# WP 1: Market & Awareness

# D 1.3:

# Comparison of existing modal shift studies

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CONTENT

## 1. EXECUTIVE SUMMARY

The European Commission has set specific modal shift goals to achieve a more sustainable, safe and efficient integrated transport system. When looking at the historical development in the last two decades, it can be seen that the transport performance of road transport has increased much faster compared to IWT, therefore resulting in a decreasing trend of the modal share of IWT. To achieve the EU objectives of shifting more freight from road to waterway transportation, it is necessary to *understand the conditions necessary to achieve modal shift towards IWT in market segments with high potential (with a special focus on continental container transport).*

Based on desk research of existing modal shift studies, a **conceptual framework for modal choice** has been developed, which presents the main determining factors of logistic decision makers in order to understand the interrelation, order and hierarchy between them. From the demand level, customers can have specific requests for a particular transport mode and quality of transport based on the type of goods to be transported and the dimension of the shipments. From the supply level, the modal choice is mainly based upon two key drivers:

- costs (i.e. door-to-door transport costs and inventory costs);
- quality of the transport service (i.e. reliability, door-to-door transit time, flexibility, safety/security, frequency, network coverage, mass/bundling capability, availability of loading units, information exchange, organisation of the supply chain and complementary logistics services).

These two key drivers are mainly influenced by the location of shippers, recipients and ports/terminals; the availability and quality of the transport network infrastructure; the legal and political framework and the economic and external factors. The quality of transport also influences the costs. For the transport of containerized goods, the total door-to-door transport costs are the most important modal shift criteria. Therefore, special attention should be given to solutions that reduce costs.

The developed conceptual framework has been validated through a review of **12 practical cases** in promising IWT market segments in order to get more insight into how modal shift is actually implemented in these market segments and the success factors and bottlenecks encountered. It can be concluded that the conceptual framework developed is in line with the factors identified in the

practical cases. Only 'strategy' has been identified as an additional factor, but it only plays a role at the beginning, the evaluation and as clarification of the process.

Success in modal shift is achieved when clear and direct advantages are achieved in one of the following determining factors, while withholding the equilibrium between the other determining factors: 1) transport cost; (2) reliability; (3) transit time; (4) flexibility and (5) safety.

Also from the review of the practical cases, the total door-to-door transport costs have been identified as the most important modal shift criteria. It is important to note that when economic reasons were put forward shippers were prepared to accept, for a certain period, a higher transport cost as their running contracts - as long as they were convinced of the economic advantage on mid or long term. When solely environmental reasons were put forward as a strategic driver, modal shift would only be implemented when there was also a direct economic advantage.

Since the total door-to-door transport cost is the most important factor, special attention should be given to this aspect. One of the most promising ones for containerized continental goods is the hub-and-hop system (i.e. bundling of goods by combining more inland terminals in one trip through an existing service or a new service in case of sufficient volumes). This may require multiple contracts and co-ordination with different parties in the intermodal transport chain.

When introducing a new logistic concept, it is important to invest in awareness and provision of information on the advantages in costs, but also quality of transport (especially reliability) of IWT for the short, medium and long term (e.g. by highlighting practical cases of leading modal shift actors; carrying out studies on costs advantages for IWT and developing information tools for logistics decision makers).

Based on the practical cases reviewed, the following success factors have been identified:

- *Offering strategic and immediate advantages* to the shipper within the intermodal shift.
- *Efficiency in the operational flows*: enhancing the operational flow always offers a direct advantage on at least one of the determining factors.
- *Handling costs*: the "vertical transport" is the preponderant element in the transport cost and the key to an efficient transport operation.
- *Cooperation*: both between the shippers and between the logistic operators. It offers the opportunity for bundling transport stream and to enhance the operational flows.

Based on the practical cases reviewed, the following bottlenecks have been identified that prevent the development of modal shift towards IWT for continental intermodal transport:

- Lack of fitting and competitive *intermodal transport unit*. The 45' pallet wide high cube short sea shipping container seems the most appropriate intermodal unit for continental container transport.
- *Handling operations (in cost and time)*, especially where there are no direct waterway connections to major production plants/distribution centres.
- *Investments* in superstructure and infrastructure are often required though making use of existing services sometimes offers an answer.

Besides the continental container market, the review of the practical cases indicated that the transport of indivisible, high and heavy loads appears to be a very promising market for IWT, certainly in the Danube corridor.

# 2. INTRODUCTION

## 2.a.1 Background

### *EU Transport Policy*

The EU transport policies aim at achieving a greener, safer and more efficient integrated transport system. This vision has been set out in the European Commission's Transport White Paper of 2011 entitled "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system". Key goals in the White Paper include amongst others a minimum 40% cut in shipping emissions, a **50% modal shift of freight journeys above 300 km from road to rail and waterborne transport,** all of which will contribute to a 60% cut in transport greenhouse gases emissions by 2050 (compared to 1990 levels).

The goal towards a more sustainable, safe and efficient integrated transport system can been seen in the different measures, policies and strategies introduced by the European Commission, such as: the Marco Polo I and II programmes (2003-2013) aimed at shifting freight away from the roads; the Trans-European Transport Network (TEN-T) policy and the Horizon 2020 strategy.

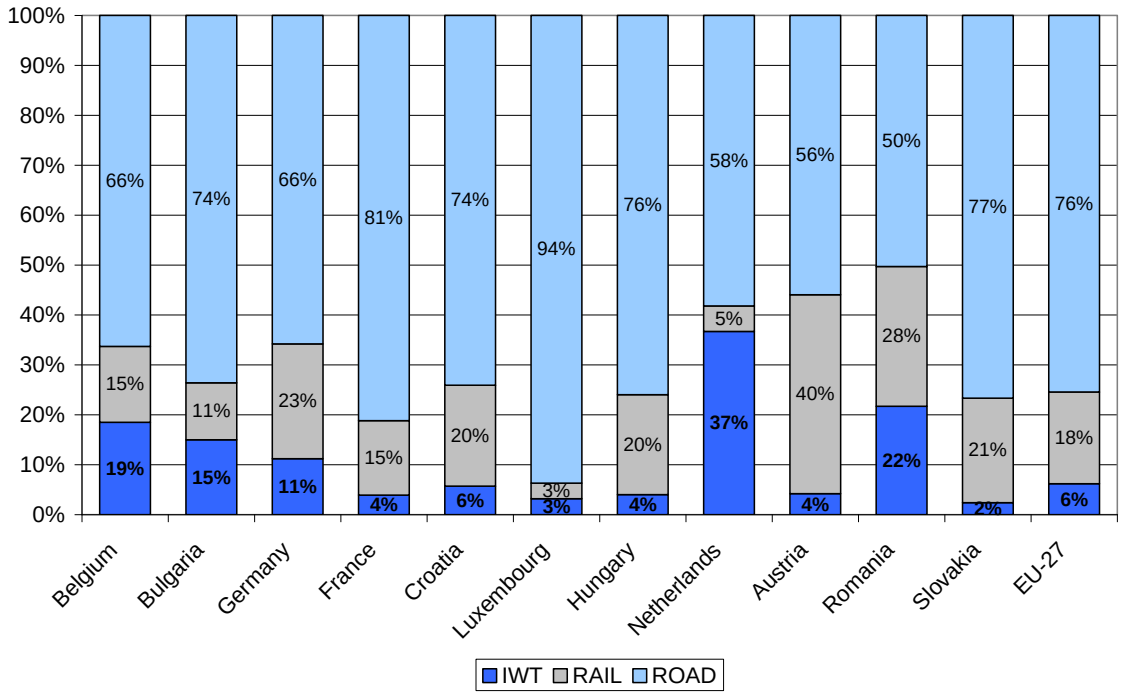
Specifically for inland waterway transport (IWT), the European Commission has introduced the NAIADES policy package (NAIADES I and II). The NAIADES II policy package "Towards quality inland waterway transport" seeks to create the conditions for inland navigation to become a quality mode of transport and sets its priorities on **shifting freight to waterway transport** and reducing emissions.

### *Modal share in Europe*

As is the case in most countries, road transportation has the largest modal share in Europe (see Figure 1). However, it is important to note that the modal share differs considerably per country. For example, the Netherlands has the highest modal share for IWT in the EU. The major reasons for the relatively high IWT modal share in the Netherlands are:

- a very high density of waterways;
- the quality of the network;
- the presence of many terminals;
- the major network role of the mainports (e.g. Rotterdam and Amsterdam). In the hinterland of these ports, several IWT 'hot spots' can be found, i.e. the Ruhr area, Frankfurt area and Basel.

**Figure 1 Modal share of 11 interconnected IWT countries in Europe and the average for EU-27 in the year 2011 (in % based on tonne-kilometres)**

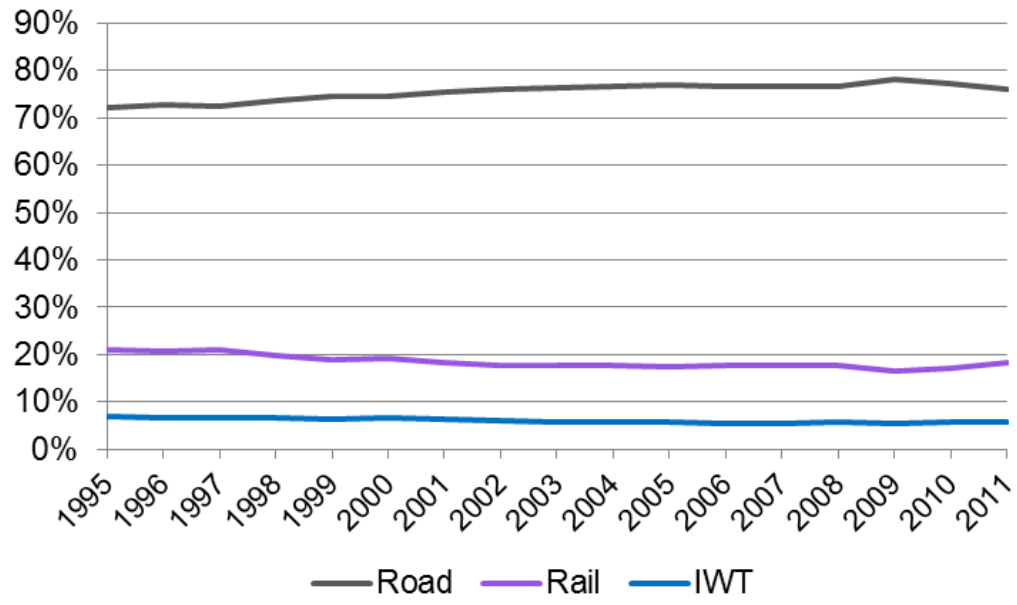



*Source: EUROSTAT*

When looking at the historical development of the modal split between the different transport modes, it can be seen that the modal share of road freight transportation has gradually grown relatively faster compared to rail transport and IWT (see Figure 2). Since 2009, the modal share of road transportation has experienced a slight decrease, especially in favour of rail transportation.

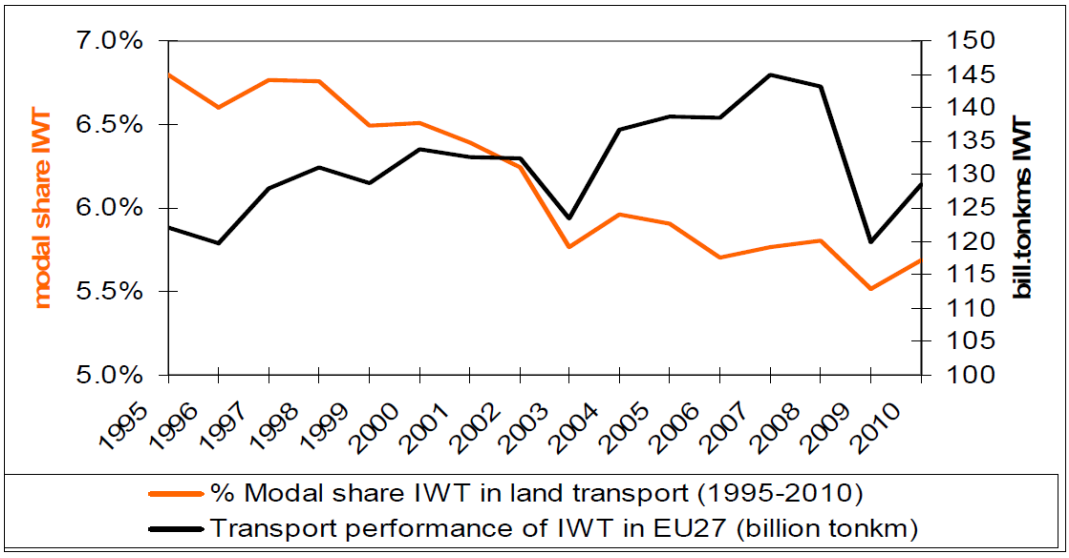
The decreasing development of the modal share in IWT can be seen in more detail in Figure 2. It can be concluded that although the overall performance of IWT has increased (especially in the decade before 2009), the transport performance of other modalities has increased much faster therefore decreasing the modal share of IWT.

