PRIORITY 6
SUSTAINABLE SURFACE TRANSPORT

MTCP

Maritime Transport Coordination Platform
Contract: 506328
Start: 13th April 2004
End: 12th April 2007

Work Package 2.1
Quality & Efficiency

Comparative Benchmarking of Performance for Freight Transport across the Modes from the Perspective of Transport Users: Short Sea Shipping vis-à-vis Rail, Road and Inland Waterways

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Document ID: **M21.00.19.052.001**
Document Author/s: **ISL**
Contributing to WP/ Task: **2.1**

Date: **January 2006**
Circulation: **Public**

CLASSIFICATION AND APPROVAL

Classification: Public

DEFINITIONS

Public:

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Name	Date	Signature

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1 Introduction

This study deals with benchmarking service performance in the area of freight transport across modes from the perspective of transport users. Based on desk research on existing literature, studies and projects the study makes an inventory of existing tools for the benchmarking of different modes, i.e. short sea shipping, rail and inland waterways from a multimodal, door-to-door perspective, and road from an unimodal perspective. Following some general information and definitions (chapter 1) the specifications of characteristics of relevant modes have been defined in chapter 2 “Inventory of Tools”. The modes to be included are

- short sea shipping (SSS) including pre- and end-haulage with subdivision roro transport and container transport,
- inland water transport (IWT)
- rail transport
- road transport
- combined transport with subdivision road / rail, road / IWT and SSS / rail.

In chapter 3 “Extraction of KPI” some essential projects among the number of different projects and studies that are to be considered have been described. Special emphasis has been laid on the recommended work done by the European Shippers’ Council and the UK Freight Trade Association. Based on the results of the desk research and own evaluations the main SPIs (service performance indicators) or KPIs (key performance indicators) have been extracted.

In chapter 4 these indicators were allocated to different clusters, like for example costs, availability / flexibility, safety and security etc. and have been examined against the background whether they could be used in a manner that would allow a comparison of performance between modes.

In chapter 5 “Small-scale Demonstration” some transport routes were defined in order to apply the indicators and validate their practicability and feasibility. The modal performance of door-to-door short sea shipping has been compared with rail, road and inland waterways. As far as information is already available it could be shown that the proposed method works.

Finally, the study concludes with the positioning of the modal performance of Short Sea Shipping vis-à-vis the other modes. It also analyses areas where Short Sea Shipping might need to increase its performance, and makes appropriate recommendations. Conclusions regarding the practicability and feasibility of the indicators are based on chapters 4 and 5 and on comments given by several external experts.

1.1 About Benchmarking

Benchmarking (= BM) has been introduced by the industry in the USA where first standards were formulated in 1987. Benchmarking is a process in which products, services, company structures or processes are compared among the companies. Thereby benchmarking partners learn from each other. Benchmarking includes the assessment of the compared objects, the definition of benchmarks and the preparation of solutions, the so-called Best Practices. The aim of benchmarking is the volatile improvement and then the continuing development of products, services, company structures or processes of a company by learning from others. Performance and efficiency shall be increased to keep competitiveness.[1]

In other words: Benchmarking means a continuous process in which innovative partners increase their capability to learn and their know how by systematic gathering of information and open exchange of experience based on fair competition.

Professional benchmarking between companies requires a code of conduct regulating the confidentiality of data, the provision of a professional project management, the definition of benchmarking objects and exact benchmarks for an assessment of the actual situation, the definition of standards for the collection of data, a benchmarking infrastructure and creativity in the application of Best Practice.

In general, benchmarking goes beyond competitive analysis by providing an understanding of the processes that create superior performance. It first identifies the key areas that need to be benchmarked and the appropriate criteria. It then sets out to identify best practices world-wide and to measure how those results have been achieved[2]. During the check of existing literature on BM the authors came to the following findings:

- Transport benchmarking could be a very useful aid in policy making.
- Supply chain benchmarking initiatives mainly tend to be taken by private firms; the reported benefits tend to be at the (micro) level of the firm.
- Traditional micro indicators are useful for internal and external measurements of single companies‘ logistic performance, but inadequate for the whole supply chain. Supply chain indicators could be seen as a combination of aggregated micro indicators, disintegrated macro indicators and meso indicators.
- At present, no direct macro supply chain indicators exist[3].

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1 Modernes Lernen von anderen, in: Wirtschaft in Bremen 11/1998, p. 30

2 Benchmarking Communication, European Commission, COM(96) 463 final

3 Demkes/Tavasszy: Third International Meeting for Research in Logistics, 2000

The aim of the study is to answer three questions:

1. Is it feasible to benchmark transport performance across modes?
2. What could be the tools or performance indicators that would allow such a comparison?
3. Are these tools available and are they practicable?

While it is expected that these questions can be answered, it is also intended to create a tool for policy purposes and for the industry (both transport users and the maritime industry) to be utilised for decision-making purposes.

1.2 Definitions

"A literature review on performance measurement showed that the terms *performance indicator* (= PI) and *performance measure* are synonymous, with their usage depending on the country. Where a distinction is made, *performance measure* generally has a broader meaning than *performance indicator*. *Performance measure* indicates the direction for the performance (e.g. reduction, increase) while *performance indicators* are conceived more narrowly as data elements."[4]

The OECD adopted the following definition for both *performance indicator* and *performance measure*:

A tool enabling:

I) *the effectiveness of an operation or of an organisation to be measured*; or

II) *an achieved result to be gauged or evaluated in relation to a set objective*.

Of the 15 performance indicators selected by the OECD for the field test for road transport, ten could be defined as exact measures with an associated absolute value. The other five were "yes/no" indicators. Additional data are required for further analysis, particularly to give detailed explanations for the "yes" or "no" answers.

A performance indicator can only serve as exact measure with an associated absolute value. Such a characteristic value or reference number will be called *key figure* as can be seen in the PI clusters in chapter 4.

[4] Performance Indicators for the Road Sector, OECD, 2001, p. 35

2 Inventory of Tools

In this chapter an inventory of existing approaches and tools for benchmarking different modes from a multi-modal and unimodal perspective has been performed. This has mainly been done by desk research in existing literature, studies and projects and by contacting persons and organisations involved in similar exercises. In the first part of this chapter the specification of characteristics of the relevant transport modes is presented. In the second part an overview of some relevant projects in the area of benchmarking is given.

2.1 Characteristics of Transport Modes

2.1.1 Short Sea Shipping (SSS) Including Pre- and End-haulage with Subdivision Roro and Container Transport

According to the European Conference of Ministers of Transport[5] short sea shipping can be defined as the “movement of cargo by sea between ports situated in Europe as well as between ports in Europe and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe”.

The EU definition on short sea shipping[6] is more detailed. In this case, short sea shipping is described as the “movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non European countries having a coastline on the enclosed seas bordering Europe. Short sea shipping includes domestic and international maritime transport, including feeder services along the coast, to and from the islands and on rivers and lakes. The concept of short sea shipping also extends to maritime transport between the Member States of the Union and Norway and Iceland and other States on the Baltic Sea, the Black Sea and the Mediterranean.”

The ongoing tendency towards ever larger ships – especially containerships – for intercontinental transport results in a reduction of the number of ports of call with the ability to handle these larger ships. Therefore, the need for smaller (short sea) ships which can serve the smaller ports is increasing. For example, short sea shipping is used to feed services for maritime containers from main ports to smaller ports in Europe, for direct transport between North Africa and Europe or within Europe, e.g. from southern Europe to the Baltic ports. In comparison to intercontinental shipping the distance in short sea shipping is limited and the ships are relatively small. Regarding the market segment for short sea shipping, in inland transport short sea competes with

5 http://www.cemt.org/online/glossaries/termcomb.pdf

6 European Short sea Network http://www.Short sea.info/

road and rail transport. Due to the fact that transit times in short sea shipping are in most cases longer than those of road and rail, short sea shipping is competitive for cargos that do not require a short lead time. [7]

With regard to pre-haulage in the area of short sea shipping, this means the loading unit is hauled from the shipper to the consignee through a pre-haulage leg, usually made by truck and a main haulage, performed by the main "non-road" means of transport (in this case short sea shipping). In case of intermodal transport the loading unit is hauled as well over a final end-haulage leg. Between the pre- or end-haulage and the main haulage there are the necessary transhipment operations at terminals. It is of course possible that more than one main haulage could exist, as well as more than one kind of terminal could be part of the intermodal transport chain.[8]

Short sea shipping can be liner shipping as well as tramp shipping and all kind of cargo can be transported, e.g. dry or wet bulk, conventional cargo, neo-bulk, project cargo, rolling cargo and containers[9].

2.1.1.1 Roro Transport

"Roro" is the shortening of the term, "Roll on/Roll off." It is a method of water cargo service using a vessel with ramps which allows wheeled vehicles to be loaded and discharged without cranes[10].

Based on the European Conference of Ministers of Transport Roro transport is the "loading and unloading of a road vehicle, a wagon or an ITU (Intermodal Transport Unit) on or off a ship on its own wheels or wheels attached to it for that purpose. In the case of rolling road, only road vehicles are driven on and off a train."

The advantage of the roro system is the high flexibility regarding cargo units. Besides normal trucks, swap bodies on chassis or semi-trailers a wide variety of trucks with oversize cargo, wheeled platforms (Mafi Trailer) or goods on pallets moved by fork-lift-trucks (FLT) can be stowed in the same ship without any modifications. In the Storo method break bulk like paper reels or packaged wood is stowed by FLT without pallets directly on the ship's main cargo deck or in lower holds by a cargo lift.

Another form of roro is the transport of complete road vehicles, using roll-on/roll-off techniques, on trains comprising low-floor wagons throughout[11]. In Europe, roro transport road-rail is mainly used for transports crossing the Alps.

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7 FANTASIE - Forecasting and Assessment of New Technologies and Transport Systems and their Impacts on the Environment, Deliverable 13 "Definition of European Transport Systems", May 1999, http://www.etsu.co.uk/fantasie/D13_pdf.pdf

8 SPIN - Scanning the Potential for Intermodal Transport, Project funded by the European Commission under the GROWTH Programme of the Fifth Framework Programme, Deliverable 1, Actors and factors in transport mode decisions in supply chain, October 2002

9 European Short sea Network http://www.Short sea.info/

10 REALISE - Regional Action for Logistical Integration of Shipping across Europe, http://www.REALISE-sss.org

2.1.1.2 Container Transport

The European Conference of Ministers of Transport defines container as a "generic term for a box to carry freight, strong enough for repeated use, usually stackable and fitted with devices for transfer between modes"[12].

On the website of the project REALISE[13] a container is described as "a truck trailer body that can be detached from the chassis for loading into a vessel, a rail car or stacked in a container depot. Containers may be ventilated, insulated, refrigerated, flat rack, vehicle rack, open top, bulk liquid or equipped with interior devices. A container may be 20 feet, 40 feet, 45 feet, 48 feet or 53 feet in length, 8'0" in width, and 8'6" or 9'6" in height."

The pallet-wide container for European SSS has a width of more than 8' to allow the stowage of two pallets (1200 x 800 mm) side by side. Only the pallet-wide container of 45' length has the same capacity of 33 pallets of a road trailer. The disadvantage is that an inside width of > 2,40 m requires an outside width of about 2,55 m. This outer dimension is compatible to the width of a truck but not always to the cell guides of container vessels or the width of the cargo hold of inland barges. Container feeder vessels with an intake of more than 500 TEU are normally fitted with cell guides to speed up loading and increase safety.

In former times, the term container – in connection with goods traffic – has been used when meaning standardized transport units of different types and whose dimensions were matched to one another so that they could be linked together as "transport modules". In general, this is still true today, but the term has moved more and more towards large or bulk container that are transported by road, rail, water and – in modified form – by air.[14]

2.1.2 Inland Water Transport (IWT)

Inland water transport (IWT) is one of the oldest economically and environmentally sustainable modes of transportation and in some areas it is the only means of transport. Due to its nature, the density of the inland shipping infrastructure network is lower than that for rail and road. But for industrial areas which are accessible for inland ships, this transport mode plays an important role in the supply of raw materials. IWT is used to transport bulk goods like coal, sand and gravel, but also for containers (both maritime as inland containers). Especially for maritime containers the market share of inland shipping is increasing due to capacity problems in rail and road and the relative low transport costs in shipping. IWT is useful for nearly all kind of goods that are not time-sensitive, because it is the mode with the lowest speed of all modes – but with

11 UB/ECE, ECMT, EC, Terminology on Combined Transport, New York and Geneva, 2001, p.20

12 http://www.cemt.org/online/glossaries/termcomb.pdf

13 http://www.REALISE-sss.org

14 http://www.containerhandbuch.de

less congestions. As in many cases door-to-door transports can not be organised only by IWT, it is increasingly used as part of a chain in intermodal transport, e.g. in IWT / sea, IWT / road or IWT / rail.

2.1.3 Rail Transport

Rail transport can be defined as the land transport of passengers and goods along railways or railroads. It is an energy friendly mode of transport that makes highly efficient use of space: a double-tracked rail line can carry more passengers or freight in a given amount of time than a four-laned road.

In recent years there has been a particular emphasis on intermodal traffic in an attempt to combine the advantages of rail with those of other modes, particularly road transport. Modern rail freight operations are increasingly customer oriented and attempt to provide a more flexible, reliable service using information technology to track consignments and ensure the efficient operation of services.

2.1.4 Road Transport

The greatest share of land transport within the European Union is shouldered by road transport. The road network has the highest density of all transport modes. Because of the network density, road transport is in most cases the only mode for unimodal door-to-door delivery chains. In recent years road transport has been increasing. More and more logistics service providers take care of door-to-door transport and arrange not only transport, but also stock keeping and value added services. The integration of these activities has caused an increasing market share in the past decades.

Furthermore, road transport is the mode with the highest flexibility. A truck can start a transport whenever it is needed. In case of bottlenecks in the road network, trucks may use bypasses. On the other hand, a number of restrictions have to be in mind when planning road transports. These restrictions concern e. g. driving prohibitions on Sundays, speed and weight limitations, dangerous goods, measurement of trucks, and limited working hours of the drivers. For the emissions of trucks EU-norms are existing. These norms influence the amount of the tax which is to be paid for trucks and indirectly the norms influence the price the shipper has to pay for road transport.

2.1.5 Combined Transport with Subdivision Road / Rail, Road / IWT and SSS / Rail

According to the Organisation for Economic Cooperation and Development (OECD)[15] “the term “combined transport” is used for intermodal transport of unitised cargo when the major part of the European journey is by rail, and any initial or final leg is carried out by road.

[15] Organisation for Economic Cooperation and Development, Benchmarking Intermodal Freight Transport, Paris 2002

For EU subsidy schemes, this definition is even more detailed.” The EU defines combined transport more precise as “the transport of goods between Member States where the lorry, trailer, semi-trailer, with or without tractor unit, swap body or container of 20 feet or more uses the road on the initial or final leg of the journey and, on the other leg, rail or inland waterway or maritime services where this section exceeds 100 km as the crow flies, and make the initial or final road transport leg of the journey;

- between the point where the goods are loaded and the nearest suitable rail loading station for the initial leg, and between the nearest suitable rail unloading station and the point where the goods are unloaded for the final leg, or;
- within a radius not exceeding 150 km as the crow flies from the inland waterway port or seaport of loading or unloading.”[16]

Based on OECD information the expression “intermodal transport” as it is used in the common terminology in force within the European Union (EU), UN Economic Commission for Europe (UN / ECE) and the European Conference of Ministers of Transport (ECMT) means the movement of goods in one and the same loading unit – for example a container – or vehicle that uses successively several modes of transport without handling the goods while changing modes.

2.1.5.1 Road/Rail

Combined transport road/rail is divided in accompanied and unaccompanied transport. **Accompanied** combined transport means the transport of a complete road vehicle, accompanied by the driver, using another mode of transport[17] (in this case rail). Normally, the driver does not stay in the driver’s cabin of the truck during the journey in resp. on the train but he stays in a couchette coach. Accompanied combined transport rail/road is mainly to be found in transport crossing the Alps. The technique of loading and unloading of the road vehicle on or off a train is roll-on/roll-off (roro) on the vehicle’s own wheels.

Unaccompanied transport rail/road is the transport of a road vehicle or an intermodal transport unit (ITU, i. e. containers, swap bodies and semi-trailers), not accompanied by the driver, using another mode of transport[18] (in this case rail). In Europe, normally ITUs are used in unaccompanied combined transport. For the transhipment of the ITUs between the modes the lift-on/lift-off technique (lolo) by lifting equipment is usual. This is the reason why road vehicles are the exception in unaccompanied intermodal transport.

[16] European Union, 1992, Council Directive 92/106/EEC on the establishment of common rules for certain types of combined transport of goods between Member States (Brussels).

