and Water Management Inspectorate (the Inspectorate) of the Netherlands Ministry of Transport, Public Works and Water Management, has developed new methods for their inspections and supervision for inland shipping. The Inspectorate strives for a more efficient and effective use of their capacity. This means the Inspectorate develops risk based supervision and invests in learning opportunities from the past (incidents), by thorough Incident Investigation focusing on the root causes of the incident.

Risk Matrix

The inspectorate developed a tool (risk matrix), which helps with making a good risk analysis and to make choices which incidents needs to be investigated. The matrix distinguishes between the potential consequences of an incident and the chance that incident will occur. The bigger the potential consequences and the bigger the possibility that the incident will occur, the more the Inspection focuses on the risk. When there is an incident, the Inspection uses the Matrix to decide if and in what way the Inspection will start an investigation.

Risk analysis

Based on the matrix, the Inspection made several risk assessments for inland shipping. Among them was an assessment about dangerous goods. The risks located in the red squares have priority for the supervision of the Inspection. Examples in of the high rated risks in the dangerous goods risk analysis are, e.g.: Failure of technical safety measures (safety valves, etc.) and Human failure (lack of good instructions).

Incident investigation

The matrix is also used for the classification of incidents. The classification is based on the potential consequences of an incident. If for example a coupling breaks during loading and staff does not suffer injuries, however he/she could have been injured when

located a few meters closer, then the incident will be classified as if the employee is wounded.

The incidents are classified as follows:

- **Red** square:

  an investigation team is organized to execute a major investigation and a formal report is written.

- **Yellow** square:

  an inspector will do the investigation, a short report will be written.

- **Green** square:

  the incident will be recorded; if data analysis shows that many of similar incidents happened, a thematic study will be started.

9. CLEAN IWT

9.1 EU Policy: quality navigation in compliance with surrounding environment

The European Commission emphasized a clear general message regarding energy savings and environmental protection in respect to IWT: “Achieve and maintain a good navigation status while respecting the applicable environmental law”.

The EU strives to put this message into force by:

- Exploring and preparing new emission limits for new and existing engines;
- Securing financial support for initiatives and innovative research to further reduce emissions by IWT;
- Exploring the uptake of LNG as fuel in the IWT by regulatory, financial, technical and infrastructural support through the LNG Masterplan;
- Reviewing possibilities to use infrastructural charging (ship operators are to pay for using the waterway infrastructure, which is not the case in the EU at the moment) to achieve internalisation of external costs in IWT;
- Imposing the implementation of shore-side electricity facilities in IWT ports;
- Provide good practices on integrated approaches for sustainable inland waterway management in compliance with other waterway function, and in particular where the ecology is a major concern;
- Support the development and use of waste collection systems in IWT;
- Implementing the upgrade of existing main inland waterways to reach the standards of minimum inland waterways class IV which benefits the carbon emissions of IWT.

9.2 Greening the Fleet

9.2.1 Emission limits

Inland Waterway Transport (IWT) is an energy efficient, safe, almost congestion-free and silent transport mode. However, due to longevity of engines in inland vessels and less strict emissions standards in contrast to road transport (with much higher replacement rates enforced by strict emission limits), IWT is losing its competitive position as “green” transport mode. Concerning carbon footprint related to fuel emissions, IWT is still the most efficient way of transport. A major concern is the outcast of air pollutants nitrogen oxides (NOx) and particulate matter (PM), which worsens asthma and exacerbates heart disease and respiratory illness. Inland waterway transport already has higher air pollutant emission levels than road transport per tonne kilometre for certain vessel types. Without specific action this situation will further deteriorate in the future and the air pollutant emission will remain high for IWT.

Emission standards are set in EU legislation for new and existing engines in respectively Directive 97/68/EC and 2006/87/EC. As published in the Staff Working Document:

"Greening the fleet: reducing pollutant emissions in inland waterway transport", two approaches with varying ambition levels have similar cost/benefit ratios. The more ambitious "innovation" approach is applicable to both new and existing engines, requires more upfront investment in emission reduction solutions but induces emission limits equivalent to the level of road transport. The more "conservative" approach addresses new engines only, although requiring less upfront investment with the consequence of insufficient reduction of emission for IWT to reach the level of road transport regarding air pollutant emissions.

In the decision for amended legislation, the level of emission limits and date of entry into force, the European Commission may differentiate between small and large vessels and existing and new engines, because of the technological and economic limitations that existing engines and small vessels face. Regarding the date of entry into force, the European Commission understands that sufficient time is needed for the sector to adapt to new emission standards due to the limited amount of resources of barge owners to invest in new technologies. Nevertheless the decision process for emission limits should be strictly neutral in perspective of reduction technology and fuel type. To this end it is expected that the technology with the best cost/benefit ratio will prevail, depending on vessel type, size and operational profile.

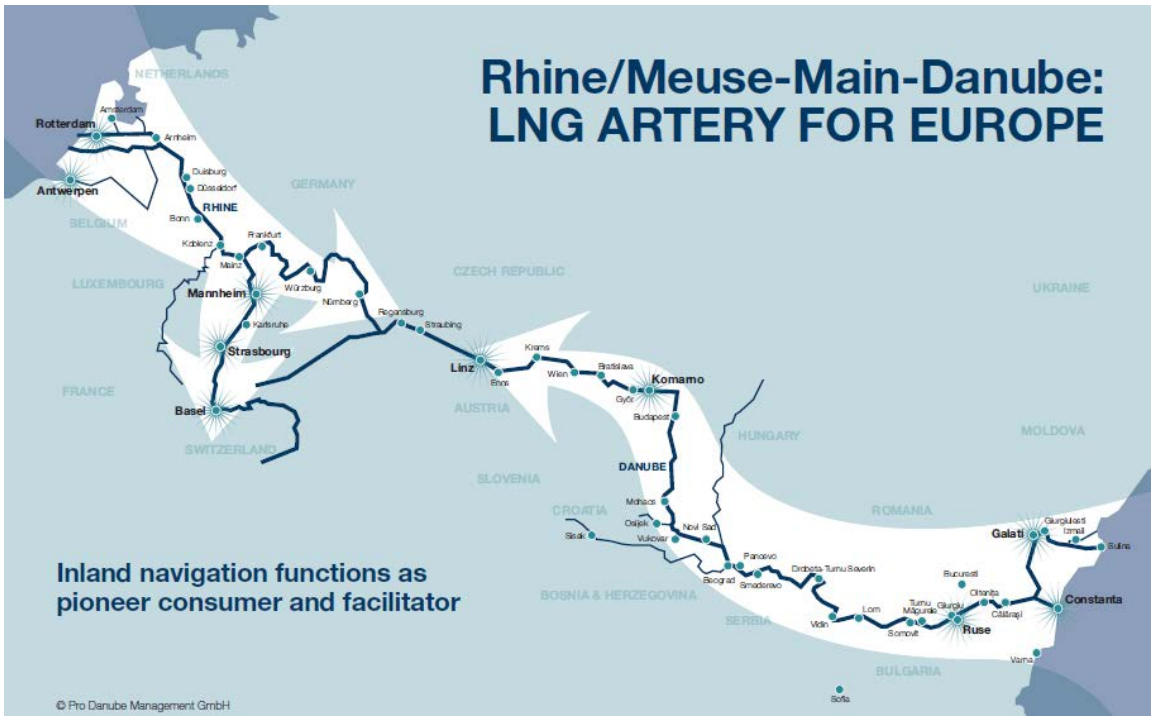
9.2.2 Implementation of LNG in IWT

The potential of Liquefied Natural Gas (LNG) as fuel in general is emphasized in the European Commission communication "Clean Power for Transport: A European alternative fuels strategy" (January 2013), which states that LNG provides benefits for ports since it is a measure to improve the local air quality, without increasing the costs of transport. The implementation of LNG in IWT is recognized as a promising and commercial viable technology option in order to comply with strict emission standards in line with the more ambitious approach of the European Commission. This is especially the case particularly in the category of larger vessels (>110 meter, >1000 kW propulsion power) that consume over 80% of fuel used in IWT[29].

