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Report on working group on European IWT infrastructure:

Concretisation of the EC transport policy for IWT infrastructure needs on the Rhine corridor - a first approach

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INTRODUCTION

The context

Between 2008-2010, the various PLATINA partners in workpackage (WP) 5 on Infrastructure developed the D 5.5 report "Inventory of available knowledge on strategic inland waterways projects". The report was agreed upon by the EC in 2010 and was published on the www.naiades.info website and disseminated to several stakeholder organisations.

The D 5.5 report provides an overview of the available knowledge on strategic inland projects relating to physical infrastructure, not ITS infrastructure. The report includes:

1. an overview of the various elements of IWT infrastructure developments;
2. an overall policy perspective, including macro-economic developments and the IWT positioning in the perspective of overall supply chain management, comodality and network development;
3. an identification of several elements of inland ports and terminals;
4. a list of IWT bottlenecks and missing links;
5. an overview of cargo flows on major European inland waterways over the year 2007;
6. a forecast of the IWT cargo flow in 2025.

As a follow up to the D 5.5 report, PLATINA WP 5 continued its research on IWT physical infrastructure development. Various WP 5 partners were of the opinion that the then current IWT infrastructure approaches are rather limited, being primarily developed from an IWT only perspective, thereby undermining the opportunities to identity the market potential of IWT from an overall freight transport –supply chain - perspective. To overcome this limitation, PLATINA WP 5 conducted additional research developing an Issue Paper identifying the opportunities for a framework and elements of an integrated European strategy for IWT infrastructure development. The need for an integrated IWT infrastructure development strategy and implementing initiatives were identified - applying a network approach. The aim of the strategy is to endorse IWT to connect to the overall transport and logistic performance in global and regional supply chains.

PLATINA WP 5 finalised the Issue Paper in April 2011. The UNECE UN-ECE Secretariat for the Inland Transport Committee (working party on Inland Water Transport) showed great interest in the PLATINA D 5.5 report and the Issue Paper. In a joint effort to further stimulate discussion within th e UN-ECE on IWT infrastructure development, it was agreed with the UN-ECE secretariat UNECE was to take the content of the Issue Paper on board and turn it into a UN-ECE secretariat document to be discussed by UN-ECE at its meeting with member states on 16 June 2011 in Geneva.[1] The WP 5 work package leader participated in this discussion.

In May 2011, several PLATINA WP 5 members discussed the way how to further elaborate on the D 5.5 report findings and execute parts of the approaches developed in the Issue Paper. Also the EC (DG MOVE) was consulted on the most appropriate way ahead. The EC requested PLATINA to sketch the concretisation of the current EC transport documents for inland waterways transport (IWT) infrastructure needs on the Rhine corridor[2]. The major reason being the need to validate the new EC generic transport policy approach, as issued in 2011, regarding IWT infrastructure opportunities. Amongst the most important EC transport policy elements are:

1. Decarbonisation and less dependency on fossil fuels.
2. Freight transport shift from road to rail or waterborne transport, especially above 300 km.
3. Strengthening of a multimodal approach (multi-modal logistic chains).
4. Development of a EU (multimodal) core network (ready 2030) and underlying, comprehensive networks (ready 2050). The core network will prioritize projects along the 10 implementing corridors on the core network. Inland waterway projects will be part of 7 multimodal core corridors, which should promote the integration of IWT into the multi-modal logistic chains. [3]

Based on the elements identified in the Issue document (chapter 1 of this report) and the request of the EC, the PLATINA WP 5 project group developed a working plan focussing on

[1] This chapter has been developed by PLATINA, WP 5. It has been provided to the UNECE secretariat in 2011 to be used as Document ECE/TRANS/SC/W P.3/2011/18, in the UNECE Inland Transport Committee, Working Party on Inland Water Transport, Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, Thirty-ninth session, Geneva, 15–17 June 2011, Item 4 of the provisional agenda, Strategic development of inland waterway infrastructure

[2] . The Rhine-corridor was selected based on the availability of useful data for this corridor and because the Rhine river is the most important corridor for European Inland Waterway Transport.

[3] Corridor implementation structures of the core network will be developed, in particular through corridor platforms and the corridor development plans, to support the integration of IWT into the multi-modal logistic chains and help with the coordinated implementation of the TEN-T core network.

the concretisation of the EC transport policy on the Rhine-corridor, being part of the core TEN-T corridor.[4] The first results of the work were discussed in a meeting with the EC on 16 October 2011. During this meeting, the EC requested PLATINA also to propose a method to identify the various elements necessary (building blocks) to develop a corridor implementation plans. Within the context of the future TEN-T policy, 2014-2020, the EC envisages future project proposal for policy execution and implementation to be based on a sound assessment per corridors for multimodal transport.[5] On 6 March 2012, PLATINA WP 5 and the EC met and discussed a draft report presented. It was requested to further elaborate on a general method for developing a corridor implementation plan. In May 2012, the final draft report was disseminated to the EC. In October 2012, the EC provided some additional feedback to the report, which is incorporated in this final report.

The report

This report provides a first approach to describe the effects of the current EC transport policy on IWT infrastructure needs on the Rhine corridor. The report aims:

1. To identify the various elements guiding towards a European IWT infrastructure development strategy.
2. To apply these elements by identifying the opportunities and IWT infrastructure needs of the current EC transport policy initiatives[6] for more IWT intermodal transport on the Rhine corridor. The major objectives being:
   - To provide a picture on the size and characteristics of IWT on the Rhine
   - To assess the volume of cargo in the Rhine corridor that could potentially shift from road to alternative modes, relating container transport;
   - To benchmark the different transport alternatives in the corridor (road, rail, IWT or a combination), relating container transport on the Rhine;
   - To provide recommendations on how the potential of IWT on the Rhine can be enlarged
3. To propose a general method for developing a corridor implementation plan, based on the insight gained while providing a first contribution for the Rhine corridor.

[4] The Rhine corridor is one of the main transport corridors in Europe also connecting various networks and corridors. The Rhine is an important part of the corridor 6 (Genova – Rotterdam) in the proposal for the Connecting Europe Facility.

[5] See also chapter 7

[6] EC White Paper on a Single European Transport Market, the EC proposal on the revised TEN-T guidelines and Connecting Europe Facility (CEF)

The research was carried out in 7 major steps, i.e.:

1. Develop an Issue Paper describing applicable approaches leading towards an IWT development strategy on a European scale.
2. Identification of the opportunities and the constituting elements to execute a first of a IWT infrastructure promoting approach/application on the Rhine corridor.
3. Define and describe the Rhine corridor and the IWT market and the selection of the major Origin and Destination pairs on the Rhine corridor to compare.
4. Assessment of the intermodal alternatives on the existing OD-pairs and benchmark the performances of IWT (including an analyses and validation of results with key stakeholders in the market on the Rhine corridor).
5. Assessing the major vulnerability of IWT on the Rhine corridor and how to cope with it.
6. Scenario development, identifying IWT's modal shift potential on the Rhine corridor.
7. Describe an eligible general method to develop a corridor implementation plan

These steps are described in 7 subsequent chapters. In chapter 8 the results of the report are summarized and major recommendations are provided. An executive summary is provided on pages 10 – 13. In annex I, information is provided on transport data and forecasts. In Annex II, a list of the inland container terminals on the Rhine corridor and connecting waterways is provided. In Annex III, more information is provided on the five selected OD-pairs. In Annex IV, the research sources are being provided. Annex V provides additional information on possible indicators to build a corridor implementation plan on. In Annex VI, the various data elements that could assist in monitoring IWT measures are elaborated.

EXCUTIVE SUMMARY

IWT STRATEGIC INFRASTRUCTURE DEVELOPMENT

A strategic orientation underlying the development of IWT infrastructure is necessary to connect IWT to global supply chain developments and (inter) national/local policy requirements. This strategy built on the requirement for all transport modes, various stakeholders and operators to co-operate, create value added services, provide green logistics, innovate and strengthen the European infrastructure network as a whole. Connectivity is key.

A strategic European IWT infrastructure development plan, incorporating EC transport policy objectives, should at least cover the following major challenges:

- To strengthen the competitiveness of IWT
- To lower the impact of mobility on the environment, make transport cleaner and greener, reduce energy consumption, improve energy efficiency and enhance security of energy supply by decreasing dependency on fossil fuels
- To optimize the use of existing infrastructure, making transport more efficient, improve mobility in urban and inter-urban transport, increase throughput and reduce congestion
- To improve traffic and transport safety and security
- To adjust the design and construction methods to climate change and future trends of bigger vessels
- To determine and apply the correct price for IWT considering the external costs induced by IWT.

To effectively implement an IWT infrastructure strategy, insight should be obtained regarding which infrastructure investments yield the highest benefit for IWT and the efficiency of transport chains. In addition, the benefits of improving linkages between cities, ports, and other main economic centres should be assessed. The EC transport policy view is overarching. From a top down and bottom up approach various elements to evaluate the potential of IWT – and thereby its specific infrastructure needs - on a corridor shall be developed. Per corridor the various elements that constitute the IWT potential and therefore determine the IWT infrastructure needs have to be defined.

The basis of a European IWT infrastructure strategy is interaction and commitment of all major stakeholders. Together they decide what to do and can be done.

OUTCOME RESEARCH OF IWT INFRASTRUCTURE NEEDS ON THE RHINE CORRIDOR

Four major conclusions can be derived from the sketch provided in the study identifying the IWT infrastructure needs on the Rhine corridor.

First, the competitive edge of IWT largely depends on:

- The existence of high quality waterways, terminals and the type and size of economic activity in the area.
- The related transport volumes and transport distances, allowing sufficient critical mass for IWT to provide frequent services and interconnections with other transport modes.
- The technical feasibility to transport various types of goods, independent of transport distance such as perishables, high value goods, etc.
- The local circumstances, such as the specific location of ports and terminals and the pre-end haulage time needed to serve distribution centres and/or production plants and the transhipment costs at the terminal.
- IWT sensitivity to the water level conditions. In low water situations the IWT operators do calculate low water surcharges to compensate for the loss of payload of vessels as result of reduced fairway depth.

Second, IWT has a great potential to raise its modal share of IWT in the intermodal chain. These opportunities especially become manifest when the following elements conditions can be fulfilled:

- Increasing the frequency of the services.
- Shorten the transport time in pre-end haulage operations between terminal and customer.

Third, some structural issues jeopardize the competitiveness of containerized IWT.

The major problems are:

- In many cases there are no direct waterway connections to major production plants and/or distribution centres;
- Expensive and time consuming pre-end haulage and transhipment operations;
- IWT transport distance, which is often much larger than the transport distance by truck or rail (e.g. Antwerp – Metz);
- Consolidation of cargo requiring contracts with multiple clients and co-ordination with multiple parties in the intermodal transport chain;
- Specific barriers on stretches in the network that can emerge.

Fourth, the IWT infrastructure needs on the Rhine are:

1. Spatial development planning which stimulates manufacturing and distribution/wholesales companies to locate its subsidiaries close to the waterways in combination with targeted investments in the handling capacities to serve these new cargo flows.
2. More integrated IT services, including cooperation (Public to Private as well as B2B).

3. Solutions for low water problems.

GENERAL CORRIDOR IMPLEMENTATION PLAN

The work to develop a corridor implementation plan should minimally follow the next steps:

1. A detailed survey of the corridor.
2. Execution of a GAP analysis comparing the overall transport performance compared with the EC policy objectives.
3. Assessment of possible measures for the development of the corridor, including a definition and analyses of options to effectively implement measures.
4. Roadmap for implementation of measures
5. Monitoring and evaluation

The elements to be covered by a corridor implementation plan are:

1. Description of the corridor.
2. The actual participation of the various freight transport flows.
3. The current and future demand and supply structure (for freight transport).
4. Existing physical and virtual bottlenecks and missing links.
5. The contribution and participation of the various transport modes in the freight flows.
6. The magnitude of potential transport mode market growth.
7. A comparison between the performance of the various transport modes, based on a set of criteria (policy objectives relating to the development of sustainable transport).[7]
8. A scenario to develop more interconnectivity between the modes or improve the performance of a specific transport mode.
9. A description of the most important features affecting the performance of a specific transport mode (or all transport modes): technical, functional, regulatory, and infrastructural.
10. Assessment of the possible measures related to elements such as:
    - Solving physical infrastructural bottlenecks, upgrade and construct missing links and improved maintenance of existing infrastructure.
    - Development of infrastructure for alternative fuels, including distribution network.
    - Awareness and promotion activities about sustainable transport alternatives, neutral logistics advisory to support multimodal transport solutions.
    - Deployment of ITS systems – including indications of estimated costs and time horizons - to enhance freight transport performance.

[7] In Annex V a list of possible indicators has been provided

- Solving possible shortcomings of the terminal network to boost interconnectivity and multimodality.
- To promote interconnecting freight terminals development advise on measures relating functional layout, spatial development and intermodal connections, capacity expansion, etc.
- Develop opportunities to match the operational demands of the relevant market for specific transport mode undertakings and logistics services.
- Smoothen cross-border procedures and common timetable development.

11. A roadmap, including recommended investments, projects and transport policy initiatives to stimulate the freight performance of a transport mode, including competitiveness and market share growth.

12. A method to monitor and evaluate the effect of the corridor implementation plan

RECOMMENDATIONS

To enhance the overall competitiveness of IWT, the door-to-door and pre-haulage costs need to be substantially lowered while the frequency of barge services needs to increase. A differentiated approach is needed which focuses on areas where inland waterways are available and where IWT is or can be connected to major terminals/ports and industrial areas. This approach should take into account the available transport volumes, as well as the transport characteristics.

Based on current EC transport policy the IWT infrastructure needs on the Rhine corridor require:

1. For public policy: spatial development planning which stimulates manufacturing companies to locate its subsidiaries close to the waterways in combination with targeted investments in the handling capacities to serve these new cargo flows,
2. For business: to seek consolidation and more integrated services and cooperation between the various modes and operators in order to bundle cargo and to optimise the various processes within the transport chain.

Based on these lessons learned from the PLATINA investigations for the Rhine corridor it is recommended to further elaborate the Rhine corridor within the current EC transport policy and also to include the six other TEN-T core network corridors[8]. In particular the potential of

[8] In general it should be noted that the underlying IWT data on the Rhine corridor of more reliable and up-to-date than the IWT data relating the other corridors.

IWT to participate in the continental container transports (not seaport related) is valuable in this respect. [9]

[9] The approach applied in this study could be transposed onto other EC selected corridors, i.e. OD-pairs within these corridors.

1. - TOWARDS AN INTEGRATED EUROPEAN STRATEGY FOR PHYSICAL IWT INFRASTRUCTURE DEVELOPMENT

1.1 Introduction

This chapter seeks to provide a way forward to assist various international organisations and countries in establishing an integrated IWT infrastructure development strategy and implementing initiatives.[10] Overall, a network approach is advocated, connecting IWT to the overall transport and logistic performance in the supply chains. The competitive edge of IWT depends on a further integration of its operations in a coherent European infrastructure policy approach.

1.2 Background

To support an efficient economy in Europe, effective traffic and transport systems have to be developed and maintained. In the medium to long term, transport volumes are expected to rise significantly, whereas the boundaries of current traffic systems are reached and exceeded more frequently. Insufficient transport infrastructure leads to increasing emissions, accident numbers and congestion as well as a decline in the reliability and punctuality. The IWT sector can deliver a valuable contribution to coping with the rising transport demand in a way that is effective as well as sustainable and environmentally sound. IWT is, and has been for a long time, regarded as the most environment-friendly and safest surface transport mode with favourable energy efficiency. Therefore, various organisations promote and aim to strengthen the competitive position of IWT.

Within the current context of the EC transport policy the major strategic IWT infrastructure challenges are[11]:

- To strengthen the competitiveness of IWT.

[10] This chapter has been developed by PLATINA, WP 5. It has been provided to the UNECE secretariat in 2011 to be used as Document ECE/TRANS/SC/W P.3/2011/18, in the UNECE Inland Transport Committee, Working Party on Inland Water Transport, Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, Thirty-ninth session, Geneva, 15–17 June 2011, Item 4 of the provisional agenda, Strategic development of inland waterway infrastructure

[11] This paragraph was not included in the UNECE document

- To lower the impact of mobility on the environment, make transport cleaner and greener, reduce energy consumption, improve energy efficiency and enhance security of energy supply by decreasing dependency on fossil fuels.
- To optimize the use of existing infrastructure, making transport more efficient, improve mobility in urban and inter-urban transport, increase throughput and reduce congestion
- To improve traffic and transport safety and security.
- To adjust the design and construction methods to climate change and future trends of bigger vessels.
- To determine and apply the correct price for IWT considering the external costs induced by IWT.

1.3 A European IWT infrastructure policy

One of the actions that allow the execution of a European IWT promotion policy is to design and structure the development of a European wide physical infrastructure network. In support of that endeavour, two phases to assist in the development to structure a European IWT infrastructure network can be identified:

- In the first phase, the status quo of IWT infrastructure in Europe should be assessed, identifying various infrastructure bottlenecks and missing links at the European level and generated some concepts on how to perceive various elements and determining trends[12].
- In the second phase, a European infrastructure network strategy has to be developed, elaborating the framework for further actions, i.e. the prioritisation and phasing of infrastructure improvements. The generic strategic orientation underlying the development of IWT infrastructure is to connect IWT to global supply chain developments and (inter) national/local policy requirements. Thus challenging all transport modes and various stakeholders and operators to co-operate, create value added services, provide green logistics, innovate and strengthen the European infrastructure network as a whole.

This report further elaborates the second phase, taking into consideration the EC transport policy documents, most issued in 2011.

1.4 Towards the development of a European IWT infrastructure network strategy

The establishment of a European wide infrastructure network strategy is a prerequisite to foster IWT. Two activities are required:

1. To define a common IWT infrastructure network strategy.
   In support of that endeavour, various inventories (UNECE Bluebook, TEN-T, PLATINA) can substantially contribute to the work. Additionally, in the process of developing a Eu-

12 Reference: PLATINA report *Inventory of available knowledge on strategic inland waterway projects* – www.naiades.info/waterways

ropean IWT infrastructure strategy various questions need to be asked and answered. If possible, the preferred end state of the IWT infrastructure network should be defined.

2. To agree on a common view how to effectively implement a European IWT infrastructure strategy based on the TEN-T corridor concept.
   To establish this view, choices have to be made regarding the prioritisation and phasing of IWT infrastructure improvements. It is useful to effectively determine what improvements would yield the highest efficiency gains in the entire transport chain.

   Efficiency gains can result from a decrease in costs, increase in modal shift and sustainability, the opening up of new markets and/or stimulation of regional development. Waterways and basins differ (greatly) regarding infrastructure components, fleet composition and markets served. Therefore, infrastructure developments in these waterways and basins will also differ in impact. Insight should be obtained regarding which infrastructure investments yield the highest benefit for IWT and the efficiency of transport chains, while a distinction is made between waterways and basins.

   In addition, the benefits of improving linkages between cities, ports, and other main economic centres should be assessed. Increased connectivity, especially for IWT, can stimulate economic developments and enhance the competitiveness of cities, ports, and other economic centres. Investments in IWT infrastructure can have positive influence on regional economic development. When cities, ports, and other economic centres attain high quality IWT connections, this could induce industries and companies to settle and set up activities in the area. The economic development that results can allow certain sectors of industry to grow and can provide great benefits to the local society.

Overall, these two actions constitute an IWT Infrastructure development strategy creating a momentum to interact and involve the countries and all other parties concerned in establishing a European IWT infrastructure agenda.

Two approaches to come up with the most appropriate elements and questions to be integrated in the IWT infrastructure strategy have been identified:
1. Top down approach (the policy – long term - perspective)
2. Bottom up approach (the business – short/medium term - perspective)

1.5 Questions based on the top down approach

Within this approach the current state of the infrastructure network is confronted with the ideal end state, the desired situation. Different types of gap analysis can provide insights into where and which kind of infrastructure investment is most needed, and how much this would take in effort, financial and other costs.

The various questions that can be asked are:

1. What is the status quo of the current infrastructure network, focusing on the following elements:
   - Layout of the waterway network.
   - Class of the waterway and other characteristics, such as bridge clearance, draught restrictions, fairway dimensions, lock capacity, port characteristics.
2. What is commonly accepted among stakeholders to be the ideal state or end view of infrastructure development in the long term, including information on:
   - Residential or industrial areas of (potential) economic value to be disclosed by IWT, in and outside the EU.
3. Which missing links and bottlenecks exist with regard to the ideal state (for instance by using the definitions used in the UNECE Blue Book[13])?
4. How far is the current infrastructure network removed from the end state?
   - How much would it cost to reach the end state?
   - How far are the different regions/basins/corridors removed from the end state?
   - How much would the infrastructure improvements cost per region/basin/ corridor?
5. Which types of bottlenecks or missing links are mostly lacking: bridge clearance, draught restrictions, fairway dimensions, lock capacity, ports?
   - Which types of bottlenecks are prevalent in the different regions/basins/ corridors?
   - To which extent are these bottlenecks basic or strategic (in the definition of the UNECE Blue Book)?
   - How does this overview relate to the different regions/basins/corridors?
6. How many missing links ought to be constructed?
   - How many missing links ought to be constructed in the different regions/basins/corridors?
7. To what extent main or upcoming economic centres, industrial or residential, are connected?
   - To what extent are main economic centres connected to sea by IWT?
   - To what extent are main economic centres connected to each other by IWT?
   - To what extent are main economic centres connected to sea or to each other by IWT in the different regions/basins/corridors?