[17] UN/ECE, ECMT, EC, Terminology on Combined Transport, Geneva 2001, p. 21

[18] UN/ECE, ECMT, EC, Terminology on Combined Transport, Geneva 2001, p. 21

2.1.5.2 Road / IWT

Road/IWT is a type of combined transport consisting of inland water transport (IWT) and road transport. It combines one of the oldest economically and environmentally sustainable modes of transportation (IWT) with one of the most flexible means of transport for pre- and end-haulage.

2.1.5.3 SSS / Rail

Combined transport by short sea shipping and rail normally combines two relatively long legs of a transport chain. Both legs normally need longer distances to be done in a economically way. Three terminals are needed at the minimum:

- First terminal: loading the unit to a ship.
- Second terminal: transhipment of the unit from the ship to the train.
- Third terminal: unloading the unit from the train.

In Europe, combined transport short sea shipping/rail is mainly to be found in the Baltic Sea region and on the Rhine River from the North Sea up to Duisburg.

2.2 Overview of Relevant Benchmarking Projects

ADVANCES

The ADVANCES (Added Value Network Concerning European Shipping) Thematic Network is intended to be an arena in which all the relevant actors; shippers, ports, shipping operators and land transporters meet to achieve a common understanding of how to combine the industrial concept of total logistics quality with the IMO and European desire for improved safety at sea into one, coherent operational platform. The knowledge base generated in the Thematic Network will be used to co-ordinate relevant European and national research.

The resulting operational platform will subsequently be extended to shipping in other regions as well through the supply of European Added Value products.

The objective of ADVANCES is to establish an extensive network for:

- Establishing a common understanding of Added Value shipping among policy makers and the industry
- Identifying the missing elements needed for establishing Added Value shipping operations as integral parts of European intermodal transport systems.
- Evaluating previous and ongoing research to clarify the availability of the required elements for Added Value shipping.

- Initiating new research and development in order to close the gap between status-quo and the future quality requirements.
- Validating of practicality and viability of Added Value shipping and Added Value elements.
- Disseminating the intermediate and completed results of relevant projects in an effort to provide an operational platform for the industry for adapting these new quality elements, as they are becoming available.

Waterborne transport is energy and cost efficient. Hence, it has a significant potential for absorbing an increased volume of cargo transport. This network activity will contribute to making waterborne transport even more attractive for intra-European transport than it is today, with the following effects:

- Lower energy consumption for transport improves the environment.
- More attractive waterborne transport will contribute to ease the pressure on European roads
- Efficient intermodal chains using waterborne transport should shift transport of dangerous goods form road to sea, thereby improving overall transport safety.

The type of intermodal transport system that is being enabled through ADVANCES will lead to extensive use of telematics in mobility industry, and is considered to make a major contribution to innovative developments in Europe. This is expected to have significant impacts on transport efficiency and job creation.

The topic of ADVANCES is not an issue that can be handled on a personal, company or national level. Unless it is being solved on a European basis it will not have the desirable effect. Otherwise, the initiatives to improve the safety and image of waterborne transport taken by the Commission and the governments of UK and the Netherlands will be in vain.

ADVANCES will also help bringing policymakers and industry together in order to ensure that there are only winners in the "battle" for Added Value shipping.

Economic growth in Europe is dependent on an efficient logistics infrastructure for the European industry. The ADVANCES network will facilitate a new technological development in the European maritime industry. It will therefore directly influence the technological and commercial development in the maritime industries, and it will facilitate new, competitive logistics solutions to the benefit of other industries as well[19].

This project has been used to gain background information, no key performance indicators have been developed in this Thematic Network.

[19] http://www.maritime.deslab.naval.ntua.gr/research/projects.asp?id=advances

INTERMODA - Integrated Solutions for Intermodal Transport between the EU and the CEEC

The project INTERMODA was funded by the European Commission in the R&D Programme "Promoting Competitive and Sustainable Growth" - Key action "Sustainable Mobility and Intermodality". It contributes to the creation of an integrated transport system across Europe - between the European Union (EU) and the Central- and East European Countries (CEEC) and furthermore will also contribute to the objectives of a Common Transport Policy (CTP) in Europe.

The main objectives of INTERMODA are:

- Specification of a Pan-European Intermodal Transport Network
- Specification of technical performance indicators, market determinants and parameters for regulatory framework conditions
- Record, analysis and assessment of status quo for intermodal transport
- Forecast on future traffic volumes and demand
- Measures to improve and align current and future network
- Estimation of the feasibility of interventions (means and measures) for an intermodal network between EU and CEEC, together with their impact

INTERMODA aims to measure the performance of the intermodal transport system. The goals and objectives for this system differ among the various actors. Customers (end users) of intermodal transport services have different objectives (and perceive quality differently) from policy makers such as the European Union. The first group might want a system that is reliable and has low costs whereas the latter is looking for a system that is sustainable. It is very hard to identify one central goal for the customer as a group, since each user has specific needs mainly depending on the type of goods and other characteristics of the shipment. The requirements set by shippers and by transport companies/forwarders working on behalf of shippers may even differ. The shipper may focus on maximum safety and reliability but may be less demanding with regard to transport speed. The transport company, on the other hand, will of course make the shipper's requirements known to the intermodal operator but may also add requirements of its own, such as high transport speed in order to ensure that its equipment is available for the next shipment as soon as possible. The intermodal operator will try to satisfy both sets of requirements.

INTERMODA's objective is to measure the performance of the intermodal transport system in order to identify bottlenecks and to identify policy measures that can improve the system's performance. Quality is therefore perceived in a broad sense and not only seen from a customer's perspective. The policy objectives of the EU are the starting point; their requirements are of central importance. This does not mean that INTERMODA will ignore requirements of other actors in the intermodal transport chain since, in many cases, the requirements of the policy maker and the user are the same. One of the consequences for identifying indicators is that a market segmentation of indicators according to commodity type is not necessary, since the aim is to create a safe and reliable system for all types of goods[20]. The performance indicators developed in INTERMODA are listed in chapter 3 – Extraction of KPI.

IQ – Intermodal Quality

The project IQ – Intermodal Quality was funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme – Integrated Transport Chains. It has been used as reference project in INTERMODA - Integrated Solutions for Intermodal Transport between the EU and the CEEC. The main objective of the project was to supply the necessary tools for enhancing European intermodal transport by improving: inter-operability among terminals, inter-connectivity and accessibility, and taking for base the quality of the transport chain.

The aim of IQ is to improve the quality of intermodal transport, and the quality is considered at the level of the final user. In IQ it is assumed that the demand side of the market is heterogeneous and therefore an optimal service to one client might not be optimal for an other. The segmentation of the market must highlight this heterogeneity, which was not the case of the previous segmentation proposed, based on supply characteristics.

With this approach all the different aspects of the intermodal transport system have to be taken into account, as well as their interactions, in order to assess the impact of a specific action on intermodal quality: these aspects are economic, organisational, technical, spatial and define what has been called an « integrated » approach for « integrated transport chain ».

In the two work packages, the quality of terminal and the quality of network is assessed for the present situation and an horizon of 2010 with performance indicators. In a later stage, IQ will integrate the element of terminals and networks analysis along the lines of spatial, professional and technological consistency requirements. An extensive database on terminals and network services allow the creation of a tool for simulation of services improvements.

IQ considers the quality at the level of the end user and makes a distinction between external and internal quality. External quality refers to the quality perceived by the customer (total door-to-door chain), whereas internal quality indicates the quality perceived by actors in intermodal operations (the quality of a chain link).

The objectives of the EU regarding the intermodal transport system might be characterised (following the general policy objectives expressed in EC, 1997) as efficient and cost effective. These differences in perceiving performance are important in identifying

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[20] **INTERMODA - Integrated Solutions for Intermodal Transport between the EU and the CEECs**;, Project funded by the European Community under the 'Competitive and Sustainable Growth' Programme (1998-2002); www.intermoda.org

meaningful and practical indicators of the system's performances[21]. The indicators are listed in chapter 3 – Extraction of KPI.

REALISE - Regional Action for Logistical Integration of Shipping across Europe

REALISE is a three year Thematic Network under the Competitive and Sustainable Growth Programme. The overall objective of REALISE – taking account of what has already been achieved by EU and national activities and projects – is to develop technological strategies, methodologies, and tools for the European business community and decision-makers in order to encourage the use of short sea shipping. These efforts will focus on the carriage of unitised cargo.

The project is to assist European business actors and policy-makers to secure the key maritime transport objective of the European Commission White Paper on 'A European Transport Policy'. This is to achieve a substantial modal shift of incremental freight from road to sea and a development of intermodality during the next decade. REALISE sets out to provide these methodologies and tools in the context of the development of Short sea shipping via its integration in the complete logistics supply chain.

REALISE is considered to be a flagship project at European Level for Short sea Shipping and Transport. The overall objective of REALISE is to develop strategies, methodologies, and tools for the European policy-makers and business community to expand the use of Short sea shipping.

REALISE analyses Short sea shipping, therefore, in the context of its integration into overall logistics transport chains. During its 3-year activities, REALISE achieved interesting and important results on Statistics, environment impacts comparisons across modes for the internalisation of external costs, transport market functioning and services, port hinterland developments and infrastructure requirements and modal drivers and modes performance assessments.

The REALISE findings provide valuable insights for the efficient integration of different transport modes. One aim is to make intermodalism a preference for the movement of goods in Europe.

RECORDIT - Real Cost Reduction of Door-to-door Intermodal Transport

RECORDIT was an international project under European Commission's Fifth Framework Programme for Research, Subprogramme area "Modal and Intermodal Transport Management Systems" co-ordinated by the Directorate-General for Energy and Transport (DG TREN). It addresses on a European scale the theme "Analysis of the cost structure of door-to-door intermodal freight transport services and the conditions to optimise it". The recent White Paper of the EC on the revision of the Common Trans-

[21] **IQ – Intermodal Quality,** Final Report for Publication, Project funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme – Integrated Transport Chains, Juli 2000

port Policy devotes a special attention to intermodal freight transport services. In its section: “Linking up the modes of transport”, the White Paper advocates a number of technical, economic and organisational innovations that directly aim at increasing the attractiveness of intermodal solutions. On the other hand, and no less importantly, many other measures and actions proposed by the White Paper, although they do not target intermodal freight transport as such, are immediately relevant to the general objective of promoting intermodality. Specifically: the revitalisation of European railways (through radical increases in efficiency and the eventual establishment of a dedicated freight network), the introduction of an adequate system of transport infrastructure charging, the generalised improvement of the quality of transport services, are all fundamental prerequisites to achieve a higher degree of competitiveness in the intermodal freight sector.

RECORDIT addresses those policy needs in a comprehensive way. It is based on the recognition that, in Europe, the current intermodal market is characterised and constrained by an insufficient knowledge of the mechanisms of cost and price formation. Increasing the transparency of those mechanisms will stimulate fair competition, and, as a result, raise efficiency levels and improve the quality of service, while contributing to increase the sustainability of the transport sector, social welfare and quality of life.

The main objective of RECORDIT was to improve the competitiveness of intermodal freight transport in Europe through the reduction of cost and price barriers which currently hinder its development, while respecting the principle of sustainable mobility. The following items have been realised in the project:

1) Design of a comprehensive methodology for the calculation of real (internal +external) costs of intermodal freight transport and for the understanding of cost formation mechanisms
2) Validation of this methodology through its application to three meaningful European corridors (including CEEC): Patras-Gothenburg, Genova-Manchester and Barcelona-Warsaw
3) Analysis of the current charging and taxation systems to understand price formation mechanisms
4) A systematic cost comparison for intermodal and all-road alternatives have been carried out
5) Assessment of current imbalances and inefficiencies
6) Development of a decision support module to foster generalisation
7) Identification and analysis of technical and organisational cost reduction options
8) Formulation of recommendations on public policies and business actions to reduce real costs and to internalise external costs
9) Promotion of consensus building among operators and users

A major development of RECORDIT was the implementation of a Decision Support System (DSS). The DSS is an interactive software allowing one to estimate the costs (internal and external) of freight transport services along any intermodal or all-road corridor. It incorporates the basic data set of the three RECORDIT corridors, from which unit costs and parameters are drawn for extrapolation purposes. The DSS further allows one to simulate the impact on costs of policies and actions, by mapping those against the cost drivers on which they act. A number of simulations have been carried out to estimate the potential impact of policies and actions advocated in the White Paper[22].

Information from this project has mainly been used for background information especially with regard to costs. Performance indicators have not been developed in this project.

TRILOG – Europe

The Trilateral Logistics Report (TRILOG) was initiated in 1996 as a project within the OECD's Programme on Road Transport Research and Intermodal Linkages and performed for the EU Directorate DGVII and the OECD. Based on experiences in Europe, Asia-Pacific and North America, the study focuses on three main issues: global trends in logistics systems, opportunities for policy makers to influence these chains, and the performance of intermodal logistical systems.

TRILOG aims to stimulate the exchange of concepts and experience on multimodal management, freight transport logistics and the associated policy challenges encountered on a multi-regional and international basis. Three task forces representing the European, Asia-Pacific and North American regions produced reports focusing on the common challenges encountered in international freight logistics and supply chain management[23].

The main objectives of the TRILOG project are:

- Provide an overall vision on global supply chain management.
- Provide inputs for OECD’s comparison of Supply Chain Management in Europe, Asia-Pacific and North America.
- Identification of best practices and possible policy actions (in particular for the EU).

In this context, the following themes have been addressed:

- Trends in Global Supply Chain Management

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[22] RECORDIT – Real Cost Reduction of Door-to-door Intermodal Transport, supported by the Commission of the European Communities – DG TREN Key Action 2: Sustainable Mobility and Intermodality, Type of Action: Accompanying Measure, 2000-2001

[23] http://www.oecd.org/document/16/0,2340,en_2649_201185_1943888_1_1_1_1,00.html

- Interregional Flows and Logistics
- Sectoral and Industrial Characteristics of Logistics Systems
- Intermodality, Technology and Logistics
- Financing and Global Supply Chain Management
- Human Resources Requirements of Global Logistics
- Evaluation of Global Supply Chains - Indicators

The main results of TRILOG are clear schemes detailing current trends in international logistics. A review of the opportunities and constraints in Europe, in terms of international intermodal supply chains has been carried out. Suggestions for policy application have been done and a methodology for measuring the performance of international intermodal supply chains have been developed [24]. More information about the performance indicators of this study can be found in chapter 3.

[24] **TRILOG Europe – Indicator Report,** Deliverable 7 of TRILOG - Supply chain management from a global perspective, (TRILOG - Europe part of an OECD study), Chalmers University of Technology, Göteborg, Sweden, September 1999; **TRILOG Europe – Intermodal Transport in Europe**, Deliverable of TRILOG Europe Tasks 4.1, 4.2., 4.3, TNO-reportInro/log.2005-26, December 1999

3 Extraction of KPI

The service performance indicators (SPI) or key performance indicators (KPI) detected in various studies described in the foregoing chapter are presented in this part of the study.

FTA

The chapter starts with the eight SPI finally chosen in the FTA Study "Service Performance Indicators for Short Sea Shipping (2001), because there is a detailed description of the SPI and the findings of the study had the agreement by many users and other participants of working groups and the steering committee. The eight SPI for SSS are:

1. The booking
2. Pick-up shipment
3. Deliver shipment to terminal
4. Terminal handling and the voyage I
5. Terminal handling and the voyage II
6. Collect shipment from terminal and deliver to consignee I
7. Collect shipment from terminal and deliver to consignee II
8. Collect shipment from terminal and deliver to consignee III

Each of these SPIs has been developed in a "Service Pyramid" with a general structure:

For each of the identified SPIs the FTA authors ask:

- What should be measured for that indicator ?
- Who has the management responsibility to deliver the service ?
- Who should measure the performance against the measure?
- What should be the **performance standard** that should be?

For the purpose of BM of modes one has to ask: Are these SPI applicable to IWT or rail transport and will the application show differences between these modes?

A first answer is that they are not sufficient because important aspects like costs, external costs or safety are not regarded.

Performance Indicators in the Netherlands

The following tables show indicators which are proposed in the Netherlands by various target groups.[25]

Policy makers:

Aggregate performance indicators	Journey time index (True origin to final destination) Average cost index Reliability index
Environmental performance of the different modes/modal combinations	Emission (NO_x, CO_2) Fuel consumption
Efficiency and use of infrastructure	Average use of road, inland waterway and rail network Length of road, inland waterway and rail network Average travel speed on road, inland waterway and rail network Growth and growth potential of road, inland waterway and rail network Congestion / risk Costs of maintenance and repair of the road, inland waterway and rail network
Safety per mode	Number of deaths/accidents
External costs (per mode)	Infrastructure costs; safety; noise; emissions

25 Benchmarking Intermodal Freight Transport, OECD 2002, Annex 8

Shippers:

Relative performance of the intermodal chain	Total logistic costs (production, sales, collection, storage, transport) Transit time from true origin to final destination Reliability; flexibility; risk of damage

Semi-public organisations:

Terminal efficiency	Handling time per container Number of container cranes TEU per container crane Movements per hour Crane-intensity Movements per crane-hour Net crane-productivity
Use of space	Stackable height Deposit area Total container area in hectares
Handling cost and revenue	Cost per container per handling Cost per container for stacking Cost for renting the container Revenue per container
Service level	Reliability Facilities (Quayage, maximum draught, deposit area, container-cranes) Average waiting time Level of technology / EDI Number and frequency of connections (to other terminals)

Transport industry and logistic service providers:

Transport company performance	Return on assets Return on equity Trading margin etc.