**Figure 2 Development of modal split in EU-25**




*Source: Eurostat*

**Figure 3 Modal share and transport performance of IWT in EU-27**




*Source: Medium and Long Term Perspectives of IWT in the European Union, NEA et al, 2011*

### 2.a.2 PLATINA II and modal shift

To achieve the EU objectives of shifting more freight from road to waterway transportation, it will be necessary to understand how the modal choice process works and to determine the market segments with a high shifting potential. This work will be carried out in the PLATINA II project, which is the implementation platform for the NAIADES II policy package mentioned before.

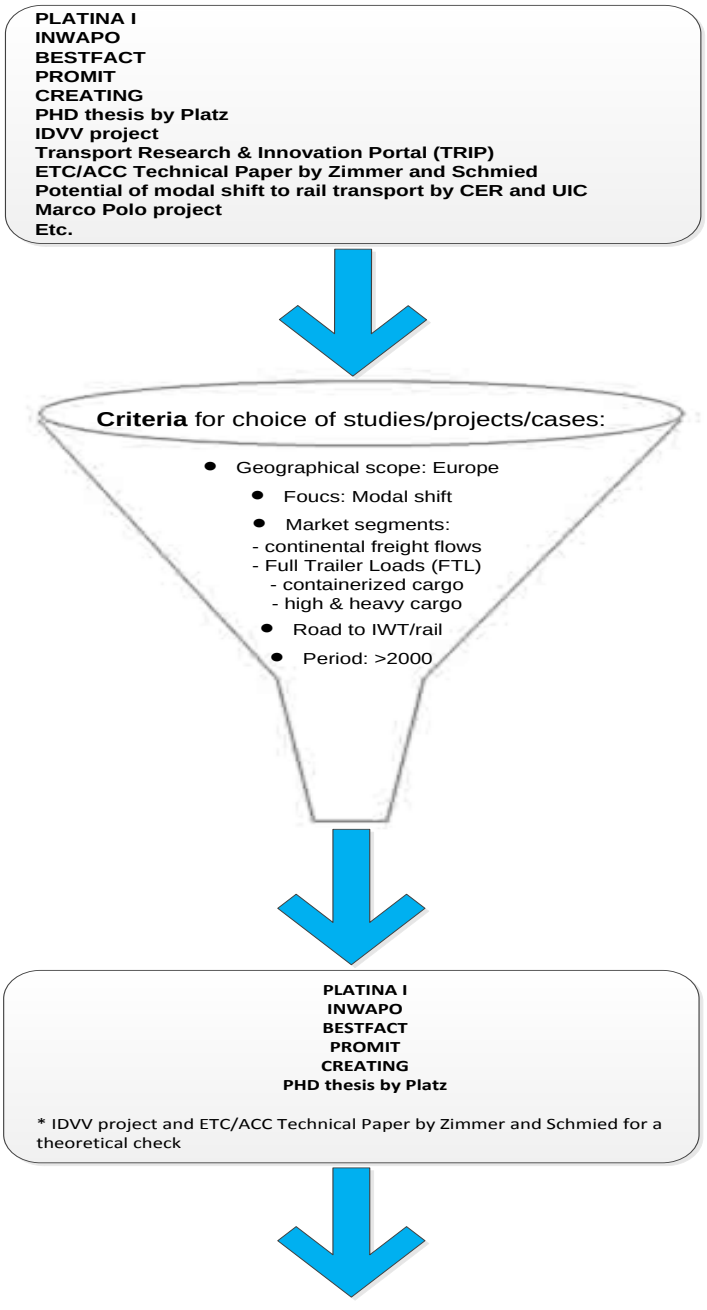
The PLATINA II Work Package 1 (WP1) 'Markets and Awareness' aims at identifying new markets for inland waterway transport. The purpose of the task: "Comparison of existing modal shift studies" (task 1.1.1) is to distil success factors and bottlenecks out of an analysis of modal shift studies and out of previous concrete modal shift cases. Once a clear view on drivers, success factors and bottlenecks is determined these insights will be used in PLATINA II WP1 task 1.1.2, which consists of an analysis to establish which continental cargo streams have the greatest potential to be shipped as full containers loads in side of the network of inland container terminals. By applying these insights within the analysis of the cargo streams the aim is to identify individual cargo streams compliant with the drivers and success factors and/or for which answers have been found for eventual bottlenecks. This should lead to cargo streams with the highest modal shift potential.

### 2.a.3 The report

This report will present an analysis of the conditions necessary to achieve modal shift towards IWT, especially in market segments with high potential.

The goal of WP1 is to achieve an insight in the potential of IWT in the transport of continental cargo within the network and operations of inland waterway container transport. This report is a first step to determine the bottlenecks and opportunities of IWT in this specific market. The studies and cases in this report have been chosen in light of the overall purpose of WP1 and therefore a structure has been set up in which available studies and cases were filtered with the aim to distil conclusions that will form the starting point of the following tasks in the workpackage.

Based upon the input of all partners a general overview was brought together of studies and cases fitting the purpose as stated above which has led to the following structure.




**Theoretical review**

**Practical cases**

- Clabe: Potato peels by IWT
- Agrokor - Vupik Vukovar
- Nexe group - Nasicecement d.d. Nasice
- Zapf GmbH Bayreuth
- Transhipment of windmill parts in Bad Deutsch-Altenburg
- Audi
- Ford, Köln
- BSH Bosh und Siemens Hausgeräte GmbH
- AMS Barge
- Orange Juice by IWT
- Green Barge
- GreenRail

The first part of the report is a desk research of existing modal shift studies. A great number of studies have been reviewed out of which 6 studies have been chosen in the context of the aim of this work package, which is to discover new markets or opportunities for the further development of IWT with a special focus on continental container transport.

All studies are described, categorized to region and commodity and analysed. The goal is to derive from each study the determining factors in a modal shift from road to IWT. For each study the main elements, in regard to the current research, are bundled in a conclusion.

The determining factors for modal choice will be lined up based on the comparison of the modal shift studies. They will be analysed in a methodological framework as to understand the interrelation, order and hierarchy between them.

In the second part of the report the aim is to go into more detail on how modal shift works in practice in the market segments which are interesting for our research. Again a great number of, this time practical, cases were reviewed out of which 12 cases have been chosen with a specific element (e.g. region, commodity, transport stream, intermodal unit) fitting the research aims.

The cases will be analysed based on the more ‘theoretical’ approach of the first part of this report. This should give more insight into how a modal shift is actually implemented in an existing transport operation and the success factors and bottlenecks that are encountered during this process. Furthermore the determining factors, derived in the first part of the study, will be check with the drivers and considerations of the shippers and logistic actors in the practical cases.

The aim is to distil further elements, recognizable for the actors in logistic operations, that are useful in approaching the market with modal shift concepts.

The main findings will be bundled in the concluding remarks of the report.

# 3. DESK RESEARCH OF EXISTING MODAL SHIFT STUDIES

## 3.a. Introduction

Modal shift from road transportation to IWT has not yet reached the desired levels established by the European Commission. It is therefore important to understand first how the decision-making process of shippers and freight logistics providers works in order to know the variables that would need to be adapted from the practical side to stimulate modal shift towards IWT in promising market segments.

Different European studies and projects have focussed on the topic of modal shift. Most of these studies present the theory (or part of it) behind the modal choice process. There are also different projects and Framework Programmes (FP) focussing of the promotion of modal shift, among others through the collection of best practices.

The objective of this part of the analysis is to review and analyse the results of these studies and projects and merge the knowledge obtained (i.e. determining factors in modal shift, success factors and bottlenecks), in order to *develop a conceptual framework of the modal choice process*. This will serve as a basis for the next chapter that will go into more detail on how this works in practice, specifically in the market segments with high potential.

For the analysis, a selection of studies and projects has been made based on the following criteria:

- European studies/projects focussing of modal shift possibilities (i.e. from road to IWT and/or road to rail);
- European studies/projects focusing on market segments with high potential for the IWT sector, for example: containerized cargo (e.g. 45 feet, pallet-wide high cube containers and reefers), continental freight flows, Full Trailer Loads (FTL) and high & heavy cargo;
- European studies/projects from the year 2000 onwards.

Based on the criteria mentioned above, the following studies and projects have been selected and reviewed:

- A PhD thesis by T.E. Platz "**The Efficient Integration of Inland Shipping into Continental Intermodal Transport Chains – Measures and Decisive Factors**" (2009);

- The FP7 project called **PLATINA I** (D5.11 “Concretisation of the EC transport policy for IWT infrastructure needs on the Rhine corridor – a first approach” (2012);
- Upgrading of Inland Waterway and Sea Ports (**INWAPO**) – Market review analysis on national level (Austria);
- The FP7 project called **BESTFACT** (Best Practice Factory for Freight Transport);
- The FP6 project called **PROMIT** (Promoting Innovative Intermodal Freight Transport);
- The FP6 project called **CREATING** (Concepts To Reduce Environmental Impact And Attain Optimal Transport Performance By Inland Navigation).

## 3.b. Existing studies and projects on modal shift

### 3.b.1 Thesis “The Efficient Integration of Inland Shipping into Continental Intermodal Transport Chains – Measures and Decisive Factors”

#### *Description of the study*

The PhD thesis “The Efficient Integration of Inland Shipping into Continental Intermodal Transport Chains – Measures and Decisive Factors” by T.E. Platz (2009) investigates the market potential of *continental* intermodal transport chains by inland shipping both from a theoretical as an empirical point of view. The thesis provides information on 47 measures taken by decision-makers to enable efficient integration of inland shipping into continental intermodal transport chains. An interdisciplinary approach was chosen because of the various fields of action and the multitude of interrelationships. The measures have been identified based on 23 real cases, including an assessment of the outcomes of these projects. Some of these cases are presented in chapter 4 (‘Practical cases’) of this PLATINA II report. The success factors, barriers and obstacles which hinders a sustainable inland shipping transport of containers have also been thoroughly analysed.

#### *Categorization*

##### Region

The focus is on the waterway core network, consisting of the most developed and interconnected inland navigation areas in Europe, covering the northern part of France, Belgium, the Netherlands,

Luxembourg, Germany, Poland, the Czech Republic, Switzerland, and the countries along the Danube corridor (Austria, Hungary, Slovakia, Croatia, Serbia, Romania, Bulgaria). Along this core network, many of the most important economic centres of Europe are located.

### Commodities

The thesis focusses on combined transport of semi-products and finished goods of a higher value (e.g. consumer goods), because in the carriage of low-value bulk goods, inland waterway shipping is already relatively strong, and because (semi-) finished goods are expected to have high growth potential in the inland shipping market.

## *Determining factors*

The main determining factors of logistics decision-makers when considering intermodal transport are:

- total door-to-door transport costs (including pre-end haulage and transhipment costs);
- total door-to-door transit time/speed;
- flexibility;
- reliability;
- readiness of information;
- complementary additional services offered.

There are several critical factors, leading to the success or failure of the continental intermodal transport service. Based on the theoretical approach and validated through the empirical cases analysed, the following minimum thresholds have been identified as *crucial* success factors that must be fulfilled, otherwise a project is expected to fail:

- bundling of cargo in space and quantity, in order to achieve low door-to-door transport costs;
- guaranteed lead times and backup transportation to ensure transport reliability;
- easy intermodal load transfer, which has a positive impact on all determining factors mentioned before;
- complete transport-related service package (all-in), including: the use of different modes; transhipment, supply of the loading unit; processing of freight documents, transport monitoring and event management, intermediate storage at a terminal and just-in-time delivery;
- intermodal loading units providing the same capacity for Euro-pallets as the standard semi-trailer.