[13] UNECE Inventory of Main Standards and Parameters of the E Waterway Network.

8. To what extent are the bottlenecks and missing links eminent regarding the possibility of opening up new residential and industrial regions and the economic development that could result?
   - How does this overview relate to the different regions/basins/corridors?
9. To what extent can a European IWT network interconnect the regions?
   - How does this overview relate to the different regions/basins/corridors?
10. When considering the end view, what will the improvement realised means in terms of uniformity and consistency of the infrastructure network?
    - To which extent is uniformity and consistency realised in the different regions/basins/corridors?

As described in the PLATINA D 5.5 report “Inventory of available knowledge on strategic inland waterways projects” inventories, it appears that most of these questions have or can be answered using the information that is already gathered. The layout has been described including several waterway characteristics. An additional task would be to define an ideal end state (waterways of international importance, all of class IV and up). Based on the answers to these questions it should be possible to determine the type of infrastructure investments to be undertaken in various parts of the infrastructure network.

An issue that might be called for is a re-evaluation of projects on the basis of opportunities to open up residential and industrial regions, or regions that are likely to portray economic development. Even though this exercise will not result in directions on steps to be taken next, it will deliver a qualification of which kind of infrastructure investment will have larger impact regarding reaching the end state than other kinds. Investing in infrastructure projects should be assessed by taking all projects in a certain basin or corridor into account, not on a project basis. Moreover also the wider impacts on society, economy and environment need to be considered such as the impact on enterprises, jobs, nature and biodiversity, health, emissions to air, etc..

1.6 Questions based on the bottom up approach

The basic question is how to obtain the highest value for money spent on infrastructure, for IWT, the region, or society at large. Opportunities attainable through infrastructure investment are sought for. These opportunities can consist of productivity improvements for IWT, new market opportunities in terms of additional freight volumes and modal shift, or increased competitiveness of main cities, ports, and centres. Examples of questions that can be posed in the bottom up approach are:

1. What are IWT fleet characteristics and activities in a region, basin or corridor:

- Current freight flows in type and volume, distinguished per waterway, basin or corridor.
- Composition of fleet utilising distinctive waterways.
- Cost structures of the fleet.
- Loading capacity of vessels (in connection to water conditions).
- Travel and waiting times (for locks and bridges).
- Markets that are served by IWT and other modes of transport.

2. Which type of bottleneck (bridge clearance, draught restrictions, lock capacity, inland port characteristics, availability of inland ports, fairway dimensions) impedes IWT efficiency most?
    - Depending on the relevant type of freight flow, freight volume, IWT fleet characteristics et cetera, how can investment in certain bottlenecks allow IWT to gain productivity in a particular waterway or corridor most? To exemplify:
        - When most freight flows consist of large bulk, draught restrictions should be lifted; when most freight flows however consist of container transport, enhancing bridge clearance might yield a higher benefit for IWT in that particular corridor.
        - When a corridor is largely utilised by ships that sail on a day-trip basis, IWT efficiency can improve through investing in overnight staying possibilities; when the corridor is mostly utilised by ships that sail on a continuous basis there is less need for these investments.
3. Which investment sub-strategies (investing in a particular type of bottleneck) would create the highest return on investment for IWT and society at large?[14]
    - Which investment sub-strategies would create the highest return on investment in the different regions/basins/corridors?
    - How much would the infrastructure improvements cost per region/basin/ corridor?
    - In which region is the highest return on investment to be attained?
4. To what extent can IWT gain by improving connections with or between main economic centres or potentially important ones, industrial or residential?
    - Which (potentially) important economic centres are currently not (optimally) connected to sea or to each other by IWT (bottleneck or missing link)?
    - Which of these centres are services by other modalities (road and/or rail)?
    - How do the cost structures of IWT compare to the cost structures of other modalities, and in connection, which modal shift opportunities could be obtained for IWT by infrastructure investments to improve the connection?
    - Which opportunities for new freight flows can be seized by IWT by connecting developing economic centres?
5. To what extent can cities, ports, and other economic centres or European regions as a whole gain by improving connections with other main economic centres or potentially important ones, industrial or residential?

[14] This question can be answered by assessing the return of investment on a sample of projects from a certain bottleneck type.

- Which European cities, ports and other economic centres can mostly benefit from increased competitiveness due to increased connectivity in IWT?
- In which European region can most opportunities regarding new markets, freight flows and modal shift be found?
- To which extent are regions enabled to develop due to the IWT infrastructure connection that is established or improved, and which benefits could be attained as a result by society?

6. Which European region as a whole has the largest potential of developing areas economically through investments in IWT infrastructure?
7. How do the costs of the infrastructure investments relate to the costs in general; e.g. do geographical and other conditions allow for infrastructure investments that have a good potential of yielding favourable returns on investment?
8. What impact will the investments have on fleet composition in relevant waterways and corridors?

The information that is presented in the UNECE Bluebook updates and the PLATINA inventory will not be sufficient to assess the return on investment of infrastructure developments. The information gathered on type and volume of freight flows lacks detail. Furthermore, it should be assessed how proposed infrastructure improvements relate to the type and volume of freight flows. Different types of freight flows require different types of infrastructure enhancement, as has been exemplified above (e.g. heavy bulk versus container transport). This exercise has not yet been executed regarding European IWT infrastructure[15]. Information on bottlenecks in inland ports will be useful in assessing which improvements to inland ports and terminals will provide most benefits to IWT.

In the short (to medium) term, as a certain budget is set for infrastructure improvement: discussing these questions should enable stakeholders to decide which infrastructure investment strategies will bring most benefits to IWT and society at large. By opposing the return on investment of sub strategies, priorities in project types can be set. The assessment can provide answers to other questions, such as whether investing in inland ports and terminals, particularly in the smaller waterways of the network, yields higher benefits than investing in the enhancement of waterway dimensions. Another issue that could be looked into is whether enhancing a waterway class II to class IV yields a higher return on investment than enhancing a waterway class IV to class V. It is however vital to make a distinction between different regions in assessing the return on investment on sub strategies, as the return on in-

[15] Such a study has been undertaken in the Netherlands. In 2006-07 the Dutch government commissioned a study on the competitiveness of the Dutch IWT (*Policy Strategy Inland Waterway Transport*, conducted by *Policy Research Corporation* on behalf of the Dutch Ministry of Transport, Public Works and Water Management, 2006-7). Part of this study focused on assessing the costs and benefits of different types of IWT infrastructure projects. Several cases of infrastructure projects have been assessed in order to derive general conclusions on the social benefit of infrastructure project types and blueprint regarding the prioritisation of IWT infrastructure projects. Information on freight flows has also been taken up in the analysis.

vestment on investment strategies might differ. This could also imply that return on investment in some regions or corridors yields higher productivity gains for IWT than investments in other regions or corridors.

2 - IDENTIFYING THE IWT INFRASTRUCTURE NEEDS ON THE RHINE CORRIDOR

2.1 Introduction

In chapter 1 various elements have been identified which allow describing in more detail the opportunities for IWT on the Rhine corridor. Various elements (questions) being raised in the top down as well as the bottom up approach can be applied. Due to a lack of data and lack of time and resources not all elements could be addressed. A more general, first approach to describe the IWT potential on the Rhine corridor is therefore presented. The elements covered are described in this chapter.

It must be remarked that in terms of physical infrastructure bottlenecks the Rhine is considered to be a "mature corridor". As explained in the report "Medium and Long term perspectives of Inland Waterway Transport in the European Union (Panteia/NEA et all, 2012) compared to other corridors the Rhine corridor is the most developed, maintained and utilised corridor. The Rhine corridor consists mainly of upper CEMT classes (IV or higher). For instance, almost 50% of the large network of Dutch waterways are of class IV or higher. This is also seen in Belgium and on waterways in the western part of Germany merging to the Rhine River. As physical infrastructure restrictions have been considered in this report are:

- Limited draught
- Limited bridge clearance
- Limited lock capacity/ dimension

Moreover, already high density inland terminal network is available on the Rhine corridor. Focus for infrastructure development in this corridor will be on coping with low water problems (maintenance work) as well as preservation of quays and inland terminals. The general policy is to develop a 2.8m usable fairway on the lower Rhine - low fairway depth at dry seasons between Cologne and Duisburg (2.5 m) and from St. Goar to Mainz (1.9 m). Over 1 billion euro is needed for dredging. Also on some stretches more waiting/resting areas are needed. Finally it was concluded that specific attention needs to be paid to waterside location of new logistic areas and industrial plants. The latter has a direct link to this PLATINA report addressing in particular the intermodal transport market and the position of terminals and the transport services to/from terminals.

Bulk cargo is seen as a captive market for IWT as there is almost no alternative possible via other modes of transport. This is also presented in the chapter 3 of this report. However the competition and therefore the potential for IWT is quite strong in intermodal transport. The PLATINA exercise for the Rhine therefore did focus on the container transport flows on the Rhine corridor, see chapter 4 of this report..

2.2 Identifying the current potential of the Rhine corridor for more IWT usage

To describe the potential for more IWT on the Rhine corridor the following elements have been covered:

- Define the corridor and specify its characteristics;
- Define which Origin-Destination (OD)-pairs[16] sufficiently represent the specific corridor;
- Describe the role of the OD-pairs on the comprehensive, underlying transport infrastructure, connecting to other networks;
- Analyse the most important OD-pairs which allow for a modal shift, i.e.:
    - Size and type of freight flows,
    - Involvement of existing transport mode (modal share characteristics) and
    - Forecasts.
- Select the most important Key Performance Indicators (KPI) for a transport service to effectively deliver the goods. The FP7 project BE LOGIC suggests 6 main KPI to apply in transport benchmarking analysis: time, cost, flexibility, reliability, quality and sustainability. As flexibility, reliability and quality are rather subjective indicators, the KPI applied relates to transport time, costs and sustainability (limited to CO_2 emissions) and frequency of services (indicating flexibility).
- Identify the commercial transport services available on the OD-pairs for short term potential. The FP7 project BE LOGIC has provided a database, the European Intermodal Route Finder (EIRF), enabling users to find intermodal services by barge, rail and sea

[16] The corridor consists of a multitude of routes – Origin and Destinations – and networks being used by the various transport modes. They serve to enable supply and demand to meet, connecting nodes/terminals within the total supply chain.

across 29 European countries. The database contains information on transport schedules of intermodal transport operators including frequency of the service, departure and arrival terminal, transport time and modes used.

- Describe the performance of the various transport modes on the selected OD-pairs relating the KPI's. Information on the KPI frequency and transport time can be collected through the EIRF (rail and barge); for road the transport time can be calculated through route planning websites, whereas the frequency of road freight services are considered to be daily services. Sustainability performance of the different transport modes can be calculated with emission calculators, available through websites as well (i.e. ecotransit.org). Actual transport prices are considered to be volatile. Therefore it is better to use estimation of transport costs for the operators involved. Information was collected through means of direct interviews with transport service providers with regular services on the respective OD-relation; names were found through the EIRF database. In this study transport cost data was used from NEA as well as from operators active in the market.
- Study the possible evolution of commercial transport services based on trends and forecasts (medium and long term potential);
- Identify the major bottleneck(s) of a transport mode to serve the EU transport policy objectives on the OD-pairs[17];
- Identify measures and develop scenarios to upgrade the IWT potential in the modal split on a specific OD-pairs;
- Define the outcome of this scenario;
- Identify what should be done to act in reality in accordance to the scenario.

To use the Rhine corridor on a wider EU scale, it should be evaluated whether the OD´s selected for this corridor can be meaningful for other corridors. Moreover a consultation and dialogue with market parties (e.g. large shippers, forwarders, intermodal transport operators, terminals, port authorities) should be part of the process.

[17] In the PLATINA D 5.5 report "Inventory of available knowledge on strategic IWT projects" an assessment has been made on all European IWT infrastructure bottlenecks and projects, see Chapter 4, Bottlenecks and missing links in the European IWF infrastructure network, pages 26-38, 2010 edition. www.naiades.info/waterways

2.3 Selecting OD-pairs

As the research cannot be conducted on the total corridor as a whole, OD-pairs have to be selected. For this research, five important and potentially interesting routes – for intermodal transport and taking cargo off the road and onto the IWT - were selected in coordination with the EC. The selected routes for the Rhine corridor are:

1. Antwerp - Metz
2. Antwerp – Strasbourg/Mulhouse
3. Duisburg/Düsseldorf - Frankfurt/Wiesbaden
4. Rotterdam – Heilbronn/Stuttgart
5. Duisburg – Rotterdam.

These routes were evaluated based on:

- Container transport;
- Origin-Destination transport data on 2007 and 2020 from ETIS/TRANSTOOLS data-bases and NEA forecasts for 2020;
- Transport modes active on the routes;
- Commercially active terminal handling capacity;
- Available terminal capacity on the route;
- Available process and opportunities to provide services to IWT.

Related to the selected OD-pairs the following research questions were addressed:

- Which (intermodal) transport alternatives (including IWT, rail) exist on the selected OD-pairs?
- What is the performance of the IWT alternative compared to road-only and possibly the rail alternative?
- Is the IWT alternative more energy-efficient?
- Is modal shift towards IWT a realistic option on the selected OD-pairs?
- If not, how could the IWT performance be (substantially) improved?

2.4 Selection of the most important indicators to identify the contribution of a transport mode for developing a sustainable network per corridor

To identify whether IWT can substantially increase its performance on the Rhine corridor, four KPI’s have been used to measure the transport performance (included in the transport cost structure of the supply chain):

- Time
- Frequency of services
- Cost
- CO_2 emissions (part of environmental performance).

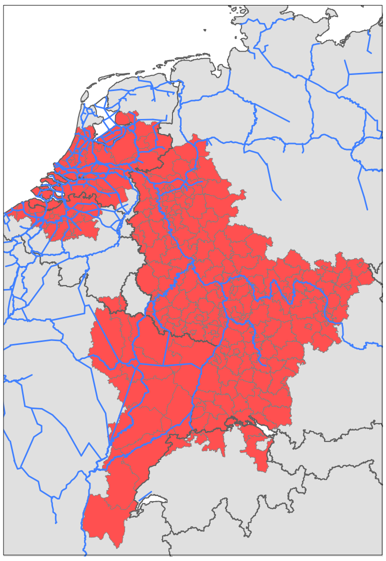
To determine whether a project or transport mode adds value to the core and comprehensive network, a more complete set indicators could be developed based on the way a transport mode performs in the overall supply chain (see annex V).

3 - OVERVIEW OF THE RHINE CORRIDOR AND ITS IWT MARKET SHARE

3.1 Definition of the Rhine corridor

The Rhine corridor is defined in terms of the geographic scope. A selection was made of the areas in the origin-destination matrix for the year 2007 that are close to the Rhine river. The data for the Rhine is a subset of the data that was developed in the European project ETIS (European Transport Information System)[18] and is used by the European transport model TRANSTOOLS. Figure 3.1 presents the selected area for the analyses.[19]

Figure 3.1. Selected NUTS areas for the Rhine transport analyses



[18] See also: http://www.etisplus.eu for more information about the ETIS database on transport flows in Europe

[19] Regarding the quantitative figures for the selected areas along the Rhine river and its tributaries, one has to keep in mind that these number only include data from origins *and* destinations combinations on the Rhine. It does not include cargo coming from or going to other corridors (e.g. corridors such as the Danube, North-South and East-West). Therefore the data selection shall be seen as a subset of the overall freight volume transported on the Rhine corridor. The year 2007 was selected because this in the most recent year with a reliable base of information from TRANSTOOLS.

3.2 Transport data on the Rhine corridor

The Rhine corridor is very important for Europe. The corridor has the highest IWT transport intensity and connects to the various other navigational waterways. In 2007, 158 million tons transported was transported IWT in 2007 on the Rhine, covering approximately 1/3 share of the overall volume transported by IWT in the EU27[20]. In figure 3.2 a map of waterways in Europe and transported volumes illustrates the transported volumes by IWT on the Rhine in 2007.

Figure 3.2 Map of waterway in Europe and transported volumes in 2007

In table 3.1 the size of the market as well as the modal share for modes Road, Rail and IWT is presented.

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20 In total there is 454 million ton of cargo transported by IWT in the overall TRANSTOOLS/ETIS dataset for EU27 + rest of Europe

Table 3.1: Modal split (in 1000 tonnes and million tkm) on the Rhine corridor in 2007

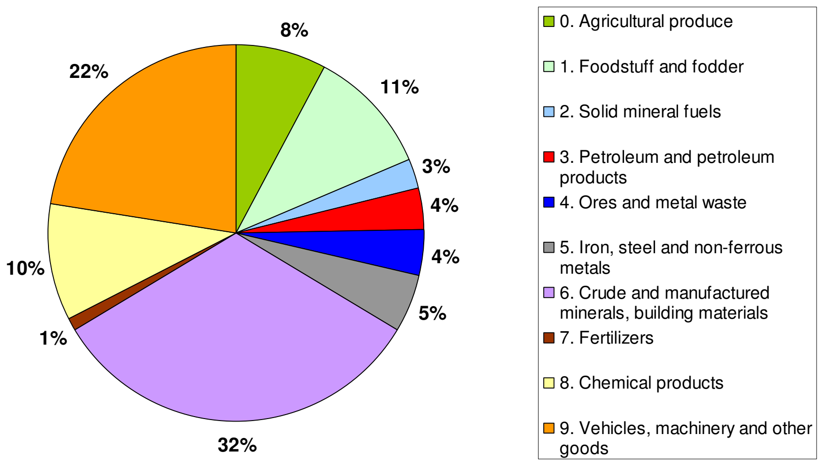
Mode	Volume		Performance	
	(*1000t)	Share (in %)	(in million tkm)	Share (in %)
IWT	158,732	8%	33,547	16%
Road	1,690,833	90%	160,714	79%
Rail	32,100	2%	10,070	5%
Total	**1,881,665**	**100%**	**204,330**	**100%**

On the Rhine, the modal share of IWT is approximately 8% in terms of volume transported and 16% in terms of ton kilometer performance. The length of the journeys for each mode causes this difference. In 2007, the average distance per mode on the Rhine in 2007 was:

- Road – 95 km
- IWT – 211 km
- Rail – 314km

Figure 3.3 shows the overall composition of freight transport in terms of NSTR goods classification on the selected origin-destination pairs for the Rhine corridor.

Figure 3.3: Share of volume transported on the Rhine per market segment



The major findings relating the modal share in Rhine corridor market are[21]:

- IWT has the largest volume of the transport of building materials (32% in total).
- For the finished goods, road haulage is the dominant mode of transport.
- The transport of finished goods (NSTR 9) is rather important in IWT and represents a share of 22% of the overall volume.
- The modal share of IWT per market segment is relatively high for the transport of NSTR 4 (Ores and metal waste) and NSTR 2 (Solid mineral fuels).
- Based on tonnage, 34% of the volume transported by road consists of NSTR 6 (crude minerals and manufactured minerals, building material) while 31% of the volume carried by trains consists of metal products such as steel coils (NSTR 5).

3.3 Transport distances on the Rhine corridor

Table 3.2 presents the total volume transported on different distance categories per transport mode.

Table 3.2 Volume (in m tonnes) per transport mode by distance class (in km) on the Rhine corridor in 2007

Mode	<50km	50-100	100-200	200-300	300-400	400-600	600-800	>800km	Total
IWT	33,384	27,107	31,147	32,537	6,902	15,784	11,286	586	158,732
Road	899,328	385,114	184,104	95,517	55,016	55,536	15,844	374	1,690,833
Rail	2,088	2,865	5,859	5,456	5,245	7,648	2,793	147	32,100
Total	**934,800**	**415,086**	**221,109**	**133,509**	**67,163**	**78,968**	**29,923**	**1,107**	**1,881,665**

Table 3.3 presents within a distance category the share transport mode. As distances increases, the dominant role of road transportation decreases. The longer a transport takes, the more attractive IWT and rail transport become.

Table 3.3 Share (in %) per transport mode by distance class (in km) on the Rhine corridor in 2007

[21] In Annex II, the 2007 figures on the division of the modal share per NSTR goods are further elaborated.