However the uptake of LNG by the sector up till recently is hampered by regulatory, financial, technical and infrastructural barriers. To resolve these barriers the LNG Masterplan was initiated, consisting of 33 beneficiaries and over fifty associated companies and organisations, providing a project platform facilitating parallel development of the necessary harmonized European regulatory framework for LNG as vessel fuel and cargo and delivering initial deployment in terminal and vessel infrastructure (using cryonic hoses). It delivers technical concepts for new and retrofitted vessels being propelled by LNG and transporting LNG as well as a significant number of pilot deployments of vessels and terminals. It also develops a comprehensive strategy together with a detailed roadmap for the implementation of LNG in line with the EU transport/energy/environmental policy goals and actions. Not only inland navigation is considered to be a pioneer market for LNG as transport fuel but also an enabler to bring LNG cost-effectively from the seaports to the customers (fuel & energy) in major

[29] Source: Study "Support to Impact Assessment of measures for reducing emissions of inland navigation".

industrial areas along the inland waterways. This facilitates a wide-scale development of LNG as fuel and as energy source.[30]



9.2.3 Massive introduction of retrofit solutions and other clean energy options

Besides promising developments through the implementation of mono- and dual fuel LNG engines in new Inland vessels or as vessel retrofit, there are other promising solutions to reduce air pollutant emissions and carbon oxides in IWT. Further research, pilots and massive introduction of a range of alternative energy concepts and technologies to reduce emissions in IWT, is foreseen in the Horizon 2020 programme of the European Commission. Horizon 2020 is the financial instrument implementing the "Innovation Union", a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness[31].

Additionally to the most promising emission reduction techniques (LNG, SCR/DPF (Selective Catalytic Reduction/Diesel particulate filters), hybrid solutions, right sizing of engines), a testing and monitoring regime is required to be established for the application of strict emission limits to various categories of existing vessels/engines, including certification, implementation and type approval of retrofit solutions, appropriate test cycles and procedures for compliance monitoring. At the same time efforts in the development of digital tool, including simulator-based tools, for education/training and cost-efficient navigation following inter alia, the assessment of manning and

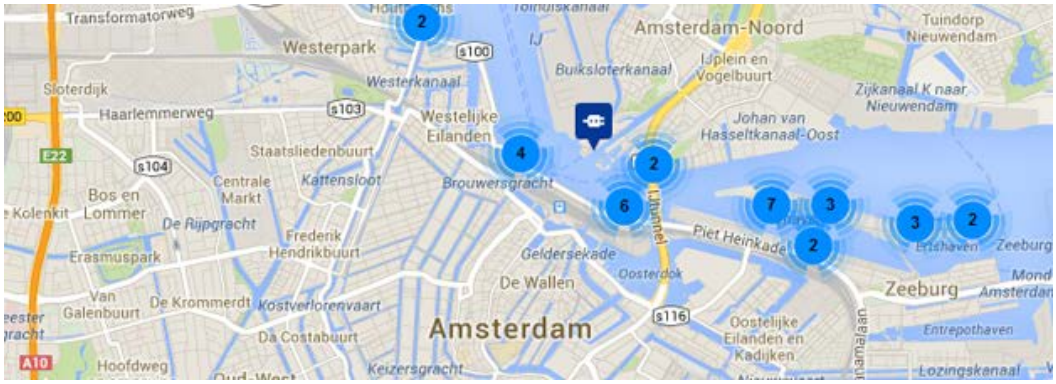
[30] See also: www.lngmasterplan.eu

[31] For more information about Horizon 2020, see: http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

training/qualification requirements with regard to vessel operation and cargo handling (including modal links).

Regarding the alternatives for clean energy solutions, the availability of shore-side electricity facilities is considered to serve as clean power supply for inland navigation, in particular to improve air quality and reduce noise in ports situated in urban areas. The deployment of shore-side power supply makes the use of generator sets in IWT during mooring redundant. The new Directive on the deployment of alternative fuels infrastructure indicates that EU Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels is assessed in the national policy frameworks. The deadline for installation in ports of the core transport network is 31 December 2025, unless there is no demand for these type of installations and the cost/benefits analysis (including environmental benefits) indicates negative results.

Locations for shore-side power supply for both maritime and IWT can already be found in The Netherlands, see figures below.



Source: https://walstroom.nl/nl/home/

Source: https://walstroom.nl/nl/home/

9.2.4 Internalizing external costs

Usage-based infrastructure charges are the best instrument to internalize infrastructure costs as well as external costs of noise, air pollution, accidents and congestion. Currently inland ports are not covered by efforts of the European Commission to harmonize regulations on market access to port services and financial transparency of ports. The IWT sector will be consulted shortly to examine the need for any rules to assist inland ports in this matter.

Nevertheless internalizing external costs provides knowledge basis for a future consultation on the use of infrastructure charges for internalizing external costs in inland waterway transport. Receiving discount to e.g. port access fees when certain emission standards are met, may contribute to the incentive for barge owners to reduce emissions of their vessels and invest in emission reduction technologies. Such developments are already implemented in The Netherlands where the port of Rotterdam gives discount to "green" inland vessels according to a Green Award certificate obtained through a thorough survey by an independent Green Award inspector[32].

9.2.5 Green award

Green Award for the inland shipping comes from the Green Award scheme established in 1994 in order to promote quality shipping amongst sea-going vessels. All over the world Green Award certifies ships, ship managers and oil companies that prove their dedication to high quality, safety and environmental standards. The benefits for extra clean and extra safe ships include image improvement, charterers' preference, reduction on port dues, discounts on pilotage services and various trainings, reimbursement by a bank for a part of the certification costs etc.

The Green Award requirements for the inland shipping are compact and apply to the technical equipment on board and to the crew. A ship needs to score a minimum number of points in order to be certified.

A Green Award surveyor assesses if a ships is eligible for the certification during a two-hour inspection on board. During the assessment the inland vessels is checked whether it complies with the most strict technical standards, such as: main and auxiliary engines in compliance with CCR 2 emission (current emission standard of inland vessels, amendments towards more strict emissions standards are expected, dry bilge, propeller shaft seals, high-level alarm in fuel bunkers, closed grey water system, connection for OPS (Onshore Power Supply), course 'Smart steaming', fuel consumption monitor / cruise control, Waste management plan.

9.2.6 Greening of the fleet in other water basins

The current European and Chinese initiatives and developments towards cleaner and greener IWT vessels is followed with interest in other waterway basins, mainly the US, but much less in other countries. Under the international maritime regulations, US vessels will be faced with more progressive limits for NOx and SOx emissions, and within the US waters, for example the rivers, these emission standards are implemented through the Act to Prevent Pollution from Ships (APPS). NOx emissions limits are being imposed in a tiered approach, based on engine speed, while SOx is being limited primarily by regulating the sulphur content in fuel.