There are other important factors that are not necessary directly related to the success of continental intermodal transport service, but that reduce the specific disadvantages of this market segment:

- road congestion and lack of railway slots;
- legal restrictions on road transport (e.g. working time and driving hours of truck drivers), tolls and public pressure to maintain safety and security in transport;
- door-to-door transport service;
- the parallel use of all land transport modes (road, rail, inland waterway), for example: in case that backup transportation is needed; for the possibility of increasing transport capacity at a short notice and in order to choose the best transport mode depending on the service requirements and cost aspects of shipment.
- pre- and on-carriage by rail at suitable inland ports
- collaboration in product development, transport planning and transport operation
- electronic data interchange (EDI) between the actors (e.g. port, terminal, shipping company, intermodal transport operator, trucker);
- a good pricing strategy;
- promotion/marketing of transport services directly to shippers in order to decrease the mental barriers of logistical deciders;
- financial power of a freight integrator;
- small sunk costs for ships, handling equipment and intermodal equipment;
- continuous operation with a high frequency of service to offset the disadvantage of the lower IWT speeds.

### *Main conclusions from study*

The final recommendations for practitioners from this study are:

- Critical mass is needed. This implies a bundling effort, which can be organised by companies with high own network volume (e.g. logistics service providers) or by co-operation by *shippers* (to avoid exploitation of the new service by freight forwarding companies). Logistics service providers should introduce new services on the market as standardised modular products, rather than working out tailored solutions (that are not reusable by other shippers). Bundling between short sea shipping and continental flows also enables new projects.
- Keeping initial costs low, one could start with existing container inland shipping, continental cargo hitch-hiking. Integration of ICT is crucial, using AIS for tracking and tracing. It is also important that the terminals cooperate as part of the network.

### 3.b.2 PLATINA I D.5.11

#### *Description of the study*

The main objective of the Seventh Framework Programme (FP7) PLATINA I is to support the European Commission, Member States and third countries in the implementation of the NAIADES action programme. One of the studies carried out in PLATINA I is D.5.11 “Concretisation of the EC transport policy for IWT infrastructure needs on the Rhine corridor – a first approach” (2012), which presents a first approach to describe the effects of the current EC transport policy on IWT infrastructure needs on the Rhine corridor. In the study an assessment has been carried out of the cargo on the Rhine corridor that could potentially shift from road to alternative modes, relating container transport. Recommendations are also provided on how the potential of IWT on the Rhine can be enlarged. Based on the insight gained from the assessment of the Rhine corridor, a general method for developing a corridor implementation plan has been proposed.

#### *Categorization*

##### Region

PLATINA I D.5.11 presents information about the modal share of goods on the Rhine area and its main tributaries.

##### Commodities

The transport of all type of commodities have been assessed. Specifically for benchmark of the different transport alternatives in the corridor (road, rail, IWT or a combination), the assessment focussed only on the container transport on the Rhine.

#### *Determining factors*

For the study, the most important Key Performance Indicators (KPI) have been selected for a transport service to effectively deliver the goods. This has been done based on input from another FP7 project BE LOGIC, which suggests six 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 that have been applied relate to transport time, costs and sustainability (limited to CO2 emissions) and frequency of services (indicating flexibility).

Generally, transport decision makers focus on costs and thus consider the *total* transport costs (including pre-end haulage and transhipment costs) as the most important indicator. Transport decision makers who are focusing less on transport costs and thus allocate more weight to the other KPI (e.g. transport time or frequency of the transport services), would most likely opt for road transport.

Lessons learned from the PLATINA I D5.11 study:

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 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 fairway conditions.
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 bottlenecks in waterway infrastructure.

### *Main conclusions from the study*

The following aspects are important in order to improve the transport performance of IWT:

1. Pre-end haulage costs and time:
   - Highly efficient pre-end haulage processes require (1) low (minimum) waiting times; (2) high utilisation of the road truck (return loads) and (3) short distance to be covered by the truck for pre- and/or end haulage as it directly affects the transport costs and emissions;
   - 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 and (2) ICT applications (integrated RIS services) in order to increase efficiency and reduce waiting times.
2. Volume: 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. Transhipment processes: 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.

## 3.b.3 INWAPO market review analysis

### *Description of the study*

The INWAPO market review analysis[1] underlines the advantages of inland waterway transport on the Danube in comparison to other modes of transport for several types of cargo. Based on information and data available in studies, surveys and statistics as well as on interviews with partners from the demand and supply side the INWAPO market review analysis aims at assessing sector-specific potentials for a modal shift towards inland waterway transport.

Generally speaking, inland navigation has the ability to transport large quantities of goods per transport unit (bulk freight capacity) as well as goods with large dimensions or heavy weight (e.g. concrete panels, generators). Especially industrial raw materials, agricultural goods, chemical and

[1] Source: “Upgrading of Inland Waterway and Sea Ports (INWAPO) – Market review analysis on national level.

steel products as well as oil and petrochemical products are ideal to exploit the full potential of inland waterway transport on the Danube. With regard to intermodal transport, the Danube waterway currently plays a minor role in the repositioning of empty containers. This is a market segment where existing potentials still have to be exploited.

In this market review analysis, the modal shift potentials for nine specific types of cargo have been analyzed, taking into account the specific requirements of the transported cargo, locations of production and processing sites as well as the involved transport flows (relations and volumes). In addition sector-specific good practices for the use of inland navigation are presented, resulting in final conclusions and an evaluation of future prospects for the particular type of cargo.

## *Categorization*

### Region

The market review focused particularly on transports relevant for the Austrian industry (including imports and export flows), meaning that the scope was limited to transport flows from/to and within Austria.

### Commodities

1. Automotive components and cars
2. Chemical Products
3. Waste and recycling products
4. Construction Materials
5. Empty Containers
6. Renewable Resources
7. High and Heavy cargo
8. Machinery
9. Paper and Pulp

## *Determining factors*

The above mentioned commodities are the most promising for a modal shift to inland waterways. For a successful modal shift not only the type of product plays an important role, but also the following factors:

- In general, the probability of a successful modal shift is higher if production sites and/or customer resp. processing sites are located close to the inland waterway (minimization of pre-end haulage).
- In most of the cases inland waterway transport is slower than other modes of transport. In special cases where the equipment for other modes is limited or restricted by law or size (e.g. high and heavy transports) inland waterway transport can also be faster in the overall transport of a certain volume of cargo from A to B.
- Transshipment costs become more and more important and a decisive factor; especially if the total transport distance is very short.
- There is a possible tradeoff between investments into transshipment facilities for waterside handling and road transportation costs if certain volumes and distances are reached.

### *Main conclusions from the study*

A market review analysis as carried out in the framework of the INWAPO project is a very powerful tool to identify potentials for modal shifts. As the cargo flows change quite regularly in some branches it has to be updated in regular intervals.

It makes sense to have a look at the identified market segments on a European level and to extend the market review beyond the Austrian import and export flows.

As a result of the study the most promising branches for modal shift to inland waterway transport on the Danube are currently:

- High and heavy transports
- Renewable resources

These two market segments are covered in dedicated expert working groups organized by via donau where business representatives from the shipper's side as well as shipping companies, brokers and ports discuss how to exploit the full potential of inland waterway transport for these branches. Finally modal shift towards inland navigation, one of the most environmental friendly modes of transports should be achieved.

### 3.b.4 BESTFACT

#### *Description of the study*

BESTFACT focusses on three clusters: 1) urban areas, 2) Green-logistics and Co-modality and 3) paperless freight transport processes. In this document, only the topics focussing on IWT in the second cluster ('Green-logistics and Co-modality') will be described.

BESTFACT presents more topics than only modal shift from road to IWT. It also includes best practices on modal shifts from road to heavy rail or maritime, as well as passenger transport and topics that deal with energy efficiencies and alternative fuels. In this document, the shifts from road to IWT and the shifts from road to rail are discussed.

A total of 39 inventory cases were selected based on a simplified Multi-Criteria Analysis (MCA) for pre-assessment covering the following aspects (1) Innovative character and feasibility; (2) Impact and effects; (3) Accessibility of information and (4) Transferability of practice cases.

Most of the best practices presented in the cluster 'Green-logistics and Co-modality' are related to the use of cleaner vehicles or vessels, voluntary and mandatory $CO_2$ objectives, investments in infrastructure in order to increase the use of cleaner transport modes and transport associations focusing on the development of corridors and the promotion of intermodality.

#### *Categorization*

##### Region

BESTFACT includes best practices in the Europe Union, for urban, interurban and long distance transport.

##### Commodities

- Food / pallets for supermarkets;
- Parcels;
- Flowers.

The commodities mentioned above are either time-sensitive and/or perishable.

#### *Determining factors*

The BESTFACT study presented the following determining factors:

*Costs*: all actors mentioned that rising costs for road transport – either by fuel prices or additional taxes – were one of the main reasons for the modal shift.

*Unreliability of road transportation*: in the former situation, shippers transported their goods by road. A lack of access to inner city centres or congestion and thus unreliability of transport was one of the main reasons for the modal and mental shift. Inland waterways and railways (although on a lesser extent) seem a reliable mode of transport, compared to the road sector.

*Location*: processing sites should be close to the waterway or rail network, in order to overcome the disadvantages of road transport.

*Loading units*: the usage of reefer containers in transport provide a good solution for time sensitive and perishable goods.

*Controlling the whole supply chain*: this is another success factor. If pre-end haulage are controlled by the same company, reliability in the total rail transport is assured.

The bottlenecks for intermodal transport identified are related to:

- Capacities for (high speed) cargo rail transport;
- The fact 45 ft. containers are too high to be transported on all railway axis;
- Long start up times.

### *Main conclusions from the study*

The BESTFACT project concluded that time sensitive cargo can be transported successfully by barge and rail. A trend can also be seen in the use of IWT for urban distribution. Within city centres, operation speeds of trucks are low, and thus, alternative distribution by inland waterways becomes an option.

The slower transport of IWT and rail compared to road do not seem to be a hindering factor, as reefer containers ensure the quality of products. In urban areas, operation speeds of trucks are low due to congestion and certain 20/30-km zones. Barges can provide a reliable and relatively quick service compared to road transportation. If volumes are high enough, even in urban areas intermodal transport can be successful.

### 3.b.5 PROMIT

#### *Description of the study*

PROMIT (Promoting Innovative Intermodal Freight Transport) is an European Coordination Action for intermodal freight transport. The objective of PROMIT is to contribute to a faster improvement and implementation of intermodal transport technologies and procedures and to help promoting intermodal logistics and mode shift by creating awareness on innovations, best practices and intermodal transport opportunities for potential users as well as policy makers and the research community. PROMIT included studies that shifted cargo from road to maritime, short-sea, inland waterways and rail.

Within PROMIT, four clusters have been identified. These are:

- *Organisation and business models*: this cluster looks at all kind of organisation and business models within intermodal transport chains. Concepts that improve performance of intermodal solutions, enlarge service, align services or develop concepts are taken into account in this cluster.
- *Infrastructure and equipment:* this cluster looks at all infrastructure and equipment issues related to intermodal transport between consignor and consignee. The main focus is how infrastructure and equipment impact the overall performance of the intermodal operation.
- *Communication and Information Technology*: this cluster looks at all kind of information and communication technologies within intermodal transport chains. The topics that the cluster deals with is the variety of technological solutions developed in order to have a fast, accurate and easily achieved propagation and spread of the information concerning the transport to all involving parties.
- *Operation and services*: this cluster looks at all kind of services and operations within intermodal transport chains between consignor and consignee. The main focus is on the client's point of view (quality and costs) and on the operators point of view (efficiency and profit growth).

#### *Categorization*

##### Region

PROMIT includes studies within Europe, either on a long or a middle long range.

##### Commodities

1. Food / pallets for supermarkets;

2. Containerized goods;

### *Determining factors*

Different reasons for modal shift have been identified in the PROMIT project:

*Costs*: one of the main reasons to shift cargo to rail and IWT was the reduction of transport costs.

*Reliability*: by moving cargo to intermodal solutions, shippers gained benefits on delivery reliability and customer satisfaction.