Mode	<50km	50-100	100-200	200-300	300-400	400-600	600-800	>800km
IWT	4%	7%	14%	24%	10%	20%	38%	53%
Road	96%	93%	83%	72%	82%	70%	53%	34%
Rail	0%	1%	3%	4%	8%	10%	9%	13%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

In table 3.4, the IWT volume per NSTR category by distance class on the Rhine corridor is illustrated. [22]

Table 3.4: IWT volume (in 1000 tonnes) per NSTR category by distance class (in km) on the Rhine corridor in 2007

NSTR	<50km	50-100	100-200	200-300	300-400	400-600	600-800	>800km	Total	Share in total
0: agricultural produce	2,169	2,041	2,063	870	164	911	579	73	8,871	6%
1: foodstuff and fodder	446	1,463	1,597	385	80	238	223	23	4,454	3%
2: solid mineral fuels	5,297	4,515	6,018	7,735	1,140	1,567	1,353	33	27,658	17%
3: petroleum and petroleum prod-ucts	1,178	3,750	4,299	1,724	784	2,005	1,790	144	15,674	10%
4: ores and metal waste	2,621	3,519	6,935	12,105	3,099	6,429	4,055	86	38,849	24%
5: iron, steel and non-ferrous met-als	2,692	1,367	1,696	2,632	392	976	432	49	10,237	6%
6: crude minerals and building ma-	18,067	6,935	5,251	4,815	744	2,189	1,492	74	39,566	25%

[22] In Annex II figures on the transported volume for each NSTR type for different distance classes for Road and Rail have been attached.

terials										
7: fertilizers	197	423	591	594	106	228	175	10	2,324	1%
8: chemical products	569	2,461	2,020	894	168	601	547	39	7,299	5%
9: vehicles, machinery and other goods	149	633	677	781	224	639	640	55	3,798	2%
Total	33,384	27,107	31,147	32,537	6,902	15,784	11,286	586	158,732	6%
Share in total	21%	17%	20%	20%	4%	10%	7%	0%	100%	

Table 3.5 presents the modal share of IWT for the different distance classes and type of goods, based on the volumes per NSTR for each distance class.

Table 3.5 Modal share of IWT per NSTR category by distance class (in km) on the Rhine corridor in 2007

NSTR	<50km	50-100	100-200	200-300	300-400	400-600	600-800	>800km	Total
0: agricultural produce	3%	6%	12%	11%	4%	15%	24%	39%	6%
1: foodstuff and fodder	0%	4%	6%	3%	1%	3%	11%	35%	2%
2: solid mineral fuels	51%	33%	61%	97%	59%	65%	83%	100%	58%
3: petroleum and petroleum products	3%	20%	53%	90%	67%	87%	77%	80%	22%
4: ores and metal waste	15%	28%	62%	93%	68%	80%	81%	87%	54%
5: iron, steel and non-ferrous metals	6%	10%	17%	29%	8%	14%	18%	47%	11%
6: crude minerals and building materials	6%	4%	8%	11%	3%	10%	22%	58%	6%
7: fertilizers	3%	8%	23%	43%	18%	23%	28%	21%	13%
8: chemical products	1%	9%	9%	6%	2%	6%	15%	29%	4%
9: vehicles, machin-	0%	1%	2%	3%	2%	5%	22%	44%	1%

ery and other goods									
Total	4%	7%	14%	24%	10%	20%	38%	53%	8%

The major conclusions comparing the figures on distances are:

- In road haulage, the distances are relatively short. Only 13% of the road haulage trips do have a length over 200 kilometres, while 76% of road haulage is carried out on distances below 100 kilometres. Referring to the 300 kilometres distance mentioned in the EC White Paper on Transport, the volume is limited to 126 million tons. This is 7.5% of the overall volume transported by road haulage.
- Rail transport is in particular strong on medium and longer distances. For example 24% of the volume transported by rail takes place on distances between 400 and 600 km. Only 16% of the volume transported by rail has a distance shorter than 100 kilometres.
- Already quite a lot of transport (21%) by IWT takes place on distances below 50 kilometres. In total, 78% of the transport by IWT takes place on distances below 300 kilometres. 22% of all IWT is above 300 kilometers.
- In particular market segments and distance classes, the share of IWT is remarkably high. An example is the transport of coal (NSTR 2) and ores (NSTR 4) on the distance class 200-300 km. The major reason being the very high volumes transported between seaports (e.g. Rotterdam, Amsterdam, Antwerp) and the Ruhr area (e.g. Duisburg) for the steel and energy industry.

3.4 Container terminals on the Rhine corridor

Figure 3.4 illustrates all containers terminals on the Rhine corridor and connecting waterways, which can be either used for Origin or Destination of IWT. A list of the inland container terminals on the Rhine corridor and connecting waterways is provided in annex III.

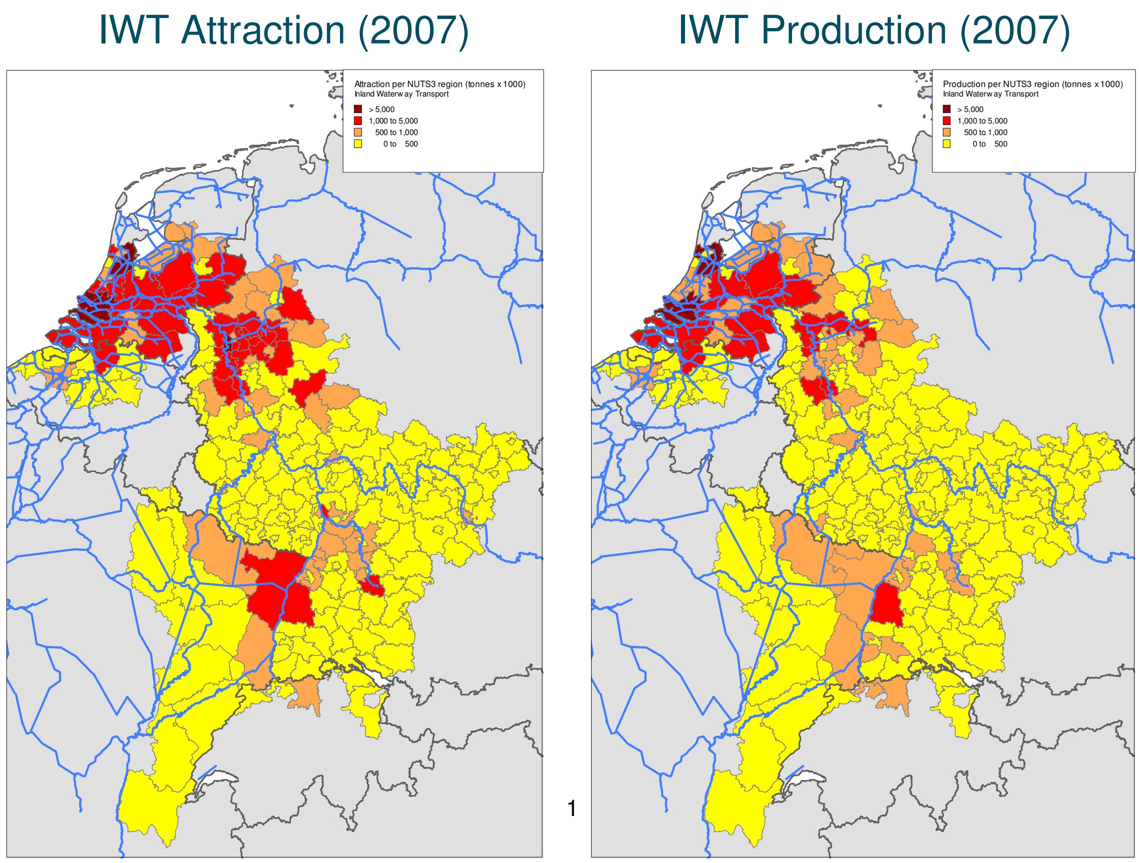
Figure 3.4 Container terminals on the Rhine corridor and connecting waterways

Source: http://www.bureauvoorlichtingbinnenvaart.nl/maps/?mapid=csl

3.5 Sketching the geography of freight transport on the Rhine corridor

Transport is related to supply chain management[23], which embodies the need to match the demand for goods with the delivery of goods and services. A geographical orientation can be made, identifying whether the areas where most demand for goods are located can connect to the services provided by the various transport modes. Based on this orientation, a demand and supply structure for goods transported by IWT has been developed. In figure 3.5, the transport attraction for IWT on the Rhine corridor is illustrated.

Figure 3.5: Transport attraction and generation for IWT on the Rhine corridor, selected origin-destination pairs, 2007



[23] Council of Supply Chain Management Professionals (CSCMP): "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies"

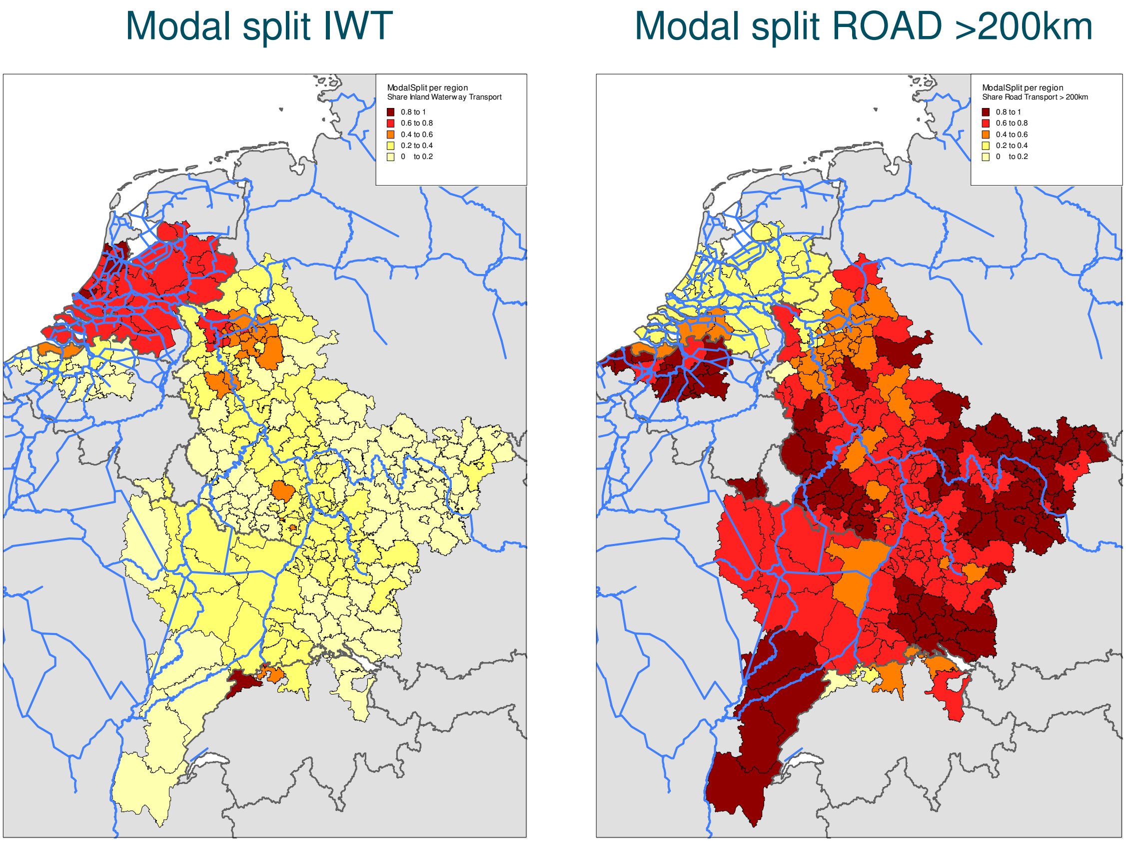
The Netherlands has a relatively high production and attraction for IWT volumes. In particular the seaport areas, Rotterdam and Amsterdam, provide a lot of work for inland waterway transport. In figure 2.5 the modal split-levels for the regions selected in the Rhine corridor are presented. Again it can be observed that The Netherlands has a high modal share for IWT.

The major reasons for a high IWT modal share are:

- A very high density of waterways.
- The quality of the network.
- Many terminals.
- Major network role of the mainports (e.g. Amsterdam and Rotterdam). In the hinterland of these ports, several `IWT ‘hot spots’ for IWT can be found, i.e. the Ruhr area, Frankfurt area and Basel.

Figure 3.6. illustrates a comparison of the modal split for IWT to road over 200km on five selected OD-pairs. From the modal split map for road haulage over 200 km it is clear that in particular high shares for road haulage are found in areas that have less favourable direct connections to the inland waterway network and the major seaports in the Rhine delta.

Figure 3.6: Modal split IWT and road haulage over 200 km on the Rhine corridor, selected Origin-Destination Pairs, 2007



In the area on the West of Switzerland (prospective market for Rhine-Rhone connection) also the area Trier the share of road haulage is rather high.

3.6 IWT transport forecasts

In the PLATINA D 5.5 report, it was illustrated that the Rhine continues to be the major transport corridor for the next decades, certainly till 2025. In the study "Medium and long term perspectives for inland waterway transport in the EU"[24] an analyses was made on the

[24] NEA, report can be downloaded at: http://nea.panteia.nl/NEA-Nieuws/Nieuwsberichten.aspx?newsid={5769EA27-0EAC-4F8A-91CF-BA5FF77F411B}. The Annex Report Chapter 2 presents the methodology and the approach for the forecasting for the developments towards the years 2020 and 2040 in a baseline scenario.

expected development of freight flows the EU27 and for various corridors with significant international IWT transport. Table 3.6 presents the baseline scenario for the Rhine area for the index of freight flows per NSTR in the year 2020 and 2040 compared to year 2007.

Table 3.6. Baseline scenario for the Rhine area for the index of freight flows per NSTR in the year 2020 and 2040 compared to year 2007

NSTR	IWT		Road	Rail	IWT		Road	Rail
	2020 low	2020 high	2020	2020	2040 low	2040 high	2040	2040
0: agricultural produce	95	105	111	121	109	129	129	156
1: foodstuff and fodder	95	105	108	120	109	129	119	150
2: solid mineral fuels	120	148	116	110	141	178	143	122
3: petroleum and petroleum products	91	96	99	94	70	91	96	80
4: ores and metal waste	86	110	105	107	67	99	113	113
5: iron, steel and non-ferrous metals	91	126	116	114	105	199	142	131
6: crude minerals and building materials	96	101	100	117	101	112	99	142
7: fertilizers	94	101	106	101	85	103	116	97
8: chemical products	112	143	115	139	134	253	139	218

NSTR	IWT		Road	Rail	IWT		Road	Rail
	2020 low	2020 high	2020	2020	2040 low	2040 high	2040	2040
9: vehicles, machinery and other goods	143	184	125	151	249	470	174	274

The major conclusions based on these forecasts are:

- A substantial growth for all transport modes can be expected in NSTR 2, 5, 8 and 9.
- Agribulk (NSTR 0,1,7) will become relatively less important.
- IWT growth is expected to be most substantial in NSTR 2 and 9.
- IWT contribution is most likely to decline in NSTR 4.
- IWT will equal its transport volume in NSTR 6.

3.7 Selecting major Origin and Destination pairs on the Rhine corridor

To further identify the opportunities to take freight off the road and onto IWT on the Rhine corridor, various Origin-Destination (OD) pairs have been researched. The basic research question being: What OD-pairs are representative for freight flows on the Rhine corridor, which would possible benefit from and allow for EC transport policy implementation?

The top performing OD-pairs of the three transport modes have been identified followed by an inventory of OD-pairs for road transport above 200km.[25] Based on these OD-pairs, 5 OD-pairs have been selected which possibly allow substantial opportunities for more transport onto IWT. The selection criteria for the 5 OD-pairs are:

- Total volume: the OD-pair represents a substantial volume in tonnes; tonne-kilometres or containers.
- Border crossing: origin and destination are located in different countries; Geography: not only origin or destination in the Netherlands and Germany, but also France should be represented (possibly Switzerland).

[25] This exercise is being more detailed presented in Annex III of this report

- Either the origin or destination (or both) are close to terminal locations, which enable the use of intermodal transport.

The top five OD-pairs are presented in table 3.7. In the next section an overview of inter-modal alternatives will be given for each of these selected OD-pairs in the Rhine-corridor.

Table 3.7 Selected top five OD-pairs for further analysis

Origin-Destination (both ways)		Road million TKM (2007)*	Tonnes transported by road transport (2007)
Antwerp	Strasbourg/Mulhouse	697	1,435,656
Antwerp	Metz	812	2,220,811
Duisburg/Düsseldorf	Frankfurt/Wiesbaden	1,001	4,089,678
Rotterdam	Heilbronn/Stuttgart	1,176	1,951,360
Duisburg	Rotterdam	393	1,859,952
* 200 km and above and combination of border crossing and continental cargo near intermod-al terminals.			

In total, the 5 OD-pairs represent a transport performance by road haulage of 4 billion ton kilometres and 11.6 million tons of cargo. Compared to all OD pairs with a distance over 200 km on the Rhine corridor the 5 selected OD pairs represent 5.2% of the overall size of car-ried by road haulage.