Degree of utilisation of vehicle	In volume: measured by payload of weight, pallet numbers and average pallet height In distance/empty running: measured as the number of miles the vehicle travelled empty and the number of miles the vehicle travelled with only returnable items In time: measured on hourly basis as one of seven activities (running on the road, rest period, loading or unloading, pre-loaded and awaiting departure, delayed or otherwise inactive, maintenance and repair, and empty stationary) over a 48-hour period
Schedule adherence and deviations from schedule	Problem at collection point and/or delivery point Own company actions Traffic congestion on major corridors and at border crossings Equipment breakdown Lack of personnel Availability of required infrastructure (terminals, access roads, right-of-way, highways, short-line rail services) Availability of appropriate equipment at terminals Operating procedures at ports and terminals
Fuel efficiency	Measured as km per litre Measured as ml. fuel needed to move one standard industry pallet 1 km
Relative performance of the intermodal chain	Timing: transit time, frequency of service and on time reliability The total logistics costs and service in relation to the level and quality of logistics services Efficient, seamless transfers between modes Use of integrated enterprise systems Compatibility of technology in different global regions Use of ITS to speed transport, improve connectivity, reduce congestion High asset utilisation, leading to lower cost of operation, leading to lower freight rates
Harmonisation / regulation	Harmonised vehicle weights and dimensions Harmonised safety regulations Harmonised labour regulations Immigration policies (leading to such issues as trucking companies not able to hire drivers from other countries during periods

	of driver shortage) Conflicting policies between government departments leading to tensions in transportation system.

INTERMODA - Integrated Solutions for Intermodal Transport between the EU and the CEEC

In this project in a first step a set of ideal performance indicators has been developed, from which a selection has to be made for reasons of practical feasibility.

The ideal performance indicators are:

- time (e.g. the total length of time between when the load unit is ready for transport and when it is delivered);
- reliability (the absence of unforeseen lowering of performance);
- flexibility (the ease with which the system adjusts to an unexpected change in logistic requirements);
- qualification (the capability of personnel to cope with complex logistic requirements);
- accessibility (the ease with which the intermodal transport system can be used);
- monitoring (how well the status of the loading units can be tracked);
- safety and security (the risk of losing equipment and goods).

In a second step the project uses the following categories for the classification of the final selection of performance indicators:

- time
- reliability
- flexibility
- safety
- capacity
- tariff
- accessibility
- utilisation
- monitoring

IQ – Intermodal Quality

The project proposed performance indicators for terminals and investigated the main technological developments (hardware, software) in order to measure their impact.

The performance indicators refer to:

- load unit moves per hour
- dwell time of load unit or vehicle
- reliability, maintainability, availability
- flexibility and automation
- safety and security

TRILOG – Europe

Commonly used indicators measuring the performance of the core logistics function can be classified as follows:

	External performance indicators	**Internal performance indicators**
Business perspective	Delivery time Sales Price Customer satisfaction	Result vs budget Inventory value Customer service
Engineering perspec-tive	Sustainability Availability Reliability Quality	Cycle time Turnover rate Productivity Asset utilisation

General indexes have been developed in order to compare different logistics items in various countries and in several industries. The TRILOG consortium uses the taxonomy proposed by Andersson et al. They define the external performance according to the following indicators:

- availability
- reliability
- quality
- lead time
- customer service
- price

Those six elements have been chosen because of their involvement and influence on total cost and level of service. They are mostly related to single companies but can be used at an aggregated level as the Supply Chain

Parallel to other activities implemented in order to increase the supply chains efficiency an extensive work regarding performance indicators has been conducted. The focus is mainly on aspects that influence TTM (time to market) and TTC (time to customer) and the following performance indicators are used for the supply chain:

- time to customer (TTC)
- off-time delivery
- inventory turn over (ITO)
- costs
- time to market (TTM)

Work done in chapters 4 and 5 shows that the PIs developed in the INTERMODA Project are the best suited PIs including their short descriptions. In spite of a similar number they include much more aspects than the selection by FTA. Otherwise they are not too detailed which makes them easier to handle than the Dutch proposals.

The authors of this study feel that the PIs should

- be suitable for several transport modes or legs of the transport chain,
- cover all important issues influencing the modal choice,
- be applicable in desk work to a larger extent, e.i. it should be possible for a potential user to get the required data from transport or terminal operators.

4 Comparison between Modes

The scope of this study is widened from a single transport mode to a comparison of performance with other modes. This requires the addition of further Pis. While the eight SPI mentioned above (FTA Study) could be clustered as quality indicators the additional belong to different clusters like

- Economy
- Ecology
- Safety
- Security

The benchmarking process is made easier if the indicators get the same, or at least not so much different key figures. Example: If transit time is measured in hours and reliability in per cent of shipments arrived in time, the question arises, what is more important. If reliability is measured as average delay, both KPI are measured in hours which can be added resulting in the most important KPI for all time sensitive cargo.

For the definition of indicators first of all so-called clusters have been created and all associated aspects have been summarized in tables. Terms in brackets have been classified as secondary or replaceable, the others have been allocated with key figures. In the bottom line of the respective table the final key performance indicator and its definition can be found.

Below the tables a few short explanations to the tables and reasons for the definition of the KPIs are given. More background information is provided in subchapter 4.2. A few other PIs which seem to be less important are mentioned in chapter 4.3.

4.1 Performance indicator clusters

PI Cluster: Costs

Performance indicator	Measure	Definition	Key figure
Capital costs	Costs/vehic.	Repayment and interest for building costs of vehicle/vessel	€ per km
Fixed operation costs	Costs/vehic.	Personnel, M&R, insurance, administration	€ per km
Variable operat. costs	Costs/vehic.	Fuel costs, road tax, fairway and port dues	€ per unit
Terminal handling costs	Costs/vehic.	Cargo handling costs	€ per unit
Pre-haulage and end-haulage costs	Costs per unit	Price, because costs per km are higher on short distances	€ per unit
(prices)	price/ t or vehicle	Transport prices should reflect the costs plus profit	€
Load factor	Per cent	Percentage of load capacity used, needed for calculation of costs per load unit	units
(Fuel efficiency)	-	See external costs	
KPI: Transport costs	**Costs per unit**	**Total freight cost to the customer**	**€ per load unit**

Explanations (comp. 4.2.1):

Costs are not the same for every operator. E.g. for ships the capital costs depend not only on the age of the ship but also on the place of built and kind of financing. Fixed operation costs depend on the flag, the company, type of operation etc. Variable operation costs depend on the route. With prices the chance to get reliable transport costs information is not much better: They depend on costs, competition, load factor and give no idea of the share of profit which may be good or not existent. For ships and trucks costs can be calculated or partly estimated. For rail transport this becomes easier with privatisation (Track fees, locomotive rental etc.).

Costs can be calculated for the main run on longer routes. There are also empirical values like 1 € per km for truck transport over longer distances in central Europe, or less than that sum in eastern Europe. For general cargo and container ships it is easier and more realistic to take a published charter rate per day which includes all capital and fixed operation costs.

For **pre- and end-haulage** the prices are preferred because costs per km are not relevant for short distances. Terminal handling costs may be estimated for inland terminals. Ports publish some prices but major customers will get rebates.

The **load factor** is just a factor in the calculation of costs per load unit for vessels which can take in more than one load unit. By division of total units per year by number of departures the average load factor can be calculated.

Fuel efficiency depends on speed and capacity of vessel/vehicle and is, therefore, clearly different between the modes. There is no immediate need to compare because the efficiency results in costs.

User fees: Road tolls or bridge tolls are included in variable operation costs. Sea transport faces some fairway dues, also called pilotage dues or lighthouse dues, as well as harbour dues in addition to the terminal handling costs.

Attention: For many FCL shipments the key figure "€ per load unit" is not yet exact enough. This is always the case when the goods are on pallets and the load units (container, swap body and semi-trailer) have not the same capacity by number of pallets. Then it is necessary to break the costs down to a pallet.

PI Cluster: External costs / socio-economic impact

Performance indicator	Measure	Definition	Key figure
(Infrastructure costs)	€	See below	-
Air emissions		Air emissions depend on quantity and quality of fuel and on mitigation measures	€ per tkm
(Fuel consumption)	Litres/km	Fuel consumption is a factor of KPI costs and leads to air emissions	-
(Fuel efficiency)	Litres/tkm	Consumption per cargo unit per km differs between the modes. This is included in fuel consumption.	-
Noise emissions	db	Cost of passive noise counter-measures per mode	€ per tkm
(Injuries)		See below	-
(Deaths)		See below	-
(Employment)		See below	-
(Wages and salaries)		See below	-
KPI: External costs		**Costs to the public because of emission of noxious gases**	**€ per tkm**

Explanations (comp. 4.2.2)**:**

Infrastructure costs are not fully considered here because the attribution to cargo transport and passenger transport is very difficult. It is partly included in variable operation costs e.g. in form of port dues, railway track fees or road toll where applicable. Transport policy is leading to take into account these costs more and more.

Air emissions: The noxious gases in the air emissions of different motors or other power sources are known. The most important are CO_2, NO_x and SO_x. The volume of emissions depends on the quantity of fuel used, on the quality of fuel (e.g. low sulphur fuel) and on abatement techniques. Thus, the volume of a certain gas per tkm can be calculated. Otherwise the EU uses tables where, region by region, the costs to the public of one tonne of emitted gases can be found. Combining both figures the costs to the public (external costs) can be broken down to tkm made by the different modes.

Fuel consumption is an information needed for the calculation of emissions. Fuel efficiency is not used separately as PI because it is part of the operation costs and of the external costs.

Noise: Objective burdens are difficult to evaluate. What can be compared are the total costs of noise countermeasures in a country (in the EU) per mode. These costs per mode may be divided by the tkm per mode to get costs per tkm.

Injuries, deaths: There are figures how much a life is worth or how many working days are lost by accidents, so that benchmarks could be set for the different modes. Problems arise when deaths or injuries caused by cargo transport should be separated from those caused by passenger traffic.

Employment, wages and salaries: The modes have a different effect on social welfare by the number of jobs created or the level of wages paid to the employees. It is not so difficult to count the persons directly paid by transport companies, but there are many more people indirectly involved in the transport industry, infrastructure construction, maintenance etc. where the problem arises again how to separate goods transport from passenger traffic.

Finally, the question is how to compare these social issues with other KPIs like costs or time. There could be some way to translate the social issues into costs, but contrary to other costs which are borne by transport operators or by customers the social costs are mostly borne by the public. Altogether social issues are difficult to attribute to cargo transport. Their effects may be expressed in a PI but this is difficult to weigh up with other KPIs. Therefore, no KPI for socio-economic issues is selected.

Remarks: Emissions are also a socio-economic issue. A cost-benefit analysis for abatement of air emissions is possible. Here either the costs of emissions reduction are included in transport costs or the external costs of emissions are applied.

PI Cluster: Time

Performance indicator	Measure	Definition	Key figure
(speed of mode)	Km/hour	Average speed from terminal to terminal, same as transit time for a defined distance	-
Transit time	Hours	Time in hours/minutes between terminals, shipper and terminal, terminal and consignee	Hours
Terminal time	Hours	Average time in terminal including handling	Hours
(waiting time)	Hours	Average waiting time for handling resp. spare time calculated for arrival in time	-
frequency	Dep./day	Number of departures results in waiting time for next departure. Average waiting time is half time between two departures	Hours
KPI: Total transit time	**Hours**	**Average total time of regular service including transport, handling and waiting**	**Hours**

Explanations (comp. 4.2.3)**:**

The period that elapses between the moment that transport demand becomes manifest and the moment of the start of the transport from the shipper's door, i.e. time for packaging, order picking, documentation and loading into the truck, is excluded from total transit time because it is too much influenced by the shipper itself.

Speed of the specific mode in km/hr is only interesting for the calculation of the transit time which results from a division of distance by speed = time (in hours).

Terminal time counts from the arrival resp. requested time of arrival for handling and departure from terminal. The handling time itself is just part of that time.

Average **transit times** and average terminal times include waiting times. Waiting times before pre-haulage and after end-haulage are not regarded.

Frequency is a matter of regular ship, train or road serves, not for full truck loads going door-to-door.

Transit time is a value suitable for BM, but more important is that the cargo arrives in time.

PI Cluster: Reliability / Punctuality

Performance indicator	Measure	Definition	Key figure
In time (punctuality)	Per cent in time; average delay	Logistics services may be deemed reliable if goods are collected and delivered within the agreed time window. Worst case: they are not delivered at any time. An exact measure for comparing modes is the average delay.	
(Condition of cargo)		See PI cluster safety	
Congestion	Hours	Reason for being not in time because of infrastructure capacity	
Equipment breakdown	Per cent	Reason for being not in time because of downtime of equipment	
KPI: Delay	**Average delay**	**Average time resulting from delays additional to total transit time**	**Hours**

Explanations (comp. 4.2.4)**:**

Reliability could be defined as the absence of unforeseen lowering of performance. Reliability relates to occasions on which a service that is offered and accepted is not delivered.

Punctuality has both a frequency (percentage of shipments arriving late) and a time component (degree of delay). No-one can guarantee 100 % punctuality in practice. There is therefore always some tolerance with respect to delays, in frequency and in time.

Punctuality is measured as average delay which includes late arrivals within the agreed time window and even later. If the punctuality is measured as average delay annually, what about cargo which never arrives? This is dealt with under the KPI Safety.

Equipment breakdown: to compare the age of the equipment between the modes is not useful because rail equipment and ships have a longer lifetime than trucks. It is better to measure the time transports are delayed because transport and transhipment equipment is out of service.

PI Cluster: Accessibility / Availability

Performance indicator	Measure	Definition	Key figure
Accessibility	hours	Obstacles for booking and time elapsed between booking and start of transport	hours
(Access)	km	Spatial and temporal distance to the next terminal	-
(Terminal)		Point of transhipment giving access to a mode	-
(Network density)	km/km^2	Km of roads, rail tracks or water-ways per square km	-
(Hours of operation)	hours	Access times to terminals	-
KPI: Availability		**Minimum time required between booking and start of transport**	**hours**

Explanations (comp. 4.2.5)**:**

Accessibility: the ease with which the transport system can be used. While pre-haulage is already included in the transport chain, cost-wise and in Total Transit Time, the minimum time required between booking and start of transport can be added to the Total Transit Time.

Access: the distance to the next terminal (access point) expressed as minimum driving time including spare time to be in time for transhipment. In other words this is the duration of pre-haulage which is included in KPI Total Transit Time. Maritime access: depth of approach channel (maximum vessel size -> economies of scale) and berth availability leading to delays.

Terminals are different regarding the number of modes connected and the number of destinations to reach. A BM of terminals is not necessary since the aim of the study is the benchmarking of different modes in one transport relation.

Network density: a theoretical figure, for practical use the distance to the next access point (terminal) is more useful.

Restricted **hours of operation** may lead to waiting times. Waiting times are already included in KPI Total Transit Time.

Availability not only depends on the spatial and temporal distance to the next terminal but also on the organisation of the total transport chain, e.g. chartering and positioning a ship for bulk transport.

PI Cluster: Flexibility / Organisation

Performance indicator	Measure	Definition	Key figure
Responsibility	Number	Number of persons the client has to contact	Number
Number of partners	Number	Number of companies involved in transport chain	Number
EDI		The proportion of transactions performed by EDI	Per cent
Compatibility of EDI		Compatible system ease the data exchange	Yes / no
Compatibility of load units		Non compatible load units make change of mode difficult or impossible	Yes / no
Documentation	number	The number of documents for each cargo unit; the number of documentary clearances	number
Tracking and tracing		Information provision	Yes / no
Information accessibility		Time needed to obtain desired info	hours
Info on deviation		Customer gets info when deviation from schedule	Yes / no
(Ease of use)		Combination of PI like simplicity of documentation, tracing, number of partners etc.	-
KPI: Flexibility	**time**	**Reaction to special requests of customers and reaction to hold-up of transport**	**Ranking**

Explanations (comp. 4.2.6):

Flexibility is the ability to meet short-term requirements. The organisation of a transport company or logistic chain influences flexibility heavily.