*Transport volumes*: an important success factor for intermodal transport are steady transport volumes. This ensures barges or trains to have a high utilization rate, in such a way that it makes the undertaking profitable. All cases in PROMIT showed that a high utilization rate of the barge or train is an important success factor.

*Door-to-door transport services*: offering door-to-door transport on a reliable basis are success factors too. It increases reliability of the intermodal solution. The lower speeds are for the majority of the products not a decisive factor.

*Organisation of the supply chain*: the cases of PROMIT show that organising these in such a way that clients have only one actor to go to, help making intermodal solutions a success.

Barriers to intermodal solutions can be high investment costs in order to develop enough coverage, ensure high frequencies or acquire enough critical mass. Lack of slots on the railway network can be a barrier as well.

### *Main conclusions from the study*

PROMIT concluded that cooperation between partners in the intermodal initiative is one of the key factors that determine success or failure for the solution. Logistic services and transport providers should ensure that cooperation with partners is well anchored in the business model. Honest division of costs and benefits will raise the trust between the partners. Service level agreements (SLA) for shippers with their contact person and frequent evolution of this SLA will improve the satisfaction of using intermodal transport solutions.

### 3.b.6 CREATING

#### *Description of the study*

The project 'Concepts To Reduce Environmental Impact And Attain Optimal Transport Performance By Inland Navigation' (CREATING)[2] aimed at stimulating the transport via inland waterways by identifying land-based cargo flows that can be maritimised as well as shippers interested in shifting their cargo to inland waterways and providing the optimal logistic and technical conditions to make this modal shift a success. The main objective of one of the work packages within CREATING (WP2) “Innovative logistic concepts for integrated transport chains Objectives” was to identify and acquire *continental* cargo flows which are being transported by truck and for which it is feasible to carry out the transport by water. To identify these flows, a set of criteria has been developed in order to obtain quick insight into which cargo flows are potentially suitable for modal shift towards inland waterways. The CREATING project included four case studies.

#### *Categorization*

##### Region

CREATING includes studies within Europe, either on a long or a middle long range.

##### Commodities

The four case studies in CREATING were related to:

1) transport of bio mass;
2) transport of food products (time sensitive, perishable): bananas by reefer containers to several destinations in Germany;
3) Ro/Ro transport on the Danube;
4) liquid cargo transport by small, double hulled tankers.

#### *Determining factors*

*Biomass in Sweden*

[2] Source: http://cordis.europa.eu/projects/rcn/73954_en.html

- *Costs*: transport by water could present cost advantages of €400,000 per year. As a conservative approach has been used, this could possibly end up at over €1,000,000 a year. In order for a vessel to achieve these costs advantages, a continuous operation should be executed.
- *Storing possibilities at the loading stations and the power plant*: the study indicated that if storage over a prolonged period of time (e.g. 1 month) was possible at the loading stations and/or the power plant, the barge's sailing schedules could be optimised (by only going to loading stations if an entire shipload is available) and possibly extended into the summer months (by building up a buffer at the power plant)
- *Weight and carrying capacities*: the weight and carrying capacities of the barges determined whether or not the bio mass case in Sweden could be successful. Ice breaking capacities of the barge are essential to be operation all year, but it required a heavy construction. This reduces the cargo carrying capacity of the barge. In order to break the ice, also a powerful engine needed to be used. This resulted in a higher fuel consumption in months at which this power is not needed (i.e. during the summer months).

*Banana transport*

*Costs*: calculations on costs proved that transport from Antwerp to the ripening house in Strasbourg by barge was cost-effective. The transport by barge from Antwerp to Hamburg was still cheaper by truck.

*Location*: the ripening houses in Hamburg (with large capacity) and Strasbourg (low capacity) were located badly compared to the available IWT infrastructure. The narrow channels in Germany and the large number of locks that had to be passed by vessels on their journey from Antwerp, limited the operational speeds. In order to keep the schedule, the barge could sail to Hamburg in day time operational mode; semi-continuous operation was required. This increased the personnel costs.

*Transport conditions*: the quality of the bananas is considered to improve when they are transported under a controlled atmosphere. This is both possible in containers and in reefer ships.

*Ro/Ro transport*

*Road charges and taxes*: in the Danube region, road charges and taxes are having a high share in the total transport costs by road. At least 45% of the costs involved taxes. This stresses the needs of having a Ro-Ro terminal in each Danube State. Transit limitations in Austria for non-EU trucks helped developing the intermodal solution by Ro-Ro vessel as well.

*Liquid cargo transport by small, double hulled tankers*

*Other factors to consider:* ship design. Calculations on small liquid vessels indicated that the ship should be designed for less diverse cargo, in order to use the ship optimally. Double hulling these ships moves the centre of gravity up, and this can make the barge unstable.

### *Main conclusions from the study*

In order for concepts to be successful, cooperation of the actors involved is a key element. Commitment from each of the stakeholders is essential.

There seem to be differences on the Rhine and Danube market. The Rhine market can acquire new cargo flows, as IWT has already a strong market position in this geographical area. In the Danube, a lack of capital and bad quality of the waterway infrastructure harms the potential of IWT. This disturbs not only the chances of *modal shift*, but it is one of the drivers of shippers for not making the required *mental shift.* Market positions of inland shipping should be improved in the entire region and guaranteed drafts should be realised. In addition, safe ports/berths and ships are needed. CREATING concluded that without these infrastructural investments in transport, the sector cannot expect large growth in the future.

## 3.c. Determining factors for modal choice based on the comparison of existing modal shift studies

Based on the different studies on modal shift presented in the previous section, a set of main determining factors influencing the choice of transport modality have been identified. These have been summarized in Figure 1. In general, the choice of transport mode (or combination of modalities) is affected by influencing factors from the supply and the demand side.

From the supply level, the modal choice is mainly based upon two key drivers: (1) **costs** and (2) the **quality of the transport service**.

(1) Costs: the price of the door-to-door transportation for the shipper includes the transhipment costs in case of intermodal transportation. Logistics costs such as inventory costs are also important to consider, as these are reduced through just-in-time deliveries.

(2) Quality of the transport service:

- Reliability: punctuality is an important factor for customer satisfaction. For many shippers reliability is more important than the transit time (e.g. just-in-time deliveries).
- Door-to-door transit time/speed: this includes loading and unloading, transport time and time needed for the transhipment activities (in case of intermodal transportation).
- Security / safety: this is related to the protection of goods against damage during transportation as well as against theft or loss and the safety aspects required when transporting certain type of goods (e.g. dangerous goods).
- Frequency: delivery frequency strongly depends on the volumes need to be transported and thus on the demands of the recipient.
- Network coverage and accessibility: this greatly depends on the infrastructure density of the mode of transport, in which road transportation has an advantage over the other modes.
- Mass / bundling capability: this results in higher load factors, which decreases the transport costs per units.
- Flexibility: this is related to an overall adaptability to changed conditions, a short reaction time, the ability to ship different shipment sizes, or the availability of transport resources.
- Availability of required loading units: the availability of loading units able to compete with standard semi-trailers and able to transport perishable goods (e.g. reefer containers) have been identified as an important factor.
- Readiness of information & exchange: this is related to the availability of information for decision making and ICT applications (e.g. for tracking and tracing) in order to increase efficiency and reduce waiting times.
- Organisation of the supply chain: organisation by one actor that clients go to help in the decision of using intermodal solutions and increases reliability.
- Complementary logistics services, including cooperation: this includes not only the transport organisation, but also other transport-related services such as transhipment, supply of the loading unit, processing of freight documents, packaging, commissioning, storage, processing and returned-goods management. Cooperation is essential here.

The costs and the quality of the transport service are mainly influenced by the following aspects:

*Location*: transport costs will vary depending on the distance between the shipper and the recipient and the distance between these actors and the ports/terminals. If the shipper and/or the recipient are not located directly along a waterway, transhipment of cargo onto other transport modes is needed which increases the costs. The location will also have impacts on the indicators of the quality of transport, such as the reliability (e.g. locations in structural congested areas), door-to-door transit time, the frequency of the available services, the network coverage and the bundling capabilities (e.g. based on the type and size of the economic activity in the area).

*Transport network infrastructure*: this is not only related to the availability and quality of the infrastructure of waterways, railways and roads, but also to infrastructure at the terminals, ports, DC

and production/processing sites. These aspects will affect the quality of the transport (e.g. transit time) and the level of the costs (e.g. transhipment costs).

*Legal and political framework (in a country or corridor):* restrictions, taxes and charges increase the level of the transport costs. Restrictions also affect the quality of transport (e.g. network coverage and accessibility).

*External factors*: there are other external factors such as congestion, water levels, strikes, obstructions due to accidents or infrastructure works that influence the quality of transport (e.g. reliability, transit time, network coverage and flexibility). Costs are also affected by these external factors, for example through low water charges or additional labour and fuel costs in case a trucks needs to adjust its route).

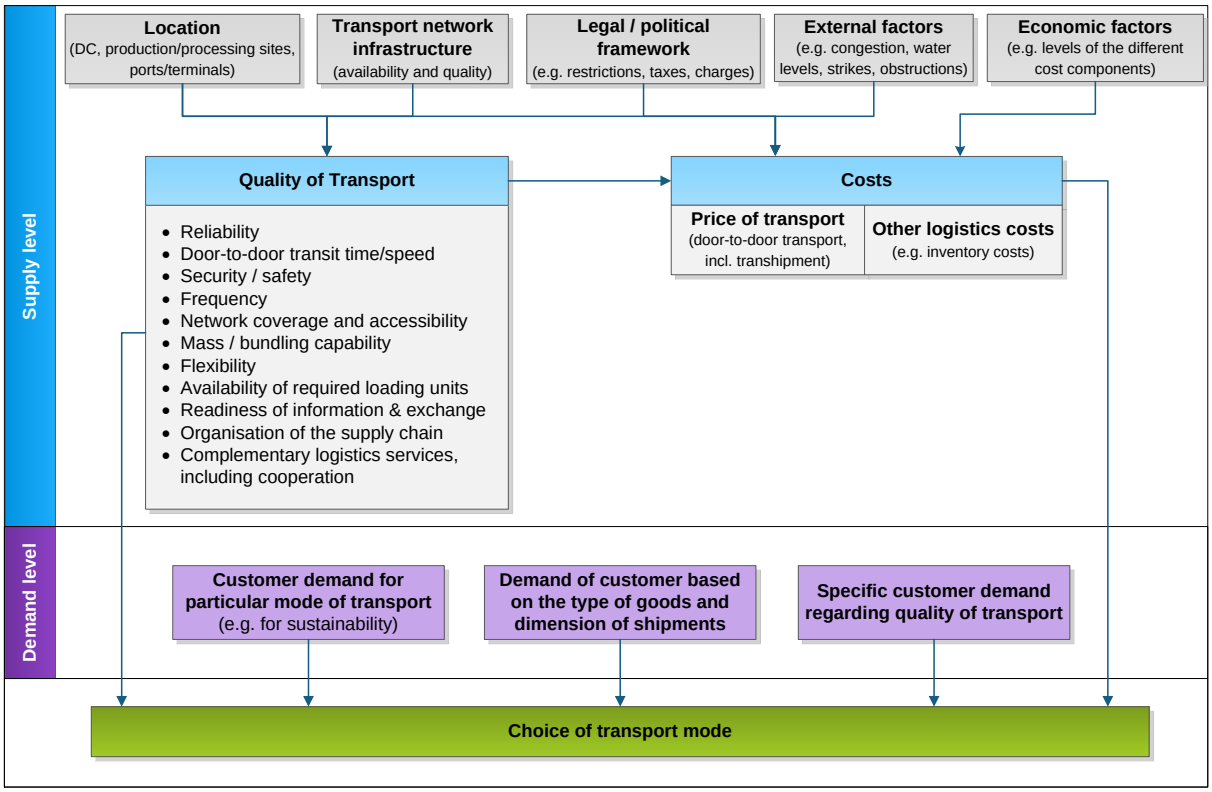
*Economic factors*: costs are also influenced by economic factors such as the levels and development of the different cost components (e.g. fuel costs, labour costs, maintenance, capital costs, insurance and other type of costs).

The quality of transport also influences the costs. For example, just-in-time deliveries are made possible by reliable transport services with a high frequency. This reduces the inventory costs. Also, the possibility of bundling cargo leads to higher frequencies of services and through higher load factors the transport costs per units can be is decreased.