The various OD-pairs are illustrated in the figures 3.7 – 3.11

Figure 3.7 OD pair Antwerp-Strasbourg/Mulhouse

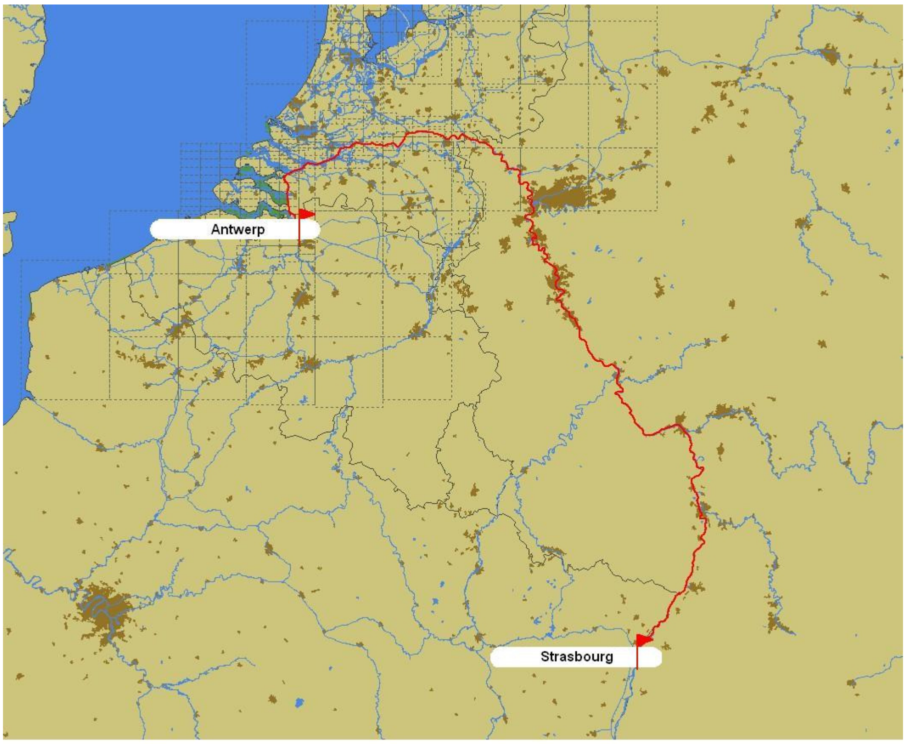


Figure 3.8 OD-pair Antwerp-Metz

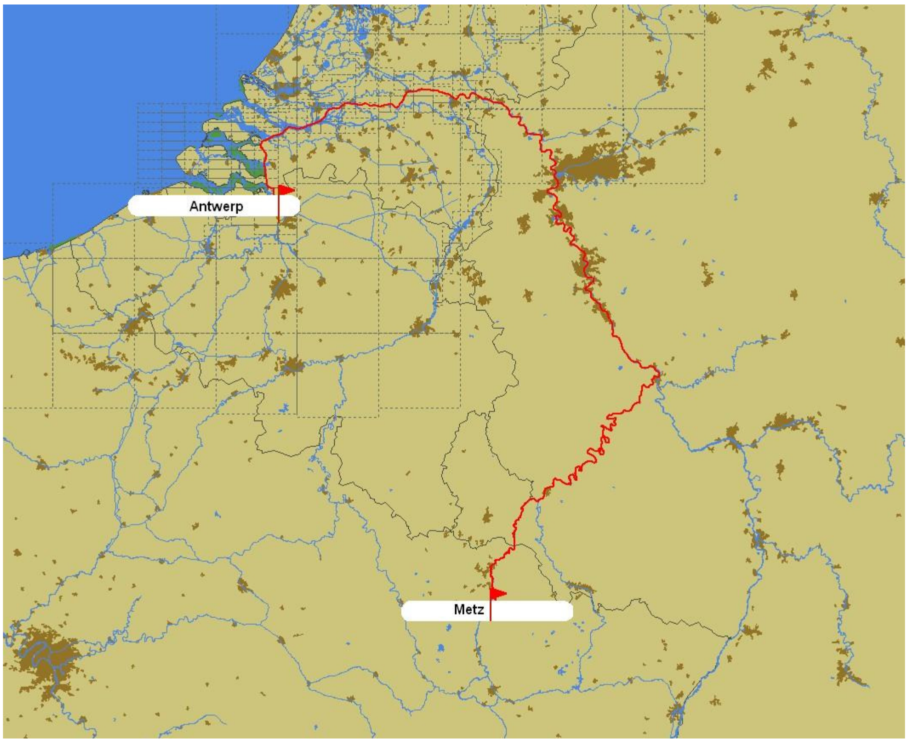


Figure 3.9 OD-pair Duisburg/Düsseldorf – Frankfurt/Wiesbaden

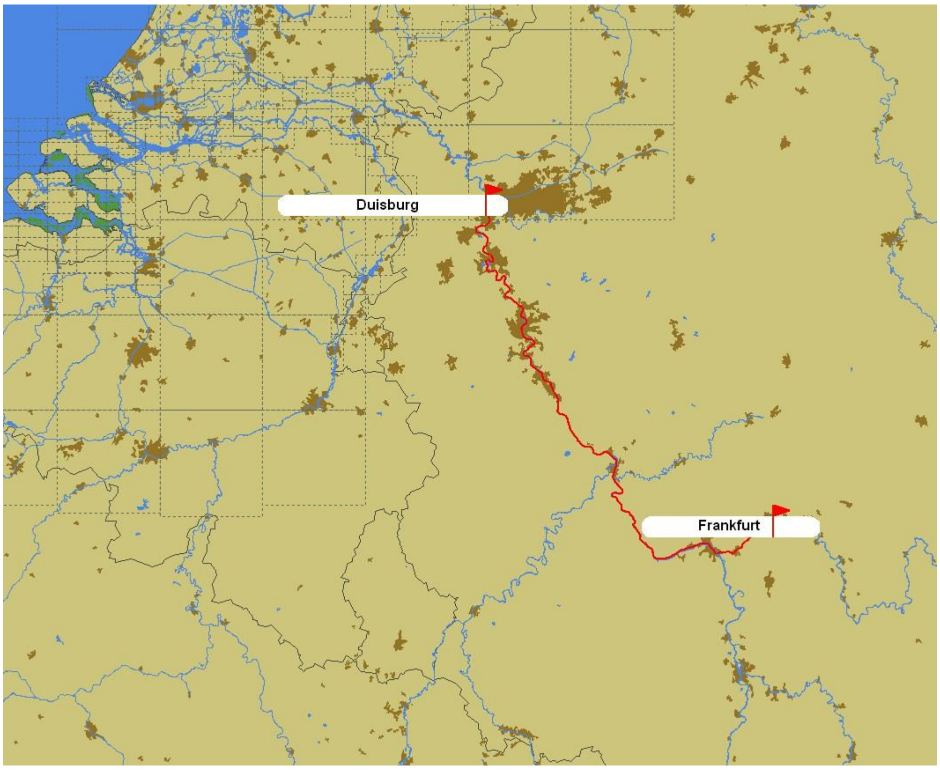


Figure 3.10 OD-pair Rotterdam – Heilbronn/Stuttgart

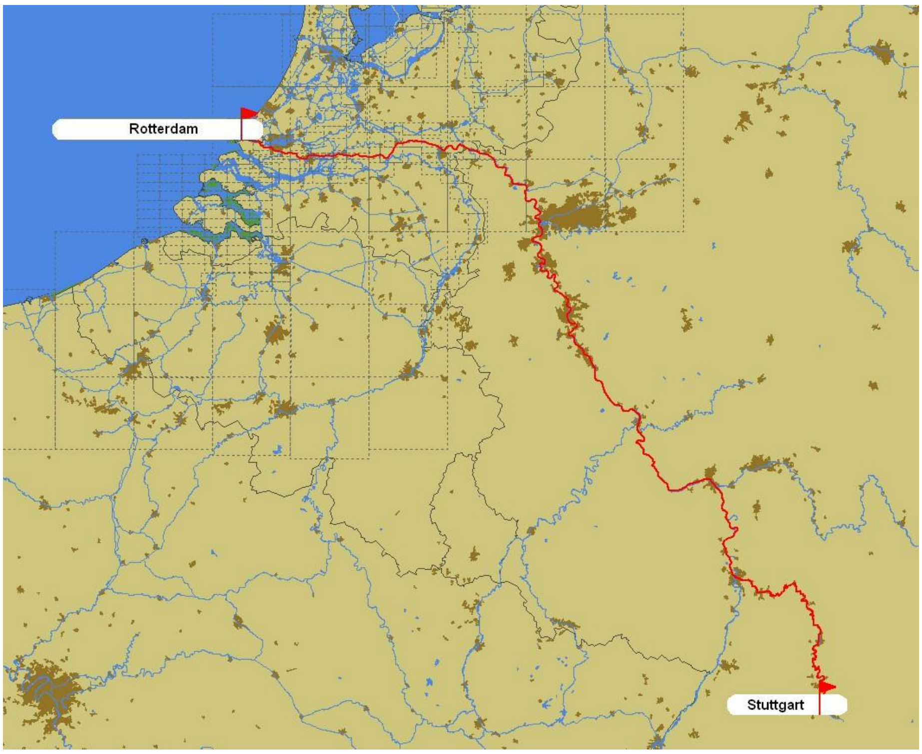


Figure 3.11 OD-pair Duisburg - Rotterdam

The modal share for the 5 selected OD-pairs is presented in table 3.8.

Table 3.8: Modal share for selected five OD-pairs, based on tonkm performance

Origin-Destination (both ways)		Modal share		
		Road	IWT	Rail
Antwerp	Strasbourg/Mulhouse	56.7%	33.7%	9.6%
Antwerp	Metz	55.2%	35.5%	9.3%
Duisburg/Düsseldorf	Frankfurt/Wiesbaden	94.9%	1.7%	3.4%
Rotterdam	Heilbronn/Stuttgart	51.1%	45.4%	3.5%
Duisburg/Düsseldorf	Rotterdam	21.7%	75.8%	2.5%

It can be observed that on the selected continental OD pair, the modal share of IWT is remarkably low while on ODs linked to seaports the share of IWT is quite significant.

The specific details of the modal share on the five selected OD-pairs are elaborated in chapter 4.

4 - ASSESSING AND BENCHMARKING IWT-INTERMODAL ALTERNATIVES ON THE RHINE CORRIDOR

An assessment for more involvement of IWT on the 5 OD-pairs in the Rhine corridor, presented in chapter 3, has been executed. Therefore, alternatives to current transport modes on the OD-pairs have been selected with the European Intermodal Route Finder (EIRF)[26]. For each OD-pair the intermodal alternatives are being benchmarked[27] with road transport and an intermodal rail alternative (if existing) by measuring four important Key Performance Indicators (KPI):

- Time.
- Cost.
- Frequency and
- Emissions (CO_2).

The results of the analyses have been validated in interviews with operators. Main outcomes of this validation are presented at the end of this chapter.

In order to calculate the cost and the emissions of the transport options, assumptions have been made to identify the type of vehicle/vessel/train, average load factor, and transhipment costs at ports and inland terminals. These characteristics have been validated with various operators. The main assumptions are summarised in table 4.1.

[26] The European Intermodal Route Finder (EIRF) has been developed under the FP7-project BE LOGIC. The tool enables users to construct intermodal routes via waterborne (inland shipping and short sea) and rail transport across 29 European Countries.

[27] The benchmark is performed with the Logistics Benchmarking Tool developed under the FP7-project BE LOGIC.

Table 4.1 Characteristics transport modes on the Rhine corridor

Characteristics	Road	IWT	Rail
Load factor	Load factor 60%	Load factor 65%	Load factor 60%
Type	Euro III engine Payload weight 24-40 tonnes	CEMT Class V	Electrified 1000 tonnes train
Transhipment costs € / container • Port area • Inland terminal	 • € 25 / move • N/A	 • € 70 / move • € 45 / move	 • € 45 / move • € 25 / move

In some of the intermodal alternatives, the main leg by IWT or rail might be preceded and followed by road transport. The average distance of this pre- and end haulage by road is assumed to be around 25 kilometres each. For reason of comparison, containers (either 20' feet, 40' feet or another dimension) have been expressed in TEU[28].

4.1 Transport operators and terminals

For each of the selected OD-pairs, aggregate figures on average transport time and frequency of IWT and rail services have been produced. These figures are based on the individual transport schedules of the IWT and rail operators offering direct transport services on each of the OD-pairs and are included in the EIRF-database. Table 4.2 summarises:

- The average frequency (number of departures per week) and transport time (in number of days) of both rail and IWT operators on the respective OD-pairs and
- The number of transport service providers (included in the database) who are actually operating these direct transport services.

[28] The ratio container / TEU is approximately 1.7.

Table 4.2: Average frequency and transport time of rail and IWT services per OD-pairs

OD-pairs	Average frequency	Average transport time	Number of transport Operators[1)]
Antwerp-Strasbourg			
• Rail	3.4	1.9	5
• IWT	2.5	3.3	4
Antwerp-Metz			
• Rail	3.4	1.9	5
• IWT	2.5	3.3	4
Dusseldorf-Frankfurt			
• Rail	-	1.0	-
• IWT	-	3.0	1
Rotterdam-Stuttgart			
• Rail	2.0	1.0	1
• IWT	4.0	4.3	2
Duisburg-Rotterdam			
• Rail	4.9	1.2	3
• IWT	1.8	1.4	6

1) Some transport operators offer direct transport services by both IWT and rail.

For most OD-pairs, transport by rail takes less time and is offered at a higher frequency than the IWT option.[29] Based on the direct connections found in the EIRF-database, the transport operators (at least one rail operator and one IWT operator) offering the best service in terms

[29] These are aggregate figures

of transport time and frequency have been selected for further detailed analysis in separate cases.[30]

4.2 5 OD-pairs

In this paragraph the five OD-pairs are further elaborated, and analysed based on container transport, thus NSTR 9.

4.2.1 Antwerp – Strasbourg pair

The figures for this OD-pair are included in table 4.3.

Table 4.3: Modal share per NSTR Antwerp - Strasbourg/Mulhouse, based on tonkm performance

NSTR and transport performance (tonkms * 1000)			Modal share		
			Road	IWT	Rail
0	agricultural produce	238,665	54.4%	30.4%	15.2%
1	foodstuff and fodder	75,588	66.9%	25.6%	7.5%
2	solid mineral fuels	6,360	30.4%	68.0%	1.6%
3	Petroleum and petroleum products	72,049	10.3%	87.6%	2.1%
4	ores and metal waste	23,075	58.0%	37.2%	4.8%
5	iron, steel and non-ferrous metals	173,402	61.0%	28.4%	10.6%
6	crude minerals and	388,604	56.4%	35.3%	8.4%

[30] The data on transport time, frequency of the service, and terminals of departure and arrival are based on information derived from transport schedules provided on the websites of the transport operators. This information is also available in the EIRF database.

NSTR and transport performance (tonkms * 1000)			Modal share		
			Road	IWT	Rail
	building materials				
7	Fertilizers	31,301	65.2%	25.9%	8.9%
8	chemical products	120,074	65.2%	24.4%	10.3%
9	vehicles, machinery and other goods	99,914	70.4%	22.8%	6.8%

The container is transhipped in the port of Antwerp and transported by road to a distribution centre in Strasbourg (base case). This transport operation is compared with intermodal alternatives by IWT and rail. The intermodal alternative includes transhipment in the port area (from sea to IWT or rail) and transhipment at the intermodal terminal near Strasbourg (from rail/IWT to road) and a final leg by road (end haulage) from the intermodal terminal to the distribution centre (see figure 4.1)

Figure 4.1 Transport on the Antwerp-Strasbourg OD-pair

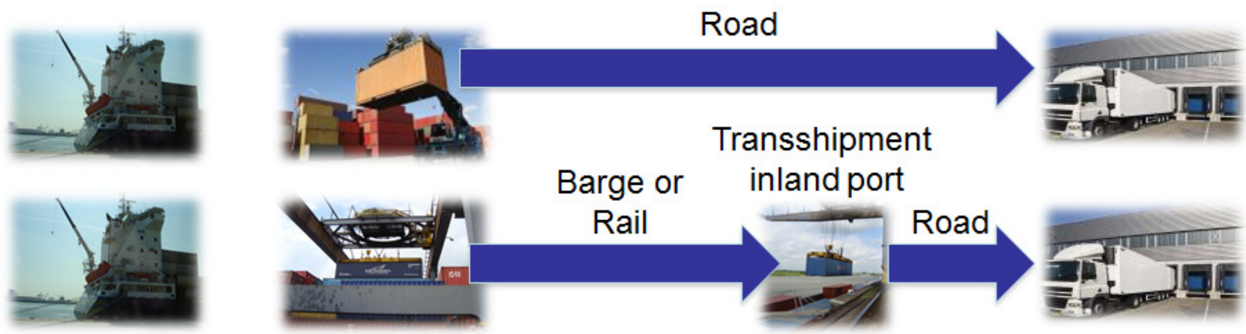


Table 4.4 and figure 4.2. summarise the main parameters for each option (road, intermodal IWT, intermodal rail). The major outcomes for best performing mode:

1. Transport time: Road
2. Costs: IWT
3. Frequency: Road
4. CO_2 emission: Train

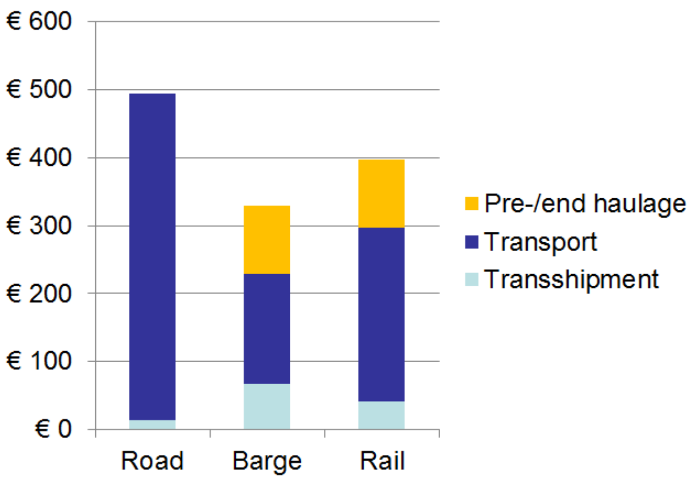
In terms of CO_2 emissions rail is the best option as the total volume of CO_2 emissions is only one sixth of the total road emissions of CO_2.Though lower than road, transport by IWT shows a relatively high volume of emissions which is caused by the long travel distance.

Table 4.4. Outcome 3 KPI's per mode Antwerp – Strasbourg OD-pair

From Antwerp	To Strasbourg	Mode	Distance	Frequency	Transport time	CO_2
Antwerp Quai 730	Strasbourg	Road	480	Daily	6,5 hours	0.40 tons
Antwerp Quai 730	Via Terminal Nord & South	IWT	742	3x per week	3 days	0.33 tons
Antwerp Main hub terminal	Via Terminal Nord	Rail	492	5x per week	1 day	0.07 tons

Figure 4.2. KPI on costs:

In terms of total transport costs the intermodal alternative by IWT performs at the lowest costs, followed by the intermodal rail alternative. The share of transhipment costs and costs of pre- and end haulage in both intermodal alternatives are significant, though.



Overall, the IWT option performs poor at the key performance indicators frequency and transport time, but is the best option in terms of transport costs.

4.2.2 Antwerp – Metz OD-pair

The figures for this OD-pair are included in table 4.5.

Table 4.5: Modal share per NSTR Antwerp - Metz, based on tonkm performance

NSTR and transport performance (tonkms * 1000)			Modal share		
			Road	IWT	Rail
0	agricultural produce	260,853	51.1%	38.4%	10.4%
1	foodstuff and fodder	78,072	70.1%	22.8%	7.0%
2	solid mineral fuels	82,064	58.9%	35.7%	5.4%
3	petroleum and petroleum products	155,161	26.4%	67.3%	6.4%
4	ores and metal waste	73,914	64.1%	29.5%	6.4%
5	iron, steel and non-ferrous metals	291,995	58.3%	31.2%	10.5%
6	crude minerals and building materials	279,425	52.5%	35.2%	12.3%
7	fertilizers	25,253	63.1%	29.9%	7.1%
8	chemical products	125,037	66.4%	24.3%	9.2%
9	vehicles, machinery and other goods	98,591	72.1%	20.8%	7.1%

The container is transhipped in the port of Antwerp, and transported by road to a distribution centre in Metz (base case). This transport operation is compared with intermodal alternatives by IWT and rail. The intermodal alternative includes transhipment in the port area (from sea to IWT or rail) and transhipment at the intermodal terminal near Metz (from rail/IWT to road) and a final leg by road (end haulage) from the intermodal terminal to the distribution centre (see figure 4.3).

Figure 4.3 Container transport transport on the Antwerp – Metz OD-pair

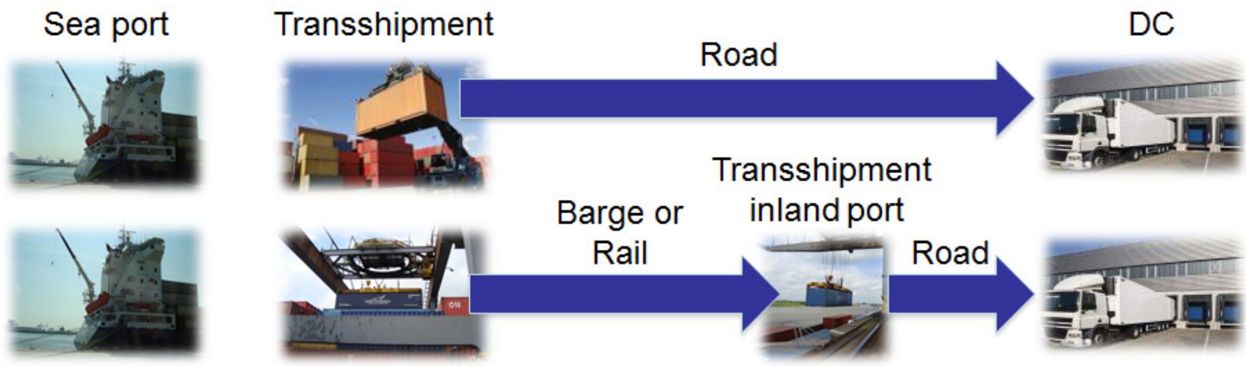


Table 4.6 and figure 4.4 summarise the main parameters for each option (road, intermodal IWT, intermodal rail). The major outcomes for best performing mode:

1. Transport time: Road
2. Costs: Road
3. Frequency: Road
4. CO_2 emission: Train

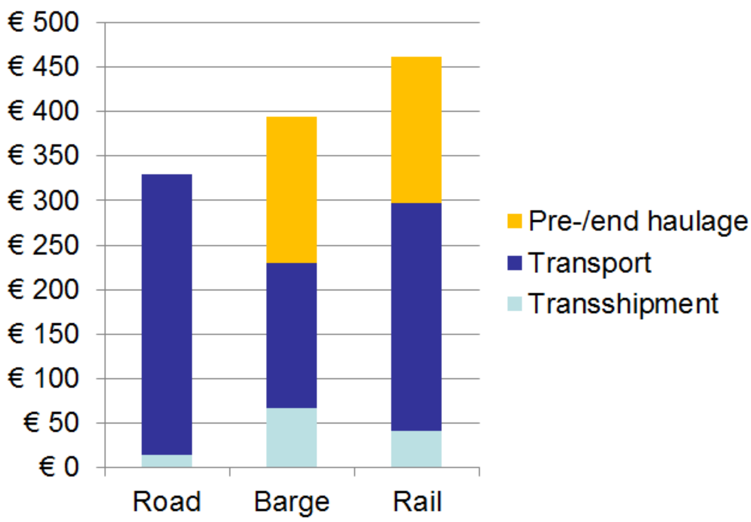
IWT shows a relatively high volume of emissions, which is caused by the long travel distance, including long end haulage by road.

Table 4.6 Outcome 3 KPI's per mode Antwerp – Metz OD-pair

From Antwerp	To Metz	Mode	Distance	Frequency	Transport time	CO_2
Antwerp Quai 730	Metz	Road	315	Daily	4,5 hours	0.30 tons
Antwerp	Strasbourg	IWT	742	1x per week	3 days	0.41 tons

Strasbourg	Metz	Road	165			
Antwerp Strasbourg	Strasbourg Metz	Rail Road	492 165	3x per week	1 day	0.15 tons

Figure 4.4 KPI on costs



In terms of total transport costs the intermodal alternative by IWT performs as second best, followed by the intermodal rail alternative. Share of transhipment costs and costs of pre- and end haulage in both intermodal alternatives are again very high.

Overall, IWT option performs poor at most key performance indicators, which is mainly caused by the long travel distance (742 kilometres by IWT) compared to the road and rail option (315 kilometres and 492 kilometres respectively). Further it is believed, that in practice the intermodal IWT option with a transfer in Strasbourg would not have been selected. A better alternative to road would have been intermodal rail from Antwerp to a transhipment point closer to Metz (i.e. Bettembourg).

4.2.3 Düsseldorf – Frankfurt OD-pair

The figures for this OD are included in table 4.7.