Despite the huge reserves in natural gas in the US, the use of LNG is so far only a political issue. The Obama Administration is embracing LNG's potential on vessels working on inland waterways, but currently there are no known projects working to build and deploy LNG vessels on the inland waterways. Though there are some ongoing studies and several operators have indicated their interest.

[32] See also: http://www.greenaward.org/452-inland-shipping.html

9.3 Waste collection system

The requirements for waste management are based on the principles of effectiveness in protection of the environment regarding waste management. They are usually defined as the waste hierarchy. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste. Once waste is generated there are several options for recovery or disposal ranked by their desirability, as is shown in the figure underneath:

Prevention – Waste prevention is a primary goal. Waste prevention means that waste generation is avoided.

Minimization – (also "source reduction") Source reduction involves efforts to reduce hazardous waste and other materials by modifying industrial production. Source reduction methods involve changes in manufacturing technology, raw material inputs, and product formulation. A ship related example is the thoroughly disembarking from bulk carriers, to minimize the amount of cargo residue. For proper disembarking of tank ships efficient stripping is a good practice.

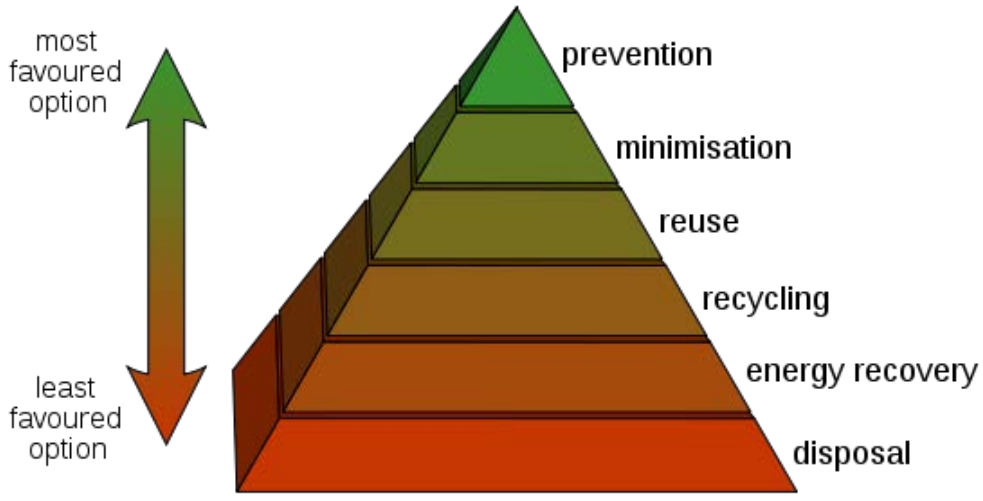
Reuse – The reuse of a waste or component for other purposes is encouraged. For instance returnable packaging has long been useful (and economically viable) for closed loop logistics systems. Inspection, cleaning, repair and are often needed.

Recycling – Recycling is the reprocessing of materials (pre- and post-consumer) into new products. Emphasis is focused on recycling the largest primary components of a waste: steel, aluminium, papers, plastics, etc. Small components can be chosen which are not difficult to separate and do not contaminate recycling operations.

Energy recovery – Waste-to-energy and Refuse-derived fuel in approved facilities are able to make use of the heat available from waste components. For instance used oil can be used as substitute fuel in power plants of the cement industry, but also mixed shredded plastics, which are contaminated with e.g. oil, can be used as substitute fuel.

Disposal – Incineration and placement in a sanitary landfill are needed for some waste materials.

Options for recovery of waste is given in the figure below.



Regarding water transport as a source of waste, prevention, minimization, and to a lesser extent reuse, can be applied on board. As soon as the generated ship waste is collected it needs to be operated on the highest achievable level: reuse, recycling, energy recovery and final disposal (incineration or landfill). Achieving the highest level of the waste hierarchy imposes certain requirements on the waste management on board and during the waste collection and transport:

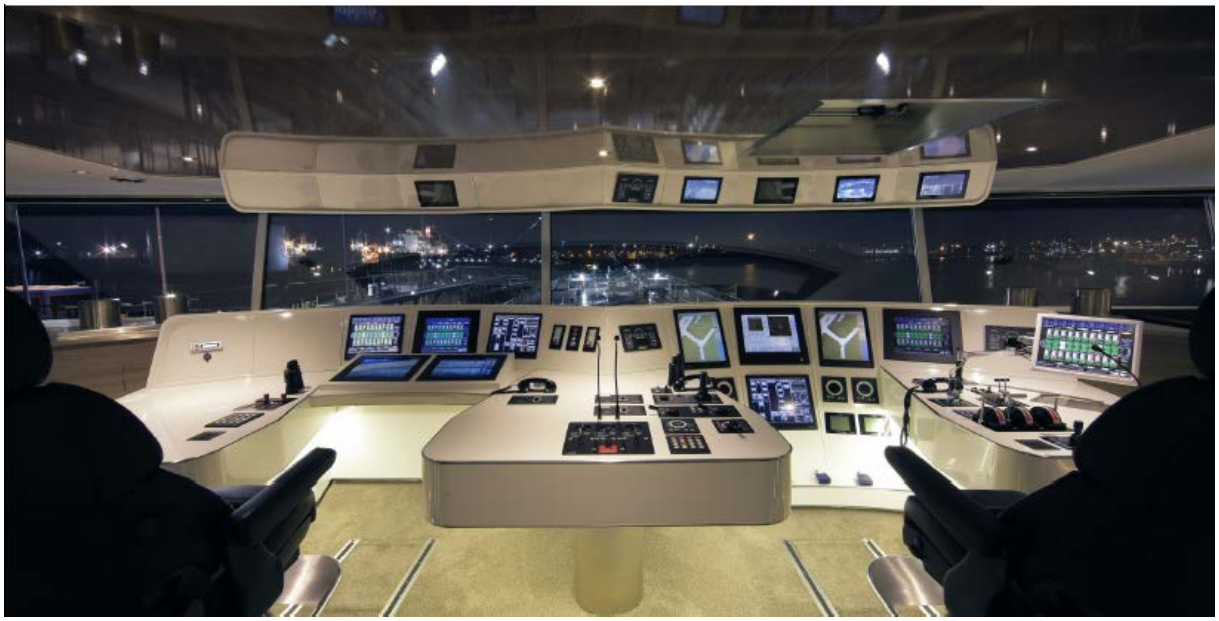
- waste which can be reused may not be damaged or mixed (= contaminated) with other waste.
- waste which cannot be reused, may not be mixed with other waste, except when this cannot be avoided, and/or separation after collection is possible and economically feasible. For instance paper waste for newspapers cannot be reprinted, so it has to be reprocessed. The result is a lower quality recycling paper with limited uses. But when it is mixed with food waste it cannot be recycled anymore. One level lower – energy recovery – is then the only option.
- waste which can be used as a substitute fuel or used for the production of fuel may not be mixed with substances which:
- cause high pollution of air and soil when used as fuel, e.g. chlorine in waste oil;
- disturb the production process of (bio)fuel. E.g. to much inert material in the wet organic compound of domestic waste, cause troubles in mechanical-biological treatment which can be applied for treatment of household waste. Contamination with substances for mixed hazardous waste will kill the micro-organisms and stop the mechanical-biological treatment process.