Compatibility of load units is not optimal. ISO sea containers are not optimised for European pallets, railway containers are not stackable on ships; railway gauges and profiles differ from country to country etc. Roro transport is much more flexible regarding a mix of cargo units and the road vehicles are better compatible to European pallets and sales units than ISO containers.

Ease of use in the intermodal transport chain relates to administrative procedures such as the simplicity of documentation. It also includes the error rate in invoicing clients, shipment tracing capability and aspects of the relationship between the service providers and the client.

This cluster contains a lot of different PI which can hardly be transformed into costs or time if the key figure is e.g. just yes or no. Nevertheless, such PI can be decisive for the modal choice in some cases. Because they are, generally, less important than costs or time they should be combined in one KPI called flexibility, the key figure of which is a ranking of modes or transport chains composed by the individual rankings of the single PI. Examples for individual rankings: Yes leads to a higher ranking; a high number of documents or responsibilities to a lower ranking and longer times also to a lower ranking.

PI Cluster: Safety and Security

Performance indicator	Measure	Definition	Key figure
(Accidents)		Accidents per tkm per mode	-
Damage, fire		Cargo is delivered in damaged condition -> financial damage	€
Loss of cargo		Cargo is not delivered -> financial damage	€
Dangerous cargo		Type of cargo with higher transport risk requiring careful handling and special equipment	€
(Theft)		A reason for total loss or damage to cargo	-
Terrorism		Risk per cargo tonnes lost	
Liability		Legal claim for refund	€
KPI: Safety		**The risk of financial damage expressed by insurance premi-ums and security fees**	**€ per load unit**

Explanations (comp. 4.2.7):

Accidents can result in damage or loss of (parts of) the cargo and to delays in delivery. While the number of accidents differs between the modes, the decisive issue here is what happens to the cargo.

Damage and loss of cargo require, at least, the transport operator to refund the financial damage to the customer (**liability**). Figures should exist how much is the total damage per mode and, thus, per tkm. The losses are normally covered by insurance companies. Therefore, it is also possible to add the insurance premiums the transport operator or others have to pay per load unit to the transport costs resp. to isolate them from total transport costs.

Dangerous cargoes are commodities which require careful handling. Since any requirements surplus to normal depend more on the commodity than on the means of transport, no special attention is paid here.

Terrorism: Terrorist attacks are more often aimed to destroy human lives or transport equipment, to a lesser extent the cargoes themselves. This risk is lower than the risk of damage or theft. In the aim to protect ships, passengers and cargo the IMO has introduces the ISPS Code and ports pass on the costs of implementing the code to their customers in form of a security fee.

PI Cluster: Political / Regulatory Issues

Performance indicator	Measure	Definition	Key figure
Restrictions		See below	n.a.
Technical standards		Basic requirement for compatibility, transport safety etc.	n.a.
Harmonisation		Aims for common regulations in all (EU) countries	n.a.
Liberalisation		Opening of transport markets	n.a.
Privatisation		Transferring publicly-owned assets to the private sector	n.a.
IMO conventions		Regulations for international sea transport	n.a.
Dangerous goods		Regulations for safe transport of hazardous goods for every mode	n.a.
KPI: Regulations		**Framework conditions**	n.a.

Explanations (comp. 4.2.8):

Restrictions are numerous on EU, national and local levels. They include maximum gross mass limitations, driving time limitations, operation hours regulation for terminals, emissions limitations and many more.

Harmonisation regards many issues like restrictions, technical standards, documentation, road taxes etc.

Same **technical standards** are necessary for combined transport and border-crossing traffic. Examples are ISO containers, ETCS, standardised couplings or break systems for rail transport and road standards.

Liberalisation is removing barriers to trade in the Single European Market, e.g. abolishing road haulage permits

Privatisation means also exposing state-owned enterprises to free competition, to end hidden subsidisation

The **IMO** (International Maritime Organisation) has established conventions for ship safety and environment impact of sea transport beyond national or EU responsibility

Remarks: These are structure indicators not performance indicators.

4.2 Background Information

4.2.1 Costs

The cluster costs includes the following single performance indicators:

- Capital costs
- Fixed operation costs
- Variable operation costs
- Terminal handling costs
- Pre-haulage costs
- Prices
- Load factor
- Fuel efficiency

The capital costs are those for equipment necessary for transport like ships, vehicles, wagons, containers etc. They are composed of repayment and interest. Repayment periods are different for infrastructure investment, ships, rail or road vehicles, but investment banks or institutes can provide some general figures. Interest depends on the London Interbank Offered Rate which follows world-wide interest rates.

Operating costs are partly fixed – e.g. labour, maintenance, repair, insurance or administration costs – and partly variable like fuel costs, port and terminal costs and charges. Fixed costs are unavoidable to keep the vehicle in an operational condition while the variable costs depend on the route chosen and the distance. Charges can be defined as prices paid to an infrastructure owner (road, rail or inland waterway administration or investor).

A terminal can be described as a place with functions and technical assets to tranship a load unit between two different modes of transport. Depending on the structure of the terminal the transfer could take place between various modes rail, road, sea and inland waterway. The cost for terminal handling can vary from region to region and in case of sea and inland waterway from port to port.

Pre-haulage costs arise when a load unit is hauled from the shipper to the terminal through a so-called pre-haulage leg, usually made by truck. In the terminal the tranship from the pre-haulage carrier to the a main haulage, performed by the main non-road means of transport (e.g. short sea shipping or rail) takes place. In the area of intermodal transport the load unit is mostly hauled as well to a final consignee on a end-haulage leg. Of course, more than one main haulage could exist just as more than one kind of terminal could be part of the intermodal transport chain. The pre- and end-haulage to and from terminals is normally provided by road transport companies. These companies incur costs involved in the ownership and operation of vehicles, which in most cases include the payment of taxes. The total costs contain the time spent during loading and unloading as well as movement. Costs could also be incurred for the payment of infrastructure in form of tolls. For pre- and end-haulage often a tariff per km is applied which is, of course, much higher than the costs per km on the main-haulage.

Prices can be described as the income received by an operator for a transport or terminal services; from the customer perspective the prices for such services become his costs.

The load factor represents the average use of capacity and is a factor for cost calculation per load unit. In some cases poor load factors can be generated by imbalance of flows in the two directions, seasonal pattern and strong day-to-day fluctuations. The load of the vehicle also plays an important role in the emissions of several pollutants. In addition, the load factor of a vehicle will also have an impact on fuel efficiency. The latter depends also on the type of engine and on the speed.

Dangerous goods require special treatment, not only during transport by also in this study. Regulations for the transport are such detailed for the means of transport and specific for certain commodities that the shipper and specialised forwarder have to plan much more careful than for a normal transport. Most of the KPIs are also applicable to dangerours cargo but the KPI "costs" and "accessibility" need additional attention. The calculation of costs is similar for general cargo but often a surcharge for dangerous cargo is requested. Such a surcharge can only be asked from the operator, e.g. the ferry operator. There are also restrictions to carry dangerous goods on ferries as long as passengers are on board. The capacity is limited and the stowage is a further restricting factor.

The single indicators mentioned above can be summarised in the key performance indicator "transport costs" defined as total freight costs to the customer measured in costs per unit. The transport unit could be a container, semi-trailer or a tonne of bulk cargo and the costs include the direct transportation charges plus any other costs associated with transportation paid by the user to move the transport unit from the point of commissioning to decommissioning. Assuming that also intermodal transportation will usually apply an end-to-end freight rate, this indicator should be comparatively straightforward to measure in all relevant transport modes.

The cluster includes a mixture of costs and prices. Costs are the better key figure because prices depend on the market and could include a major profit or a loss. Where prices are non-negotiable tariffs, the prices are suitable as key figures, e.g. in case of pre- and end-haulage. Where prices are not yet known because a new service is only planned, the calculation/estimation of costs is necessary. This is especially interesting for comparison of roro and lolo sea transport where costs also depend on ship sizes. If the potential transport volume is known it can be calculated if sea transport is less expensive then road transport.

Another case may also prove the necessity to know the costs and not only the prices. Ferry and roro shipping companies are free to calculate their prices. Many of them even avoid to publish their prices, only customers get an information. A new customer will then, probably, pay the official price while good customers having many load units per year get high rebates. A difference of 20 or 30 % between official tariff and the price paid by such good customers can decide on the choice of this shipping company or route. In case of an empty return trip, when the ship may also be half empty, sometimes nearly every price is acceptd by the ship operator. In any case, the position of the client who negotiates a price is better when he knows the costs of the operator.

Remarks: It would be useful to create an average cost index per mode

4.2.2 External Costs / Socio-economic Impact

The area of external costs and socio-economic impacts is very extensive. External costs relate to those costs, which are incurred by other parties resulting from operator's transport or terminal activities and some of them may also have socio-economic impacts. These are for example costs induced from accidents, air pollution, climate change and noise nuisance.

In general, the Gross Domestic Product (GDP) of a country, the population and the level of unemployment can be seen as the main socio-economic indicators of a country's development. Important socio-economic aspects are employment, education and training, working conditions, environment, quality of life, health and safety of the citizens. Each of the relevant transport modes can have effects on GDP or the social welfare, e.g. by the number of jobs created or wages paid. A comparison of the transport modes with regard to these social effects is difficult due to its complexity as well as in some cases the lack of information. An example may be the evaluation of noise. Noise can be described as unwanted sound or sounds of a duration, intensity or other quality that causes physiological or psychological harm to humans. Due to the complexity of noise, objective burdens are difficult to assess. The perception of sound as noise differs from person to person, from moment to moment[26].

For the cluster external costs / socio-economic impacts the following performance indicators have been identified:

- Infrastructure costs
- Air emissions
- Fuel consumption
- Fuel efficiency
- Noise emissions

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[26] External Costs of Transport, Accident, Environmental and Congestion Costs in Western Europe, Zürich/Karlsruhe, March 2000

- Injuries
- Deaths
- Employment
- Wages and salaries

For the definition of the key performance indicator for this cluster, the infrastructure costs are not completely taken into account due to the difficulty to differentiate between cargo transport and passenger transport. The same is true for injuries and deaths, because the relevant statistics only refer to the number of injuries and deaths by transport mode and do not distinguish between cargo and passenger transport. Regarding employment, wages and salaries information is available about the number of employees directly involved in transport activities, the difficulty is the identification of the indirect impacts and in this case again the distinction between cargo and passenger transport.

The KPI of this cluster have been summarized as the KPI “External costs” generally focusing on air and noise emissions. It is expressed in € per tkm and defined as “costs to the public because of emissions of noxious gases”. The fuel consumption is needed as an information for emission’s calculation, whereas the fuel efficiency is an aspect but mainly taken into account in the KPI costs (see 4.2.1).

4.2.3 Time

According to information from Intermodal Transport in Europe[27] “Time is not only relevant to the customer but also to the producers of the transport services, because it has a direct effect on costs. If transport assets move fast, the time-related costs of transport are reduced and transport efficiency is improved.”[28]

“An important time factor in any logistics service is the period that elapses between the moment that demand becomes manifest and the moment of delivery. Logistics services must be able to deliver at the required time. The service does not just consist of moving the goods, but must also allow time for preparing them for dispatch, including operations such as order picking and handling, documentation and packaging, loading and unloading the cargo into the truck or loading unit, as well as transport as such.”[29]

In this cluster time can generally be defined as the total length of time between the point when the load unit is ready for transport and the point when it is delivered. The time for packaging, order picking, documentation and loading has not been taken into account because it depends on the capabilities of the shipper in its own premises and it

[27] Intermodal Transport in Europe, European Intermodal Association (EIA), Huub Vrenken, Cathy Macharis, Peter Wolters, Brussels 2005

[28] Intermodal Transport in Europe 163].

[29] Intermodal Transport in Europe [162].

should be similar for all modes. The possible performance indicators for this cluster are as follows:

- Speed of Mode
- Transit time
- Terminal time
- Waiting time
- Frequency

The speed of mode defines the (average) speed of the transportation of goods. The average speed is influenced by the average speed on the various links (restriction of speed on roads, characteristics of tracks and waterways) as well as by delays at terminals, border crossing points and gauge transfers. Monitoring the transit time is more straightforward. For example in case of container transport it is the time span from the time of container availability for collection at the point of consolidation to the time of delivery at the point of de-consolidation[30].

With terminal time the average time in terminal including handling is meant. It describes the time a transport unit spends within the terminal. This involves as well the productivity of the terminal as well as the efficiency of the work. Furthermore, it includes the waiting time between entry and exit of the terminal. Another aspect of the waiting time refers to e.g. border crossing points as well as to frequency.

Frequency relates to how often a transport service is provided within a time period. The higher the frequency, the higher the quality of the service since it will more likely be available when desired. All of the above mentioned aspects will form the key performance indicator “Total transit time” measured in hours and referring to the average total time of regular service including transport, handling and waiting.

Remarks: It could be useful to create a journey time index.

4.2.4 Reliability / Punctuality

The cluster reliability / punctuality is composed of the following aspects:

- In time (punctuality)
- Condition of cargo
- Congestion
- Equipment breakdown

[30] **Integrated Solutions for Intermodal Transport between the EU and the CEECs**; **INTERMODA**, Project funded by the European Community under the ‘Competitive and Sustainable Growth’ Programme (1998-2002); www.intermoda.org

In general, reliability can be defined as the absence of unforeseen lowering of performance. Transport services can be seen as reliable if goods are collected and delivered at the agreed time (punctuality) and arrive in good condition (safety and security). The latter aspect “condition of cargo” will be treated in the cluster safety and security.

Delays or errors always cause some inconvenience to the customer, whose departure and arrival schedules are disrupted. Sometimes logistics equipment and staff rosters have to be revised, which may reduce the efficiency of cargo handling operations.”[31]

Due to the fact that in practice it is not possible to guarantee a 100 % punctuality there exists always some tolerance with respect to delays, in frequency and in time. To maintain high punctuality is more difficult when the time constraints are stricter. This is a trade-off customers as well as transport operators have to accept. Transport operators have to weight this factor in the balance when scheduling their services: the promise of a fast transport system is more difficult to keep and any resulting loss of reliability will disappoint and possibly even alienate customers. Poor punctuality also generates costs for transport operators, because it has a negative effect on the use of transport equipment and drivers. Extreme delays can even affect subsequent assignments or require costly repositioning of vehicles and crew”.[32]

Punctuality in the area of transport can be influenced by a large number of factors. The more complex the form of transport service production, the greater the risk of delay and the more severe the constraints facing transport. One source of concern for punctuality is infrastructure capacity limitations, which cause congestion.

Congestion arises when traffic exceeds infrastructure capacity and the speed of traffic declines. It can be defined as a situation where traffic is slower than it would be if traffic flows were at low levels. The definition of these “low levels” (reference level) is complicated and varies from country to country[33].

This is most apparent in road transport in regions with dense traffic, but intermodal transport is also concerned. Infrastructure limitations can be overcome by extending capacity, by either construction or better management. The risk of delays may also be reduced by avoiding capacity constraints through rerouting- choosing other routes or other terminals- or by rescheduling, e.g. by opting for a different timing. A second type of risks relates to long transport processes, which are more exposed to disruption. This is the case with long distance transport and with (intermodal) transport chains with sequential phases and operations. Finally the risk of delay increases with the number of players involved in the production of the transport service. The more players, the more room there is for imperfections in these agreements and in communications between the players. Even if there is no deviation from schedule within the chain, the

[31] Intermodal Transport in Europe [163].

[32] Intermodal Transport in Europe [164].

[33] **REALISE - Regional Action for Logistical Integration of Shipping across Europe:** http://www.REALISE-sss.org

different priorities of the different players may result in delays. Examples may be found in port terminals, where handling a vessel is postponed to cater to an ocean vessel arriving late in the port and in rail transport, where operators reassign drivers from freight to passenger trains.[34]

Speed is also affected by weather conditions independent of the quality of the transport infrastructure. Longer periods of low temperatures may stop ship transport at all, especially on inland waterways. In this case reliable operators provide transport alternatives.

Rail-based transport chains, particularly in international traffic, are subject to all of the risks to punctuality described. Both Short sea and inland waterway traffic have good images where their ability to deliver a punctual service is concerned but neither has systematically collected data on punctuality. These modes use open infrastructure which offers the flexibility to adapt sailing speeds if it is necessary to catch up with sailing schedules. The risk of delay lies mainly in the seaports, where terminal handling capacity may be otherwise occupied. Most Short sea and inland waterway services anticipate on this by allowing extra time margins.

All intermodal chains have a degree of flexibility to attenuate or completely offset delays. By timely and appropriate information about upcoming delays customers can also offset the consequences of late deliveries, which thereby increases their tolerance of delays."[35]

The final key performance indicator relevant for this cluster is "Delay" expressed in average delay (hours). It is described as the average additional time to total transit time resulting from delays. In practice it would be the time elapsing beyond the agreed time window.