From the demand level, the choice of transport mode depends on:

- Customer demand for particular mode of transport (e.g. for sustainability and the image of the company);
- Demand of customer based on the type of goods to be transported and the dimension of the shipments;
- Specific customer demand regarding quality of transport (e.g. safety aspect for the transport of dangerous goods due to specific transport regulations).

Figure 4 Determining factors in modal shift for freight transportation[3]




## 3.d. Ranking of main determining factors in modal choice

The final choice of transport mode and thus the possibility of modal shift will depend on how the logistic decision makers (i.e. shippers and freight logistics companies) prioritise the different drivers described in section 3.c. This is difficult to assess, since the exact situation will depend to a large extent on: (1) the specific characteristics of the logistics chain involved, (2) the type of freight to be transported and (3) the framework conditions applying in each individual country.

Based on the thesis Platz (2009) and the study by W. Zimmer and M. Schmied (2008) both of which analysed different studies on this topic, the following can be mentioned regarding the raking of the determining factors for *container* transportation:

[3] Based on the framework presented in the study from 2008 by W. Zimmer and M. Schmied "Potentials for a modal shift from road to rail and ship - A methodological approach" (ETC/ACC Technical Paper 2008/18. European Topic Centre on Air and Climate Change) and adapted according to the determining factors identified from the studies presented in section 3b.

- The most decisive factor for the modal choice is the level of **door-to-door transport costs** (including the costs incurred for pre- and on-carriage, transhipment etc.).
- When the total costs of the different modes are more or less similar, **reliability** becomes more important. Reliability is considered to be more important than transit time.
- **Flexibility** is required in terms of varying shipment sizes, available capacities and frequent departures.
- The role of **transit time** is not clear, but there is a trade-off with transport costs, as some shippers have indicated that savings in transport prices can compensate for longer lead times when using inland shipping. This will depend on the type of goods, as for example transit times is considered to be more importance for high value goods (mainly transported in containers) than bulk products.
- **Readiness of information**, and therefore also course supervision and tracking and tracing, is gaining in importance.
- **Transport safety** is only decisive for the carriage of chemicals.
- **Environmental aspects** play a minor role. The environmental benefits are nowadays welcomed by the logistical decision-makers, but generally not at the expense of costs.

## 3.e. Conclusions

Based on desk-research of existing studies of modal shift, a framework of the determining factors of modal shift for freight transport has been developed. Besides specific customers demand aspects, the costs and the quality of the transport service mainly influence modal shift.

For the transport of containerized goods, the total door-to-door transport costs are the most important modal shift criteria. Therefore, all measures that can really contribute to reducing these costs should be considered to be the most important for the IWT sector.

One possible measure is the bundling of goods through the hub-and-hop system (i.e. combining more terminals in one trip). This may have a negative influence in the transport time (due to the extra time needed for loading and unloading) and may require multiple contracts and co-ordination with different parties in the intermodal transport chain. Nevertheless, for most containerized goods, costs and reliability are considered to be more important factors than transit time.

Spatial planning is also of high importance. One of the main bottlenecks of containerized IWT is that there is no direct waterway connections to major production plants/distribution centres. Spatial

planning influences the points of origin/destination and the terminal locations and therefore the transhipment costs and the costs for terminal haulage.

Transport reliability is the most important aspect of the quality of transport. Therefore, reliability should be emphasised by the organisations dealing with the promotion of the intermodal transport services (especially for the new IWT market segments of perishables and high value goods). ICT applications (e.g. RIS) and the organisation of backup transportation increases reliability and helps in the decision making process of shippers and logistics providers.

# 4. PRACTICAL CASES

## 4.a. Introduction

This chapter will go into more detail on how modal shift works in practice in the market segments with high potential for the IWT sector. The focus of the research is on the potential market of existing continental cargo streams that are currently being transported in full trailer loads and moved alongside, but separated off, the network of inland container terminals. The question raised is whether it is possible to capture part of this market by loading these cargo streams in containers and shipping them within the network of inland container terminals.

Although this question has been investigated in studies and concrete modal shift cases, no successful full operational service has ever been realized. All loaded containers that are moved within the network of inland containers terminal have as origin or destination a seaport and are destined for overseas export or import. No loaded containers are moved from one inland container terminal to another in a continental chain. The only containers moved within the network are empty containers that are repositioned to be loaded from another terminal so they can be shipped to a seaport for overseas export or import.

Therefore, the studies and cases that are brought together in this task are either examples which are not or only partly operational or are selected (from other transport modes) in order to derive insights on key aspects of the supply chain operational flows which are important for continental or container transport.

The main selection criteria for the practical cases were:

- Continental cargo flows (i.e. excluding hinterland transport of maritime containers between the European sea ports and the continent;
- Full Trailer Loads (FTL) or containerized cargo (e.g. in 45 feet, pallet wide high cube containers);
- Europe as geographical area;
- Cases from the year 2000 onwards;
- Transport modes: cases with modal shift from:
  - Road to IWT (successful, unsuccessful and not yet completely implemented cases);
  - Road to rail (successful cases).

Where specific regional aspects or promising commodities come in to view, time will be invested in these studies or cases in a way that these opportunities can be withheld in the further elaboration of this Work Package as it aims at identifying new markets and opportunities for IWT also in a broader vision.

## 4.b. Description of cases

The case information was gathered in data sheets which have been added as an annex to this report.

Taking into consideration valid commercial motives, not all cases are fully documented. Some conclusions were derived during personal contacts, but not completely rendered in the data sheets.

### 4.b.1 Clabe: Potato peels by IWT

The first case addressed is the transport of steamed potato peels, a waste product of the food industry (potato producers), to the feed industry as a component of animal fodder. During a test period in 2012 and 2013 IWT remained despite several enhancements in the operational transport chain, more expensive compared to truck transport. Since then about 6 additional transhipments have been made so this case is still partly operational.

The main driver to include IWT in the transport chain was a strategic consideration: due to congestion and traffic jams, and with the political decision reached to apply in the future truck toll charges in Belgium, forecast of higher transport costs by truck led to the testing of modal shift operations. Out of the test period it became clear that the so called “vertical transport” meaning the loading and unloading operations were the major cost factor in the new build operational chain. Though these always are a bottleneck in the cost structure of intermodal operations the case also proved that during operational test several enhancements are achieved “on the floor”. In this case the introduction of bobcats while unloading the vessel and using the pumps of the tank trucks for loading the vessel were major factors to reduce cost and time.

A vital lesson learned never the less is that operational staffs do find solutions to enhance or improve the operational chain as it is drawn on “paper”. And a further identified success factor is the availability of storage facilities. Production plants often aim at reducing stock in an effort to minimize overall production costs. This necessities, or opens an opportunity, for storage facilities nearby production plants thus allowing “Just In Time” or” Just In Sequence” delivery or the direct acceptance of finished products in a “zero stock” environment.

### 4.b.2 Agrokor – Vupik Vukovar

The case of Agrokor has been introduced to allow an insight in the regional development of IWT in Eastern Europe. Infrastructure, certainly inland container terminals, is far less developed as in Western Europe.

Agrokor is there for an example of bulk transport of agricultural products in Croatia and Serbia which is fully operational. After initially shipping his goods through the port of Vukovar, and there with becoming one of the biggest clients of the port, Agrokor invested in his own infrastructure and superstructure building out an intermodal terminal connected to the waterways, rail and truck. Here again we find that in a strategic vision, inclusive investments in infrastructure and superstructure, IWT gained its place in the transport operations of the company as a secured approach for the mid and long term future.

On the other hand it is also clear that, where inland terminals – certainly container terminals, are open facilities achieving their success in grouping cargo streams of several clients, there is more advantage for a single actor controlling very large cargo streams to invest in “exclusive” infrastructure.

### 4.b.3 Nexe group – Nasicecement d.d. Nasice

Also the NEXE group is active in Eastern Europe, more specific located in Croatia and transporting in Serbia and Croatia. Core activity is the production of construction and building materials. NEXE uses IWT as a complete integrated part of his transport operations; in that view this case is fully operational. NEXE introduced and still develops the use of IWT in his transport chains out of a strategic point of view.

On the one hand IWT offers clear advantages in a pure economical consideration – certainly on a larger, to the future directed, time scale. On the other hand IWT plays a major role in the business model of NEXE where it is aimed at a sustainable and durable development of his entire business system as a key element in the company’s future and growth planning.

### 4.b.4 Zapf GmbH Bayreuth

In the case of Zapf GmbH pre-fabricated garages are transported by IWT from Bamberg to Krems with an end haul to Zielsdorf near Vienna. This case is fully operational, main drives behind the modal shift were sustainability and carbon footprint considerations. The inclusion of IWT in the transport operations also offered economic advantages. The transport of “high and heavy” goods offers great potential for IWT certainly in central Europa which will be further looked upon in the next case.

### 4.b.5 Transhipment of windmill parts in Bad Deutsch-Altenburg

Transport of windmill parts from the production plants in Northern Germany to the destined building areas in Eastern Austria forms a comprehensive example of the potential of the “high and heavy” commodity as a capture market for IWT.

The regulatory framework for the transport of High & Heavy goods over the road infrastructure offers opportunities for modal shift operations towards IWT. In most cases IWT is considered as a ‘slower’ transport mode compared with road transport. But slow is a relative notion in transport chains. First of all accurate planning and reliability are more important in logistic chains. Secondly IWT is often much faster in tonkm per time unit on account of the larger load capacity: when larger quantities are shipped in one vessel or convoy it is impossible to match this with road transport over an equal distance on the same time. And in this third case restrictions and regulations for the transport of High & Heavy goods over the road infrastructure allowed IWT to cover the same distance in a shorter timeframe.

The main drivers behind this modal shift case were cost savings, environmental motives and the regulatory framework for High & Heavy transport by road. Bottlenecks were the loading and unloading facilities, both regarding superstructure or equipment and infrastructural accommodations. Determining factor proved to be cost efficiency.

The main lesson remains that road infrastructure is not designed for the transport of such goods and that IWT offers a clear economic and operational advantage. There lies the key in placing IWT as a dominant transport mode for this commodity. As private operators conclude that IWT offers those advantages and direct their transport solutions towards the use of IWT as main transport mode legislative actors should include IWT in the regulatory framework of the transport of High & Heavy goods by road. Directing, or even diverting those transports towards the inland waterways network. The regulatory framework was already a main driver in this specific case but could be a compelling factor in the transport chains of this commodity.

### 4.b.6 Audi

Next case consists of the transport of CKD-parts for export to Short Sea or overseas destinations and is fully operational. The actors involved are Audi and their logistic partners. Both IWT and rail are used as an alternative for road transport. The commodity, CKD-parts, proves that IWT has it place in a complex logistic chain were stringent planning and quality of service are of at most importance.

The case also demonstrates that leading actors in any sector are susceptive for durability and sustainability. More of, it shows that once leading actors in a sector have opted for IWT as a solution other actors contemplate and often implement similarly.

### 4.b.7 Ford, Köln

Ford is in the automotive industry the leading actor in using IWT to transport finished cars in between his European plants. The geographical locations of the Ford plants throughout Europa and the strong commitment of some of their transport partners have led in 1982 to the start of their IWT logistic operations.

The major lesson to be learned out of this case is the role of the transport partner. Production companies are concentrating on their core business. Activities - even integral components of their production chain - which are not considerate core business, are subcontracted. Even though susceptive for economic or operational arguments most companies will not invest in certain activities, among which certainly transport and logistics, regardless of the advantages on mid or long time.

So the role of the logistic partner is not limited to the execution of transport operations, the logistic partner has to take over investments which seems to be part of their customers production activities and integrate the depreciations in their own business model.

The cars are transported by Ro/Ro vessels. Also for Full Trailer Loads Ro/Ro transport has been implemented and specific concepts were engineered.