Full collection systems for waste from IWT vessels are not yet very common. It is likely that this will change quickly as environmental effects of transport are becoming of increasing importance. Rivers with high-density traffics are inevitably linked to the damage it brings to the water and the ecological system around the water. For inland waterways transport, this especially has to do with ship generated waste, such as (oil, bilge water, rags, filters, engine coolant and contaminated packing materials), cargo-related waste (residues, slobs, washing water, ballast water), other waste such as garbage, plastics, wood (non-dangerous) and sanitary waste water.

10. SPECIFIC SOLUTIONS

10.1 Vessel innovations

Only a selection of topical and recent vessels innovations are given in de paragraphs below. As an introduction the following picture is presented without further explanation using the header “new generation vessels” (source: VT Group):



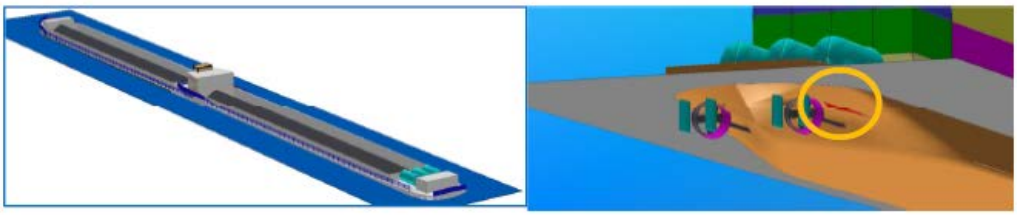
10.1.1 Innovative Danube Vessel

For example, the Danube is a free flowing river over long distances. Whereas 18 dams with locks provide stable and favorable conditions for navigation (with the exception of a few days of ice in some years), the free flowing stretches, which account for roughly 75% of the waterway, result in instable and often unfavorable conditions for navigation. This is caused by limited lock dimensions, insufficient air clearance at bridges and limitations in full utilization of vessels due limitations in draught. Therefore the project “Innovative Danube Vessel” (IDV) was started to make recommendations to improve the Danube IWT fleet, considering: Requirements of the transport market in the Danube region; Specific fairway and navigation conditions of the Danube river; The state of the art in inland waterway vessel technology; Innovative technical solutions derived from published research projects.

The project identified three most promising vessel design concepts leading to energy and cost savings and reduced environmental impact: two new types of Danube pushers as well as an innovative version of a self-propelled vessel (max. draught 2.8 meter, fully operational at draught of 1.7 meter). A pre-requisite for both existing and new vessel types is to perform proper fairway maintenance on the Danube for energy and cost-efficient inland waterway transport operations.

The design of the innovative LNG Pusher for the Danube[33]:

Design innovative Self-propelled LNG vessel for the Danube

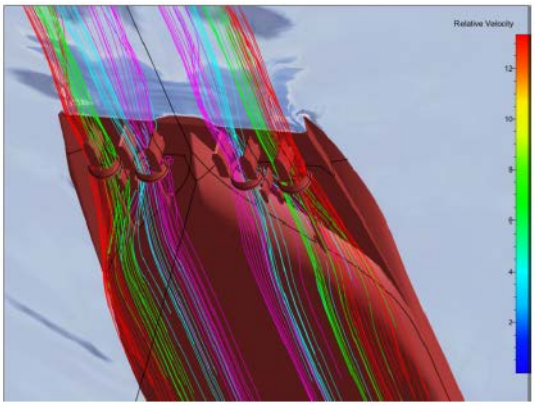


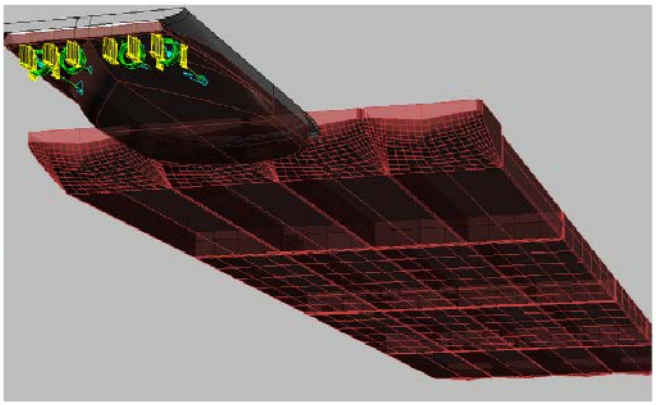
10.1.2 Vessel innovations in Paraguay

Together with companies from different parts of the world a pushed convoy has been developed as new concept to navigate the Paraná River in Paraguay. The basis of the success is the new design of the Concordia Group in the Netherlands, after extensive model tests at the Marin Institute from Wageningen. The Tsuneishi Group, mother-company of the Paraguayan Tsuneishi shipyard Astillero Parguay SA, has its own engineering department in Japan and worked out the basic design in detail. At Concordia's suggestion a large number of Dutch companies were involved. SIP Marine provided CFD calculation and an engineer from Holland Ship Electric visited Japan to draw out the entire electrical plan. In order to ensure the performance of the pusher, a propeller shaft system of the Waal is used. The nozzle is manufactured and supplied by Nautican from Canada. The Waal supplied steering equipment and rudders taken into consideration the Nautican concept.

Four propellers have powered the pusher, with a total capacity of more than 6500 HP. The pusher has a length of 43 meters, a beam of 18 meters and a draught of only 1.9 meter and is considered a new appearance on the Rio Paraná River in Paraguay and attracts the attention of all operators. Many local pushers are designed by the EWT and / or Mississippi concept. In contrast, the new type RP6000 of Concordia Shipbuilding proves that Concordia has its own ideas about shipbuilding and which is now also being implemented in Paraguay.

[33] Source: DST (IDV Executive summary)





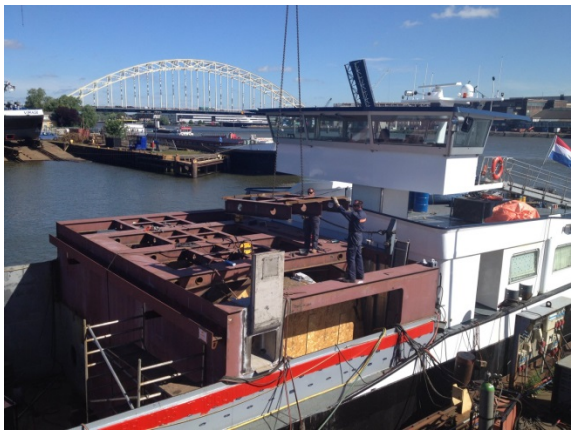
Concordia Group is closely linked to Holland Shipyards and Instalho Shipbuilding and is a newcomer on the Paraguay market. Together with a number of Dutch suppliers and investors Concordia is building one of the largest inland container vessels in the world. This vessel will be able to transport 720 TEU. The project is completely managed by Concordia Group will be completed is the end of first quarter of 2016. The vessel will be used between the container line Asuncion/Paraguay and Montevideo/Uruguay. The subsidiary of Concordia, Rio Parana Navigation SA will operate the vessel.

Low draft container vessel 720 TEU sailing between Asuncion -Montevideo

10.1.3 First LNG retrofit

To meet the increasing demand for sustainable transport, Danser Group decided to retrofit one of their own barges (Eiger-Nordwand) with a Dual-Fuel (LNG / Gasoil) propulsion system. As a result, the engines of the Eiger will be powered by LNG for 99%.