4.2.5 Accessibility / Availability

For this cluster the following indicators can be extracted:

- Accessibility
- Access
- Terminal
- Network density
- Hours of operation

In general, accessibility can be seen as the ease with which the intermodal transport system can be used. Availability is very close connected to flexibility and is influenced

34 Intermodal Transport in Europe [170, 171].

35 Intermodal Transport in Europe [174, 175].

by the same trends of more customer focus. It is not a very widespread indicator but there might be some possibilities of how to measure it and what should be included.[36].

In the case of comparing different transport modes, the terms “accessibility” and “availability” rather refers to the transport connection as well as to the time required between the booking and the start of the transport. For example, in maritime transport the depth of water available in a port will constrain the maximum size of vessel that can be deployed. By far the most common cause of delays to shipping in the container transport industry is the lack of berth availability. If the vessel cannot come to berth on schedule, the implications for the efficiency, timeliness and predictability transport movements are obvious. Such consequences of availability are already included in the KPI Delay.

Terminals can usually be seen as transfer points that are the principal component of an intermodal transport chain, constituting the node where transhipment of goods from one mode to the other takes place. The main terminal types are continental terminals, inland waterway terminals and maritime terminals. The major difference between maritime terminals and inland (continental and inland waterways) terminals is the size and the types of loading units (mainly in Europe). Volumes handled at seaport terminals are much higher than in inland terminals.

The network density is a more theoretical figure and refers to the physical infrastructure. It can be described in terms of number of network elements and total kilometres of the links. The TENT comprises 75 185 km of roads, 20 609 km of which are planned, 79 440 km of conventional and high-speed railway lines, 23 005 km of which are planned, 381 airports, 273 international seaports and 210 inland ports (EC, 2001d). Obviously, this is the total transport infrastructure, regardless of whether intermodal transport uses it[37]. If a terminal can be used depends on the individual location and services offered, not on a theoretical figure like network density etc.

The key performance indicator for this cluster will be “Availability”, defined as the “minimum time required between booking and start of transport” measured in hours. Where no common carriers with fixed schedules are used but individual transport solutions the chartering of a ship or special vehicle and its positioning in the port of departure adds to that time.

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36 TRILOG Europe – Indicator Report, Deliverable 7 of TRILOG - Supply chain management from a global perspective, (TRILOG - Europe part of an OECD study), Chalmers University of Technology, Göteborg, Sweden, September 1999

37 Integrated Solutions for Intermodal Transport between the EU and the CEECs; INTERMODA, Project funded by the European Community under the ‘Competitive and Sustainable Growth’ Programme (1998-2002); www.intermoda.org

4.2.6 Flexibility / Organisation

Flexibility describes the ease with which the transport system adjusts to an unexpected change in the logistic requirements, whereas organisation will have a major impact to flexibility. Flexibility can be seen as the transport mode's adaptability to changes in the chain both on a short time basis and on a longer time scale. It can be the possibility to handle specific customer orders within, and without disturbing, the normal transport flow.

In this cluster there are indicators which are of a more qualitative nature. One has to measure one thing and then use that to indicate something that is basically not measurable. The following indicators and headwords have been extracted for this cluster:

- Responsibility
- Number of partners
- EDI
- Compatibility of EDI
- Compatibility of load units
- Documentation
- Tracking and tracing
- Information accessibility
- Information on deviation
- Ease of use

"Flexible logistics services are services which are capable of coping with unforeseen fluctuations in demand or circumstances. Flexibility implies responsiveness. No time should be lost in mobilising capacity - assets and labour - to handle and transport the goods. When transport is vulnerable to extreme weather conditions, infrastructure blockages or congestion, logistics service production requires "internal" flexibility to cope with changing circumstances."[38]

Concerning the number of partners one can state that the more partners are involved in a transport flow the more flexibility is decreasing, because there are too many responsibilities. Flexibility will be optimal when only one partner – e.g. a truck operator – is involved.

The compatibility of load units in general can not be seen as optimal. For example, ISO containers are not optimised for European pallets. A truck/trailer or a pallet-wide container contains more pallets than a 40' container. Railway containers are not stackable on ships, railway gauges and profiles differ from country to country etc. With regard to compatibility of EDI transport requires a seamless information chain. As can

[38] Intermodal Transport in Europe [165, 166].

be extracted from the INTERMODA project, there are several projects dealing with the harmonisation of information exchange:

Projects (such as CESAR) have been undertaken to harmonise information exchange between intermodal operators and their clients. The information exchange in intermodal transport is namely characterised by a number of diverse modalities each with its own terminology and regulatory framework, and by a complex network of organisations. A wide variety of communication flows already exist. Therefore, different systems have to be virtually interconnected and strict access rules to common information have to be defined. The CESAR project harmonised information exchange between operators and their clients. It demonstrated how different systems can be virtually interconnected and offered standard client interfaces to the customers.

The application of new technology can also be helpful for the improvement of various services (e.g. tracking and tracing, bookings) important to intermodal clients. INTRAR-TIP has designed an open platform for providing marketing information for organising the delivery of cargo and setting bookings, using INTERNET. OCTOPUS developed a common platform for adaptive tracing and communication chains and tracking of general cargo. ICT has also potential in improving the integration of transport modes and the managing of transport demand, supply and the optimal use of infrastructure.

The usage of electronic booking systems and the Internet is gradually taking place in the short sea market but still in an early stage. For the short sea market a system was developed, which can be integrated when short sea trade has fully incorporated new communication systems (3SNET). The benefits for the shippers lie then in the fact that they are able to compare competing schedules, to extend the supply chain information, and that there are zero costs at the point of delivery. The benefits for the sea lines include a new large market to be reached and the possibility to exploit new routes by co-operative opportunities”[39].

Especially in intermodal transport the ease of use refers to the simplicity of documentation, whereas also the number of documents for each cargo unit and the documentary clearances are important. In this context, tracking and tracing as well as information on deviation and as a consequence the accessibility of information is relevant.

The above mentioned indicators have been summarized as KPI “Flexibility”. Instead of absolute figures there will only be a ranking (positive – negative) for comparison.

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[39] Integrated Solutions for Intermodal Transport between the EU and the CEECs; INTERMODA, Project funded by the European Community under the ‘Competitive and Sustainable Growth’ Programme (1998-2002); www.intermoda.org

4.2.7 Safety and Security

“Safety and security in themselves are quality requirements.[40] Because of public interest in safety, there are many regulations and strict enforcement of the provisions governing the technical state of the equipment, staff qualifications and working conditions, such as driving hours. On top of this, shippers and transport operators do much to increase safety on a voluntary basis. High risks and the heavy impact of incidents will immediately be reflected in insurance costs.”

“Safety requirements may be expressed in terms of the degree of acceptance of risks to third parties or the environment. High-impact accidents, e.g. with personal injuries or with major damage to the environment, are rare in any of the freight transport modes. The small number of such accidents makes it complicated to make a proper assessment of logistics safety levels. Safety comprises internal factors, such as personnel skills and qualifications, but is also subject to external factors like traffic safety. The degree of reliability can only be measured once the service has been performed: logistics services are deemed reliable if experience shows that promises are kept.”[41]

Security relates to the level of security on the transport system and at interchanges. It is assessed on a qualitative basis. It relates more to missing or violated (not destroyed by accident) cargo, for example by theft or terrorism.

In this cluster the following indicators have been extracted:

- Accidents
- Damage
- Loss of Cargo
- Fire
- Dangerous cargo
- Theft
- Terrorism

Accidents can on the one hand result in injuries or death of persons and on the other hand in damage or loss of the cargo or parts of it as well as to delays in delivery. While the number of accidents is different according to the modes, the decisive issue here is what happens to the cargo. Damage to cargo leads to a loss in its value, which may exceed the full intrinsic value of the shipment. Damage can be caused by improper handling during logistics operations (contamination, breakages, incompleteness or insufficient packaging, e.g. perishable cargo) or by external factors such as traffic accidents.

[40] Intermodal Transport in Europe [178].

[41] Intermodal Transport in Europe [164, 165].

Theft and fire can be reasons for the damage or loss of cargo whereas terrorist attacks are more often aimed to destroy human lives or transport equipment and to a lesser extent the cargoes themselves.

In a reaction to terrorist attacks the IMO has released the new ISPS Code requiring security plans and security officers in shipping companies, on board and in ports. Access to terminals for international sea transport has been restricted by checkpoints and fences. Ports have decided to levy a security fee per load unit to cover the costs for security. Typical fees per container are 5 to 10 Euro.

Universal regulations for the liability in combined transport do no exist but there is national law, the national terms of forwarding/carriage. "Uniform liability" is applied in case of one single B/L for combined transport. In combined transport, including sea transport, liability is limited to 2 sdr per kg of damaged goods or to 1 m sdr per damage resp. 2 m sdr per event, it all depends which amount is higher. If the place of damage can be localised the local law may be applicable. For road transport the liability limit is four times higher (8.33 sdr), a fact which may influence the modal choice. To be able to pay for any damages the truck operator arranges a liability insurance. The carrier/forwarding insurance is arrangnged by the carrier according to the value of the goods for the individual transport order. Only by written declaration of the customer the insurance is not arranged.

For this cluster the KPI "Safety" will be of utmost relevance. It is defined as "the risk of financial damage that can be mitigated by paying insurance premiums" and will be measured in € per load unit. Regarding security additional fees are levied which can be directly used as key figures.

For customers the liability of the carrier is a major issue. It differs from mode to mode and can also be expressed in €.

4.2.8 Political / Regulatory Issues

There are various differences in national policies among EU member states (and non-member states), well-known differences and performance unevenness in physical infrastructure throughout Europe due to historical factors and conditions such as under-investment or over-usage (congestion), and various other natural (e.g. distance) and artificial (e.g. local subsidies) influences on logistics systems.

The number of regulations to follow is dependent on the number of modes used and the number of countries involved in the transport chain. This cluster refers to more qualitative indicators which are:

- Restrictions
- Technical standards
- Harmonisation
- Liberalisation

- Privatisation
- IMO Conventions
- Dangerous goods

Regarding restrictions these could be the limitation for road transport operations, e.g. the maximum gross mass allowed for road transport, driving bans, labour laws for road operations: the payment of all working periods, speed restrictions or the limitations for terminal operations: hours of operation, handling of dangerous cargo.

Technical standards define the minimum requirements of infrastructure and transport equipment. For example, they prescribe the minimum depth of waterways and the maximum gradient of roads. Background information for technical standards can be derived from the INTERMODA project[42] :

Technical Standards: Road

In the AGR (European Agreement on Main International Traffic Arteries (15 November 1975), a number of technical parameters are associated with categories of roads. The road category is determined based on the average daily traffic in Passenger Car Units (PCUs). Some of the parameters allocated to road type are design speed, length of straight-line alignment, curvatures, maximum gradient or slope, lane width, shoulders and median width, type and distance of intersections, etc. Technical standards for road transport can be divided into standards for roads and standards for vehicles.

Technical Standards: Rail

In the AGC (European Agreement on Main International Railway Lines (31 May 1985), interoperability is guaranteed by standards relating only to speed, loading gauge and technical specifications (such as number of tracks, vehicle loading gauge, minimum distance between track centres and nominal minimum speeds). The AGC sets high standards, which means that compliance can be costly. It must be noted that minimum speeds are associated with maximum gradients. Adjustments in this field can consequently call for the construction of costly tunnels and viaducts. Similarly, an allowed maximum train length is associated with a minimum platform length, and lengthening platforms is expensive. Technical standards for rail can be divided into standards for tracks, standards for stations, standards for signalling systems, energy supplies and standards for trains (e.g. automatic train protection).

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42 Integrated Solutions for Intermodal Transport between the EU and the CEECs; INTERMODA, Project funded by the European Community under the 'Competitive and Sustainable Growth' Programme (1998-2002); www.intermoda.org

Technical Standards: Inland Waterways

The AGN (European Agreement on Main Inland Waterway of International Importance (19 January 1996) sets technical criteria for European ports. For example, an European port has to be situated on an European waterway, it should accommodate certain classes of vessels, and it should have a certain minimum capacity. As with road and rail, meeting the standards may present a problem. Similarly, an inland waterway in Europe needs to comply with certain rules relating to the depth and width of waterways, the height under bridges, minimum requirements for vessels, etc.

Technical Standards: Maritime Transport

According to the TINA (Transport Infrastructure Needs Assessment) report, there is no specific EU legislation or international agreement relating to port infrastructure (except for some UNCTAD handbooks). On the other side, there is a large body of national legislation that covers port and inland waterway structures in general. Unlike road and rail, the problem for ports may not be to meet standards but rather the lack of standards to meet.

Technical Standards: Combined Transport

In 1991 the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) (United Nations, 1999) was signed and has been amended in 1997 with by the Protocol on Combined Transport on Inland Waterways to the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) of 1991.

These agreements relate to a Pan-European intermodal network consisting of:

- railway lines of importance for international combined transport – defined by the primary stations – for each European country,
- terminals of importance for international combined transport for each European country,
- border crossing of importance for international combined transport,
- gauge interchange stations of importance for international combined transport,
- ferry links/ports forming part of the international combined transport network.
- European Inland Waterways of importance for international combined transport
- terminals in ports of importance for international combined transport

Additionally, the AGTC[43] agreement provides technical and operational regulations for the network. This network includes two types of elements:

- network of important international combined transport lines referring to the following lines:
  - railway lines which are currently used for regular international combined transport,
  - railway lines which serve as important feeder lines for international combined transport,
  - inland waterways which are currently used for regular international combined transport,
- related installations, which refer to combined transport terminals, border crossing points, stations for the exchange of wagon groups, gauge interchange stations, ferry links/ports and terminals in ports important for international combined transport.

Besides these international agreements, there exist as well some national standards (e.g. RAS - in Germany) as well as some recommended practices like:

- TER (rail): Trans-European Railway (standards and recommended practices developed by the UN)
- TEM (road): Trans-European North-South Motorway (standards and recommended practices developed by the UN)
- UN-ECE Working Party on Transport Trends and Economics.

Furthermore, there are a number of regulations concerning environmental standards for e.g. land use, energy consumption and efficiency, noise, waste, emissions, for the transport of hazardous goods and regulations for international sea transport (IMO).

With regard to liberalisation, which means the opening of transport market there exists as well a multiplicity of market regulations to protect the market against unhealthy growth, potential overcapacity, unfair competition, et cetera, but also guard against unfair restrictions of trade. Market regulations can differ considerably among modes.

Market Regulations: Road

Since all quantitative restrictions (quotas) were abolished on 1 January 1993, access to the market is now governed exclusively by qualitative criteria that have to be met by haulage firms and applicants for a Community road haulier licence. The Community licence is issued by the relevant authorities of the Member State of establishment for five years and may be renewed (*Council Regulation (EEC) No 881/92 1992*).

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43 www.unece.org/trans/new_tir/conventions/documents/agtce.pdf

In the event of a crisis the Member State concerned supplies the Commission with substantive, quantified information. The Commission may then take measures designed to prevent any further increase in haulage capacity on the affected market by placing limits on the growth of the operations of existing carriers and placing restriction on market access for new carriers (*Council Regulation (EEC) No 3961/90, 1990*).

Only those Community carriers authorised to operate international road haulage services will be allowed to operate domestic-haulage services in other Member States (*Council Regulation (EEC) No 3119/93, 1993*). Cabotage operations will be exempted from any quantitative restriction on market access. Subject to Community law, cabotage operations will be subject to the laws, regulations and administrative provisions in force in the host Member State in the following areas:

- the prices and conditions governing the transport contract; weights and dimensions;
- requirements relating to the carriage of certain categories of goods;
- duration of driving and rest for drivers;
- VAT on transport services.

The host Member State must, when applying its national provisions, observe the principle of proportionality. No discrimination will be made between national and international haulage services. The definitive system of cabotage for the carriage of goods by road entered into force on 1 July 1998.

Council Directive 93/89 EEC seeks to harmonise the levy systems – vehicle taxes, excise duties on fuel and user charges – and to establish a fair mechanism for charging infrastructure costs to haulers in order to eliminate distortions of competition between transport undertakings in the various Member States. Six years later, *Directive 1999/62/EC* was adopted to replace this Directive with respect to heavy goods vehicles.

Market Regulations: Rail

Directive 2001/12/EC defines the trans-European Rail Freight Network (TERFN), which includes all relevant freight lines and access to the main terminals and ports. A list of ports and maps are annexed to the Directive. As regards the opening up of the European Rail Network to competition, the Directive provides that railway undertakings that hold a licence for the international transport of goods will have right of access to the trans-European Rail Freight Network from 2003. This right of access will be extended to the entire rail network covering all Member States for the international transport of goods in 2008.