It illustrates that FTL that are transported by road alongside the waterway network in a parallel corridor could, alternatively, travel part off their journey over this waterway system. Avoiding congestion, driving bans and road taxes and thus seeking economic advantages are the main drivers behind the concept. In a Ro/Ro concept semi-trailers and road trains are loaded on their own wheels aboard of the vessels or pontoons. Thus the loading cost is minimized and the use of an intermodal unit such as a container is avoided. Some concepts focused on speed by introducing catamarans or high speed vessels but were never implemented though similar initiatives along the Rhine corridor, purely aimed at avoiding the weekend driving ban in Germany are in operation between the North Sea ports and Switzerland. And a similar system was operational on the Danube. It started in 1982 with a regular liner service between Passau (DE) and Vidin (BG) over a distance of 4.435 km. In 1983 Linz (AT) was included to also serve the transport relation Linz-Vidin, reaching a frequency of 20 departures per week in each direction. But the service stopped about a year ago.

The main drivers: road congestion and or driving bans. The poor conditions of road and rail infrastructure and the waiting times at border crossing helped to the success of the floating motorway.

The two major bottlenecks for the continental intermodal chain, handling costs and the lack of suitable intermodal units, are - inherent on the Ro/Ro concept - avoided.

This case also brings forward a key success factor: these kinds of logistic solutions must be offered in a regular liner service where frequency and punctuality form the bottom-line for the attractiveness of the operation.

### 4.b.8 BSH Bosh und Siemens Hausgeräte GmbH

Bosh und Siemens Hausgeräte GmbH has integrated inland waterway container transport in their delivery lines from South-western Germany to the UK. This has always been a typical Short Sea connection which was effectuated with mega trailers specially adapted for their products.

The transport units used to replace these mega trailers are special pallet wide, high cube, 45' containers. These containers are introduced in Short Sea Shipping as an answer to the evolution of truck trailers which, responding to shippers needs, became higher, wider and longer.

Without the use of these containers IWT would never have been involved in this operation. Because IWT does not apply an own intermodal unit matching nowadays trailers dimensions. IWT uses the intermodal units of the maritime transport, being it overseas or Short Sea services. By using these intermodal units two clear bottlenecks for a continental container service were solved. IWT operators never invest themselves or subcontract to partners investments in equipment. And any intermodal unit that could be introduced to enhance a modal shift to continental container services has to match nowadays trailers capacities.

### 4.b.9 AMS Barge

The AMS barge concept is a vessel developed by the Mercurius group for container transport with a crane installed on board of the vessel. The vessel is currently used to relocate containers within the port of Amsterdam. The handling of containers, though there is an enormous extended choice of handling equipment that can be deployed for about any cargo stream, demands certain investments both in human and financial resources. Therefore it will only become cost effective as from a certain turnover.

The AMS barge was designed to enable loading and unloading of containers at locations were this turnover could not be reached. As the handling costs form such an important part of the total transport

costs of any container operation the equipment deployed, as accurately as possible adopted to the expected turn over, is a key success factor in container operations.

### 4.b.10 Orange Juice by IWT

The transport of orange juice from Rotterdam to juice packers located in Bonn and Strasbourg fits, of all cases, closest to the concept of continental container transport. About all the elements touched in the previous cases were addressed in this project which is partly operational in the sense that several pilot shipments were actually effectuated but it remains that the concept, due to operational and economic bottlenecks is not – yet – implemented.

Main drivers were the reduction of transport costs and externalities.

The juice was shipped in tank containers matching the capacities of the previous used tank trailers.

The lack of handling equipment at the place of departure required pre haulage to loading facilities.

The logistic players took the leading role in the development and tray-outs of the concept.

In the pilots several enhancements were found during the operations.

Tank cleaning, as an additional logistic service, formed part of the transport chain.

At this moment the concept still remains, on a cost compared basis, uncompetitive with road transport. Solutions are sought in further reduction of the transport or handling costs or in the acquisition of return loads.

### 4.b.11 Green Barge

Green barge (flowers transported in containers by IWT) is the continental container transport chain on the inland waterway system which is the closest to being fully implemented. Green Barge started in 2010 with a smaller pilot which proved to be successful. Upon this success a larger pilot started in 2012, still in play, and expected to be fully implemented end of 2014.

Again almost all elements as yet identified came into play.

Main drivers were congestion and reliability of road transport together with environmental considerations.

The flowers are shipped in 45’ pallet wide reefer containers.

Pre- and end haulage by truck is required.

Logistic actors played a major role in the development – cooperation between those actors appeared to be a vital factor.

The solution can only be implemented when there is an inland waterway network and the necessary transhipment equipment at inland terminals and/or logistics sites.

Another aspect that can be determined from this case lies in the role of FloraHolland. In this sector production is divided over a lot of individual players, each organizing their own logistic chain. For continental container transport by IWT to be successful a certain volume is required. But those individual players are very hesitating to share logistic solutions as they bring, literally, their products to the markets on which they are competing. A sector organization as FloraHolland, recognized by his members as an impartial actor, can act as a lever to bring those individual cargo streams together thus forming the volume required for a successful implementation of the concept.

### 4.b.12 GreenRail

Greenrail is the equivalent of Greenbarge but this concept is directed to rail transport and it is fully operational. There are many more, fully operational, continental intermodal transport chains implemented by rail transport. The reason to opt for Greenrail is the presence of the equivalent, Greenbarge for IWT. The concept is the same the most distinguishing factor is the distance. As Greenbarge is a local transport solution in the Netherlands, from the growers to the auction halls. Greenrail transports the products from the auction halls to the markets in Italy, Hungary, Romania, Poland and Switzerland.

Furthermore than what has already establish clearly in the past, that intermodal rail transports requires much larger distances than IWT to be competitive with road transport, the same findings also appear in cases of continental intermodal rail transport chains.

Drivers are often congestion, unreliability or lack of infrastructure for road transport in combination with environmental aspects.

The intermodal unit, in this specific case also 45ft containers, but in a much greater variety present in rail transport is a key success factor.

The operators of the intermodal units, which are as already derived from the other cases both in de sense of availability as in operating ownership itself a bottleneck in IWT, are the rail companies themselves.

Rail companies have the ability to invest themselves in infrastructure and superstructure and take a leading role in the deployment of a logistic concept.

And, in this specific case, the sector organization FloraHolland play an important role in bringing the shippers together to form a cargo stream with sufficient volume for the concept to work.

## 4.c. Comparison of the practical cases reviewed

The following table presents an overview of the main drivers, success factors and bottlenecks identified from the *practical cases* reviewed.

**Table 1 Comparison of the practical cases reviewed**

| Case | Main drivers behind modal shift | Success factors | Bottlenecks |
|---|---|---|---|
| **Potato peels (waste product of food industry) to production plant of animal fodder** | Congestion and traffic jams for road transport<br>Forecasted rising cost of truck transport<br>Strategic decision in operational business structure | • Successful collaboration of barge owner<br>• Efficient usage of trucks to load the barge<br>• Reliability of Estimated Time of Departure and Estimated Time of Arrival of the barge<br>• The usage of bobcats to sweep the barges<br>• The quality of potato peels did not deteriorate during transportation by barge | The shorter route (in distance) by barge through the Albert canal seemed unreliable due to queue times at the Locks of Lanaye. |
| **Grains and oilseeds from production plant in bulk to customers** | Cost-effectiveness and the reason that the company is situated near the Danube river | Lower transport costs | Occasional limitations due to low or high water or ice on inland waterways |
| **Construction materials, transport in bulk of coal and slag within Croatia and Serbia** | Economical motive | Achieved price | Occasional limitations due to low or high water or ice on inland water ways |
| **Transport of pre-fabricated garages from Bamberg to Krems (Danube); the end haul to Ziersdorf (close to Vienna) takes place by truck** | By waterborne transport ZAPf garages can be transported to the customers in an environment protecting way. As ZAPF anyway manufactures its garages from the natural resource concrete, the sustainability concept is supported from the first step to the | Striving for growth across national borders and the opening of new markets in Europe play a decisive role in company policy and require up-to-date logistics.<br>Close distance to inland port of Bamberg. | unkwon |

| Case | Main drivers behind modal shift | Success factors | Bottlenecks |
|---|---|---|---|
| | final transport. Caring for the environment is a key part of the way Zapf does business. | | |
| **Delivery of windmill parts in Eastern Austria. by inland vessel from northern Germany to Bad Deutsch-Altenburg** | Cost savings, environmental reasons, restrictions for high & heavy transports on the road | Successful collaboration of 2 private companies and 1 public infrastructure provider | Restrictions for high and heavy transports on the road, capacity restrictions in terms of number of trucks available for high & heavy transports at one time in one location to unload the ship. Load of road infrastructure |
| **Transport of CKD-parts in container from Duisburg to Antwerp and Rotterdam** | Environmental aspects, optimization of processes, acceleration in exports, reliability of inland waterway transport, larger quantities to be shipped, approx. 16,000 truck movements between Duisburg and the West European seaports can be avoided; | More than 500 suppliers will deliver their components to Duisburg by truck. Shipments are going to be prepared at the Duisburg facility to be transported afterwards to the West European sea ports by inland vessel or train. | unknown |
| **Transport of new passenger cars from Köln-Niehl to different destinations in Germany, Europe and abroad** | Environmental aspects | Savings of more than 14,500 car transporter loads, 3.3 million km on roads and 1.1 million litres diesel (these figures cover only transports between Cologne and Great Britain) | |
| **Cookers, fridges and freezers and dishwashers**<br>**The products from the factories in South-western Germany are consolidated in Bretten. From here, special transports with oversize** | Congested roads, rising number of traffic jams, reliability, increasing costs for road transport (toll in Germany), higher safety and security for the goods and the whole shipping process | Greater efficiency of waterborne transport | |

| Case | Main drivers behind modal shift | Success factors | Bottlenecks |
|---|---|---|---|
| **containers to the trimodal terminal at Gernsheim take place every day (3 containers per day). The containers are transferred to inland waterway vessels for their journey to Rotterdam and their onward movement by short sea ships (2 vessels per week) to Purfleet (UK). From there, their final leg to the main warehouse in Milton Keynes is by truck.** | | | |
| **Collection and Distribution of container in the Amsterdam area with vessel Mercurius Amsterdam (144 TEU) with crane on board.** | handling tariff lower than the handling<br>tariff for containers, charged in a conventional inland waterway container terminal, suitable for smaller cargo volumes | Using this technology, unloading and loading a ship at the middle of a canal without the need of a quay is made possible and therefore the possibility of a barge being used as a floating terminal is created. This particular crane vessel is ideal to use at short distances with many handling activities per timeframe, like working in a port where many operations are needed. | Due to high building costs this vessel should not sail along long distances. |
| **Transport of orange juice from Rotterdam to juice packers in the hinterland by barge, using 30 ft. tank containers.** | Increase cargo visibility (track and tracing) - quality information for logistics decision makers (efficiency in the supply chain).<br>Reduction in freight transport costs which should be transferred through the supply chain to the final customer. | The quality of the product did not deteriorate during the transport.<br>If the tank container could return loaded, costs could be equal to direct road transport. | Costs are higher than direct road transport due to regular cleaning of the tank container and the pre-haulage needed for cleaning. There is also no load back from Germany/France to the Netherlands |

| Case | Main drivers behind modal shift | Success factors | Bottlenecks |
|---|---|---|---|
| | Reduction of externalities | | |
| **Green Barge (flowers transported by IWT)** | Congestion affected the reliability and efficiency of the road based service and a more efficient, greener and less energy consuming alternative to transport floricultural products was needed. | • The Green Barge concept uses 'proven technology' (i.e. existing terminals, reefer containers, complete Track & Tracing and inland waterway transportation).<br>• Cooperation between all the factors in the supply chain, from grower to auction.<br>• Reliability of 95%.<br>• Quality of the products remained the same as with direct road transport.<br>• Due to the success of the first pilot, a second one started with larger volumes. | No structural bottlenecks encountered so far. During the pilot phase, only once did transport not on time due to miscommunication with the barge owner. |
| **GreenRail (flowers transported by rail)** | The following drivers for modal shift have been identified:<br>• Rising costs of road transport<br>• Increasing limits around driving and resting times<br>• Increasing road traffic jams and thus unreliability of transport<br>• Lack of pro-active development and product/service development within the rail sector<br>• Reducing the carbon footprint of the | The key for the transport of time critical perishable products by rail is to separate the predictive part of the fast moving products and the less predictive part of the fast moving products.<br>The availability of an export market, railway infrastructure and existing shuttle services in the region.<br>GreenRail proved to be as reliable as road transport. Although road transport is faster than rail transportation for ornamental plants, it is not the time but the reliability that determines that the freshness and the commercial value of the products in the | GreenRail has encountered the following barriers and issues:<br>• Lack of confidence from both the floricultural industry and the rail freight industry in transporting perishable goods by rail.<br>• Little understandings from the rail sector of the logistical requirements for perishable cargoes.<br>• Few initiatives and business developments by the rail cargo industry.<br>• Insufficient communication between |

| Case | Main drivers behind modal shift | Success factors | Bottlenecks |
|---|---|---|---|
| | floricultural transportation | market. The quality of the products and the logistical requirements can be insured using rail transport.<br><br>Booking system: normally a rail customers need to book a train-slot a day or more before the departure date. However, the exporters for floricultural products usually do not even know their complete orders one day in advance. The 4PL shuttle service made it possible to combine the requests of different customers into bookings and made it possible that also a few hours before the departure of the train the exporters were able to book the train slots. | players along the entire supply chain.<br><br>• One standard service level for all products offered by the rail sector.<br><br>• Inconvenient opening time at the destination terminals.<br><br>• Long waiting time during the rail transport.<br><br>• High cube containers cannot be transported on all rail tracks throughout Europe. |

