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State of the Art of conventional and innovative techniques in intermodal transport

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STATE OF THE ART OF INTERMODALITY IN EUROPE

Annexes

1 The Concept of Intermodality

Because of growing freight traffic and an increasing imbalance in the use of the various transport modes and infrastructure, the transport system in the European Union is showing signs of inefficiency from a socio-economic point of view. Increasingly, freight transport appears as a source of environmental and social costs to its citizens.

The “business as usual” scenario, based on modal policies, is unlikely to be able to cope with the complexity of today’s and tomorrow’s mobility requirements in a sustainable manner. An overall systems approach (Annex 1) is called for. The furthering of intermodality is a promising and innovative policy tool which can support an overall transport systems approach aimed at a more balanced and efficient use of the available transport capacity (infrastructure, rolling stock, handling equipment etc. – Annex 2).

In order to create a common understanding of the concept of intermodality, the following definition is proposed: “Intermodality is a characteristic of a transport system, that allows at least two different modes to be used in an integrated manner in a door-to-door transport chain”.

Intermodality is a quality indicator of the level of integration between the different modes: more intermodality means more integration and complementarity between modes, which provides scope for a more efficient use of the transport system. The economic basis for intermodality is that transport modes which display favourable intrinsic economic and operational characteristics individually, can be integrated into a door-to-door transport chain in order to improve the overall efficiency of the transport system. The integration between modes needs to take place at the levels of infrastructure and other hardware (e.g. loading units – Annex 4; vehicles – Annex 2; telecommunications – Annex 5), operations and services, as well as the regulatory conditions.

Intermodal policy should provide the framework in which the transport user himself can decide the optimal use of the different transport modes. The door-to-door approach of intermodal transport will therefore entail a strong consideration of the transport user’s requirements.

Intermodality is not bound to certain modes. It is a trading and mobility issue in which rail, water (Annex 3), air and road are called on to contribute to the optimisation of the whole, where they are supported by advanced information and communication services. On the level of transport operations new services, information and communication technologies will improve the utilisation of the existing capacities (Annex 5).

Intermodality clearly is not about forcing a specific modal split. However, by improving the connections between all modes of transport and integrating them into a single system, intermodality allows a better use to be made of rail, inland waterborne transport and short sea shipping which, by themselves, in many cases do not allow door-to-door delivery. Intermodality is, therefore, complementary to other EU transport policies such as liberalisation of transport markets, developing the TENs and the promotion of fair and efficient pricing (Annex 6).

2 The Concept of Logistics

Freight transport is a derived demand. It is therefore part of the economic process. The requirements of industrial processes have changed drastically during the past 10 years and are characterised by global competition, shorter production processes and product-life-cycles and the need to cut costs. The use of just-in-time delivery, customised production and the concentration of supply- and distribution centres has led to a close interrelationship of production and distribution processes and transport, aimed at high service performance, reduced time-to-market and lower costs. At the same time, competition in global markets has increased the number of players and the geographic scope of the supply- and distribution chains.

Efficient logistics have become a crucial factor of competitiveness. Transport plays a major role in the logistics and service quality of the overall supply and distribution chain. Freight transport has to meet increasing quality requirements in terms of flexibility, speed and reliability in order to deliver the goods at a precise time and place. This includes the movement of goods as well as storage/warehousing functions, packaging or customisation. Depending on the type of good, logistics costs can account for up to one third of the final market price, although this proportion is often smaller and has generally decreased over the last decades. About one quarter of these can be transport-related costs.

Taking into account the complex interaction of sourcing, suppliers, manufacturers, retailers and consumers, intermodality will allow the integration of a broad range of transport services in the supply- and distribution chains.
Well functioning information and communication flows are indispensable for the management of multi-party supply- and distribution chains. They allow pre- and on-trip information exchange, including service availability, negotiation procedures, tracking and tracing, information on disruptions and the flow of transport documents. Advanced services such as real-time information accelerate the information flow and make it more reliable which enhances service quality.