With this project Danser Group realizes the first ever LNG retrofit on an existing barge.



First LNG Container Vessel on the upper Rhine

Emission reductions Danser's Eiger-Nordwand after LNG refit		
CO^2	Particulates	NOx
- 20%	- 95%	- 80%

More pictures of the pEiger-Nordwand during the installation of the LNG engines can be found on the website of Danser Containerline: http://www.danser.nl/en/

10.1.4 Magnetic Mooring pads

VT Group has retrofitted one of its vessels with a new auto-mooring system, which helps fastening the bunkering process by allowing bunkering tanks to be moored alongside other vessels quickly and safely. The Docklock system, from Mampaey Offshore Industries, uses dual mooring arms with connection pads that can firmly attach to a hull at the bow and stern and then "walk" along the surface to accommodate changes in level.

The system, promises to moor vessels quickly while adapting to changing conditions. When proven explicitly in practice, The Port of Rotterdam suggests a possible new trend in mooring during bunkering operations by using magnetic mooring pads.

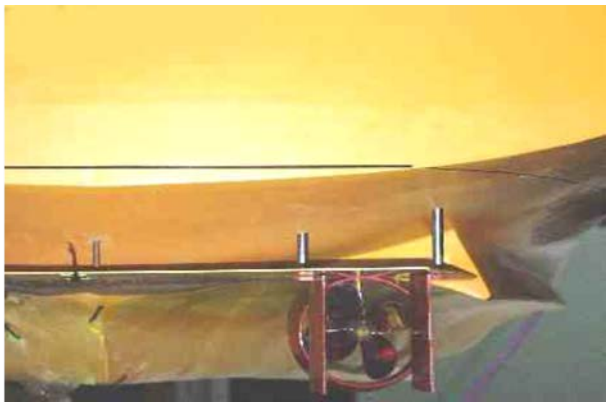
For more information, see: https://www.youtube.com/watch?v=G6PwlsetQZA

10.2 Design and adjustment of Inland Waterway Vessels

Both DST in Germany and Marin in the Netherlands are recognized as leading institutes to optimize design and specific cost efficient solutions for a.o. inland vessels. This is done by:

- Sharing expertise for initial design;
- Cost Analysis of various technical solutions;

- Computational Fluid Dynamics (CFD), e.g. for optimal hull design;
- Model tests;
- Ship Handling Simulator (Marin).



Both institutes are also involved in the Move-it project, which is a collaborative project that develops a suite of options for the cost-effective modernization of inland ships. Inland shipping is challenged by an over-aging fleet, climate change and stronger environmental & safety objectives.

The project focusses on:

- New power system configurations.
- Alternative fuels, retrofitting techniques for existing engines;
- Improved hull and propulsors;
- Assistance to the captain for efficient sailing.

An overview of retrofit solutions for inland vessels related to hydrodynamics, Ship structures, mechanical installations and operations is given in the following report: http://www.moveit-fp7.eu/assets/move_it_deliverable_1.1.pdf.

10.3 Smart terminals

Despite operational, environmental and social benefits of IWT, large infrastructural and operational investments are required to create favorable boundary conditions for IWT to remain or become a competitive transport system in both developed and developing countries, e.g. by implementing: river training works, capital/maintenance dredging, aids to navigate, modern vessels, etc.

It is already difficult to raise sufficient resources to upgrade IWT facilities in developed countries by means of public and/or private equity, e.g. Seine-Scheldt inland waterway network in Europe. For middle income and developing countries, rehabilitation plans to develop IWT after years of neglect, support from the World Bank and other IFIs seems almost inevitable.

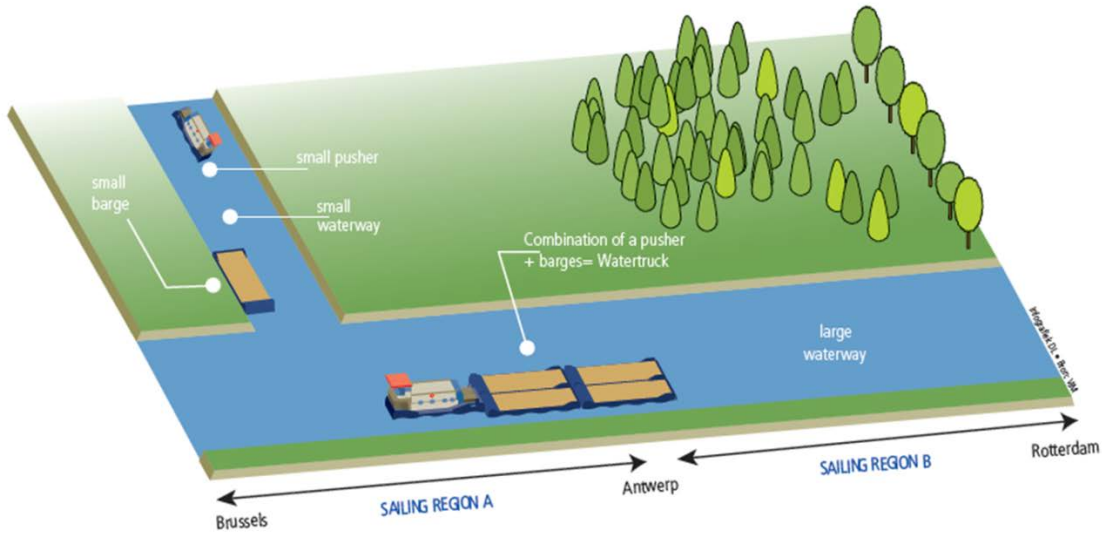
The situation regarding the (re-)development of IWT by means of infrastructural and operational investment needs, are currently experience throughout the World. Take for example World Bank and ADB loans in China for deepening of the tributaries of the Yangtze River and realization of navigation-cum-hydropower complexes; and a World Bank assisted project in India, the “Take Jal Marg Vika”: to develop a stretch of 1,620 km on the River Ganga.

Development of a multimodal network, involving an innovative IWT solution as part of green logistics supply chains to penetrate deeper into the hinterland of sea ports and improve accessibility for shippers, would also be beneficial for many inland waterway systems in the World, e.g.: Bangladesh, Myanmar, Thailand, Vietnam, various countries with rivers and lakes in Africa (e.g. Nile River, Congo River, Zambesi River, Lake Victoria, Lake Tanganyika, Lake Nyasa), and more.