Council Directive 95/18/EC of 19 June 1995 regulates the licensing of railway undertakings. It is amended by *Directive 2001/13/EC* of the Parliament and of the Council of 26 February 2001. This latter Directive is part of the ‘rail package’ defining a trans-European Rail Freight Network. Its aim is to extend the provisions of *Directive*

95/18/EC to all railway undertakings established in the Community in order to harmonise their operating conditions on a uniform and non-discriminatory basis and to prevent licensing requirements from becoming barriers to entering the market. The validity of licences is extended throughout the European Union.

Directive 2001/14/EC establishes a legal foundation for the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification. Its scope is to define the rules for setting and collecting charges for the use of railway infrastructure and for allocating this infrastructure capacity in a way that will make the transport system more efficient and promote goods services by rail. The right to use railway infrastructure is granted by the infrastructure manager concerned. The infrastructure manager also allocates the available capacity that, once allocated, may not be transferred to any other undertaking by the recipient.

Directive 91/440/EEC of 29 July 1991 on the development of the Community's railways aims to facilitate the adaptation of the Community railways to the needs of the Single Market and to increase their efficiency, by:

- ensuring the management independence of railway undertakings;
- separating the management of railway operation and infrastructure from the provision of railway transport services;
- improving the financial structure of undertakings
- ensuring access to the networks of Member States for international groupings of railway undertakings and for railway undertakings engaged in the international combined transport of goods.

Interoperability of the trans-European conventional rail system is covered by *Directive 2001/16/EC* of the European Parliament and of the Council of 19 March 2001. This Directive is meant to establish the conditions to be met to achieve interoperability of the Trans-European conventional rail system within Community territory. These conditions concern the design, construction, putting into service, upgrading, renewal, operation and maintenance of those parts of this system put into service after the date of entry into force of this Directive, as well as the qualifications and health and safety conditions of the staff who help operate it.

The Directive stipulates that work should start first on control/command and signalling, telematic applications for freight services, traffic operations and management (including staff qualifications), freight wagons and noise problems. The TSIs (technical specifications for interoperability) in these areas were to be adopted by 20 April 2004.

Market Regulations: Maritime

Council Regulation No 3577/92/EEC of 7 December 1992 applies the principle of freedom to provide services to maritime transport within Member States (maritime cabotage). This regulation grants freedom to provide maritime transport services within a Member State for Community ship owners operating ships registered in a Member State and flying the flag of that Member State, subject to these ships complying with all the conditions for carrying out cabotage within that Member State.

A Proposal for a Directive of the European Parliament and of the Council (7 February 2001) has been made on reporting formalities for ships arriving in and departing from Community ports. It should facilitate maritime transport, between ports situated in the Member States, in particular by the standardisation of reporting formalities.

Council Regulation (EEC) NO 3921/91 of 16 December 1991 lays down the conditions under which non-resident carriers may transport goods or passengers by inland waterway within a Member State. This Regulation stipulates that, in providing cabotage services, carriers may only use vessels belonging to one of the following:

- natural persons domiciled in a Member State and nationals of a Member State;
- legal persons with their registered office in a Member State and in which Member State nationals hold a controlling interest.

An additional *Council Directive 91/672/EEC* of 16 December 1991 establishes the reciprocal recognition of national boat masters' certificates for the carriage of goods and passengers by inland waterway.

Council Regulation (EC) No 718/1999 of March 1999 prescribes that for each new ship brought into the community an equal tonnage should be scrapped. This Regulation has been issued in order to prevent overcapacity.

All these indicators described are difficult to measure, a basis could be the number of regulations to follow, but as already mentioned this depends on the number of modes and countries involved in the transport chain. Therefore the KPI “Regulations” – defining the framework conditions – will be assessed by a ranking, whereas the most positive ranking will be assigned to the lowest number of regulations.

People planning transport services or individual transports should know these standards and regulations and how to live with them. They are basic requirements to be followed but they affect the performance of transport mode and the influence may change with modified or new regulations.

4.3 Other Indicators

Several other headwords and indicators have been checked but finally not been selected as KPI. For some shippers these issues may be more important than the selected KPIs but for practical reasons the number should be limited, especially in case of additional key figures. The final assessment of a transport mode is easier to make when the key figures costs and hours can be added. But it is difficult when key figures like yes/no and several rankings for KPIs are to be compared.

PI Image:

Transport modes have often a certain image like fast, slow, expensive or dangerous. This is, e.g. a reason for shippers of dangerous cargo to prefer rail or inland vessels to the road because they do not want to be in the headlines of newspapers or in the television news in connection with an accident of a dangerous cargo truck. Using the modes with a better image may be more expensive but it is better for the image of the own company. Another example: The famous German mail-order house “OTTO” uses inland barges for container transport to support its much publicised “green image”.

In these cases the image influences the choice of the transport mode, but this is only valid for a limited number of customers. Another reason for disregarding the PI Image is the difficulty to find a key figure for the valuation of the image.

PI Capital tie-up costs:

The question of interest (capital tie-up costs) is often raised to justify a faster means of transport. Assumed the contents of a container have a value of 200,000 € (e.g. 20,000 shirts) and the seller has to pay 10 % p.a. for a loan of 200,000 €, the interest per day is about 55 €. If Short sea transport takes several days more than road or roro transport, interest may be a reason for choosing the faster mode. However, many containers or trucks carry cargo of much lower values. Then interest is definitely less than the cost difference between the modes.

In case of high value cargo interest should be regarded and owners of the cargo know about that. In many other cases this PI doesn’t matter.

PI Transparency:

Transparency is mainly an issue of prices, and some logistic chains are less transparent than others in this aspect. But if one is looking for low-cost transport and the less transparent transport alternative has the lowest costs, the price will decide and not the transparency. Therefore, transparency seems to be less important. A ranking of modes according to their transparency could be possible but, again, a BM based on several rankings of different aspects is not very helpful.

PI Sustainability:

Transport services should be sustainable, especially services to be developed newly. The definition of “sustainable” by the EIRAC: “built to last and strikes the right balance between the cost to the customer and achieving the overall objectives of society” is dealt with by the KPIs “Costs” and “External costs”. The competition in the transport market will not tolerate services in the longer term which are not sustainable, except they are subsidised.

5 Small-scale Demonstration

The purpose of this chapter is to validate that the selected KPIs are suitable for a BM of various modes on the same route, i.e. between the same origin and destination. Three different routes have been defined according to

- mode-specific characteristics (as mentioned before)
- regional characteristics
  - Baltic Sea / Eastern Europe
  - North Sea / River Rhine
  - South Europe / Mediterranean
- good-specific characteristics
  - high value general cargo
  - dry bulk
  - liquids and dangerous cargo

Three routes were selected in such a way that they represent regional characteristics, that a modal choice between origin and destination is realistic and that transport of different commodities is probable. Then it has been tried to apply the KPIs and validate the practicability and feasibility of the indicators. The three tables demonstrate not only one way how to arrange the KPIs and modes, they give also some necessary general information or sources of information.

5.1 Route 1: Baltic Sea / Eastern Europe

Origin: Hamburg (Germany)

Destination: Minsk (Belarus)

Mode 1: Truck transport from door to door (for all types of cargo)

Mode 2: Combined transport truck / train (for container, swap body and semi-trailer)

Mode 3: Transport by truck, container vessel and truck (for container)

Mode 4: Roro transport by truck and Roro ship (truck or semi-trailer)

Mode 5: Transport by truck, conventional vessel and train (for bulk cargo)

(No inland vessel transport available.)

Route 1: Hamburg – Minsk 1420 km per road

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Mode 1: truck door to door	1420 km x 0.8 €/km = 1136 €	1420 km, 320 kW / truck	< 24 hours (2 drivers)	Depending on waiting at border	< 24 hrs	++ individual service	Insurance premium ?	+
Mode 2: truck and train	Pre-haulage acc. to local tariff; main run (ask train oper.); end-haulage; 2x THC 17.50€	72 kW / FEU	See train schedule	Ask operator for reliability of time-table	Ask train operator	-- minimum 3 partners, using common services	Insurance premium …?…	O
Mode 3: truck, container vessel, truck	Pre-haulage acc. to local tariff (100 €*); main run (100-150 €*); 2x THC 100 €*; Klaipeda-Minsk 350 €* (490 km) Total price abt. 800 €*	Main run: 22 kW / FEU	1-2 hrs in Hamburg; terminal 12 hrs; main run Hamburg – Klaipeda = 85 hrs; terminal 12 hrs; Klaipeda – Minsk 8 hrs; Total time = 5-8 days (Frequ. = 2 / week)	Depending on waiting at border between Lithuania and Belarus, among others	Ask ship operator	-- minimum 3 partners, using common services	Insurance premium …?…	-
Mode 4: Truck, roro ship, truck	pre-haulage = 200€* (100 km); sea transport Kiel-Klaipeda abt. 30-40 € per lane m; Klaipeda-Minsk 350 €* (490 km) Total price = 1040-1180 €.	Main run: 180 kW / truck	Hamburg-Kiel 2 hrs; term.2 hrs; Kiel-Klaipeda 22 hrs; term.2 hrs; Klaipeda-Minsk 8 hrs Total time 34 hrs + (frequ. = 5 / week)	Depending on waiting at border between Lithuania and Belarus, among others	< 24 hrs	- minimum 3 partners, using common services	Insurance premium …?…	O

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Mode 5: Truck, conventional ship, truck	Pre-haulage by volume rate; sea trsp. Hamburg-Klaipeda; port costs; complete train Klaipeda-Minsk	KW per tonne: truck = 13, ship = 0.5, train = 2	Longest total trsp. time: slowest ship; bulk cargo may require stowage in port	Less important because of long trsp. time	Longest time for organi-sation	O individual service	Insurance premium …?…	-

* rough estimates

Remarks:

<u>Transport costs:</u>

In theory the costs of all transport modes can be calculated by addition of capital costs, fixed and variable operation costs, terminal handling costs and pre/end-haulage costs under consideration of suitable load factors. Especially for not yet established shipping services such a calculation is useful and practicable, for rail services it is nearly impossible. In practice, for trucks an average cost per km is used and for rail services the prices should be asked from the operator.

For longer distances in Western European road transport assumed costs of 1 € per km are not far from reality. Special equipment may be more expensive. In eastern and south-eastern Europe wages are lower and truck transport is considerably less expensive. For short pre- and end-haulage the same costs per km are not applicable and lump sums have to be asked.

Absolutely truck transport is expensive but on a route to Belarus drivers getting lower wages will decrease the costs. Nowadays refuelling in eastern European countries where taxes are very low strengthens the competitiveness of road transport.

The costs of a container vessel are extremely low per load unit because of high intake and low fuel consumption. However, the cost of container sea transport is levelled by terminal handling costs and the requirement of pre- and end-haulage. On medium and longer European routes sea transport of containers should be less expensive than road transport.

Roro vessels have higher fuel costs than container vessels and a lower capacity by number of trucks and trailers. Even if terminal handling costs for semi-trailers are much lower, roro transport is more expensive. On short routes the costs per unit are higher than trucking costs by road. Only very large roro ships are competitive. Kiel – Klaipeda is a medium distance and, therefore, the roro alternative costs about the same as direct road transport.

For bulk transport of grain, coal, oil etc. the conventional vessel is the least expensive mode. To give an idea: a 2000/2500 tdw multi-purpose vessel gets about 2000 to 2500 Euro per day to cover the capital and fixed operation costs. Port dues and fuel consumption are also comparatively small amounts per cargo tonne.

External costs:

External costs are much lower than transport costs, therefore, a less detailed approach is sufficient for BM purposes. The result sought is the tonnes of noxious gases exhausted per load unit. This depends on the distance and the kW of the prime mover, e.g. 320 kW per truck, or kW of the ship divided by number of load units (e.g. 70 % of capacity). The 500 TEU container vessel carries 175 units of 40' and has 3825 kW. 3825 kW / 175 = 22 kW per FEU. The roro vessel carries 88 trucks and semi-trailers and has 16,000 kW, resulting in 182 kW per trailer. Regarding the train, the locomotive is assumed to develop 2000 kW and the wagons carrying 28 FEU (again 70 % capacity utilisation). This is 72 kW per FEU. While this calculation favours the container vessel, the type of engine and the fuel burnt is important. Truck and train use clean gas oil, but ships may burn fuel oil with a high sulphur content. However, the choice of fuel and the installation of catalysts for the reduction of NO_x is up to the ship operator.

Each engine type has its characteristic volume of exhaust gases and the EU has provided figures how much is the cost of a tonne of CO_2, NO_x or SO_2 to the public: the external costs.

In case of bulk cargo the calculation is made by cargo tonne. The truck carries about 24 t, i.e. the power demand is 13 kW / t. A train can carry 2000 or more tonnes, requiring 2 to 3 kW / t. Ships are available with a wide choice of capacity including 2000 tdw. For such a conventional ship 1000 kW (0.5 kW per tonne) are sufficient to make 20 km/hr while truck and heavy cargo trains can run up to 80 km/hr.

Total time:

Transport time by truck is limited resp. extended by driving time regulations. With two East European drivers a truck can make the distance of 1420 km within less than 24 hours, provided border crossings are fast. A train service with pre- and end-haulage takes several hours more because of two terminal times. Moreover, on the border between Poland and Belarus the track gauge changes and the wagon axles have to be adapted. Total time could be 2 to 3 days. Roro transport takes less than 48 hours and could be faster than train transport, depending on waiting times for border crossing between Lithuania and Belarus.

Sea transport by lolo vessels (container or conventional) takes several days more because of time consuming cargo turnover in the ports and longer sea transit. This is because of the longer route from Hamburg via the Kiel Canal (linking North Sea and Baltic Sea) and the lower speed of container and general cargo vessels compared to most roro ships and ferries. The greatest disadvantage of container feeder shipping is the often low frequency of only one or two departures per week and the long round trips of the ships with more than two ports. This extents the total transport time by several days.

Punctuality:

Delays caused by route congestion, barrages or equipment breakdown can happen everywhere. Extreme delays are not relevant because they cannot be planned but average delays on certain routes are known from experience.

A special issue on the road between Hamburg and Minsk are the irregular waiting times on the border between the EU and non EU countries. Formerly it could take days to cross the border between Germany and Poland, now it is between Poland and Belarus. Waiting times change and have to be asked actually.

Regarding sea transport the voyage between the ports is only a problem during extremely heavy weather; delays are more often caused by port congestion or by too much traffic in the Kiel Canal.

Punctuality is more important for time-sensitive cargo, i.e. for truck and roro transport, less important for container or conventional sea transport with longer total transport time.

Availability:

Availability, defined as time required between booking and start of transport, is optimal when only one mode is involved and this mode is the truck. Getting a place on a roro or container ship may not be too difficult but the time until the ship departure depends on its time table. The longest time is required for chartering a ship for bulk transport including cargo handling in ports and organisation of the final leg to the consignee.

Things become more difficult if the importing country has special requirements like provision of transport documents in a certain time before the transport starts. Such regulations may change from time to time and forwarders organising regularly transports in a certain country know about them.

Flexibility:

Flexibility includes issues like responsibility, compatibility, information or EDI. Flexibility is, clearly, highest if only one partner like a truck operator is involved. This is assessed very positive “++”. In theory direct sea transport is similar flexible but door-to-door transport by ship is seldom. If more partners are involved flexibility is decreasing. Regarding the technical compatibility the ISO container is most problematic because of its dimensions inside (intake of pallets) and outside and its gross weight.

Direct truck transport and full ship loads of bulk cargo are individual transport. Container transport by sea or train and roro transport is subordinated to common transport services.

If EDI is compatible or if information is easily to get (tracking and tracing) is to a lesser extent an issue of modes but it is up to the operators to provide such services. Thus, this KPI is more difficult to handle, but, instead of absolute figure only a ranking is expected. Information can only be provided by the transport providers.

Safety:

Safety has been reduced to a question of insurance premiums for the cargo or liability of the carriers. The forwarder, or at least transport insurers, organising the transport should know for which mode the premiums are higher or lower.

Regulations:

The number of regulations to follow depends on the number of modes and the number of countries involved in the transport (chain). Thus, direct transport by truck only is easier than combined transport and gets a “+” for lowest number of restrictions. Transport using three and more modes is assessed “-“ while using two modes is seen as neutral. Land transport involves three countries (Germany, Poland, Belarus) while sea transport involves Germany, Lithuania (or Latvia) and Belarus.

5.2 Route 2: North Sea / River Rhine

Origin: Duisburg (Germany)

Destination: Hull (England)

Mode 1: Truck, ferry (Calais – Dover) and truck

Mode 2: Truck and roro ship (semi-trailer Rotterdam – Hull)

Mode 3: Truck, container vessel (Rotterdam – Hull) and truck (container)

Mode 4: Truck, rail, container vessel (Rotterdam – Hull) and truck (container)

Mode 5: Truck, inland barge, container vessel (Rotterdam – Hull), and truck (container)

Mode 6: Truck, seagoing river vessel (Duisburg – Hull) and truck (container and bulk cargoes)

(No direct road transport possible.)