Table 4.7: Modal share per NSTR Duisburg/Düsseldorf - Frankfurt/Wiesbaden, based on tonkm performance

NSTR and transport performance (tonkms * 1000)			Modal share		
			Road	IWT	Rail
0	agricultural produce	63,267	99.6%	0.0%	0.4%
1	foodstuff and fodder	132,239	100.0%	0.0%	0.0%
2	solid mineral fuels	1,931	0.0%	100%	0.0%
3	petroleum and petroleum products	-	-	-	-
4	ores and metal waste	16,673	0.0%	97.3%	2.7%
5	iron, steel and non-ferrous metals	52,559	37.1%	0.0%	62.9%
6	crude minerals and building materials	380,992	100.0%	0.0%	0.0%
7	fertilizers	1,895	3.2%	0.0%	96.8%
8	chemical products	140,890	100.0%	0.0%	0.0%
9	vehicles, machinery and other goods	264,629	100.0%	0.0%	0.0%

The container is transhipped from an industrial site near Düsseldorf, and transported by road to a distribution centre in Frankfurt (base case). This transport operation is compared with an intermodal alternative by IWT. The intermodal alternative includes pre- and end haulage by road (between industrial site/DC and inland port or terminal) and two transhipments (i.e. from road to IWT at inland port/terminal near Düsseldorf and from IWT to road again at inland port/terminal near Frankfurt) (see figure 4.5).

Figure 4.5 Container transport on the Düsseldorf – Frankfurt OD-pair

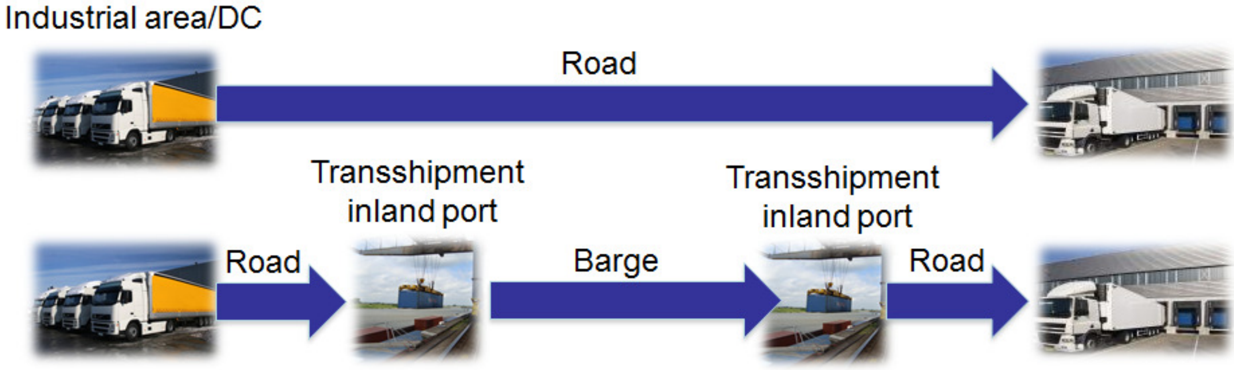


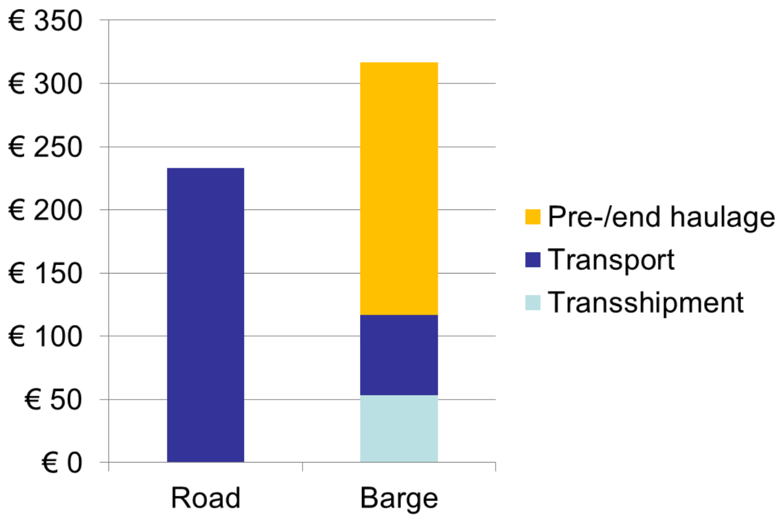
Table 4.8 and figure 4.7 summarise the main parameters for each option (road, intermodal IWT, intermodal rail). The major outcomes for best performing mode:

1. Transport time: Road.
2. Costs: Road.
3. Frequency: Road.
4. CO_2 emission: IWT.

Table 4.8 Outcome 3 parameters per mode on the Antwerp – Strasbourg OD-pair

From Dusseldorf	To Frankfurt	Mode	Distance	Frequency	Transport time	CO_2
Neuss Tri-modal	Frankfurt	Road	233	Daily	3,5 hours	0.20 tons
Neuss Tri-modal	Via Duss Terminal	IWT	278	1x per week	1 day	0.15 tons

Figure 4.6 KPI on Costs:



In terms of total transport costs (including pre- and end haulage, transhipment) the intermodal alternative by IWT performs worse than the road option. The share of pre- and end haulage costs in the intermodal IWT alternative are significant (60%). The assumption is that a return trip by truck from DC to terminal and back takes about one hour (2 x 25 kilometres drive, possibly through a congested area at rush hours), and dwell time and transhipment time at the terminal takes an hour as well. As these cases includes pre- and end haulage total transport time and thus costs are substantial.

Overall, the IWT option performs worst on three performance indicators except CO_2 emissions.

4.2.4 Rotterdam – Stuttgart OD-pair

The figures for this OD are included in table 4.9.

Table 4.9 Modal share per NSTR Rotterdam <> Heilbronn/Stuttgart, based on tonkm performance

NSTR and transport performance (tonkms * 1000)			Modal share		
			Road	IWT	Rail
0	agricultural produce	133,620	72.4%	21.2%	6.3%
1	foodstuff and fodder	197,816	87.7%	9.7%	2.6%
2	solid mineral fuels	88,279	8.1%	91.8%	0.2%
3	petroleum and petroleum products	152,149	6.5%	93.4%	0.1%
4	ores and metal waste	552,253	7.8%	91.8%	0.3%
5	iron, steel and non-ferrous metals	133,273	78.1%	17.4%	4.5%
6	crude minerals and building materials	356,213	81.4%	15.2%	3.5%
7	fertilizers	58,316	54.8%	37.3%	7.9%
8	chemical products	279,938	75.2%	19.7%	5.1%
9	vehicles, machinery and other goods	347,418	60.1%	32.0%	7.9%

In general, the container is transhipped in the port of Rotterdam and transported by road to a distribution centre in Stuttgart (base case). This transport operation is compared with intermodal alternatives by IWT and rail. The intermodal alternative includes transhipment in the port area (from sea to IWT or rail) and transhipment at the intermodal terminal near Stuttgart (from rail/IWT to road) and a final leg by road (end haulage) from the intermodal terminal to the distribution centre, see figure 4.7.

Figure 4.7 Container transport on the OD Rotterdam-Stuttgart

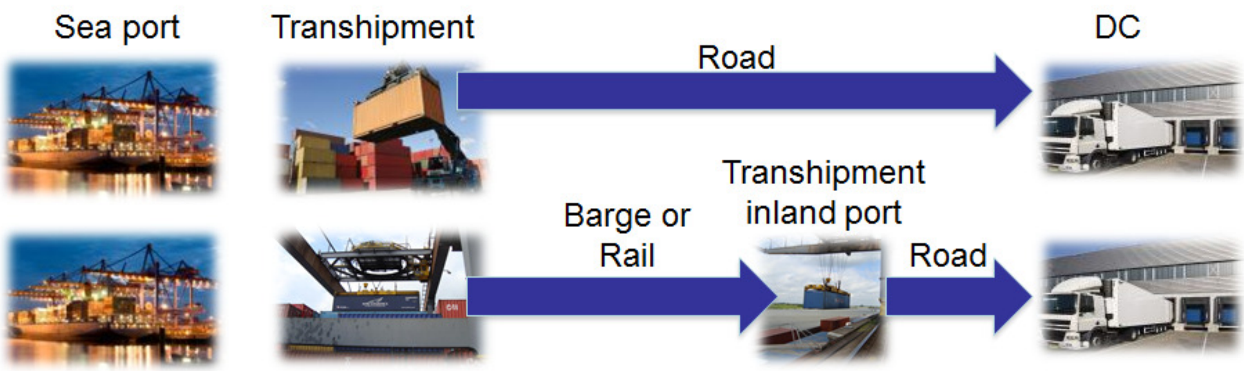


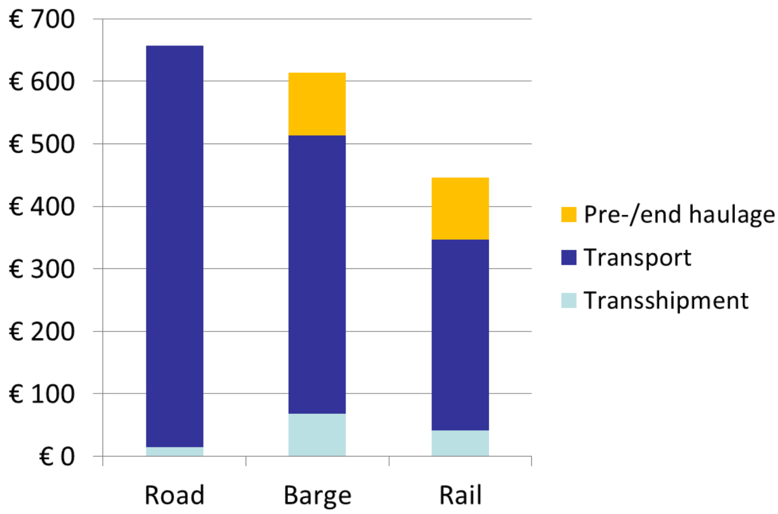
Table 4.10 and figure 4.8 summarise the main parameters for each option (road, intermodal IWT, intermodal rail). The major outcomes for best performing mode:

1. Transport time: Road
2. Costs: Road
3. Frequency: Road
4. CO_2 emission: Rail

Table 4.10 output 3 KPI on the Rotterdam – Stuttgart OD-pair

From Rotterdam	To Stuttgart	Mode	Distance	Frequency	Transport time	CO_2
Delta terminal	Stuttgart	Road	643	Daily	9 hours	0.60 tons
Delta terminal	Via SCT	IWT	742	2x per week	4 days	0.28 tons
Delta terminal	Via SCT	Rail	641	2x per week	1 day	0.12 tons

Figure 4.8. KPI on costs



In terms of total transport costs the intermodal alternative by rail performs at the lowest costs, followed by the intermodal IWT alternative. Share of transhipment costs and costs of pre- and end haulage in both intermodal alternatives are significant.

Overall, the IWT option performs moderate at key performance indicators frequency, emissions and cost, but much worse on transport time (4 days by IWT compared to 1 day by rail).

4.2.5 Duisburg-Rotterdam OD-pair

The figures for this OD are included in table 4.10.

Table 4.10: Modal share per NSTR Duisburg - Rotterdam, based on tonkm performance

NSTR and transport performance (tonkms*1000)			Modal share		
			Road	IWT	Rail
0	agricultural produce	260,853	26.2%	70.0%	3.8%
1	foodstuff and fodder	78,072	78.4%	18.1%	3.5%
2	solid mineral fuels	82,064	0.8%	99.0%	0.2%
3	petroleum and petroleum products	155,161	0.1%	99.9%	0.0%
4	ores and metal waste	73,914	0.4%	99.4%	0.1%
5	iron, steel and non-ferrous metals	291,995	17.7%	79.1%	3.1%
6	crude minerals and building materials	279,425	9.7%	88.6%	1.7%
7	Fertilizers	25,253	17.7%	79.0%	3.3%
8	chemical products	125,037	64.6%	29.9%	5.5%
9	vehicles, machinery and other goods	98,591	53.9%	38.1%	8.0%

The container is transported from an industrial area in Duisburg to the Delta Terminal in Rotterdam, including transhipment to sea (base case). This transport operation is compared with intermodal alternatives by IWT and rail. The intermodal alternative includes pre-haulage by road from the industrial site to an intermodal terminal in Duisburg, transhipment at the intermodal terminal in Duisburg (from road to IWT or rail), main leg by IWT or rail to Rotterdam and transhipment at the Delta Terminal to sea (see figure 4.9).

Figure 4.9 Container transport on the Rotterdam – Duisburg OD-pair

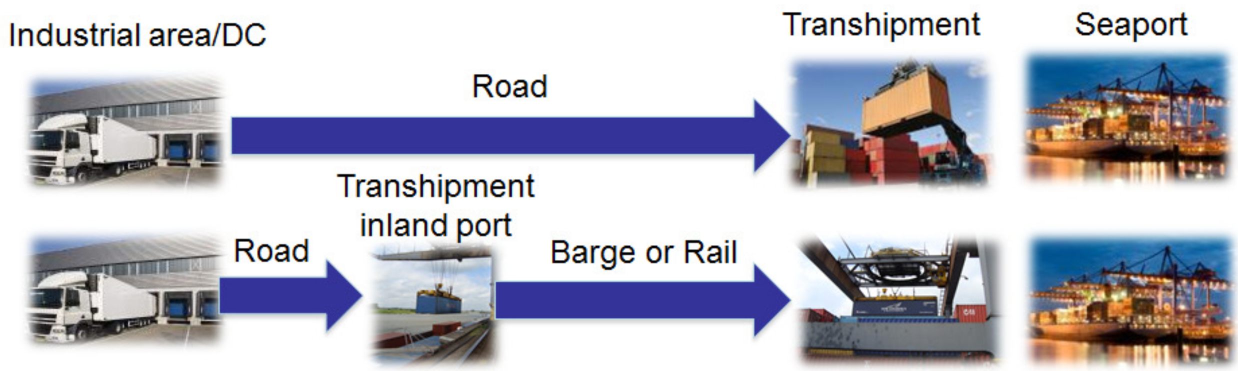


Table 4.11 and figure 4.10 summarise the main parameters for each option (road, intermodal IWT, intermodal rail). The major outcomes for best performing mode:

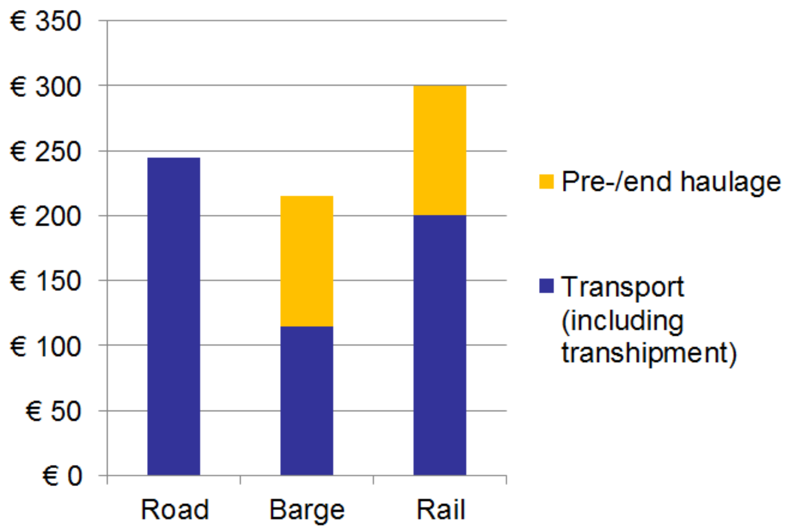
5. Transport time: Road
6. Costs: IWT
7. Frequency: Road
8. CO2 emission: Rail/IWT

Table 4.11 Outcome 3 KPI on Duisburg - Rotterdam OD-pair

From Duisburg	To Rotterdam	Mode	Distance	Frequency	Transport time	CO_2
Duisburg	Delta terminal	Road	230	Daily	4 hours	0.20 tons
Duisburg Intermodal Terminal (DIT)	Delta terminal	IWT	270	4x per week	1 day	0.10 tons
Duisburg Intermodal Terminal (DIT)	Delta terminal	Rail	252	10x per week	1 day	0.7 tons

Figure 4.10 KPI on Costs:

In terms of total transport costs the intermodal alternative by IWT performs best, followed by the road. Share of pre-haulage costs in both intermodal alternatives (IWT and rail) is very high. Cost savings in that respect would directly contribute to the competitiveness of both modes. Transport by IWT would become even more attractive than road.



Overall, transport by IWT performs very good in terms of total costs, although costs of pre-haulage are high. Further, CO_2 emissions are at the same level as emissions of the rail alternative, and much lower than road. The transport frequency of the fastest IWT service offered at this OD is however substantially lower than for rail and road.

4.3 Validation of the results

The results presented in each of the five cases have been validated in interviews with 5 transport operators.[31] Overall, the outcomes are believed to be realistic.

4.4 Sensitivity analysis

The Logistics Benchmarking Tool, which has been applied to compare the alternatives, enables the user to allocate different weights to each of the KPI (costs, transport time, frequency, CO_2 emissions). Generally, the total transport costs are believed to be the most important

[31] First the preliminary results and conclusions of the cases have been described in a summary report (power point), which was distributed to the transport operators. Then the results and conclusions presented in the summary report have been discussed during interviews (by telephone) with representatives of the transport operators. In some cases data have been slightly changed (i.e. more up-to-date information frequency of the service offered), whereas the preliminary data on transport costs by IWT in the Antwerp-Strasbourg case are believed to be too high compared to road. Transport costs by IWT have been modified here.

indicator. In order to analyse the impact of a different set of weights, the benchmark has been performed by allocating 80% to transport costs in the base case, and 40% to transport costs in the sensitivity analysis (and thus making the other KPI more important). Table 4.12 shows in qualitative terms how transport by IWT performs on the different OD-pair relations compared to alternatives (road and/or rail).

Table 4.12 IWT performance compared to alternatives (road and/or rail) on the different OD-pairs

OD-pairs	Frequency	Transport time	CO_2 emissions	Transport costs
Rotterdam-Stuttgart				
Dusseldorf-Frankfurt				
Antwerp-Strasbourg				
Antwerp-Metz				
Duisburg-Rotterdam				

worst	average	best

Transport by IWT performs best in terms of transport costs in 2 of the 5 cases:

- Antwerp-Strasbourg.
- Duisburg-Rotterdam.

Transport decision makers who are focusing on low transport costs (and thus allocate much weight on the KPI transport costs) should opt for intermodal transport by IWT on these two relations. However, in terms of transport time and frequency the performance of intermodal transport by IWT on both OD-pairs is poor. Transport decision makers who are focusing less on transport costs and thus allocate more weight to the other KPI, would most likely opt for road transport.

In the other three cases transport by IWT is – mainly due to substantial pre-/end haulage costs - more expensive than road and/or rail alternatives. Moreover, also in terms of transport time and frequency of the transport services offered, IWT is performing poorly compared to the alternatives. In that respect, allocating more weight to the other KPI (i.e. transport time, frequency, CO_2 emissions) would even further improve the overall performance of especially road compared to IWT (and rail).

5 - INFLUENCING THE MAJOR IWT SUPPLY CHAIN VULNERABILITY – PRE-END HAULAGE COSTS

The analyse conducted for this study makes it clear that the pre- end haulage costs are very important in terms of the share in the overall door-to-door costs. In particular, this is the case for continental transport that requires on both ends of the chain trucks for the pickup and delivery of containers. It is therefore worthwhile to further analyse the cost structure and the sensitivity of these costs in case of changed conditions.

5.1 Influencing conditions

To assess the opportunity for more IWT, conditions have been changed which could influence the pre- end haulage costs. These conditions relate to:

- Distance to customers.
- Average transport speed/time.
- Loading time.
- Round trip time.
- Roundtrip frequency.
- Number of TEU transported.
- Number of drive kilometres per truck.
- Variable costs.
- Truck costs.

The following assumptions are taken into account:

- Load capacity (TEU): 2
- Average utilisation of TEU capacity: 75%
- Average number of TEU per trip: 1.5
- Gross Operational hours per year of truck: 2068
- Efficiency loss in planning (waiting between trips): 35%
- Net operational hours per year of truck: 1,352

- Working hours of driver: 2585
- Fixed material costs (capital, etc.) per year: €18,250
- Personnel costs per year: € 59,222
- Other costs pear year: € 12,427
- Total fixed costs: € 89,899
- Variable costs per km (fuel, maintenance): € 0.34

5.2 Comparing various situations

The following table (5.1) presents the basic situation (A), as well as a number of alternative situations:

- Situation A: The distance between terminal and customer is 25 kilometer from the terminal
- Situation B: The distance between terminal and customer is 5 km instead of 25 kilometer from the terminal
- Situation C: The distance between terminal and customer is 5 km instead of 25 kilometer from the terminal as well as a better planning (less loss of time between trips)
- Situation D: less waiting time quick unloading of container at the customer: 0.25 hour instead of 0.75 hour.