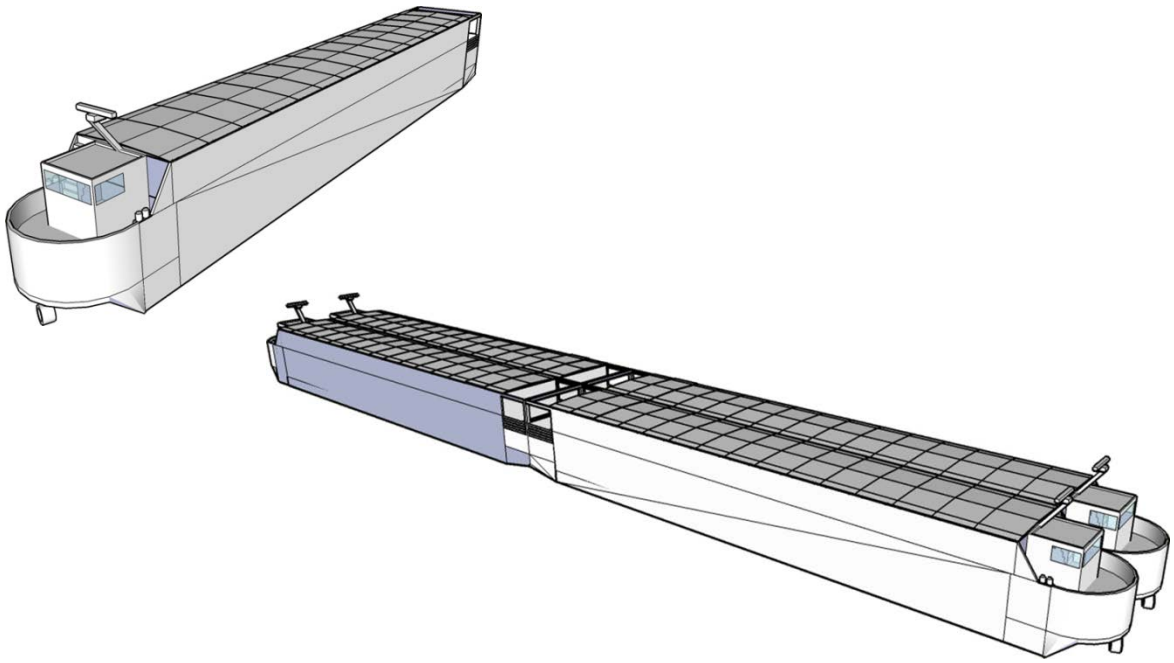
Cost and energy efficient transport on waterways is largely dependent on waterway conditions, waterway dimensions and especially waterway depths for which usually large (infrastructural) investments are needed. However further practical research is needed to implement alternative solutions for large infrastructural investments by developing a multimodal corridor network with the goal to reduce transport costs and carbon footprint of freight supply chains.

The multimodal corridor network will consist of IWT on the main artery (take for example Magdalena River in Colombia, the Hooghly river in India or the Yangtze River in China) and innovative solutions, which lead to the demand of **Smart terminals**: fast and smart transshipment points for consolidation of cargo and combined barge operations which can be (de-)coupled for efficient and frequent services on tributaries / waterway sections with smaller dimensions (see examples below).

The Concept of the Watertruck in Belgium and The Netherlands



Example Q-barge: innovative standardized vessel design for separate or joint operation

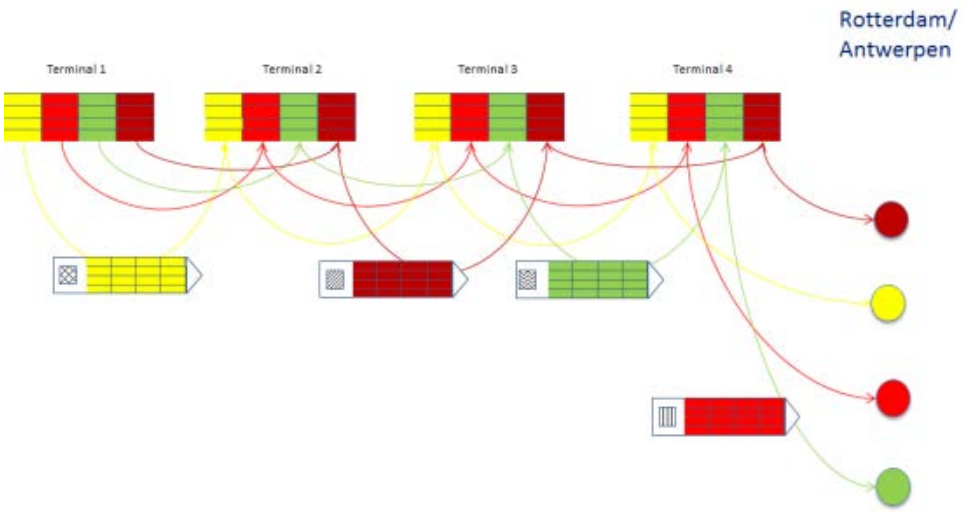


Additional costs for transshipment and pre-/end haulage by road to connect shipper are expected to be marginal against large cost benefits due to the economy of scale of IWT services. Especially when freight is transported over relatively long distances, like in Colombia, India, China etc. This was experience was also proven during a feasibility study for establishing a hub&spoke network and pendulum service in inland container transport in Europe, which has now been implemented in practice (see: for example the information of Hub& Spoken in Inland Container Shipping, included in the following paragraph and related video).

The concept of Smart terminals is also included in the description of Logistics and Hinterland Connectivity, and specifically the part of multimodal corridors including concept like Extended Gate (see Chapter 7).

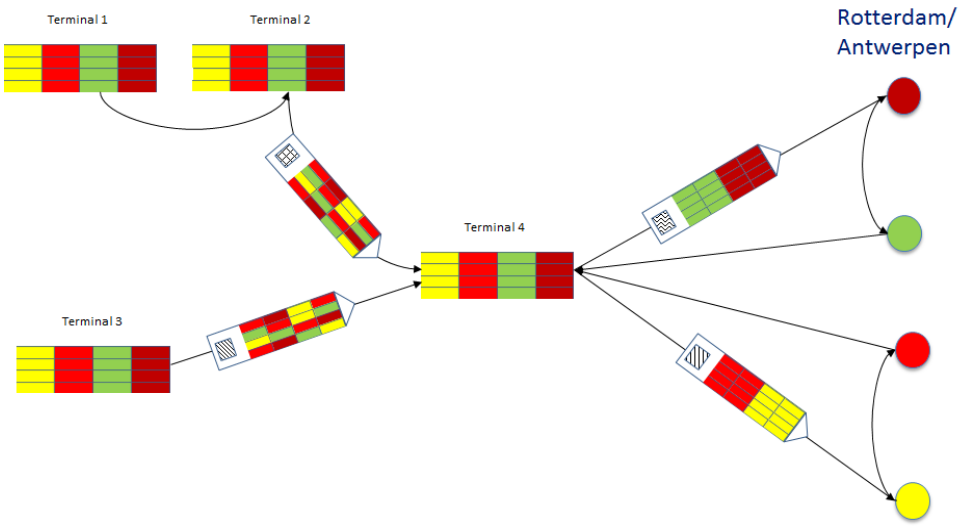
10.4 Hub & Spoke networks in inland container shipping

Because of the growing number of terminals in the seaport, the volumes are more and more fragmented over a number of terminals in the seaports. For example the Port of Rotterdam has 23 container terminals. As a result dwell times in seaports are becoming too long in the seaport and a next type of consolidation is needed: vessels are not anymore dedicated for one inland terminal (by full bargeload networks), but will focus on serving a limited number of container terminals in the seaport combined with a limited number of inland terminals to combine “Less than bargeload” volumes from several inland terminals. This situation is already seen along the Rhine terminals where vessels are hopping along inland terminals in order to have a descend load factor. The next figure shows this situation.



For the next years, it is expected that hub and spoke systems will also be implemented in hinterland container transport in Europe. While using a hub and spoke system, it could be possible to use larger transport units (e.g. 400 TEU vessels) and/or to have higher frequencies of service between the seaport and the hinterland. This could result in a better transport quality at a lower price for the shipper.