*Source: PLATINA II*

## 4.d. Determining factors

### 4.d.1 Determining factors identified from the practical cases

As described in chapter 3, shippers judge transport solution on a, coherent, number of factors. The weight of the factors in their decision making process can vary on the particular characteristics of the commodities and the markets they serve, regional aspects or even personal convictions. Out of the practical cases reviewed the following factors played an important role:

**Table 2 Determining factors identified from the practical cases**

| Determining factors | Description |
|---|---|
| Transport cost | The total direct (out-of-pocket) cost for a specific connection |
| Transport duration | Time needed for a connection on a door-to-door basis |
| Flexibility | The ease of adaption to changing customers desires or external |
| Public image | Imago towards environmental aspects, safety or other public concerns |
| Safety | Avoiding of damage or quality loss during the transport |
| Regulatory framework | All rules, obligations, border - or other -imposed proceedings |
| Reliability | Time and quality based |
| Capacity | Infrastructural network, judged on quantitative and qualitative |
| Density of the network | The presence of connections and alternatives |
| Impact | The control the shipper has on the transport process |
| Strategy | Mid or long term visions or values |

*Source: PLATINA II*

As also identified in chapter 3, out of these factors transport cost is considered the most preponderant for the decision makers from the practical cases reviewed, followed by transport duration, reliability, flexibility and safety. As stated above those factors all have a weight factor on which they are judged in the decision making process and in most of the cases a coherent equilibrium on the five preponderant factors was decisive.

This means that a shipper seeks, when remodelling his transport chain (certainly in a modal shift practical case), a distinctive advantage on one of those five factors without losing, or better: with at the same time gaining on, the existing equilibrium between the factors:

- Transport cost
- Transport duration
- Reliability
- Flexibility
- Safety

Compared to the determining factors identified in the previous chapter, 'strategy' has been mentioned as an additional factor. However, it must be noted that this factor was seldom weighted as preponderant. Nevertheless, it had a specific influence on the decision making process. Strategy was considered as a trigger or driver at the beginning of the process was, during the process determined as an evaluation method on mid and long time and it returned, after an implemented modal shift case, as a clarification for the successful implementation.

### 4.d.2 Drivers

Drivers behind the modal shift were explained or looked upon, by the shippers of the practical cases, as the initiating factors behind the decision making process. They came out of an internal need to improve logistic operations or they were presented to them by logistic operators either to enhance their current service to an existing customer or to gain a competitive edge with the services they offered.

#### *Direct advantages*

When presented by a logistic service provider a clear and direct advantage in one of the five preponderant determining factors had to be present and proven to trigger the process. At the same time the equilibrium between the other determining factors had to be withheld. A particularity of IWT, which is a direct consequence of the fact that most shippers are not familiarized with IWT, worked out in some cases to be an advantage and in other cases just a disadvantage for the case. When asked to judge how IWT (as a modus) scores on the determining factors, shippers who are actually using IWT in their operations evaluate IWT substantially more positive then shippers who are not familiar with IWT in their operations. In the examined cases this was especially revealed for the five preponderant factors. So in some cases it was actually simple to convince the shipper just by proving the (unknown)

merits of IWT on one or more of those factors. In other cases it was, on the contrary, quite difficult to convince the shipper that IWT was able to perform to the required levels. The discrepancy in evaluation of the capabilities of IWT between users and non-users is most certainly an element to be taken in consideration when presenting a modal shift proposal to a shipper.

### *Strategic advantages*

When triggered by an internal process the drivers for the cases were looked upon as a strategic consideration. These strategic visions can be divided in two approaches:

1) An *economical approach* in which case the main trigger was higher or expected higher cost for existing (road) operations due to:

- Congestion
- Existing or expected road taxes
- Lack of or inadequate road infrastructure
- Regulations imposing road bans during specific periods
- Regulations affecting travel time or load capacity for road transport
- Road safety affected by congestion and traffic jams

2) An *environment approach* in which case the main trigger was the public image of the company or product or existing or expected local and European policy measures:

- Carbon footprint
- Sustainability and durability
- Process optimization
- Reducing externalities: road congestion, safety, noise, greenhouse gases emission and air pollutants
- Reducing energy consumption

It is important to note that when economic reasons were put forward shippers were prepared to accept, for a certain period, a higher transport cost as their running contracts - as long as they were convinced of the economic advantage on mid or long term. When solely environmental reasons were put forward as a strategic driver - even when looked upon as adding value to their product, branch or company's image - modal shift would only be implemented when there was also a direct economic advantage.

Even so the practical cases proved that in introducing a new logistic concept it is important to invest in awareness. The role of policy makers, the academic world and promotion organisations can be off great influence. Through the creation of awareness and consequential internal initiatives the process is conceived as strategic which means that the potential of an intermodal shift is judged on other merits.

A further aspect is that leading actors in a sector are much more susceptive for strategic considerations then the other, minor, actors. But when a leading actor implements new approaches, the other actors 'follow the leader'.

### 4.d.3 Operational factors

#### *Handling operations*

In most of the cases handling was the decisive component of the operational flow. In most cases transport cost could be reduced by introducing IWT. Mostly, though not always, even with truck pre- and/or end haulage. But the so-called vertical transport, loading and unloading, operations were vital to achieve an efficient chain being it the time factor or the pure cost factor. In the RoRo cases handling is solved by the concept itself. Though, also inherent on the concept, RoRo operations largely reduce the load capacity of the transport mode. In the RoRo concept load capacity is balanced out with loading speed and cost of the transport chain. In itself this already proves the crucially of the handling component. It also points at a possible line of thought when handling time or costs prevent an efficient operation.

#### *Handling equipment*

In this respect the handling equipment cannot be overlooked. First of all the equipment has to be adapted to the chain and the operations. Though this seems quite obvious, and once a certain density is achieved in the flows it mostly becomes that obvious, in pilots, start-up operations and in smaller flows it requires some creative thinking. As a possible solution Mercurius Shipping introduced a crane-ship. To be able to load and unload containers at locations where no adequate handling equipment was present and the volumes were too small to invest locally in equipment. But the concept did not succeed and the ship is now used to relocate containers within the port of Amsterdam. Perhaps the market did not accept or was not ready for the concept. Or it is just a question of efficiency: in other cases bobcats or lift trucks – much smaller but faster and more manageable – did enhance the operations.

### *Intermodal unit*

In all practical cases that involved intermodal continental cargo streams the intermodal unit was, evenly with the handling, a crucial factor. First of all there simply had to be a unit. The actors in the operational flows of inland waterway transport, inclusive all actors involved in inland waterway container transport, never use own equipment. They have no subcontractors that hire out or lease such equipment. And secondly the unit had to match with the dimensions of the trailers that were used for the road transport.

In the rail case 45' containers were used. Intermodal continental transport has already long been introduced in rail transport. One of the reasons is that rail companies are investing themselves in intermodal units to include them in their operational offer to their customers. They developed intermodal units in a great variety to accommodate different operational flows needs. Those units are designed for rail wagons dimensions, or developed together with specific wagons, and at the same time fitted to be carried on road trailers or chassis. This is a major factor in the reasons why continental intermodal transport has already been introduced in rail transport as opposed to IWT. But in retrospective off the market development of intermodal rail transport it has to be pointed out that these units mostly were too specific designed which has led to a lot of empty repositioning and higher costs (mostly absorbed by the rail companies). This is of course only possible in protected markets.
In the RoRo cases the intermodal unit is the rolling material itself. Certainly a solution to investigate in the research, but as already pointed out it comes with a reduction of loading capacity.
In the Juice transport case intermodal tank containers were used. The case showed the limitations of the solution by concluding that return loads were a necessity, but not available to make the concept competitive.
Overviewing all cases intermodal units used in short sea shipping services, 45' pallet wide high cube containers – in all of its various forms – seem the most appropriate intermodal unit for continental container transport. That is because their intermodal characteristics and the fact that they best match trailer dimensions. The issue here is that in the market and in the operational structure of IWT connections they are not available for continental transport chains if they are not preceding or completing a short sea operation.

### *Liner operations*

The key for a successful liner connection is the frequency of the operation. When a cargo stream executed in full trailer loads is shifted to an intermodal solution one is actually bundling single dedicated voyages into a combined shared service. Holding this against the determining factors there is a direct advantage on transport cost but, certainly in the first observation of the shipper, a loss in transport duration, flexibility and reliability sometimes also safety (in the meaning as it is described in the table of determining factors: avoiding of damage or quality loss during the transport). To regain the equilibrium between the five most preponderant determining factors the answer, in all correspondent practical cases, was found in the frequency and punctuality of the operation. The paradox is of course that the advantage in the transport cost is obtained by bundling. By reducing the marginal cost of each supplementary unit transport cost of each individual unit is lowered. So the bigger the better. Only frequency just requires levelling into smaller entities which reduces the obtained advantage. The density of the transport steams is all defining. In two of the practical cases an answer was sought in hooking up into an existing service. It also explains why cooperation was vital in several cases.

### *Integration and collaboration*

The operational flow is composed by several logistic operators. Each operator has his specific function within the total chain of operations. But each operator functions from out his proper logic, meaning his own operations and business model. Enhancing his contribution means for each individual actor to enhance the service levels he is offering to his clients and to enhance his own cost-effectiveness. In the practical cases this proved several times to be a disadvantage for the efficiency of the total chain. Enhancements of one operator, even on specific demand, proved not to be the best solution for the total operational flow as they caused negative effects on other parts of the operation. In fact different actors in the same operational flow sometimes had quite opposite interests.

In the practical cases this was the most opportunely handled when one leading actor, whether it was a logistic operator or a sector organization, controlled the process – kept the overall overview – and integrated the different parts of the flow in view of the efficiency of the whole operation.

### *Complementary additional services*

A shipper judges the logistic performance of a solution on the whole of the operational flows. Advantages on the determining factors can be offered through complementary additional services.

In the case of the juice transport tank cleaning was an important and necessary part of the total operational flow and the problem was to incorporate this service, from where it was actually located,

into the intermodal service operation. The case made clear that if the service could be offered within the new operation it would make the operational flow a lot more efficient and it would reduce the haulage costs in an important way.

Regulatory proceedings are one of the determining factors on which shippers judge their transport streams. In the RoRo case floating motorway they were included in the main drivers. In the regulatory and quality framework they are becoming more and more important in logistic flows. Offering those services or at least making room for them in the operational flow is a necessity.

Relating to the elements mentioned in the liner operations the perceived loss in flexibility and transport duration of the intermodal chain is the most important in JIT (Just In Time) or JIS (Just In Sequence) flows. In those cases this cannot be solved by frequency alone, because punctuality is here the key performance indicator. But a perfect answer lies in offering storage facilities. Adjusted planning will be needed but with an intermodal solution a much higher score will be reached on the most important KPI, punctuality, then any unimodal road transport operational flow can ever offer.

An element that returned in several cases is the opportunities to enhance the efficiency that are hidden in the actual execution of the operational flow.

During pilots and start-ups enhancements come up “on the floor”. It is important to have confidence in the know-how of the people who actually execute their, however little, part of the operational flow. So it makes sense to include, as far as this is possible and as many as this is possible, operational actors in designing or remodelling operational flows. And it is also something to bear in mind when presenting an intermodal alternative to a shipper.