Route 2: Duisburg – Hull 845 km by road via Calais-Dover

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Mode 1: truck door to door via ferry Calais - Dover	845 km x 1.0 €/km = 845 € plus 300 € ferry fare = 1145 €	845 km, 320 kW / truck plus short ferry	< 24 hours	Depending on motorway congest.	< 24 hrs	++ individual service; high ferry frequ.	Insurance premium ?	+
Mode 2: truck and roro ship via Rotterdam - Hull	Duisburg – Europoort 260 km; roro fare 630 € plus end-haulage; total abt.1000 €	320 kW / trailer on the road; 180 kW / trailer on board	24 hours	Few delays	< 24 hrs	0 minimum 3 partners, using common services	Insurance premium …?…	0
Mode 3: truck, container ship, truck	Pre-haulage 260 km; main run 390 km in container ship (100-150 €*); THC 2x 100 €*; end-haulage Total cost abt. 700 €*	320 kW / trailer on the road; 32 kW / FEU on board	4 hrs Duisburg – sea port; main run Europoort–Hull = 15 hrs; terminals 2x 12 hrs; end-haulage 1 hr; Ttime = 48 hrs (Frequ.= 5/w)	Depending on road congestion Duisburg – Europoort and on port congestion	Ask ship operator	-- minimum 3 partners, using common services	Insurance premium …?…	0
Mode 4: truck, rail, container ship, truck	pre-haulage = 100€*; train Duisburg – sea port ?; main run 390 km container ship(100-150 €*); THC 17.50 + 2x 100 €*; end-haulage;total price >450 €*	143 kW / FEU on the train; 32 kW / FEU on board	Truck and train to sea port 24 hrs; main run Europoort–Hull = 15 hrs; terminals 2x 12 hrs; end-haulage 1 hr Ttime = 72 hrs (Frequ.= 5/w)	Depending on port congestion	Ask operators	- many partners, using common services	Insurance premium …?…	-

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Mode 5: Truck, inland barge, container ship, truck	Pre-haulage; Duisburg – sea port by inland barge <100 €*; THC 50 + 100 €* ; sea transport Europoort – Hull 100-150 €*; end-haulage; Total cost <u><650 €*</u>	13 kW / FEU on inland barge; 32 kW / FEU on board	Similar to mode 4	Less important because of long transport Ttime	Longest time	- many partners, using common services	Insurance premium …?…	-
Mode 6: Truck, seagoing river ship, truck	Pre-haulage by volume rate; river/ sea trsp. Duisburg-Hull 220 + 390 km; port costs; end haulage; Total cost <u><600 €*/FEU</u>	Ship 0.5 kW / t, 610 km	Ship trsp. abt. 30 hrs plus terminal times depending on type of cargo	Less important because of long trsp. Time	Longer time	+ Individual service	Insurance premium …?…	0

* rough estimates

Remarks Duisburg - Hull

<u>Transport costs:</u> (for general remarks see Route 1)

For longer distances in Western European road transport assumed costs of 1 € per km are not far from reality. Special equipment may be more expensive. For short pre- and end-haulage a price per km is not applicable and lump sums have to be asked.

Absolutely truck transport is the fastest and most expensive alternative. On the route via Calais – Dover it becomes even more expensive because ferry and Chunnel operators on this preferred Channel crossing ask for the highest fares per km.

The costs of a container vessel are extremely low per load unit because of high intake and low fuel consumption. However, the costs of container sea transport is levelled by terminal handling costs and the requirement of pre- and end-haulage. The assumption for THC in European sea ports is 100 € for river ports 50 €. On medium and longer European routes sea transport of containers should be less expensive than road transport. Here it is feasible because there is no uninterrupted alternative by land transport and the roro fares Calais – Dover are relatively high.

Roro vessels have higher fuel costs than container vessels and a lower capacity by number of trucks and trailers. Even if terminal handling costs for semi-trailers are much lower, roro transport is more expensive. On short routes the costs per unit are higher than trucking cost by road. Only very large roro ships are competitive. On the route Rotterdam – Hull large roro ships are operated.

For bulk transport of grain, coal, oil etc. the conventional vessel is the least expensive mode. To give an idea: a 2000/2500 tdw multi-purpose vessel gets about 2000 to 2500 Euro per day to cover the capital and fixed operation costs. Port dues and fuel consumption are also comparatively small amounts per cargo tonne.

A further alternative is the seagoing river vessel (or rivergoing sea vessel) with a cost structure between the inland barge and the feeder vessel. It saves the cargo turnover in Rotterdam and should generate the lowest costs.

External costs:

External costs are much lower than transport costs, therefore, a less detailed approach is sufficient for BM purposes. The result sought is the tonnes of noxious gases exhausted per load unit. This depends on the distance and the kW of the prime mover, e.g. 320 kW per truck, or kW of the ship divided by number of load units (e.g. 70 % of capacity). The 340 TEU container vessels of Geest Line on the route Rotterdam – Hull carry about 120 units of 40’ and have 3840 kW. 3840 kW : 120 = 32 kW per FEU. For the roro vessel a similar calculation results in 180 kW per trailer and for the inland barge the result of 13 kW per FEU is most favourable.

Regarding the train, the locomotive is assumed to develop 2000 kW (2x 2000 kW for heavy bulk trains) and the wagons carrying 28 FEU (again 70 % capacity utilisation). This is 72 kW per FEU. While this calculation favours the container vessel, the type of engine and the fuel burnt is important. Truck and train use clean gas oil, but ships may burn fuel oil with a high sulphur content. However, the choice of fuel and the installation of catalysts for the reduction of NO_x is up to the ship operator.

Each engine type has its characteristic volume of exhaust gases and the EU has provided figures how much is the cost of a tonne of CO_2, NO_x or SO_2 to the public: the external costs.

In case of bulk cargo the calculation is made by cargo tonne. The truck carries about 24 t, i.e. the power demand is 13 kW / t. A train can carry 2000 or more tonnes, requiring 2 to 3 kW / t. Ships are available with a wide choice of capacity including 2000 tdw. For such a conventional ship 1000 kW (0.5 kW per tonne) are sufficient to make 20 km/hr while truck and heavy cargo trains can run up to 80 km/hr.

Total time:

Transport time by truck is limited resp. extended by driving time regulations. The 845 km distance can be made within 24 hours if another driver continues on the other side of the Channel. Channel ferries or Chunnel Trains leave every 30 minutes.

Roro transport via ferry Rotterdam – Hull takes also less than 48 hours but departures of the ships are only offered in the early evening. If the truck is too late it has to wait 24 hours or to proceed to another ferry/roro service.

A train service Duisburg – Europoort with pre- and end-haulage takes three hours only but the frequency is lower and more time is needed because of two terminal times. Total time including sea transport could be 2 days.

Sea transport by lolo vessels (container or conventional) could be as fast as 48 hours because on the short sea route the lower speed of lolo vessels is negligible. The frequency of container feeder shipping with five departures per week from Rotterdam is acceptable.

The River Rhine opens another opportunity: barge transport between Duisburg and Europoort. While barge transport itself generates the lowest costs, one more cargo turnover is necessary which reduces the cost advantage of barges on short routes. In practice transport times of barges are longer than necessary. A trip between Duisburg and Rotterdam is only a half day (river down / longer river up) but because of the existence of three terminals in the inland port and even more in the sea port a round trip includes several terminals and takes more time. For shuttle services between two terminals only the demand or the frequency is too low.

A further alternative is the seagoing river vessel (or river-going sea vessel) which saves the cargo turnover in Rotterdam and is, therefore, faster than the combination of inland barge and Short sea vessel. The disadvantage is the lowest frequency.

Punctuality:

Delays caused by route congestion, barrages or equipment breakdown can happen everywhere. Extreme delays are not relevant because they cannot be planned but average delays on certain routes are known from experience.

Motorways between Duisburg and Europoort and access routes to the ports may be congested at certain times. Forwarders should know about that and plan enough spare time or alternative transport.

Regarding sea transport port congestion can cause delays. During 2005 container turnover rose so fast that some ports ran short of capacity and inland barges or feeder vessels had to wait for free berths. This resulted in considerably longer terminal times than usual.

Availability: see Route 1

Flexibility:

Flexibility includes issues like responsibility, compatibility, information or EDI. Flexibility is, clearly, highest if only one partner like a truck operator is involved. This is assessed very positive “++”. If more partners are involved flexibility is decreasing. Regarding the technical compatibility the container is most problematic because of its dimensions inside and outside and its gross weight. In UK trades SSS operators offer more and more pallet-wide containers.

Cont. see Route 1

Safety: see Route 1

Regulations:

The number of regulations to follow depends on the number of modes and the number of countries involved in the transport (chain). Thus, direct transport by truck only is easier than combined transport and gets a “+” for lowest number of restrictions. Transport using three and more modes is assessed “-“ while using two modes is seen as neutral. Land transport via Calais - Dover involves five countries (Germany, Netherlands, Belgium, France, UK) while sea transport with or without inland vessel transport involves only Germany, Netherlands and UK.

5.3 Route 3: South Europe / Mediterranean

Origin: Milan (Italy)

Destination: Madrid (Spain)

Mode 1: Truck transport from door to door (for all types of cargo)

Mode 2: Roro transport by truck and roro ship (truck or semi-trailer)

Mode 3: Transport by truck, container vessel and truck (for container)

Mode 4: Combined transport truck/train (for container, swap body and semi-trailer)

(No inland vessel transport available.)

Route 3: Milan – Madrid 1580 km by road

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Mode 1: truck door to door	1580 km x 1.20 €/km = 1896 € plus road tolls	1580 km, 320 kW / truck	36 hours	Depending on motorway congest.	< 24 hrs	++ individual service	Insurance premium ?	+
Mode 2: truck and roro ship via Genoa - Barcelona	Milan – Genoa 142 km; ferry cost 700 € ; Barcelona – Madrid 620 km; total abt. 1614 € plus road tolls	762 km 320 kW / trailer; 650 km 240 kW / trailer on board	48 hours	Less depending on motorway congest.	< 24 hrs	0 several partners, using common services	Insurance premium …?…	0
Mode 3: truck, container ship, truck via Genoa ……………	Milan – Genoa 142 km; main run 350 nm in container ship (250-300 €*); THC 2x 100 €*; Barcelona – Madrid 620 km Total cost abt. 1400 €*	762 km 320 kW / FEU; 650 km 32 kW / FEU on board	4 hrs Milan – sea port; main run Genoa – Barcelona = 24 hrs; terminal 2x 12 hrs; end-haulage 12 hrs Total time = 72 hrs (Frequ. = ?	Depending on road congestion and on port congestion	Ask operator or agent	-- several partners, using common services	Insurance premium …?…	0
Mode 4: truck, rail, truck	pre-haulage = ? €*; train Milan – Madrid ? (ask for price) ; end-haulage	72 kW / FEU on the train	Ask operator for transit time and frequency	Ask operator or users for average delay of trains	Ask rail operator	- several partners, using common services	Insurance premium …?…	0

*) rough estimates

Remarks Milan - Madrid

Transport costs: (for general remarks see Route 1)

For longer distances in Southern European road transport costs of 1.20 € per km are assumed. Special equipment may be more expensive. For short pre- and end-haulage a price per km is not applicable and lump sums have to be asked. Absolutely truck transport is the fastest and most expensive alternative.

Roro vessels have higher fuel costs than container vessels and a lower capacity by number of trucks and trailers. Even if terminal handling costs for semi-trailers are much lower, roro transport is more expensive. On short routes the costs per unit are higher than trucking cost by road. Only very large roro ships are competitive. It goes without saying that large ships make only sense on longer routes with high transport demand. GNV (Grimaldi Group) is offering daily departures from Genoa and Barcelona with either a large ferry or a roro cargo vessel.

The costs of a container vessel are extremely low per load unit because of high intake and low fuel consumption. However, the cost of container sea transport is levelled by terminal handling costs and the requirement of pre- and end-haulage. On medium and longer European routes sea transport of containers should be less expensive than road transport.

For bulk transport of grain, coal, oil etc. the conventional vessel is the least expensive mode. To give an idea: a 2000/2500 tdw multi-purpose vessel gets about 2000 to 2500 Euro per day to cover the capital and fixed operation costs. Port dues and fuel consumption are also comparatively small amounts per cargo tonne.

External costs:

External costs are much lower than transport costs, therefore, a less detailed approach is sufficient for BM purposes. The result sought is the tonnes of noxious gases exhausted per load unit. This depends on the distance and the kW of the prime mover, e.g. 320 kW per truck, or kW of the ship divided by number of load units (e.g. 70 % of capacity). For more details see Route 1 or 2.

Regarding the train, the locomotive is assumed to develop 2000 kW and the wagons carrying 28 FEU (again 70 % capacity utilisation). This is 72 kW per FEU. While this calculation favours the container vessel, the type of engine and the fuel burnt is important. Truck and train use clean gas oil, but ships may burn fuel oil with a high sulphur content. However, the choice of fuel and the installation of catalysts for the reduction of NO_x is up to the ship operator.

Total time:

Transport time by truck is limited resp. extended by driving time regulations. The 1,850 km distance require a minimum of three days with one driver.

Roro transport via ferry Genoa - Barcelona takes less than 48 hours but departures of the ships are only offered in the early evening. If the truck is too late it has to wait 24 hours or to proceed by road.

Sea transport by lolo vessels (container or conventional) could be as fast as 48 hours because on the short sea route the lower speed of lolo vessels is negligible. The frequency of container feeder is decisive for the total duration.

Railway alternatives have to be discussed with operators.

Punctuality:

Delays caused by route congestion, barrages or equipment breakdown can happen everywhere. Extreme delays are not relevant because they cannot be planned but average delays on certain routes are known from experience.

For transports between Milano and Madrid the coastal Motorways between Genoa and Barcelona are used normally. These are known for many congestions, especially during the tourist season. Regarding sea transport delays are more often caused by port congestion than by bad weather.

Availability:

Availability, defined as time required between booking and start of transport, is optimal when only one mode is involved and this mode is the truck. Getting a place on a roro or container ship may not be too difficult but the time until the ship departure depends on its time table.

Flexibility:

See general remarks for Route 1.

Safety:

Safety has been reduced to a question of insurance premiums for the cargo. The forwarder, or at least transport insurers, organising the transport should know for which mode the premiums are higher or lower.

Regulations:

The number of regulations to follow depends on the number of modes and the number of countries involved in the transport (chain). Thus, direct transport by truck only is easier than combined transport and gets a “+” for lowest number of restrictions. Transport using three and more modes is assessed “-“ while using two modes is seen as neutral. Land transport involves three countries (Italy, France, Spain) while sea transport involves only Italy and Spain.

6 Summary and Conclusions

6.1 Summary

The introduction contains two definitions of Benchmarking and Performance:

> In general, **benchmarking** goes beyond competitive analysis by providing an understanding of the processes that create superior performance. It first identifies the key areas that need to be benchmarked and the appropriate criteria. It then sets out to identify best practices world-wide and to measure how those results have been achieved[44].
>
> A **Performance Indicator** is a tool enabling the effectiveness of an operation or of an organisation to be measured or an achieved result to be gauged or evaluated in relation to a set objective. As far as possible the Performance Indicators should be defined as exact measures with an associated absolute value.

Chapter 2 describes the characteristics of the transport modes and introduces further technical terms used in the study. The overview of relevant Benchmarking Projects includes summaries of ADVANCES, INTERMODA, IQ, REALISE, RECORDIT and TRILOG.

The extraction of Key Performance Indicators from these and other research projects follows in chapter 3. The analysis of the PIs in the FTA Study, INTERMODA, IQ, TRILOG as well as sets of PIs defined by different Dutch interest groups show that the PIs have not only to be adapted to the object of Benchmarking but also to the organisation using them.

Chapter 4 provides the selection of Key Performance Indicators for a Benchmarking across the modes of transport:

Finally selected Key Performance Indicators:

Key Performance Indicator	**Definition**	**Key Figure**
Transport costs	Total freight cost to the customer	€ per load unit
External costs	Costs to the public because of emission of noxious gases	€ per tkm
Time	Average total time of regular service including	Hours

44 Benchmarking Communication, European Commission, COM(96) 463 final

	transport, handling and waiting	
Delay	Average time resulting from delays, additional to total transit time	Hours
Availability	Minimum time required between booking and start of transport	Hours
Flexibility	Reaction to special requests of customers and reaction to hold-up of transport	Ranking
Safety	The risk of financial damage expressed by insurance premiums and security fees	€ per load unit
Regulations	Framework conditions	n.a.