The following figure illustrates the hub and spoke system:



Such hub terminals can be developed at strategic locations in the network such as:

- junctions of waterway corridors, allowing the sorting and exchange of containers for several destinations
- at points in the network where the dimensions of waterways are larger (allowing to load additional containers on the same vessel)

There are however also constraints on the development of hub terminals, such as the capacity of the terminal (opening hours, cranes, quay length), the port dues.

Moreover, such consolidation schemes in Europe requires a strong cooperation between different market players (e.g. different container terminal operators and different barge operators). A sustainable business model is needed that provides the solution for sharing the costs and gains of cooperation. In Europe this is a challenge since the market

organization is rather fragmented because there are a lot of small companies operating a single inland terminal or small number of vessels. As a result the issue of ‘gain sharing’ between such small parties is vital.

One practical example of Hub&Spoke in inland shipping was the result of study on a potential hub and spoke model in inland navigation. The initiative by BCTN and Danser for more efficiently organized services from and to Antwerp, whereby the inland terminal in Nijmegen is used as hub, was more or less conceived during serious gaming sessions and further investigated. Additional studies were made into the feasibility and efficiency of this form of cooperation which was followed by a go/no-go decision to test this form of cooperation in practice. Hence, the result is evident by watching this short video:

https://www.youtube.com/watch?v=zF1ZmvrbPDg

This is of course much less relevant in situations where a large company has the ability to setup a large number of inland terminals and transport units or already own and operates a large number of assets. This is for example the situation in USA, where push convoys are used in a hub-and-spoke system (see pictures below).

Photo from www.ospreyline.com.

11. FINANCING OF IWT INFRASTRUCTURE AND INNOVATIONS

11.1 Financing of IWT infrastructure

The inland shipping sector pays for use of all infrastructure not administered by the national government. Overall, in the Netherlands, approximately € 50 mln is paid annually in port dues. Specifically for development of waterways there is no cost recovery for inland waterway transport. These types of infrastructural developments are financed by the European Commission and national governments.

For example navigation on the Rhine is subjected to the principles of freedom of navigation in accordance with the Mannheim Act and its additional protocols. The Member States of the Central Commission for Navigation of the Rhine (CCNR) Germany, Belgium, France, Netherlands and Switzerland reaffirmed this under the “Basel Declaration” that all necessary measures are taken to ensure the freedom of navigation. Hereto an important role is given to the Central Commission for Navigation of the Rhine (CCNR), which ensures a high standard of security for inland shipping and promotes the protection of the environment and we renew the assurances of our support for its task of promoting the further development of navigation on the Rhine.

Furthermore the member states support all efforts to achieve the sustainable and future-oriented development of European inland waterways. This includes the maintenance of the waterways, the provision of suitable infrastructure under the responsibility of the CCNR member States, as well as the implementation of the objectives of the EU Water Framework Directive coordinated between the inland shipping and water management sectors.

IWT is included in a number of the TEN-T corridors, and financing of waterway improvements, including RIS, is linked to the projects in the workplans of those corridors. Funding is arranged through the Connecting Europe Facility, other EU funding mechanisms and additional national funding.

11.2 Port facilities

In order to have a level playing for the skippers, not only the waterways but also the ports have to be “non-discriminatory”. Inland ports and quays are being operated under municipal or provincial supervision.

Mostly the municipality owns the ports and (sometimes) the facilities; the municipality lets the industrial plots in port areas and contracts out the port operations. Although ports and facilities are generally considered to be the responsibility of the public administration, there does exist however a wide variety in port set up.

For the financing of port facilities, municipalities may use non earmarked money they receive from the State Budget via the Ministry of Interior. Additional sums (subventions up to 50% of investments) can be granted by the Ministry of Transport. The municipalities may also use income generated via municipal taxes and other revenues. Furthermore, they may involve private capital, either via loans or via PPP construction.

11.3 Support systems for (small) operators

To illustrate the type of supports systems for (small) operators in the Netherlands, some examples of these type of systems are given in paragraphs below.

11.3.1 Tax deduction for environmental investments

In the Netherlands the MIA (Environmental Investment Rebate) and Vamil (Arbitrary depreciation of environmental investments) are two different support schemes for entrepreneurs.

Using the MIA\Vamil scheme, you can:

- invest in environmentally friendly products or company resources with a fiscal advantage;
- bring innovative environmentally-friendly products onto the market more quickly.

Through the MIA, you can deduct up to 36% of the investment costs for an environmentally friendly investment from the fiscal profit on the regular depreciation and with the Vamil you can yourself decide when to write off these investment costs. You decide how fast or slowly. That provides an advantage in liquidity and interest.

All Dutch entrepreneurs who pay income or company tax can make use of the MIA\Vamil. The arrangement is interesting for, e.g., entrepreneurs in the agrarian sector, shipping and industry, but also for those who invest in sustainable transport, sustainable recreation and sustainable buildings.

To find out which investments are eligible for tax deduction under these schemes, the entrepreneur can look at the current Environment List (Dutch). This includes about 300 investments for which you can apply for the MIA or the Vamil or the MIA and Vamil. These investments (on the Environment List called company resources) are less damaging to the environment and often go further than legal obligations.

11.3.2 Support for Innovative solutions

In the Netherlands technological innovations are financially supported from different sources. The Expertise and Innovation Centre for Inland Shipping[34] supports organizations in obtaining funds and grants. Institutes like the Maritime Research Institute Netherlands are a driving force in innovation in the IWT sector. Developments are especially focused at greening the IWT fleet.

Shortly, also an Expertise and Innovation Centre on European level is expected to be established.

[34] http://www.eicb.nl/

12. THE HUMAN FACTOR

12.1 Port management and human resources

12.1.1 Common practices worldwide

According to the ILO if port training policy is clearly stated and widely communicated - taking into account the external environment – and put into practice through a systematic training programme, then ports will become safe and rewarding places to work, port operations will be efficient and profitable, and customers will be well served. There are many examples of excellent port worker training programs around the world, but equally there are all too many ports where training falls short of international standards. The ILO Guidelines on training in the port sector are designed to raise standards and promote good practice, founded on a (multidimensional) approach to competency-based training that will serve the interests of all parties[35].

The ILO Code of Practice on Safety and Health in Ports emphasizes that all port workers should be trained to develop the knowledge, psychomotor and attitude skills which they need to enable them to do their work safely and efficiently, as well as to develop general safety awareness.

Educational programs in Europe can be found at various levels, differentiated at vocational programs, bachelor programs and Master programs for very practical jobs in port operations (e.g. crane operator) up till port and shipping management positions (e.g. management of deep sea terminal operator). Additionally global deep sea container terminal operators, such as APM, COSCO, DP World, PSA International, Hutchison Whampoa, COSCO, etc.

For example APMT developed the GTDP (Global Terminal Development Program) to serve as a standard for all employees worldwide. The employees are subjected to a wide range of training modules, namely: health and safety, security, yard planning, vessel planning, gate operations, rail operations and people management. Other port operators and also port authorities have dedicated internships, traineeships and on-the-job training possibilities for port management or operating positions.