Table 5.1 Four different situations

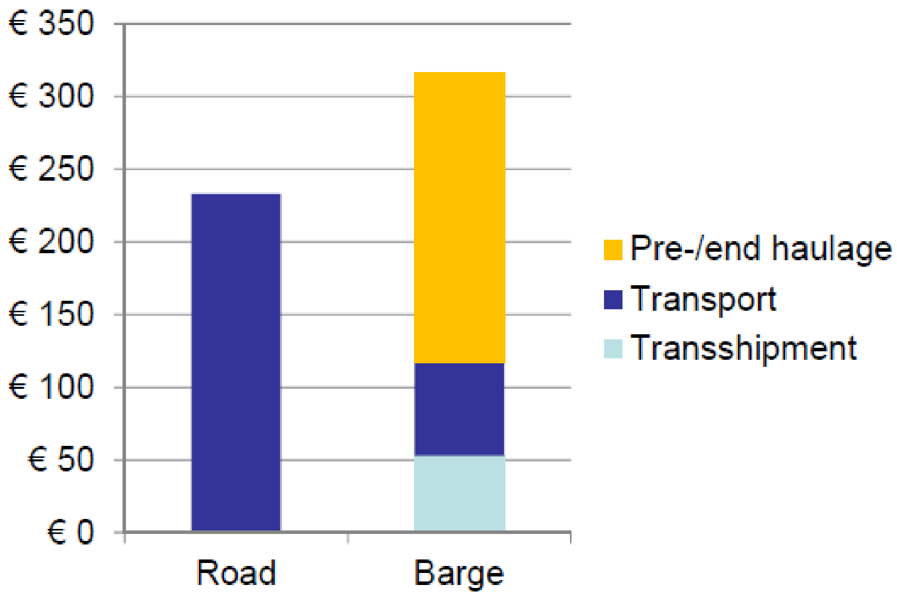
	Situation A (Basic)	Situation B	Situation C	Situation D
Terminal - customer – terminal	**Customer at 25 km**	**Customer 5 km**	**Customer 5 km and less buffer time (10% in stead of 35%)**	**Customer 5 km, less buffer time (10%) and quick unloading**
Distance from terminal (single way in km)	25	**5**	**5**	**5**
Average driving speeds (km/hour)	50	30	30	30
Waiting time for loading of container at terminal	0.05	0.05	0.05	0.05
Loading time container at terminal	0.05	0.05	0.05	0.05
Net driving time to customer (single way)	0.50	0.17	0.17	0.17
Waiting time at customer before unloading	0.05	0.10	0.10	**0.05**
Unloading of container at customer	0.75	0.75	0.75	**0.25**

	Situation A (Basic)	Situation B	Situation C	Situation D
Net driving time back to terminal (single way)	0.50	0.17	0.17	0.17
Waiting time unloading of empty container at terminal	0.05	0.05	0.05	0.05
Unloading container at terminal	0.05	0.05	0.05	0.05
Total roundtip time (hour)	2.00	1.38	1.38	0.83
Number of roundtrips per year	676	977	1345	2233
Number of TEUs transported	1013.9	1465.9	2018.2	3350.2
Number of drive kilometres by truck	33,796	9,772	13,454	22,334
Variable costs per year	€ 11,491	€ 3,323	€ 4,575	€ 7,594
Fixed costs per year	€ 89,899	€ 89,899	€ 89,899	€ 89,899
Total costs for truck per year	€ 101,390	€ 93,222	€ 94,474	€ 97,493
Total costs per roundtrip	**€150**	**€ 95**	**€ 70**	**€ 44**
Average costs per TEU	**€ 100**	**€ 64**	**€ 47**	**€ 29**

The costs for pre- end haulage - and therefore the overall door-to-door intermodal IWT costs - can be substantially lowered when the distance from the terminal to the customer and the waiting time at the terminal are lowered. Pre- end haulage operations can be much more efficient by means of improved planning and co-ordination efforts between terminal operator and the customer.

In the Düsseldorf (Neuss) - Frankfurt OD-pair the high pre-haulage cost for IWT are clearly illustrated. Figure 5.1 shows the results for Düsseldorf (Neuss) to Frankfurt assuming a pre-end haulage distance of 25 kilometres on both ends and duration of 2 hours per roundtrip (Situation A).

Figure 5.1 Situation A on the Düsseldorf (Neuss) to Frankfurt OD-pair



The distance by road is approximately 233 km. Although the transport and transhipment costs of IWT cost are much lower than for road transport, the specific pre- end haulage situation negatively defines the feasibility of intermodal IWT.

5.3 Lowering pre-end haulage costs

To carry out a highly efficient pre-end haulage process requires:

- Low (minimum) waiting times;
- A high utilisation of the road truck (return loads);
- A short distance to be covered by the truck for pre- and/or end haulage.

Two measures come to mind to lower pre- end haulage costs:

1. Establishing new clusters of industrial activities logistics/distribution functions directly along waterways and clustered around inland terminals.
   By means of clustering of activities, the critical mass can be provided for the terminal resulting in high frequencies and low transhipment prices. Moreover through clustering of industrial and logistic activities the distances in pre-end haulage by road are small, resulting in competitive chains.

2. Emphasis on ICT applications (integrated RIS services).
   The shipper/receiver of the cargo shall communicate efficiently with the intermodal operator (e.g. terminal) to ensure a smooth planning process with high utilisation per day (number of trips) and minimised waiting times of the truck for loading/unloading at the client.

It can be concluded that a differentiated approach is needed which focussing on areas where inland waterways are available and well connected to major terminals/ports and industrial areas. This approach should take into account the transport volumes, as well as the transport characteristics. [32]

[32] In order to validate this approach - assessing the modal shift potential - it is recommended to carry out a broad range of case studies, possibly supported by advanced transport system modelling software.

6 - MODAL SHIFT POTENTIAL ON THE RHINE CORRIDOR

6.1 A model to assess IWT impact on hinterland transport

This section considers the modal shift potential on the corridor. In order to assess the modal shift potential in quantitative terms, the Logit-model[33] has been applied. The model, which has been developed by Ecorys, enables to calculate the impact on the modal split (road, rail and IWT) in port hinterland transport, knowing the change in quality and cost of the different transport modes. The Logit-model outcomes depend on a number of route specific parameters, which can be changed in the model: transport price, transport time, frequency, transhipment volume in the port.

6.2 Scenarios

In order to assess the modal shift potential in the corridor, we have assumed that the performance of IWT services on each of the OD-pairs improves compared to the other alternatives (by road and rail). More in particular, transport costs and frequency of the services are the only two parameters which are considered in that respect, because transport time by IWT on the various OD-pairs is a parameter which is believed to be more or less fixed (vessels can not sail much faster).

The impact of different scenarios has been calculated which include:

- **Scenario 1**: 10% improvement of transport price per IWT compared to the alternatives by rail and road;
- **Scenario 2**: Increase in the frequency of the IWT service to more or less the same level as the rail option;
- **Scenario 3**: Combination scenario 1 and 2, including an improved transport price by barge and a higher frequency.

[33] Veldman, S.J. en E.B. Bückmann, A Model on Container Port Competition: An Application for the West European Container Hub-Ports, 2003.

As the Logit-model only takes into account port hinterland connections, the modal shift potential on 4 of the 5 OD-pairs, representing transport to/from sea ports, have been analysed.[34] The following sub-sections outline the modal shift potential in quantitative terms per OD-pair.

6.2.1 Modal shift potential Duisburg – Rotterdam

The modal shift potential of the Duisburg-Rotterdam OD-pair has been considered. Table 6.1 presents the change in modal split per mode for the various scenarios considered. Both scenarios have considerable impact on the current modal split. The major outcome being:

- The share of IWT will rise sharply at the cost of road and to a lesser extent also at the cost of rail.
- The impact of offering a higher frequency by IWT (+17%) is much higher than the impact of more competitive transport prices for the IWT option (+7%). The current IWT frequency of 4 times a week has been increased to 10 times a week (current rail option). If we assume an increase of the IWT service from 4 times a week towards a daily service (7 times a week) – that would be still below the frequency offered by the rail service - the modal share of IWT would rise with approximately 8%.

Table 6.1. Scenario outcome for Duisburg-Rotterdam OD-pair

Scenario	Road	Rail	IWT
Scenario 1: 10% price improvement IWT	-5%	-2%	+7%
Scenario 2: increase frequency IWT service	-12%	-5%	+17%
Scenario 3: Combination 1+2	-17%	-7%	+24%

[34] The OD Dusseldorf and Frankfurt has not been considered in this analysis.

6.2.2 Modal shift potential Rotterdam – Stuttgart

The modal shift potential on the Rotterdam-Stuttgart OD-pair has been considered. Table 6.2 presents the change in modal split per mode for the various scenarios considered. Again both scenarios have considerable impact on the current modal split. The major outcome:

- The share of IWT (+4%) will rise at the cost of road; - the modal share of rail on this OD is already very small.
- The impact of offering a higher frequency by IWT is much higher (+11%) than the impact of more competitive IWT prices (+4%). This would be the case if the current frequency of the selected IWT service of 2 times a week is assumed to triple to (increase to) 6 times a week. If we assume an increase in frequency towards 4 times a week, the modal share of the IWT option would rise more modestly with 5%.

Table 6.2. Scenario outcome for Rotterdam-Stuttgart OD-pair

Scenario	Road	Rail	IWT
Scenario 1: 10% price improvement IWT	-4%	0%	+4%
Scenario 2: increase frequency IWT service	-11%	0%	+11%
Scenario 3: Combination 1+2	-16%	0%	+16%

6.2.3 Modal shift potential Antwerp – Strasbourg (Metz)

The modal shift potential on the Antwerp – Strasbourg has been considered. Table 6.3 presents the change in modal split per mode for the various scenarios considered.Although both scenarios have impact on the current modal split, the effects are modest compared to the previous OD-pair. The major outcome:

- The share of IWT (+4%) will rise at the cost of road (-3%) mainly
- The impact of offering a higher frequency by IWT is slightly lower than the impact of more competitive transport prices for the IWT option. This is mainly caused by the fact that the

gap between the current frequency of the selected IWT service (3 times a week) and that of rail (5 times a week) is relatively small. Increasing the frequency of the IWT service with 2 extra departures has only a small impact on the modal share of IWT (+3%).

Table 6.3. Scenario outcome for Antwerp-Strasbourg (Metz) OD-pair

Scenario	Road	Rail	IWT
Scenario 1: 10% price improvement IWT	-3%	-1%	+4%
Scenario 2: increase frequency IWT service	-2%	-1%	+3%
Scenario 3: Combination 1+2	-6%	-2%	+8%

The outcomes for the Antwerp – Metz OD-pair are more or less similar to the figures in the previous table. Therefore, these impacts are not being presented in a separate table.[35]

[35] As already mentioned the Duisburg-Stuttgart OD-pair has not been considered as the Logit method only applies to port-hinterland connections

7 - A GENERAL METHOD TO DEVELOP AN EU CORRIDOR IMPLEMENTATION PLAN

7.1 The EC context

In 2011, the European Commission issued its Transport White paper towards a Single Transport Area[36], a Communication for integrated European infrastructures and various proposals for a Regulation, i.e. revised TEN-T Guidelines and the Connecting Europe Facility (CEF) and “Horizon 2020” proposals. These initiatives also relate to investments in key infrastructure with strong EU added value. These instruments should boost Europe’s competitiveness and be instrumental in allowing the EU to meets its sustainable growth objectives outlined in the Europe 2020 strategy.

Smart, sustainable and fully interconnected transport is considered to be a necessary completion of the European Single market. The EC strives to establish a network of interconnected cross-border transport infrastructure that is sufficiently interoperable, resource-efficient and multimodal. The new TEN-T Guidelines propose a planning and regulatory framework for infrastructure that is composed of a Comprehensive and a Core Network, i.e.:

- The Comprehensive Network should be in place by 2050 and constitutes the basic layer of the TEN-T;
- The Core Network should be in place by 2030, it overlays the comprehensive Network, constitutes the backbone of Europe’s multimodal mobility network and concentrates on those components of TEN-T with the highest European added value (i.e. multimodal nodes). The Core Network will be partly financed through the CEF.

The Europe-wide ‘Core Network’ has been established based on a European policy perspective. The core network contains ten corridors, carrying freight and passenger traffic with high efficiency and low emissions. It makes use of existing infrastructure. The EC Transport White Paper sets some relevant targets for a multimodal TEN-T ‘Core Network’, i.e.:

- By 2030: 30% of road freight over 300 kilometer should shift to other modes;
- By 2050: 50% of road freight over 300 kilometer should shift to other modes;

[36] “A roadmap to a Single Transport Area – Towards a competitive and resource-efficient transport system.” (28 March 2011)

- By 2050: all seaports should be connected, where possible, to the inland waterway system.

Within the EU Core Network, the Rhine corridor (Genova-Rotterdam, corridor number 6) is one of the 10 EU core corridors. The 10 Core Network Corridors (of which 7 include IWT) are:

1. Baltic-Adriatic corridor.
2. Warszawa-Berlin-Amsterdam/Rotterdam-Felixtown-Midlands.
3. Mediterranean corridor.
4. Hamburg-Rostock-Burgas/TR border-Piraeus-Lefkosia.
5. Helsinki-Valetta.
6. Genova-Rotterdam (Rhine corridor).
7. Lisboa-Strasbourg.
8. Dublin-London-Paris-Brussels.
9. Amsterdam-Basel/Lyon-Marseille.
10. Strasbourg-Danube corridor.

The proposed EC Regulation for revised TEN-T Guidelines and the proposed Regulations for a Connecting Europe Facility (CEF) and 'Horizon 2020' fit into the proposed EC Multi Annual Financial Programme 2014-2020. The proposals are being discussed and should be agreed upon by the European Parliament and the Council in 2012/2013. [37]

For the 10 corridors, it is foreseen that a corridor implementation plan shall be developed to further identify the elements that constitute a corridor and assist the multimodal corridor maturing in relation to the performance of various transport modes and the interconnectivity of transport modes. The following two main elements should be included to constitute a corridor implementation plan:

[37] Following Parliament's first debate on the draft TEN-T guidelines in February 2012, the Council of Transport Ministers reached a general approach agreement (http://register.consilium.europa.eu/pdf/en/12/st08/st08047.en12.pdf) on the Commission's proposal on 22 March 2012. Ministers extended the definition of 'projects of common interest' to cover any project complying with the requirements for the core and comprehensive network. The Council furthermore decided that the deadlines to complete these networks by 2030 and 2050 are no longer binding. Moreover, Member States may decide independently on the necessary investments. For example, they may refrain from certain projects when the required funds are not available or if projects are not yet mature enough. Furthermore, Member States will no longer be required to completely realise cross-border projects. The Council also agreed to modify the corridor concept. Finally, Transport Ministers decided to renounce the fixed number of countries and transport modes that should be covered by a corridor. Instead, more emphasis should be put on interoperability and cross-border connections. The Council position on the TEN-T guidelines will form the basis for negotiations with the European Parliament, whose approval is necessary before they would take effect. A vote by the European Parliament is foreseen for early 2013. The guidelines, which take the form of a Regulation, could be adopted in the first half of 2013. (Source: ESPO)

- Identification of the potential for a transport mode, or various transport modes, on the freight corridors in terms of required infrastructure capacity and performance in order to meet market demand both quantitatively and qualitatively.
- Define the required performance of a transport mode related freight services, or services provided by other transport modes, to meet customer expectations and policy objectives.

A proposal for a method to describe a corridor implementation plan is elaborated in this chapter.[38]

7.2 A Corridor Implementation Plan

The goal of the corridor implementation plan is to define the maximum capacity of the various transport modes on the freight corridor covering the different types of traffic, once the corridor is established.

The elements covered by a corridor implementation plan are:

1. Description of the corridor.
2. The actual participation of the various freight transport flows.
3. The current and future demand and supply structure (for freight transport).
4. Existing physical and virtual bottlenecks and missing links.
5. The contribution and participation of the various transport modes in the freight flows.
6. The magnitude of potential transport mode market growth.
7. A comparison between the performance of the various transport modes, based on a set of criteria (policy objectives relating to the development of sustainable transport).[39]
8. A scenario to develop more interconnectivity between the modes or improve the performance of a specific transport mode.
9. A description of the most important features affecting the performance of a specific transport mode (or all transport modes): technical, functional, regulatory, and infrastructural.
10. Assessment of the possible measures related to elements such as:

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[38] This method could possibly also be used to evaluate the eligibility of possible EU funding through the TEN-T budget. A basic condition being the realisation of a proposed project leads to EU added value, in terms of transport efficiency, sustainability and/or territorial cohesion. The proposed method could possibly assist the Commission to develop within the TEN-T guidelines a transparent methodology that would justify specific TEN-T project funding. With such a methodology projects with EU added value can justifiably be labeled as 'projects of common interest'."

[39] In Annex V a list of possible indicators has been provided

- Solving physical infrastructural bottlenecks, upgrade and construct missing links and improved maintenance of existing infrastructure.
- Development of infrastructure for alternative fuels, including distribution network.
- Awareness and promotion activities about sustainable transport alternatives, neutral logistics advisory to support multimodal transport solutions.
- Deployment of ITS systems – including indications of estimated costs and time horizons - to enhance freight transport performance.
- Solving possible shortcomings of the terminal network to boost interconnectivity and multimodality.
- To promote interconnecting freight terminals development advise on measures relating functional layout, spatial development and intermodal connections, capacity expansion, etc.
- Develop opportunities to match the operational demands of the relevant market for specific transport mode undertakings and logistics services.
- Smoothen cross-border procedures and common timetable development.

11. A roadmap, including recommended investments, projects and transport policy initiatives to stimulate the freight performance of a transport mode, including competitiveness and market share growth. [40]

12. A method to monitor and evaluate the effect of the corridor implementation plan

In paragraph 7.3 the various steps to develop the corridor implementation plan are elaborated.

7.3 The five steps to develop a corridor implementation plan

To develop a corridor implementation plan the following five-step approach is proposed:

1. A detailed survey of the corridor.
2. Execution of a GAP analysis comparing the overall transport performance compared with the EC policy objectives.
3. Assessment of possible measures for the development of the corridor, including a definition and analyses of options to effectively implement measures (i.e. to meet the policy objectives).
4. Roadmap for implementation of measures

[40] The corridor implementation plan could in addition also review (where necessary), the socio-economic costs and benefits stemming from the establishment of the freight corridor, responding to two major questions:
- What will the changes be in the volume, composition, modal split and spatial distribution (routing) of future transport flows as a consequence of the development / implementation of a Corridor, including the terminals as such?
- What are the changes in the use of the related transport infrastructure networks as a consequence of the development / implementation of a specific corridor?

5. Monitoring and evaluation

The five steps are further elaborate in paragraph 7.4 to 7.8

7.4 Step 1. A detailed survey of the corridor

This first step consists of

1. Analyses of the current situation.
2. Assessment of the market.
3. Assessment of the customers needs.
4. Market projections.

7.4.1 Analysis of the current situation

The following elements should be surveyed:

- The geographic and socio-economic context
- The commercial sphere of influence to be considered in the freight market, taking into account the different geographic levels of administration (Nomenclature of territorial units for statistics NUTS 1, 2, and 3)
- The general socio-economic situation in the relevant countries (population, GDP, and other relevant variables which influence traffic levels) as basis for the transport forecasts.
- The environmental impact assessment of the different transport modes.
- The transport market characteristics along the corridor, covering all modes of transport (IWT, Road Transport, Rail) within the sphere of influence of the corridor and also include, when relevant, inter-corridor flows.
- For each transport modes studied, the following infrastructure elements should be analyzed:
    - Main routes in the sphere of influence
    - Technical characteristics of each mode (gauges, maximum loads, tolls, possible limitations)
    - Freight terminals and logistics centres (size, connections with networks, type of services provided, legal status, I/C ratio, expansion plans)

7.4.2 Assessment of the market

Assessing the market, the survey should include:

- Actual freight market estimation per the Origin-Destination pairs (OD-pairs, being in total representative for the corridor), covering:
    - the traffic (i.e. number of shipments per day and per section per transport mode),
    - the volume and the types of goods and modal split for the corridor and if appropriate for different sections of the Corridor, including combined transport modes.

- General overview of the current situation and historical developments, of the principal regions and the points of departure and destinations (OD-pairs).

- Current Investments and maintenance costs.

7.4.3 Assessment of customer needs

Three groups of customers of a corridor can be identified and should be taken into account:

1. The specific transport mode undertakings and other applicants that operate on the corridor today.
2. The specific transport mode undertakings and other applicants that do not operate today, but might become interested in doing so in the future.
3. Other applicants such as shippers, freight forwarders, logistic service providers and other operators of other modes of transport that are/could be clients of the specific transport mode undertakings. (The provider must conduct interviews with these customers).

The survey should preferably illustrate the reasons why shippers, freight forwarders, logistics service providers and other operators use a particular transport mode.

7.4.4 Market projections (short term and medium/long term)

The survey should analyze the projections on the geographic and socio-economic context, i.e.:

- A forecast of the future development of the commercial sphere of influence to be considered in the freight corridor, taking into account the different geographic levels of administration (Nomenclature of territorial units for statistics NUTS 1, 2, and 3).