Regulations and political issues are not a straight PI. Their knowledge for the mode and specific route to be benchmarked is a precondition for every benchmarking exercise. The second part of the chapter provides more background information for the application of the individual PIs. Special attention has been paid to the section on technical standards and regulations. Finally, reasons are given for the exclusion of some PIs which were used in other studies or proposed by the group of experts.

The small-scale demonstration in chapter 5 applies the KPIs on three routes Hamburg – Minsk, Duisburg – Hull and Milan – Madrid. In each case a table has been created which combines the eight KPIs with all the modes available on the routes. As far as possible by desk work, calculated or estimated key figures regarding cost and time are used to show the practicability of the proposed approach. Were key figures are not readily available sources of information are mentioned.

The selection of the KPIs, their definition and application in Route 1 was then discussed with experts (see annex) who gave their general approval to the findings. Additions and corrections in detail are already included in this final version.

6.2 Conclusions

The first aim of the study was to show if it is possible to create Performance Indicators for a Benchmarking across the modes. Moreover, the main conclusions of the study should focus on the role of SSS: What would be, in such a benchmarking, the relative position of door-to-door short sea shipping in relation to other multi-modal or uni-modal modes door-to door, and: What are the areas where short sea shipping might need to increase its performance and what could be done for short sea shipping to allow it to perform better in the comparison?

An interpretation of the not always complete and partly estimated input into the tables showing the three routes leads to some interesting results which are clearly within the expectations:

The positioning of short sea shipping across the routes:

KPI	Trsp.costs	Ext.costs	Total time	Punctual.	Availabil.	Flexibility.	Safety	Regulat
Key figure	€ per km	€ per km	hours	hours	hours	ranking	€ / unit	Ranking
Route 1 Baltic Sea	Low costs for container by SSS	Low emissions	Longest time, roro better	Depends on end-haulage	Roro good cont. by SSS slow	Inferior to truck	Lower liability limits	O
Route 2 North Sea	SSS in any form less expens. then road incl. short ferry	Low emissions	Truck 24 hrs, SSS 48 to 72 hrs	Better for SSS if terminal capacity sufficient	Truck and ferry better than SSS	Inferior to truck	Lower liability limits	O
Route 3 Mediterran.	Advantage of SSS small because of short sea leg	Lower emissions	Truck only faster with 2 drivers	SSS less affected by motorway congestion	Roro good cont. by SSS slow	Inferior to truck	Lower liability limits	O

Transport cost:

SSS has the lowest costs were the route is long enough and if the container is used. In UK trades lolo ships and longer roro routes are less expensive than truck transport using shorter ferry routes. Driver-accompanied trucks are nearly always most expensive. Short distance sea routes are never less expensive than road transport because port costs make the total transport costs per sea mile more expensive than road costs. Trailer handling costs are comparable low, but handling charges for containers are often higher than the ship costs.

While the handling of roro units is normally performed very fast and at low costs (at least in North Sea and Baltic Sea ports) the handling of containers is often too expensive and the round trips and port times of short sea ships or inland barges take too much time.

A final calculation of the external costs is still to be made, but the energy requirement to move a container in the water is a fraction of the energy required by trucks. Only fast ferries would make an exception.

For the major part of all consignments cost is the decisive factor for the modal choice. Another factor is reliability which can also be complied with by SSS. Often the decision to use the truck is only owed to convenience or a too late start of transport planning. Rising energy prices leading to increasing transport costs will teach shippers to learn to plan earlier which allows them to use SSS more often.

Time:

Conventional ships and container ships need always much more time than road transport because of longer terminal times and lower frequency of ship departures. Roro shipping can be competitive if there is no uninterrupted land route like between the UK and the Continent. Ship transport parallel to the coast is always slower. Roro ships have an advantage when a leg of the total route can be made by sea where the driver can take his legal rest or when another driver continues from the port of destination. Such a combined transport can have cost and time advantages if a second driver is saved.

The existence of both shorter routes and longer routes proves that shippers or forwarders have different requirements. Good examples are routes like Rotterdam or Zeebrugge to Hull in competition to Calais – Dover or Lübeck to Trelleborg or Malmö in competition to Puttgarden – Rödby or to the fixed link via Denmark

Punctuality:

Punctuality of ships is not the problem. They can better plan their time of arrival than land transport modes. The problems can arise in congested ports. The more important issue is that sea transport in most cases needs pre- and end-haulage and there disruption can happen even if the sea leg was accomplished in time. A benchmarking of this PI requires the gathering of information on the specific routes over a longer period.

Availability:

Booking and supply of a truck is faster than the preparation of the complete chain in combined transport. A roro transport should also be available in relatively short time under consideration of the frequency of the ferry / roro vessel. The planning of a logistic chain including train, container terminal and container sea transport with its lower frequency is more time-consuming. The start of the pre-haulage depends on the start of the main run.

Flexibility:

Reaction to special requests of customers and a reaction to hold-up of transport is always easier for a truck driver. If train or ship operators are more flexible depends on the companies.

Safety:

A disadvantage of sea transport is the lower liability limit. In addition, since the implementation of the ISPS Code, international sea transport has become a few Euros per load unit more expensive because of ISPS fees.

Regulation:

There will always be more technical standards and regulations to obey in any form of combined transport compared to the exclusive use of the truck. SSS needs normally the truck for pre- and end-haulage. Roro transport seems to have a medium ranking.

Such a small-scale demonstration is not sufficient to present all the detailed key figures which are needed to valuate the Performance Indicators. As soon as all the required data are asked from transport and terminal operators, their agents or forwarders, the results regarding costs, times and ranking of remaining KPIs can be stated more precisely.

Short sea shipping suffers under a mixture of disadvantages and prejudices because of which potential customers prefer other modes.

- Inefficient customs procedures, over-complex paper work and high costs
- Simplified manifest procedures for intra EU shipping are not used
- Lack of interoperability in intermodal chains (e.g. lack of uniformity in intermodal loading units, lack of logistics management, difficulties in organising intermodal chains and the price of door-to-door shipping);
- High port fees
- Inflexible time-consuming working schedules, not only in smaller ports
- Priorities given to overseas ships entailing waiting times for short sea vessels

A full application of the KPIs could help to prove or dispel these prejudices.

Regarding the three questions asked in chapter 1.1 it can be stated at the end of the study:

- It is feasible to benchmark transport performance across the modes.
- Performance Indicators have been selected as tools for such a comparison.
- The application of these Performance Indicators is possible. They work in any region and for any mode. The careful application should show detailed results which can assist to specify and mitigate the disadvantages of short sea shipping.

There will always be two different types of shippers, the majority which looks for low cost transport and the remaining looking for fast transport. The ideal mode of transport respectively the ideal route for both is seldom the same. SSS can often offer the less expensive alternative and it is still the mode with the best chances for optimisation of services.

6.3 Recommendations

One proposal for improving the performance of SSS is the introduction of dedicated short sea container terminals. They have the disadvantage of parallel systems for European and feeder container shipping and cannot take so much advantage of economies of scale. But

- They don't have the problem of priority being given to deep sea ships.
- They could use faster, less expensive, size optimised container cranes.
- Ships not suffering delays could offer optimised, faster round trips.
- Smaller ships in shuttle services (not calling at too many other ports) have shorter port times and can offer a higher frequency.
- Port and ship operators could focus one pallet-wide European containers and other load units for compatible ships.

An alternative to dedicated short sea container terminals are combined roro and container terminals which could enjoy the economies of scale, speed up container transport and make roro transport less expensive.

Proposals for further studies are:

- The application of the new Performance Indicators, with detailed research for key figures, on other routes, e.g. routes proposed for Marco Polo subsidisation.
- The development of an average cost index per mode in European seas and/or an average transport time index for selected routes.

7 Bibliography

A Conceptual Model of the European Freight Transport Sector, Per Homann Jespersen, Scenario for Freight Transport Workshop, JRC-IPTS, Seville, 14-15 May 2003

Analysis of Transport Efficiency in the UK Food Supply Chain, Full Report of the 2002 Key Performance Indicator Survey, Professor Alan McKinnon, Dr. Yongli Ge Duncan Leuchars, Logistics Research Centre School of Management and Languages, Heriot-Watt University EDINBURGH, UK April 2003

Benchmarking European Sustainable Transport, Nils Fearnley, Dokumentasjon av prosjektene BOB og BEST samt TØIs delakelse, Oslo, April 2004

Benchmarking Infrastructure and Logistic Services across Europe, Asiapacific and North America, Roger Demkes, Lóránt A. Tavasszy, TNO Inro; IMRL 2000**,** Third International Meeting for Research in Logistics; Trois-Rivières, May 9, 10 and 11, 2000

Benchmarking Intermodal Freight Transport, Organisation for Economic Co-operation and Development – OECD, 2002

Benchmarking the Performance of Intermodal Transport, Anthony Ockwell, OECD Division of Transport, January 2001

Benchmarking Papers: First Report by the High Level Group on Benchmarking, European Commission, DG III – Industry, No. 2, 1999

BEST - Benchmarking European Sustainable Transport, Project funded by the European Community under the Competitive and Sustainable Growth Programme (1998-2002)

Bundesweiter Erfahrungsaustausch der GVZ-Standorte auf der Grundlage des Benchmarking-Ansatzes mit der Zielsetzung, die Verbesserung der Entwicklungsprozesse an den einzelnen Standorten (zu einem GVZ-Netz) zu forcieren, Project funded by the German Ministry of Transport, ISL Bremen, 2000

Die Wettbewerbsfähigkeit der Europäischen Industrie – eine Bewertung mittels Benchmarking („Benchmarking Communication“), European Commission, COM(96) 463 final

Energy & Transport in Figures, European Union in co-operation with Eurostat, 2004

External Costs of Road, Rail and Air Transport - a Bottom-Up Approach, Sigurd Weinreich, Klaus Rennings, Barbara Schlomann (ISI), unter Mitarbeit von Christian Geßner, Thomas Engel (ISI), Discussion Paper No. 98-06, 1998

External Costs of Transport, Accident, Environmental and Congestion Costs in Western Europe, Zürich/Karlsruhe, March 2000

FANTASIE - Forecasting and Assessment of New Technologies and Transport Systems and their Impacts on the Environment, Project funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme, Deliverable 13 "Definition of European Transport Systems", May 1999, http://www.etsu.co.uk/fantasie/D13_pdf.pdf

Innovation and mobility -Transport policy for the 21st century, Position Paper for the Informal Council of Transport Ministers in Dortmund on 23/24 April 1999, website: http://www.advances.co.uk

INTERMODA - Integrated Solutions for Intermodal Transport between the EU and the CEECs;, Project funded by the European Community under the 'Competitive and Sustainable Growth' Programme (1998-2002); www.intermoda.org

Intermodal Transport in Europe, European Intermodal Association (EIA), Huub Vrenken, Cathy Macharis, Peter Wolters, Brussels 2005

IQ – Intermodal Quality, Final Report for Publication, Project funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme – Integrated Transport Chains, Juli 2000

Key Performance Indicators 2002, Toward a Sustainable Cement Industry, World Business Council for Sustainable Development, March 2002

Learning from Collaborative Benchmarking in the Construction Industry; Luis F. Alarcón, Alejandro Grillo, Javier Freire and Sven Diethelm, 2001

Logistik-Benchmarking – Praxisleitfaden mit LogiBEST, H. Luczak, H.-P. Wiendahl, J. Weber (editor), Berlin 2001

Performance Indicators for the Road Sector - Summary of he field tests, OECD Road Transport and Intermodal Research, 2001

Preliminary Data on Road Safety in Europe in 2004, Press Release, European Conference of Ministers of Transport – ECMT, www.cemt.org

Pricing of intermodal transport: lessons learned from RECORDIT, Andrea Ricci**,** ISIS – Institute of Studies for the Integration of Systems, Rome, Italy, essay was prepared for the second seminar of the IMPRINT-EUROPE Thematic Network: "Implementing Reform on Transport Pricing: Identifying Mode-Specific issues", Brussels, 14th/15th May 2002

REALISE - Regional Action for Logistical Integration of Shipping across Europe, Thematic Network under the Competitive and Sustainable Growth Programme, 2002-2005

RECORDIT – Real Cost Reduction of Door-to-door Intermodal Transport, supported by the Commission of the European Communities – DG TREN Key Action 2: Sustainable Mobility and Intermodality, Type of Action: Accompanying Measure, 2000-2001

Reliability of Railway Systems; M.J.C.M. Vromans; TRAIL Thesis series T2005/7, The Netherlands TRAIL Research School, 2005

Service Performance Indicators for Short Sea Shipping, Phase I Final Report, Freight Trade Association, December 2001

SPIN – Scanning the Potential for Intermodal Transport, Project funded by the European Commission under the GROWTH Programme of the Fifth Framework Programme, Deliverable 1, Actors and factors in transport mode decisions in supply chain, October 2002.

Sustainable Transportation Indicators, Todd Litman, Director, Victoria Transport Policy Institute, 4 February 2003

Terminology on Combined Transport, Economic Commission for Europe (UN/ECE), prepared by the UN/ECE, the European Conference of Ministers of Transport (ECMT) and the European Commission (EC), New York and Geneva, 2001

Transport Benchmarking – Methodologies, Applications & Data Needs, European Conference of Ministers of Transport (ECMT), November 1999

TRILOG Europe – Indicator Report, Deliverable 7 of TRILOG - Supply chain management from a global perspective, (TRILOG - Europe part of an OECD study), Chalmers University of Technology, Göteborg, Sweden, September 1999

TRILOG Europe – Intermodal Transport in Europe, Deliverable of TRILOG Europe Tasks 4.1, 4.2., 4.3, TNO-reportInro/log.2005-26, December 1999

White Paper – Towards Fair and Efficient Pricing in Transport Policy Options for Internalising the External Cost of Transport in the European Union, European Commission, DG VII, COM(95)691

Winning Strategies Through Responsive Supply Chains: Efficient Customer Response; Dinesh Kumar, Paper presented at SAPICS 25th Annual Conference and Exhibition, 2 to 4 June 2003, Sun City, South Africa; www.sapics.org.za

Worldwide KPIs and Benchmarking, Milestone 1: Summary of existing UK schemes, BSRIA Limited**,** www.bsria.co.uk, 2003

Website references

ADVANCES - Thematic Network on an Operational platform for Quality Shipping:
http://www.advances.co.uk

BMT Transport Solutions GmbH :
http://www.tfk-hamburg.com

Climate Action Network Europe (CAN-Europe):
http://www.climnet.org/publicawareness/transport.html

Commission of the European Communities:
http://europa.eu.int

European Conference of Ministers of Transport:
http://www.cemt.org

European Shippers' Council, ESC:
http://www.europeanshippers.com

European Short Sea Network:
http://www.Short sea.info

Institut National de Recherche sur les Transports et leur Securite :
http://www.inrets.fr

Organisation for Economic Co-operation and Development, OECD:
http://www.oecd.org

REALISE - Regional Action for Logistical Integration of Shipping across Europe:
http://www.REALISE-sss.org

ShortSea Shipping Promotion Center (SPC):
http://www.Short seashipping.de

Statistisches Bundesamt Deutschland:
http://www.destatis.de

The World Bank:
http://www.worldbank.org

TRILOG Europe - Supply chain management from a global perspective:
http://www.inro.tno.nl/trilog/

Umweltbundesamt Deutschland:
http://www.umweltbundesamt.de

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP):
http://www.unescap.org

Victoria Transport Policy Institute :
http://www.vtpi.org

8 Index of Abbreviations

AGC	European Agreement on Main International Railway Lines
AGN	European Agreement on Main Inland Waterway of International Importance
AGR	European Agreement on Main International Traffic Arteries
AGTC	European Agreement on Important International Combined Transport Lines and Related Installations
B/L	Bill of lading
BM	Benchmarking
. / d	per day
CEECs	Central and Eastern European countries
EIRAC	European Intermodal Research Advisory Council
ETCS	European Train Control System
FCL	full container load
FEU	Forty feet Equivalent Unit
IMO	International Maritime Organisation
ISL	Institute of Shipping Economics and Logistics (Bremen)
ISPS-Code	International Ship and Port Facility Security Code (IMO)
IWT	Inland Water Transport
KPI	Key Performance Indicator
Lolo	Lift-on / lift-off transport
PI	Performance Indicator
Roro	Roll-on / roll-off transport
Sdr	special drawing right
SPI	Service Performance Indicatior
SSS	Short Sea Shipping
TEM	Trans-European North-South Motorway
TEN	Trans-European Networks
TER	Trans-European Railway
TEU	Twenty feet Equivalent Unit

THC	Terminal Handling Charge
TINA	Transport Infrastructure Needs Assessment
Ttime	Total time
. / w	per week

Appendix

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