12.1.2 Simulators as practical tool

To enhance the practical experience and competences of students one of the latest training techniques is the use of simulators, which gains more popularity and acceptance by the industrial and transport sector. The largest state-of-the-art simulator park in the world is located at the STC-Group in The Netherlands. Simulators used to train IWT personnel at STC which offer a comprehensive set of practical tools on both operational and management level in transport and logistics. For Inland Shipping the following simulators are available, which are used to expose the “learner” to simulated real life situations (scenarios):

[35] ILO code of practice: Guidelines on training in the port sector

- The Inland Navigation Radar Simulator is available. This simulator is used to perform various practical exercises with a radar in a safe and relatively cheap manner. For instance, an incident on board of a ship, from minor ones to more complex ones, can be practiced.
- The Bridge Simulator: A simulated ship's bridge where trainees are able to sail with different types of ships to enter various harbors. Aspects on navigation, communications, decision making, and use of equipment are trained amongst others.
- Vessel Traffic Service Simulator VTSS: A simulated system where trainees are able to provide information services to ships and nautical community and also monitoring and controlling harbor traffic.
- Engine Simulator: In this simulator the engine room of a large tanker has been replicated, which is linked to a control room that is provided with all instruments. This simulator with wall display has simulations of various engine rooms including one of an inland navigation ship. On the simulator, the learner learns how the various systems in the engine room are related, how he can operate them and what the consequences are if he makes mistakes. He gains an insight in output electronics, working with high voltages and solving failures. These simulations actually involve real, specific problems of the various engine rooms. The complexity of the processes in the real engine room is fully captured in the simulators.

Within the European Action Programme for the promotion of inland waterway transport, PLATINA 2, a roadmap is developed towards technical standards for ship-handling simulators. Currently a lacking European-wide harmonized system of technical standards governs the use of simulators. The lack of technical standards impedes speeding up and improving education and training. The development of technical standards for ship-handling simulators aims to raise labor mobility and to promote career progression for inland waterway transport crew members. It contributes to a general common understanding of needed functionalities and possible uses of ship-handling simulators.

Besides specific simulators for inland shipping STC also has the availability to train competences through simulators in order (maritime) transport and logistics themes:

- Transport chain simulator: offering the possibility to get familiar and practice logistic processes in the transport chain.
- Full Mission Bridge simulator: for training of maritime officers.
- Loading simulators: to practice the specifics of loading and unloading of general cargo, heavy cargo, containers, dry bulk and liquid bulk are types of cargo which all require their own approach.
- Port management simulator: simulation of day-to-day decision making processes in ports.
- Dedicated port operation simulators: straddle carrier; container crane; bulk crane.
- Dredging simulator: operational training on a cutter suction dredger.
- Fishing simulator: Navigational training of fishing boats and practicing with the equipment to locate the fish.
- Dynamic positioning simulator: training to gain experience in offshore operations.

- Thermal Power Plant simulator: training of practical operating procedures for power stations.

Besides the use of simulators as part of (regular) vocational, bachelor and master educational programs, also (global) enterprises have dedicated simulators and programs to train their staff. E.g. Shipping lines, dredging companies or companies involved in the offshore, etc.

Below an Example of the container crane simulator is given:[36]

12.2 Qualified operational personnel in IWT

12.2.1 Harmonized professional qualification

To establish a harmonized education, training and certification system for inland waterway personnel, Standards of Training and Certification in Inland Navigation (STCIN) are currently being developed within the EU. A uniform set of standards of competence does not yet exist anywhere in the world. It should be noted that STCIN has not yet been implemented yet could eventually be integrated into existing Directives, such as the 96/50/EC Directive.

STCIN is based on ongoing comparative works within the IWT education and training network EDINNA and an inventory of existing IWT education and training institutes and curricula as well as IWT education and training demands by PLATINA (currently succeeded by PLATINA 2 programme, as mentioned above). EDINNA is the educational network of inland waterway navigation schools and training institutes. It recognizes that all members use the same European waterway system and have a different background in various educational systems in Europe. It is the aim of EDINNA to come to a more structured cooperation and to establish a harmonized education, training and certification

[36] Source: STC-Group (http://www.stc-group.nl/Pages/1033/HomePage.aspx)

system for inland waterway personnel in order to ensure high quality of trained staff on board the vessels.

In the present education and training situation, there is a large variety amongst countries in the EU which are involved in IWT. Instead of the presence of a uniform set of standards of competence, there is only national control on the implementation of standards. Consequently, the structure and quality of national curricula may differ among countries. Although certificates may be recognized by other countries, this does not lead to a harmonized system of education and training for inland waterway personnel. Therefore, the STCIN has been proposed and discussed with stakeholders in the IWT sector. STCIN is meant to be applicable to personnel on board a professional/commercial inland navigation vessel including any activity in freight and passenger transport sailing on European waterways on operational and management level. It includes for instance the personnel on board self-propelled barges, tugs, pusher craft, barges, pushed convoys, side by side formations and floating equipment.

The STCIN concept should allow for the integration of the aspects mentioned before into all existing educational and training IWT systems. It allows for qualified personnel with an equal level of professional competences within the EU and aligns standards of control by competent institutes. Moreover, it makes career changes in the inland navigation working environment easier as a result of certificates and licenses that are exchangeable. Furthermore, when a person has undergone education and training according to the proposed STCIN approach, relevant authorities in the entire EU will ideally know that this person has proven knowledge and skills in a pre-defined catalogue of competencies and comes from a certified institution.

In addition to general technical standards for the use of simulator across the EU member states, the work package “Jobs & Skills” of the PLATINA 2 projects has two other main priorities. Another priority is to create a concept of a harmonized European e-standard which would ease the documentation of service time and qualification of crew members in inland waterway transport. Secondly consolidated learning material is required from existing national and European research projects (e.g. INeS Danube, IneS RMS) through the development of a “one-stop-shop” which can be disseminated through the educational network EDINNA aimed to raise the impact of inland waterway transport in logistics education and training.

Because of the fact that inland waterway basins in the different parts of the world are not connected, crew requirements and curricula are developed on country basis or waterway basin basis. This is typically true for international rivers and waterways. In many countries the Navy plays a strong role in setting out standards or rules for crewing of vessels.

Although Edinna is developed for the European waterways, it has created interest in other parts of the world and the Edinna Board has now accepted memberships from non EU countries, so that they can benefit from the guidelines and documentation produced by Edinna such as the professional qualifications for different positions in inland navigation, and related education and training programs.

12.2.2 Awareness campaigns and promotion

A major concern and difficulty is that it is very hard in the European Union to attract students to transport, logistics and the inland shipping industry. Mainly this has to do with the poor image of the sector as compared to for example the financial sector, the administrative service industry, the ICT sector and other sectors.

Promotional campaigns, supported by the European Union and the national governments, have been set up by the inland shipping promotion bureaus, the vessel owners associations, and the transport colleges. New students are targeted through specific promotion campaigns to create awareness and to emphasize the positive aspects of inland navigation and transport and logistics. This is done by promotional activities during network events and sharing information and best practices through websites on the advantages of working in the inland shipping sector, information on various levels of educational programs (also in case of career change) and practical information how to find a job in inland shipping.

In specific segments barge owners may also take the initiative to promote jobs in inland shipping. Especially for boatmasters/owners of small inland vessels (mainly privately or family owned) it is difficult to find successors, since student are often educated for continuous operation on large inland vessels (which is also seen as more attractive). Therefore the cooperative of small vessels operating in Western Europe between The Netherlands, Belgium and France offers internships on the inland vessels of its members. Hereby career switcher or students are given the opportunity to gain practical experience n living and working on small vessels.