- A forecast of the evolution of the general socio-economic situation in the relevant countries (population, GDP growth, and other relevant variables which influence on traffic levels). Elements which should be covered are:
    - Ranges of potential increases of freight demand levels and environmental impact assessment within a short term and medium/long term period.
    - Vehicle and Vehicle-km(tons and tonkm), growth and shift from other modes.
    - Environmental impact assessment (quantities and internal/external costs evaluation):

GHG and CO_2 emissions, energy consumption, vehicle operating costs, congestion, path pricing, space consumption, noise, others...
  - Socio-economic cost/benefit evaluation.
  - Financial analysis and socio-economic analysis, including possible Public Private Partnerships.
  - Sensitivity and risk analysis of the financial factors

- Trends in the freight market structure, main players, legal and regulatory framework
- A forecast of the evolution of the infrastructures, of the quality of the services and of the costs of each mode
- A forecast of the evolution of the market shares of each mode of transport / combined modes
- The expected traffic growth for freight.
- The maintenance costs to keep a suitable corridor in good shape.

7.5 Step 2. A GAP Analysis

In step 2, the overall transport performance and potential is compared with the EC policy objectives. The outcome will be an understanding of the opportunities for the various transport modes to meet the EC policy objectives. These policy requirements can be derived from the various EC policy documents, see paragraph 7.1. Possible the outcome can be identified in a matrix structure, which is very much up to the specific EC policy service to determine. A GAP analysis should also take into consideration whether the EC policy objectives should be viewed form a supply chain management perspective, i.e. an integrative approach, of a transport mode specific approach. The GAP analysis could also identify synergies.

7.6 Step 3. Assessment of possible measures for the development of the corridor

In step 3, the possible measures to develop the corridor are assessed, including a definition and analyses of options to effectively implement measures (i.e. to meet the policy objectives). Preferably for each mode of transport the following elements should be known:

- Strengths and weaknesses of the services provided by each mode
- Punctuality, flexibility, reliability, visibility.
- The freight services: type/nature of freight, carrying capacity, working timetable and

transit times between terminals, stops along the itinerary (reasons for each stop, amount of time spent in each stop and in the total journey), reliability, punctuality, flexibility

- Cross-bordering costs, dwell times and relevant procedures: pre-end haulage, drivers, safety inspections, etc.
- Information and communication technology systems/services currently in place and feasible to implement
- The transport costs of the various transport modes, also compared with one another, including the opportunities to lower those costs.
- The external costs of transport

The identification of measures which can be effectively be implemented should relate to:

1. Improvement in the transport system, i.e:
   - The performance of the infrastructure and services that clients expect from a specific corridor
   - The expected future use (short term and medium/long term) of the freight corridor by freight services.

2. The specific transport mode enhancement, i.e:
   - Measures and milestones to counteract technical, operational and organisational problems
   - A benchmark analysis of relevant practices in a specific freight transport mode market segments.
   - The most important freight market segments where the specific transport mode should concentrate competitive efforts. Market sensitiveness (cost, time to deliver, quality, security, etc.) related to freight market segments with more potential for a specific transport mode.
   - A general framework for an economically viable performance of a transport mode or various transport modes.
   - The eagerness within a transport mode to serve freight client requirements, taking into account - among several other factors - traffic volumes, flow equilibriums, range of distances, total times and delivery costs, integration in supply chain activities, value of the goods, logistics chain integration, quality standards, information and communication technology, security, etc.
   - Recommendations about specific infrastructure and terminal performance enhancements, notably
     - Short term and medium/long term intervention needed to increase flexibility, reliability or capacity, elevate service quality standards, increase competitiveness in terms of time and costs, etc.
     - Comprehensive examination of the existing infrastructure and terminals identifying the most important means for harmonising technical, operational and regulatory practices along the whole corridor.
     - Investments to prevent disruptions and incidents, to deploy interoperable systems, etc.

  - Infrastructure improvement plans and coordinated action plans for the reduction of bottlenecks; particularly for freight specific features (length, weight, loading gauge, axle load, e.o).
  - List of projects and implementation outline plan with project descriptions, corresponding to budget and time duration estimates.
  - Terminal development plans, including capacity and demand analysis expressed in quantitative and qualitative terms; potential access problems to terminals should also be addressed
- Recommendations about equipment/fleet needs, recommended deployment of trains, truck, vessels others.

In its summary, the plan should indicate the freight corridor contribution for achieving EU Transport Policy objectives.

7.7 Step 4. Developing a Roadmap

The goal of the roadmap is to involve and commit the various stakeholders and define and execute the various measures effectively. Step 4 synergize the steps 1 -3 and translates the survey, the Gap analysis and the assessment of the possible measures into a milestone based proposal identifying the necessary actions to take in order achieve the goals of the specific corridor implementation plan (see 7.2, 1-10).

A roadmap can also include recommended investments, projects and transport policy initiatives to stimulate the freight performance of a transport mode, including competitiveness and market share growth.

7.8 Step 5. Monitoring and evaluation

The monitoring of the efficiency and effectiveness of policies, legislation, projects and measures is an integral part of a corridor implementation plan. Monitoring is an ongoing activity throughout the lifecycle of policy implementation. It determines the need for further action, and possible changes and improvements in policy statements and plans, or in actions taken to implement them. Monitoring closes the loop in the 'plan - do - monitor - review ' cycle and informs decision-makers of the consequences of actions and changes in the environment. Several monitoring approaches exist.

A proposal to monitoring the progress of a corridor implementation plan should contain the following elements:

a) Definition of the goals of the plan to counteract the vulnerabilities and/or strengthening the corridor (the nine elements being identified in the description of the corridor, see 7.2, should be incorporated);
b) Identification of the vulnerabilities of the corridor, related to the goal, and an assessment of the functioning of specific features (e.g. the vulnerabilities of IWT container transport performance on the Rhine corridor)
c) System to measure the impact of the measures implemented, whether they counteract the vulnerabilities of the corridor, and/or strengthening the functioning of the corridor.
d) Method to discuss the outcome of the monitoring and possibly identify the options to enhance the efficiency and effectiveness of the policy measures.

In general, monitoring and evaluation of policy implementation is related to the definition of indicators. To obtain agreed indicators to monitor the effect of a policy measure is a very difficult and sensitive issue. It relates to:

- The various elements involved (identified in this chapter)
- Policy and economic judgment of the various elements that come into play.

For the purpose of this study, the research team has not developed a proposal for feasible indicators. Indicators only work effectively when there are not too many of them iterated and they are also very dependent on the stakeholdership of the various parties involved. It is proposed that a multistakeholder Monitoring Committee is elected and involved in defining the indicators to measure performance.

a) Definition of the plan

In general terms, the following five key elements help to monitor the impact of one or more transport modes to the overall objectives of a corridor implementation plan:

1. Value added contribution to GDP of the transport modes on the corridor both direct and indirect (in euro per year and share in total).
2. External effects of IWT: total external costs of the transport modes on the corridor (in euro per year and share in total transport).
3. Modal split on the corridor (share in total, differentiated for different types of goods (NSTR).
4. External costs per tonne km and comparison between the transport modes on the corridor.
5. Internal costs per tonne km and comparison between the transport modes on the corridor.

The elements 2-4 do logically focus on the general policy objectives (raise modal share, reduce external costs). Indicator 5 allows determining the contribution of a specific transport mode to the modal share.

b) Identification of the vulnerabilities of the corridor

Within the context of this study - measuring the potential of IWT container transport on the Rhine corridor - several IWT related vulnerabilities that could possibly be counteracted with the help of a corridor implementation plan are identified, being:

- the frequency of the IWT services;
- long pre-end haulage operations between terminal and customer;
- expensive and time consuming transhipment operations on inland terminals;
- no direct waterway connection to major production plans and/or distribution centres.

These vulnerabilities should be further elaborated and agreed upon between the various stakeholders whether they allow for specific measures to be included in a corridor implementation plan. The same system could be applied for other transport modes and corridors.

c) System to measure the impact of the measures implemented

A number of data can be identified that assist monitoring the effect of measures implemented to achieve the goals of the corridor implementation plan. These data could also assist in determining the quality and price levels of IWT and allow a benchmarking process with other modes of transport. In Annex VI, four tables are provided on IWT which list data to allow to monitoring the effect of measures relating:

- Market and Awareness,
- Fleet,
- Employment and Education
- Infrastructure.

d) Method to discuss the outcome of the monitoring

It is proposed to establish a monitoring committee to guide the implementation of the corridor implementation plan. [41] The various stakeholders should be included in this Committee. The monitoring committee should define the goal of the plan, to develop a monitor implementation plan, and to draft guidelines what to do when measures being implement do not provide the anticipated effects. The monitoring committee should preferably be assisted by a research-based organization, which can execute specific tasks to monitor the outcome of measures and, in case the measures prove to be ineffective, propose ways to counteract the ineffectiveness of measures.

Interaction and commitment are key principles in establishing an effective monitoring system.

[41] In practice this might also be executed by the TEN-T coordinators to be appointed by the EC

8. CONCLUSIONS

8.1 Towards an IWT infrastructure development strategy

An IWT infrastructure Development Strategy aims to develop an integrated approach allowing further integration of IWT in the overall EU supply chain and advocating multimodal transport. A strategic plan should:

- Sketch the ideal IWT infrastructure end state.
- Sketch what brings IWT infrastructure value for money.
- Identify the elements that should be taken into consideration, i.e. their impact.

Ideally, the strategic plan will be developed through consultation between the various stakeholder parties. The outcome of this process will be the overview of missing links and bottlenecks in IWT infrastructure (already available see report D 5.5), complemented by an assessment of:

- the relative impact of types of infrastructure development on the position of IWT in Europe per region/basin/corridor, and
- the potential in enhanced competitiveness of cities, ports, and other economic centers due to enhanced IWT connectivity.

The combined information provides a reference for IWT infrastructure decision makers to set up and assess infrastructure development while using market-based indicators for the gains that result from types of infrastructure development.

8.2 Lessons learned on an applied corridor approach for the Rhine corridor

Elements of a generic corridor approach have been applied for the Rhine resulting:

1. The competitive edge of IWT largely depends on:
    - The existence of high quality waterways, terminals and the type and size of economic activity in the area;
    - Transport volumes and transport distances, allowing sufficient critical mass for IWT to provide frequent services and interconnection with other transport modes;
    - The various types of goods to be transported, independent of transport distance, such as perishables, high value goods, etc.;
    - The local circumstances, i.e. specific location of ports and terminals, pre-end haulage to distribution centres and/or production plants and transhipment costs;
    - The water level conditions. [42]

[42] Containerized IWT faces as major problems:

2. IWT has a great potential to raise its modal share in the intermodal chain when the frequency of the services can be increased and the transport time in pre-end haulage operations between terminal and customer be shortened. Infrastructural facilities such as the locations and the multimodal connections of terminals are decisive in this respect.

3. Containerized IWT faces as major problems:
    - No direct waterway connections to major production plants/distribution centres;
    - Expensive and time consuming pre-end haulage and transhipment operations;
    - IWT transport distance, often more than the transport distance by truck;
    - Consolidation of cargo requiring contracts with multiple clients and co-ordination with multiple parties in the intermodal transport chain;
    - Specific barriers on stretches in the network

4. The IWT infrastructure needs are:
    - Spatial development planning – to stimulate manufacturing companies to locate its subsidiaries close to the waterways – including targeted investment in transhipment facilities to handle these new cargo flows.
    - High quality terminal network with multimodal connections (rail, road) and located close to industrial centres for production and distribution
    - More integrated IT services, including cooperation (Public to Private as well as B2B).
    - Solutions to reduce the low water problems.

It has been identified that WT already substantially performs under the 300 km threshold and is an alternative to road transport. Over 300 km the overall volume transported by road haulage is only 7,5%. In 2007, the average distance per mode on the Rhine was for road 95 km, for IWT 211 km for IWT and for Rail 314 km.

The performance of IWT compared to other transport modes is the following:

1. **Transport costs:**
   IWT offers the best service in terms of transport costs on two important OD-pairs, representing seaports connections with the hinterland vice versa, Duisburg – Rotterdam and Antwerp – Strasbourg. The IWT service analysed on the relation Rotterdam – Stuttgart performs slightly better than road, but much worse than rail.
2. **Transport time and frequency:**
   IWT performs worse than rail and road on all OD-pairs, except Duisburg – Rotterdam. On these four OD-pairs IWT compared to rail transport, takes 3 to 4 times longer, while the frequency of the IWT service offered is much lower than rail.

- No direct waterway connections to major production plants/distribution centres;
- Expensive and time consuming pre-end haulage and transhipment operations;
- IWT transport distance, often more than the transport distance by truck;
- Consolidation of cargo requiring contracts with multiple clients and co-ordination with multiple parties in the intermodal transport chain;
- Specific barriers on stretches in the network.

3. **Emissions:**
   For most OD-pairs, IWT alternatives related CO_2 emissions[43] perform better than road only, but worse than rail.[44] In case the rail alternative includes a significant share of diesel trains traffic, IWT and rail performs almost equally in terms of CO_2 emissions.

Generally, in order to improve the transport performance of IWT alternatives it is important:

1. To shorten pre and end-haulage time and distance by road as much as possible, as it directly affects the transport costs and emissions;
2. To increase the volumes to be transported (i.e. by combining volumes with other operators), as this directly improves the frequency that IWT operators can offer as well as improvements of scale of transport (larger vessels);
3. To improve transhipment processes in order to shorten loading/unloading time at terminal - combining more terminals in one trip may have a negative influence on transport time due to extra time of loading/unloading.

To carry out a highly efficient pre-end haulage process requires:

- Low (minimum) waiting times.
- A high utilisation of the road truck (return loads).
- A short distance to be covered by the truck for pre- and/or end haulage.

The most important measures to lower pre- end haulage costs are:

1. Establishing new clusters of industrial activities logistics/distribution functions close to terminals and preferably directly along waterways.
2. Emphasis on ICT applications (integrated RIS services) in order to increase efficiency and reduce waiting times.

8.3 The corridor implementation plan – steps to be taken

The proposed elements to be covered by a corridor implementation plan are:

1. Description of the corridor.
2. The actual participation of the various freight transport flows.
3. The current and future demand and supply structure (for freight transport).
4. Existing physical and virtual bottlenecks and missing links.
5. The contribution and participation of the various transport modes in the freight flows.

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[43] The benchmark analysis focussed on carbon dioxide as it directly relates to energy efficiency of the transport modes, being a dominant factor for the green image of a transport mode. Other emissions (i.e. nitrogen oxides, non-methane hydrocarbon, sulphur dioxide, particulate matter) have not been analysed

[44] The CO_2 emissions that have been calculated include emissions of pre-/end haulage and transhipment in ports and at terminals. With respect to CO_2 emissions the picture is rather mixed, depending on the differences in distance between the modes for each OD pair.

6. The magnitude of potential transport mode market growth.
7. A comparison between the performance of the various transport modes, based on a set of criteria (policy objectives relating to the development of sustainable transport).[45]
8. A scenario to develop more interconnectivity between the modes or improve the performance of a specific transport mode.
9. A description of the most important features affecting the performance of a specific transport mode (or all transport modes): technical, functional, regulatory, and infrastructural.
10. Assessment of the possible measures related to elements such as:
    - Solving physical infrastructural bottlenecks, upgrade and construct missing links and improved maintenance of existing infrastructure.
    - Development of infrastructure for alternative fuels, including distribution network.
    - Awareness and promotion activities about sustainable transport alternatives, neutral logistics advisory to support multimodal transport solutions.
    - Deployment of ITS systems – including indications of estimated costs and time horizons - to enhance freight transport performance.
    - Solving possible shortcomings of the terminal network to boost interconnectivity and multimodality.
    - To promote interconnecting freight terminals development advise on measures relating functional layout, spatial development and intermodal connections, capacity expansion, etc.
    - Develop opportunities to match the operational demands of the relevant market for specific transport mode undertakings and logistics services.
    - Smoothen cross-border procedures and common timetable development.
11. A roadmap, including recommended investments, projects and transport policy initiatives to stimulate the freight performance of a transport mode, including competitiveness and market share growth.
12. A method to monitor and evaluate the effect of the corridor implementation plan

To develop a corridor implementation plan the following five-step approach is proposed:

1. A detailed survey of the corridor.
2. Execution of a GAP analysis comparing the overall transport performance compared with the EC policy objectives.
3. Assessment of possible measures for the development of the corridor, including a definition and analyses of options to effectively implement measures (i.e. to meet the policy objectives).
4. Roadmap for implementation of measures

[45] In Annex V a list of possible indicators has been provided

5. Monitoring and evaluation.

ANNEX I. IWT TRANSPORT DATA

Figure II.1 clearly illustrates that the modal share of IWT is relatively high for the transport of NSTR 4 and NSTR 2. For the finished goods however, road haulage is the dominant mode of transport.

Figure I.1 Modal share per market segment

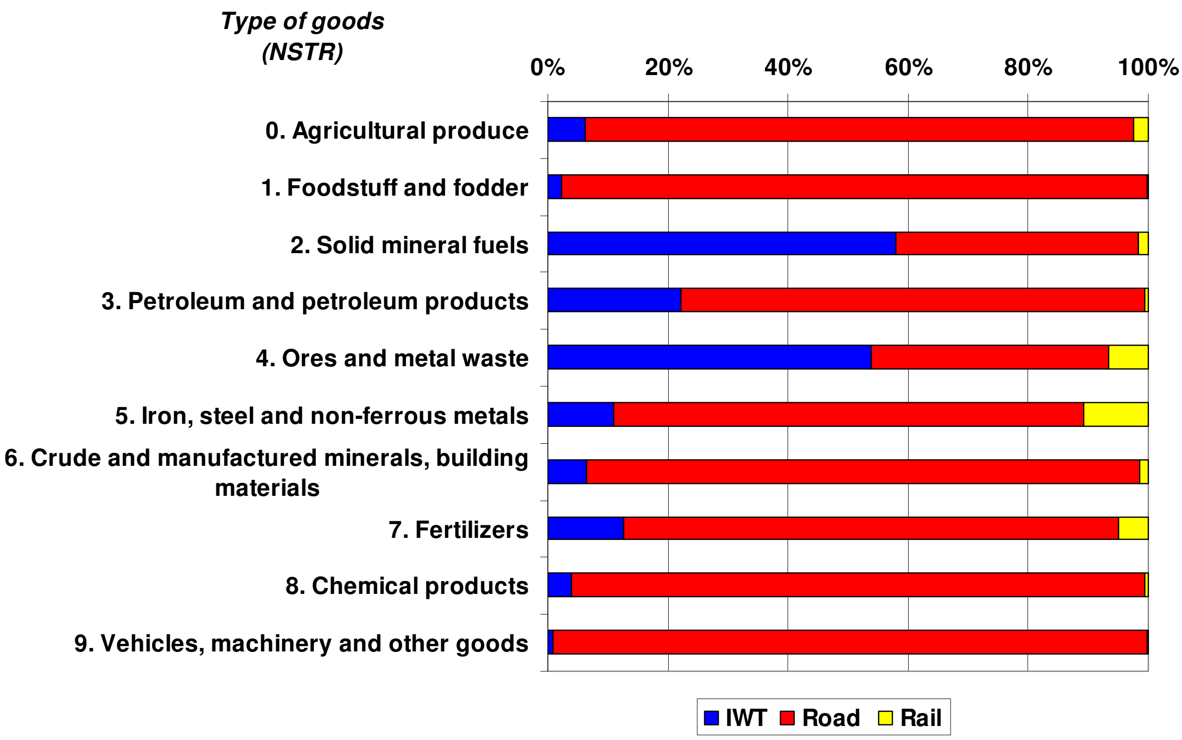
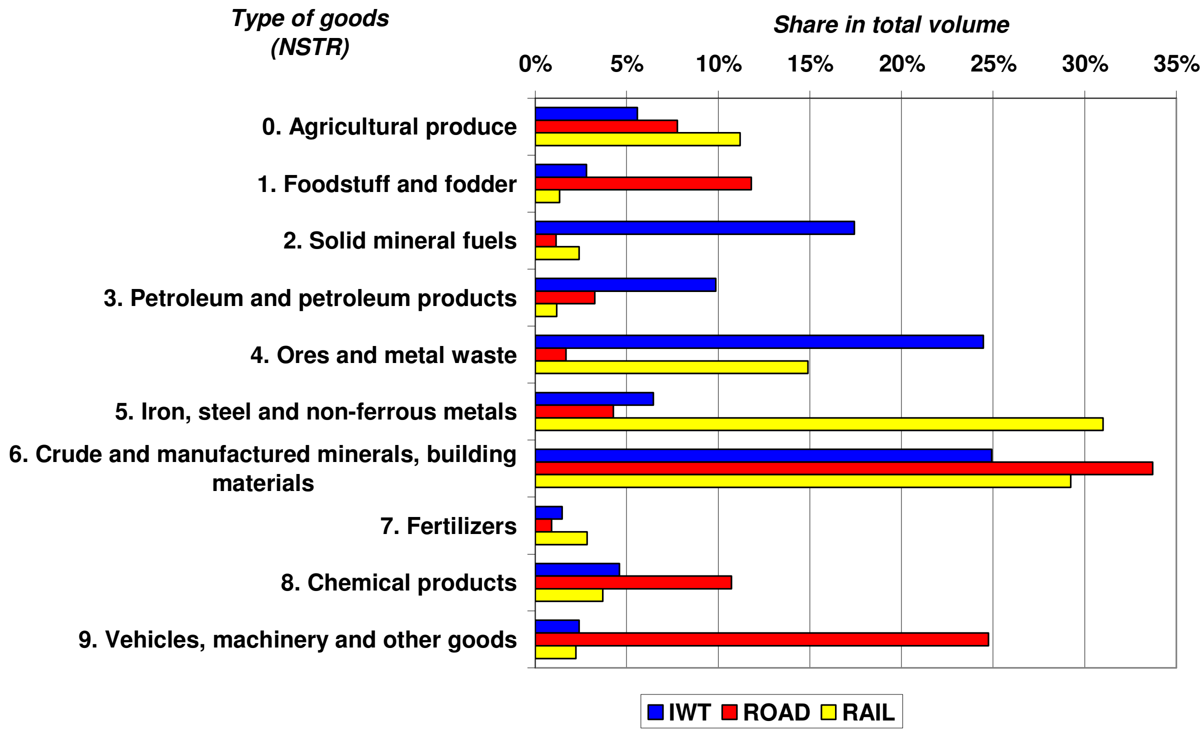


Figure I.2 presents the share of volume transported by each type of mode per market segment (based on the tonnage). It illustrates that for example 34% of the volume transported by road consists of NSTR 6 (crude minerals and manufactured minerals, building material) while 31% of the volume carried by trains consists of metal products such as steel coils (NSTR 5).