### 4.d.4 Continental intermodal unit

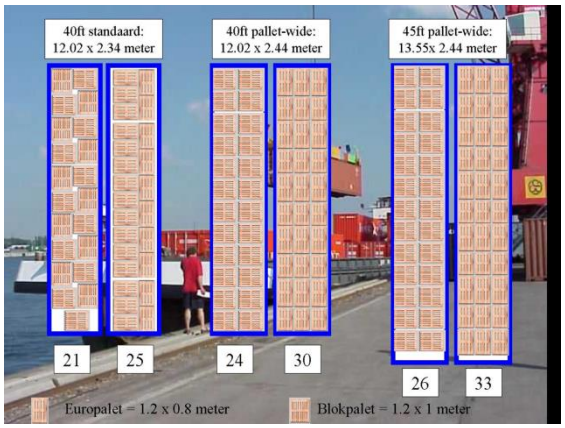
#### *Dimensions*

In intercontinental maritime transport the ISO 20’ and 40’ container are worldwide adopted as the intermodal unit. Not only the trade world but also transport and handling have adapted to this standard. Virtually all all-container ships for example are provided with cell guides with vertical guide rails as securing means for hold cargoes especially designed for the ISO 20’ & 40’ containers. This standardisation has led to the immense growth of container transport worldwide but has also blocked the way to alternative intermodal units because transport and handling equipment which is specially designed for those ISO dimensions is by definition less suited for intermodal units with other dimensions.

While all overseas transport is adapted to the maritime container, continental transport - in all continents - has developed totally other units scaled on local regulations and customers' demands.

The consequences of such a dual development become very clear in the evolution of Short Sea Shipping in Europe. SSS has two development paths: the on carriage of intercontinental, mostly containerized, cargo and the maritime carriage of European continental transport. For the on carriage of intercontinental cargo there were no issues around the intermodal unit: the ISO 20' & 40' container was simply adopted. And therefore the development of SSS in this segment followed the world wide immense growth of trade and transport. But for continental transport the standard was set by the capacity of a road trailer and SSS continental transport for a long time remained restricted to accompanied or unaccompanied trailer transport in spite of the obvious advantages of a container as an intermodal transport unit.

It wasn't until the introduction of 45' containers that continental intermodality really entered the SSS transport lanes.




## *Commercialization and operation*

Apart from some small scaled, individual organized operations, maritime containers have never been used, or re-used in the course of another transport flow, for the transport of pure continental flows. One of the reasons, as explained above, was the dimensions of the containers. The other reason was the ownership of the containers. Maritime containers are either owned or leased by the maritime shipping companies. They only allow the containers to be used in their maritime transport flows. After delivery of an import container via an inland container terminal, the containers are re-used in an export maritime transport via the inland container terminal or empty repositioned to a maritime port for the same purpose. Thus the container is simply not available for another (continental) transport.

The same issue hampers the introduction of 45' SSS containers in continental, not sea-crossing, cargo streams. Though the dimensions of the containers are suited for the transport flows the simple fact that they are owned, or leased, by the SSS shipping companies makes them unavailable for any other cargo then the flows commercialized, handled and shipped by the SSS shipping companies. All continental flows, shipped in 45' SSS containers via inland container terminals are preceding or completing a short sea operation.

Inland container operators are executing a transport that forms part of an intermodal connection as pre- or post-carriage of a maritime transport. Though the intermodal unit, the container, forms a vital part of their operations it is not included in the commercial product they offer to their customers. The containers are a part of the product that is offered by the shipping companies and the IWT product isn't but the execution of the pre- or post- carriage of a sea-going transport. Inland waterway container transport is handling containers but the container itself is not a part of their services.

Therefore the inland waterway container operators are not actors in the search for, or availability of, a suited intermodal unit. They will ship any container presented to them but they will never present a container to their customers.

There are also intermodal units used by railroad companies. But as explained above they are often too specifically designed what leads to too much empty repositioning and, very important for IWT, they are not stackable which reduces the loading capacity of the vessels. The very origin of container transport was the shipping of trailers (=chassis + loading unit in one - just decoupling the tractor of the trailer) as a RO/RO operation. Because this defined and limited the loading capacity of the vessels also chassis and loading unit were decoupled leading into LO/LO operations in which the capacity of the vessels was determined by the numbers of layers that could be stacked upon each other. The development of intermodal units for railroad transport had its own logic in which stacking wasn't a driving factor.

As a result:

- Maritime ISO containers are not suited due to their dimensions
- Railroad intermodal units are not suited due to their specific design and because they are not stackable
- SSS containers are not available due to the structure of the market

This is a major issue in the introduction of continental container transport by inland waterways. It will be further researched in Task 1.1.3:Market transfer conditions analysis for promising market segments.

### 4.d.5 Success factors

Based on the practical cases reviewed, the following success factors have been identified:

- *Offering strategic and immediate advantages* to the shipper within the intermodal shift. The strategic advantages are conceived as the main drivers whilst a direct advantage on one of the five factors: transport costs, transport duration, reliability, flexibility or safety, without losing on the equilibrium between them, is determining.
- *Efficiency in the operational flows*: enhancing the operational flow always offers a direct advantage on at least one of the determining factors.
- *Handling costs*: the "vertical transport" is the preponderant element in the transport cost and the key to an efficient transport operation.
- *Cooperation*: both between the shippers and between the logistic operators. It offers the opportunity for bundling transport stream and to enhance the operational flows.

### 4.d.6 Bottlenecks

Based on the practical cases reviewed, the following bottlenecks have been identified:

- The *equipment* used as intermodal transport unit:
  - To be competitive the alternative intermodal transport unit must match the dimension and load capacity of the unimodal transport unit used in the running operations.
  - In the current operational and commercial structure of the inland waterway container transports there are no intermodal units available for continental transport if they are not preceding or completing a maritime transport.

  This is a missing link with which, for the complexity of the connection with operational, commercial and structural elements, we will have to deal in further research.

- *Handling costs*: though it was mentioned as the success factor in some cases it also caused a major bottleneck in other cases and for the same reasons. It is clear that handling cost will be a major issue and deserves further attention in following research.
- *Investments*: for the implementation of continental intermodal transport chains investments in superstructure and infrastructure are often required though making use of existing services sometimes offers an answer. Production companies restrict investments to their core business lines and to short time Return On Investment (ROI) models. Therefor the logistic partners have to take up sometimes large investments and integrate the depreciations in their own business model over longer periods to maintain a competitive price level.

### 4.d.7 High & Heavy

The transport of indivisible, high and heavy loads deserves some special attention though the practical cases that were handled did not directly contribute to the research into the market of continental container transport. Nevertheless this “commodity” returns out of the studies as a very promising potential market for IWT, certainly in the Danube corridor.

Transport of High and Heavy goods is like a natural capture market for IWT: the road infrastructure simply is not designed for the transport of these goods and the waterway system offers an obvious alternative. The routes, in between industrial areas or from industrial areas to ports for export, are often connected to the waterway system.

A key role seems to be placed within the authorities. The regulatory framework for road transport with his restrictions on time frames, routes and equipment combined with the proceedings that have to be fulfilled is the main driver for operators and shippers to discover the economic and operational advantages of IWT.

So IWT should be integrated in this regulatory framework. Legislative actors should advice and in some cases compel the use of IWT where the waterway system offers those clear advantages.

Furthermore, the administrative authorities that handle the authorisations for ‘special transports’ are part of the ‘road administration’ and seem to see it as their task to find, whatever the circumstances, a solution or suitable route so as the transport can take place by road. It would be far more opportune to have as starting point a broader view on all available infrastructural networks instead of just the road solution.

## 4.e. Conclusions

Strategy is put forward as a determining factor but in the practical cases it is handled differently from the other determining factors and plays a role at the beginning, the evaluation and as clarification off the process. Remodelling the logistic chain is conceived as strategic when it starts from an internal process. Strategic drivers are called economical when higher road transport costs due to road taxes, road bans or congestion is expected and environmental when image or legislation pushes towards more sustainability. When the process is looked upon as strategic the case is judged on other merits though with economic strategic drivers higher initial costs are acceptable which is not accepted for environmental strategic drivers.

A leading partner plays a major role, if acknowledges as impartial, in bundling cargo streams and in consenting the opposing interests of the consecutive operational actors in the intermodal chain. A leading actor in an industrial sector is more susceptive for strategic considerations and is followed by his peer competitors in innovative approaches. In the current, bend back on core business, production models investments, even if they seem to be part of their customer's production activities, have to be taken over by the logistic partner.

The search of a fitting intermodal transport unit may have found a solution in the 45' short sea shipping container, the way to implement this possible solution in a continental intermodal concept is far from evident due to the complex relations in the commercial and operational structure of inland navigation container transport.

Handling costs and operations are a key factor in an intermodal chain as they are at the same time conceived as bottlenecks and success factors. Enhancements in the operations are often elaborated in the execution of the operation.

In intermodal transport chains storages facilities and frequency achieve the reliability sought by shippers even for Just In Time or Just In Sequence deliveries. Regulatory proceedings, on legal or quality demands, gain on importance as complementary services to be offered. Operational complementary services should not be offered as "stand alone" services, but integrated in the operational flow.

Safety in transport operations is translated by shippers as avoiding damage or quality loss during the transport process. When judging IWT on their customary KPI's shippers tend to underestimate the capabilities of the modus.

Continental intermodal transport is an existing rail transport product. Providing the intermodal transport unit and the capability of rail transport to invest in infrastructure, handling and transport equipment are

the key success factors. Too specific transport units and transport equipment are the bottlenecks for rail transport to turn continental intermodal transport profitable on shorter distances.

## 5. CONCLUDING REMARKS

The study has identified the main determining factors for modal shift through a conceptual framework developed based on different modal shift studies and projects and checked through different practical cases in promising market segments for IWT. It can be concluded that the conceptual framework developed is in line with the factors identified in the practical cases. Only 'strategy' has been identified as an additional factor, but it only plays a role at the beginning, the evaluation and as clarification off the process.

The *main determining factors* identified are linked to the costs and the quality of transport:

- Transport cost (most important factor);
- Reliability;
- Transit time;
- Flexibility;
- Safety.

Success in modal shift is achieved when clear and direct advantages in one of the five determining factors mentioned above are achieved, while withholding the equilibrium between the other determining factors. Since the total door-to-door transport cost is the most important factor, attention should be given to this aspect in the following tasks of this Work Package. The analysis has identified several possibilities to reduce costs. One of the most promising ones for containerized continental goods is the hub-and-hop system (i.e. bundling of goods by combining more inland terminals in one trip through an existing service or a new service in case of sufficient volumes). This will require more cooperation, integration and co-ordination as it may require multiple contracts with different parties in the intermodal transport chain. More attention should be given to this concept in the next tasks of PLATINA II WP1.

Attention should also be given to the promotion of IWT towards shippers and logistics providers in the IWT promising market segments of continental containerized goods, perishables, high value goods and high and heavy loads. The provision of information on the advantages in costs, but also quality of transport (especially reliability) of IWT for the short, medium and long term will be essential. The study showed that a discrepancy in evaluation of the capabilities of IWT between users and non-users is an element to be taken in consideration when presenting modal shift proposals to a shipper. This can be achieved by:

- Highlighting practical cases of leading actors that achieved modal shift. A barrier in this approach is the lack of information regarding costs (due to commercial motives).
- Carrying out studies that provide estimations on costs (with road compared to IWT) on specific routes and for the promising market segments.
- The development of tools that enable shippers and logistics providers to estimate the costs in their own situation and by highlighting the ICT possibilities for the improvement of reliability (e.g. through RIS) could facilitate the decision making process.

The study has identified several bottlenecks that still prevent the development of modal shift towards IWT. One of the main one is the search of a fitting and competitive intermodal transport unit. The 45' pallet wide high cube short sea shipping container seems the most appropriate intermodal unit for continental container transport. The operational, commercial and structural aspects related to this should be dealt with in further research.

Attention should also be given to the possibilities to reduce the handling operations (in cost and time) as this is a major bottleneck in intermodal transportation. New transhipment solutions (e.g. used in the rail sector) and spatial planning is here of high importance as there is no direct waterway connections to major production plants/distribution centres.