Figure I.2: Share of volume transported by each type of mode per market segment


Type of goods (NSTR)
Share in total volume
0%
5%
10%
15%
20%
25%
30%
35%
0. Agricultural produce
1. Foodstuff and fodder
2. Solid mineral fuels
3. Petroleum and petroleum products
4. Ores and metal waste
5. Iron, steel and non-ferrous metals
6. Crude and manufactured minerals, building materials
7. Fertilizers
8. Chemical products
9. Vehicles, machinery and other goods
IWT
ROAD
RAIL

ANNEX II. LIST OF CONTAINER TERMINALS ON THE RHINE CORRIDOR AND CONNECTING WATERWAYS

NR	LOCATION	CONTAINER TERMINAL
1	AMSTERDAM	Amsterdam Container Terminals
2	AMSTERDAM	Amsterdam Multipurpose Terminal USA
3	AMSTERDAM	Container Terminal De Vrede
4	ALPHEN A/D RIJN	OTA (Overslag Terminal Alphen)
5	ANDERNACH	Haeger & Schmidt (Andernach)
6	ANTWERPEN	Antwerp Gateway Terminal
7	ANTWERPEN	BATOP
8	ANTWERPEN	Euroports Container Terminal
9	ASCHAFFENBURG	Contargo Aschaffenburg
10	AVELGEM	AVCT Avelgem Container Terminal NV
11	BASEL	Basel Multi Terminal AG (BMT)
12	BASEL	SwissTerminal AG
13	BERGEN OP ZOOM	Markiezaat Container Term. Bergen op Zoom
14	BERINGEN	Euro Shoe Group
15	BIRSFELDEN	Birs AG
16	BONN	Am Zehnhoff-Söns GmbH
17	BORN	Barge Terminal Born
18	BRUSSEL	Brussels Terminal
19	CUIJK	Inland Terminal Cuijk
20	DELFZIJL	Wijnne & Barends Logistics BV
21	DEN BOSCH	Bossche Container Terminal BV (BCT)
22	DEURNE	Gosselin Container terminal Deurne
23	DORMAGEN	UCT (Umschlag Container Terminal)
24	DORTMUND	Container Terminal Dortmund GmbH
25	DUISBURG	D3T (Duisburg Trimodal Terminal)
26	DUISBURG	DeCeTe Duisburger Terminal GmbH
27	DUISBURG	DIT (Duisburg Intermodal Terminal)
28	DUISBURG	RRT (Gateway West / Logport II)
29	DUISBURG	RRT (Rhein - Ruhr - Terminal)
30	DUSSELDORF	DCH (Dusseldorfer Container-Hafen GmbH)
31	EMMERICH	RWT (Rhein - Waal - Terminal)
32	FRANKFURT	Contargo Rhine/Main (Terminal Frankfurt)
33	FRANKFURT	FIT (Frankfurt Intermodal Terminal)
34	GENK	Haven Genk
35	GENT	Intermodaal Platform Gent
36	GENT	Ghent Container terminal
37	GERMERSHEIM	DP World Germersheim
38	GORICHEM	Logistiek Centrum Gorinchem

NR	LOCATION	CONTAINER TERMINAL
39	HARDERWIJK	Container Terminal Harderwijk (CTH)
40	HENGELO	Container Terminal Twente BV (CTT)
41	IJMUIDEN	Container Stevedoring IJmuiden
42	KAMPEN	Container Terminal Kampen
43	KARSRUHE	Contargo Wörth/Karlsruhe (Term. Karlsruhe)
44	KOBLENZ	Contargo Rhine/Main (Terminal Koblenz)
45	KÖLN	CTS Container Terminal GmbH
46	KREFELD	KCT (Krefeld Container Terminal GmbH)
47	KRUININGEN	CCS (Continental Container Services) Vlissingen
48	LEVERKUSEN	Leverkussen Cont. Term. (Chemion Logistik)
49	LILLE	Lille Container Terminal (LCT)
50	LUDWIGSHAFEN	Contargo Rhine/Neckar (Term.Ludwigshafen)
51	MAINZ	Contargo Rhine/Main (Terminal Mainz)
52	MAINZ - KASTEL	Frankenbach Container Terminals Mainz
53	MANNHEIM	Contargo Rhine/Neckar (Terminal Mannheim)
54	MANNHEIM	MCT (Mannheimer Container Terminal GmbH)
55	MEERHOUT	Euroports Containers Meerhout
56	MEPPEL	MCS Meppel BV
57	MOERDIJK	CCT (Combined Cargo Terminal)
58	MOERDIJK	Delta Marine Terminal
59	MOL BLC	(Groep Gheys)
60	NEUSS	Contargo Neuss
61	NIEUWDORP	Scaldia Vlissingen
62	NIJMEGEN	Container Terminal Nijmegen BV (CTN)
63	OOSTERHOUT	Oosterhout Container Terminal BV
64	OSS	Osse Overslag Centrale BV
65	OTTMARSHEIM	Port Rhénan de Mulhouse-Ottmarsheim
66	RIDDERKERK	Groenenboom Container Terminal
67	ROTTERDAM	Barge Center Waalhaven
68	ROTTERDAM	Rotterdam Shortsea Center
69	ROTTERDAM	ECT Delta Barge Feeder Terminal
70	ROTTERDAM	Delta Container Services
71	ROTTERDAM	Rotterdam Container Terminal
72	STRASBOURG	Port Autonome de Strasbourg
73	STUTTGART	SCT (Stuttgarter Container Terminal GmbH)
74	TERNEUZEN	Katoennatie Westerschelde BV
75	TERNEUZEN	Verbrugge Terneuzen
76	TILBURG	Barge Terminal Tilburg BV
77	VEGHEL	Inland Terminal Veghel BV
78	VENLO	TCT Venlo (Trimodal Container Terminal)
79	VLISSINGEN	Verbrugge Vlissingen
80	VILVOORDE	Van mnoer Stevedoring
81	VOERDE	Haeger & Schmidt (Emmelsum)
82	WAALWIJK	Roc Waalwijk BV

NR	LOCATION	CONTAINER TERMINAL
83	WANSSUM	Wanssum Intermodal Terminal BV (WIT)
84	WEIL AM RHEIN	Rheinhafen Weil
85	WILLEBROEK	TCT Willebroek (Trimodal Cont.Term.Belgium)
86	WORMS	Contargo Worms
87	WÖRTH	Contargo Wörth/Karlsruhe (Terminal Wörth)
88	ZAANDAM	CTVrede-Steinweg BV
89	ZEEBRUGGE	PortConnect NV

Source: Bureau Voorlichting Binnenvaart (BVB) and Promotie Bureau Vlaanderen

ANNEX III. ORIGIN AND DESTINATION PAIRS

The top performing OD-pairs on the Rhine corridor

Per transport mode the most important OD-pairs (based on tkm) on the Rhine corridor in the year 2007 have been selected. This is presented in the tables 6-8, also indicating the most dominant NSTR categories per transport mode.

For road and rail transport, the top 5 is presented for the national as well as the international transportation. The highest volumes and performance for these modalities are achieved with national transportation. This is especially the case with road transportation, which plays a dominant role on the transport over short distances. For IWT, the highest volumes and performance are achieved in general in international transportation. For national IWT, the highest volumes and performance are achieved in the Netherlands.

Table III.1: NUTS 2 top 5 national and international OD-pairs on the Rhine corridor: IWT (2007)

Origin-Destination (both ways)		Million TKM	Tonnes (x1000) transported	Dominant NSTR categories transported
International IWT transport				
South-Holland	Düsseldorf	1,377	6,813	4, 5
North-Holland	Düsseldorf	1,361	6,659	4, 6
North-Holland	Arnsberg	1,067	3,922	4, 2
South-Holland	Stuttgart	1,043	1,757	4, 3
South-Holland	Arnsberg	1,031	3,819	4, 2

Table III.2: NUTS 2 top 5 national and international OD-pairs on the Rhine corridor: ROAD (2007)

Origin-Destination (both ways)		Million TKM	Tonnes (x1000) transported	Dominant NSTR categories transported
National road transport				
Lorraine	Lorraine	7,991	95,388	6, 9, 0
Alsace	Alsace	4,776	72,920	6, 9, 0
South-Holland	South-Holland	2,962	93,618	9, 8, 6
Franche-Comté	Franche-Comté	2,942	42,112	6, 9, 0
North-Brabant	North-Brabant	2,449	67,495	9, 1, 6
International road transport				
Stuttgart	South-Holland	1,176	1,951	6 , 8, 9, 1
Stuttgart	Antwerp	877	1,596	6, 5, 8
Antwerp	Lorraine	812	2,221	6, 5, 0
Tübingen	South-Holland	776	1,119	6, 8, 1, 9
Freiburg	South-Holland	736	1,093	6, 8,1, 9

Table III.3: NUTS 2 top 5 national and international OD-pairs on the Rhine corridor: RAIL (2007)

Origin-Destination (both ways)		Million TKM	Tonnes (x1000) transported	Dominant NSTR categories transported
National rail transport				
Arnsberg	Stuttgart	251	615	5, 6, 0
Düsseldorf	Stuttgart	246	556	5, 6, 0
Münster	Stuttgart	193	361	6, 5, 0
Düsseldorf	Tübingen	188	328	6, 5, 0
Düsseldorf	Freiburg	182	348	5, 6, 0
International rail transport				
Stuttgart	Antwerp	154	253	6 ,5, 0
Antwerp	Lorraine	137	347	6, 5, 0
Freiburg	Antwerp	129	194	6, 0, 5
Karlsruhe	Antwerp	121	222	6, 5, 0
Tübingen	Antwerp	120	164	6, 0, 5

Road transport OD-pairs above 200km

The most substantial transport mode on the Rhine corridor is road transport. In order to examine the potential of IWT on the Rhine corridor, it is interesting to analyse the volume and performance of road transport with a distance of 200 kilometres (single way) and above. A minimum threshold of 200 km was chosen, because modal shift would otherwise not be feasible. It concerns after all dry-dry locations with on both sides of the chain, the pre- and end-haulage. [46]

Tables III.4 and III.5 present the top 10 origin-destinations (based on road tkm) on NUTS 2 and 3 level and the volume transported by road (in tonnes) on these combinations.

[46] In the study „Towards a new strategy for policy on inland waterway transport in The Netherlands" (Policy Research Corporation & NEA, Dutch Ministry of Transport and Public Works, 2006) it was concluded that such transport chains are only feasible at distances starting at 200 km.

Table III.4: NUTS 2 top 10 origin-destination on the Rhine corridor (based on ROAD tkm): >200km

Origin-Destination (both ways)		Road million TKM (2007)*	Tonnes transported by road transport (2007)
1. Duisburg/ Düsseldorf	Heilbronn/Stuttgart	1,208	2,940,656
2. Rotterdam	Heilbronn/Stuttgart	1,176	1,951,360
3. Heilbronn/Stuttgart	Dortmund	1,063	2,754,740
4. Heilbronn/Stuttgart	Köln	1,032	2,858,391
5. Duisburg/ Düsseldorf	Frankfurt/Wiesbaden	1,001	4,089,678
6. Karlsruhe	Duisburg/ Düsseldorf	890	2,578,076
7. Antwerp	Heilbronn/Stuttgart	877	1,595,704
8. Rheinhessen-Pfalz/ Ludwigs-hafen	Duisburg/ Düsseldorf	836	2,997,049
9. Freiburg/Breisach	Duisburg/ Düsseldorf	814	1,654,484
10 . Antwerp	Metz	812	2,220,811
** 200 km and above*			

Table III.5: NUTS 3 top 10 origin-destination on the Rhine corridor (based on ROAD tkm): >200km

Origin-Destination (both ways)		Road million TKM (2007)*	Tonnes transported by road transport (2007)
Arr. Antwerpen	Bas-Rhin	332	722,438
Arr. Antwerpen	Moselle	349	962,986
Arr. Antwerpen	Haut-Rhin	264	498,925
Arr. Antwerpen	Aargau	169	267,819
Arr. Antwerpen	St. Gallen	159	217,838
Arr. Antwerpen	Meurthe-et-Moselle	157	455,294
Arr. Antwerpen	Ortenaukreis	151	280,701
Arr. Gent	Moselle	141	376,168
Arr. Antwerpen	Vosges	140	306,660
Groot-Rijnmond	Stadtverband Saarbrucken	137	290,169
** 200 km and above*			

ANNEX IV. RESEARCH SOURCES USED IN CHAPTER 4

Sources used:

- www.ecotransit.org, www.be-logic.info
- Statistical analysis of the logistics sector (SEALS), Factor costs freight transport (NEA)
- Price information collected from IWT operators, transport operators

Transport service information transport operators:

- http://www.hs-containerline.com/fahrplaene.php
- http://www.danser.nl/Homened/Services.aspx
- http://www.kombiverkehr.de/web/Englisch/Startseite/
- http://www.sct-container.de/de/fahrplan_index.php
- http://www.rhinecontainer.nl/en/vaarplan
- http://www.naviland-cargo.com/spip.php?article45&lang=en

ANNEX V. POSSIBLE INDICATORS TO DETERMINE THE POTENTIAL FOR MORE IWT INVOLVEMENT ON A CORRIDOR

Possible indicators that come to mind to determine whether IWT has a potential for improvement on a corridor are:

1. Costs structure and performance of IWT within the specific supply chain (i.e. logistic performance, lead time, agility in the network, cross functional capacity of the transport mode, reliability of the mode).

2. Modal share of specific transport modes for different market segments (dry bulk, container, liquid bulk) as well as freight types (NSTR) and distance classes, i.e. participation of IWT in the container market, the NSTR types and participation of IWT in these NSTR's and on what distance classes?

3. The indirect economic value of IWT: the importance of the specific NSTR's for the specific production and consumption industries affecting the economy and competitiveness of Europe as a whole and regions in specific, based on the demand and supply structure – spatial planning, i.e. land use, employment, physical accessibility, urban infrastructure, economic development[47]

4. Costs structure and performance of IWT within the specific supply chain (i.e. logistic performance, lead time, agility in the network, cross functional capacity of the transport mode, congestion, reliability of the mode). [48]

5. Social performance (Safety performance, security record, accessibility, waterway planning, transparency – efficient services – political importance)

6. Environmental performance (noise, GHG, waste management, air quality, energy performance)

7. Ability to create sustainable change, i.e. cross functional, cross-bordering project change capacity which relate to:
   - Widening the scope and functionalities of the specific network,

[47] PLATINA report D 5.5, Chapter 2, paragraph 4, IWT infrastructure network development and paragraph 5 Connectivity and market dynamics further elaborates on various elements involved.

[48] Within a supply chain co-operation has become of paramount importance. Increasingly, all supply chain players need to ensure they work together by integrating across functions, borders, interfaces and Modes

- Strengthening the transport mode and terminal handling capacities,
- Supporting cohesion in Europe and the regional economy and
- Connecting to other corridors or comprehensive networks

Relating IWT network supporting development projects, one should also take into consideration that IWT can only substantially increase its overall performance within:

- Existing intermodal supply chains;
- A limited category of freight flows (NSTR), whereby several NSTR deliverables very much depends on IWT;
- The context of existing waterways which all feature their specific (bottleneck) profiles, including terminals and terminal handling;
- The operators ability and willingness to invest in performance improvements (RIS) and external co-operation.

Moreover, regarding IWT projects in particular, it should be remarked that also many other functions are related to waterways and the surrounding areas. An integrated approach is therefore needed to address specific bottlenecks or opportunities regarding the IWT infrastructure, including the terminals and ports.

ANNEX VI. SET OF DATA ELEMENTS TO MONITOR THE EFFECT OF IWT MEASURES

In this Annex, four tables are presented that provide data to allow to monitoring the effect of IWT related measures relating:

3. Market and Awareness
4. Fleet
5. Employment and Education
6. Infrastructure.

Within the tables a qualification is given. In practise, he qualification of importance (high or low) should be done by a Monitoring Committee. In the specific case of this study, the qualification is based on possible measures to counteract the vulnerabilities of IWT container transport on the Rhine corridor.

Table VI.1 Data to monitor the effect of IWT measures related to Market and Awareness

Data related to Market and Awareness		High	Low
1A	Tonnes/ tonne kms transported (per type of vessel, market segment, per corridor)	X	
1B	Share of transport costs in total production costs for different market segments		X
1C	Share of inland waterway transport cost in transport cost		X
1D	Multiplier value of IWT to GDP for the customers (shippers, industries,		X
1E	Cost structure of transport (breakdown: personnel cost, capital cost, fuel, other costs)	X	
1F	Companies and employment (size)		X

Data related to Market and Awareness		High	Low
1G	Organisational structures (e.g. amount of trade associations, brokers, electronic freight markets, freight exchange platforms) (qualitative)		X
1H	Multiplier value of IWT for their suppliers (fuel suppliers, banks, etc.) (qualitative)		X
1J	Freight prices (time series)	X	
1K	Turnover of companies		X
1L	Profitability	X	
1M	Number of bankruptcies		X
1N	Capacity utilisation (overcapacity)	X	
1O	Average loading rate	X	
1P	Share of empty sailing in total km	X	
1Q	The perception of IWT on price-quality amongst IWT client (questionnaire)	X	
1R	Modal share in tonnes and tonne km per NSTR per corridor	X	
1S	Modal share in TEU/TEUkms in the container transport market per corridor	X	
1T	Number of intermodal shuttle services and TEU transported	X	
1U	Cost difference between modes of transport on representative origin-Destination Files	X	
1V	Differences in reliability of services	X	

Table VI.2 Data to monitor the effect of IWT measures related to Fleet

Data related to Fleet		High	Low
2A	Available number of vessels and total tonnage	X	
2B	Required number of vessels and tonnage		X
2C	Average year of construction		X
2D	Type of engines and their emission characteristics	X	
2E	Size and type of investments and R&D in the fleet (e.g alternative fuels, fuel savings, retro/fitting technologies)		X
2F	Average external costs per vessel kilometre and tonne kilometre (different vessel types)	X	
2G	Uncovered infrastructure costs		X
2H	Non/internalised costs of accidents		X
2J	Number of fatalities, seriously injured people, number of acci-dents	X	
2K	Costs of noise		X
2L	Costs of emissions (PM10, NOx, SO2, etc)	X	
2M	Costs of climate change (CO2 value)	X	
2N	Energy consumption	X	
2O	Share of fossil fuel consumption	X	
2P	External costs and emissions of other modes of transport	X	

Data related to Fleet		High	Low
2Q	Tax revenues from the transport mode (VAT, port dues, profit tax)		X
2R	Balance between external costs and tax income (internalisation of external costs)		X

Table VI.3 Data to monitor the effect of IWT measures related to Employment and Education

Data related to Employment and Education		High	Low
3A	Available number of workers	X	
3B	Required number of workers (e.g. shortages)		X
3C	Salaries of workers and entrepreneurial staff		X
3D	Level of education	X	
3E	Number of students		X
3F	Average age of workers		X
3G	Indirect employment in supply markets of IWT (fuel, banks, etc) and customers of IWT (shippers)		X
3H	Training programmes on logistics and intermodality	X	
3J	Training programmes on fuel efficiency	X	

Table VI.4 Data to monitor the effect of IWT measures related to Infrastructure

Data related to Infrastructure		High	Low
4A	Size of the waterway networks (length, CEMT class, maps)	X	
4B	Bottlenecks on waterway networks	X	
4C	Share of 24-7 service on infrastructure network (locks, bridges)	X	
4D	Costs of congestion	X	
4E	Availability and reliability of infrastructure (water levels, accidents, construction)	X	
4F	Number and characteristics of transhipment locations (ports, terminals)	X	
4G	Competiveness of inland ports	X	
4H	Utilisation of inland terminals	X	
4J	Plans to extend or limit terminal capacity		X
4K	Digital information services (RIS) provided by public authorities		X
4L	Fleet size using RIS for transport and logistics applications		X