As a result of business strategies which concentrate on core-competences, third party logistics services are a growth market. Specialised logistics service providers stem from production management, warehousing or transport operations. They are entering the market in greater numbers. Their function is to offer sector and customer-tailored solutions for integrating intra-company flows of material and goods with inter-company transport procedures. Increasingly, they will play a major role in defining transport demand requirements on behalf of their industrial clients, and explore how transportation can add value to the overall logistics chain.

3 Obstacles to the use of Intermodal Freight Transport

In the current modally-oriented transport system, any change of mode within a journey involves a change of system rather than just a technical transhipment. This creates friction costs which can make intermodal transport non competitive in comparison with unimodal haulage.

In order to make intermodal transport attractive for the user, friction costs must be identified, quantified, qualified and reduced.

At the same time, logistics services within the intermodal transport chain will need to provide added value in order to offset friction costs. The nodes and transfer points in the network should be particularly well suited to offering services such as warehousing, information management or product customisation. The market must be able to identify and exploit these opportunities, and intermodal transport policy must eliminate any bottlenecks which may prevent operators from realising such opportunities.

4 The Relation between Infrastructure and Transport Means

For a number of high density corridors in Europe, a coherent network of modes and interconnections between the modes is lacking. Missing stretches of infrastructure within one mode or missing links between modes, however small they might be, can prevent seamless intermodal chains. They impose additional transfer and friction costs on operators. Inadequate access by rail, road or waterborne transport to existing transfer points can hamper the integration of these modes and transfer between modes. They can also prevent an efficient dispersion of large volumes into smaller ones, e.g. on intercontinental or long-distance transport.

Because the current system is financed and managed separately for each mode, responsibility for strengthening the links between them is unclear. Moreover, the existence of different forms of ownership and charging for the use of infrastructure and terminals does not facilitate a transparent and co-ordinated infrastructure planning at local and regional level, let alone at European level.

Intermodal transport is as strong as the weakest link in the transport chain. Therefore, the lack of interoperability within some modes poses significant problems. The obstacles are well documented. For example, the different railway signalling systems and loading gauges, and different bridge heights along Europe’s inland waterways are hindrances.

Technical specifications for transport means are often regulated differently by country and by mode, which also raises questions of interoperability. In addition, individual operators have a tendency to acquire the rolling stock and/or vehicles which suit their operation and choice of loading units. Dealing with a variety of vehicle types for different operators is a source of congestion at terminals and causes inefficiency. Different measurements for transport means and infrastructure lower the levels of interoperability between different modes as well, for example between air and rail cargo.

The wide variation of loading unit dimensions across modes is another factor which reduces interoperability between modes. The incompatibility of the transport equipment for road, rail, short sea and inland waterway traffic raises transfer and handling costs and necessitates cumbersome transhipment techniques. If left unchanged, the growing complexity of the logistics requirements, and the projected growth in international trade, will reinforce the tendency of transport units to diverge. The use of specialised loading units will increase the occurrence of their empty returns.

5 The Relation between Operations and the Use of the Infrastructure

The weakest links in the current intermodal transport system and a major generator of friction costs, are the points of transfer between modes. One reason is the lack, or inadequacy of technical interoperability between modes and loading units. Another is that present-day terminals, which are usually marked by a combination of heavy engineering and manual processes, are not managed efficiently with appropriate telematics support.

Also, functionality such as the identification of vehicles, loading units and cargo, or the advance information for disposition purposes are often not available on an intermodal basis. In order to minimise the risk of a break in the intermodal chain, operators increasingly set up their own dedicated terminals. Although this increases their control, it also raises the cost of the door-to-door transport service to the user, particularly when there is no optimal utilisation of capacity.

Road, rail, air and waterborne transport are marked by unequal levels of performance and service quality. This is due partly to intrinsic differences in their cost structures, but also to diverging levels of competition and liberalisation within each mode. The user perceives road haulage as the benchmark for freight transport in Europe: it is competitive and dynamic and continues to improve service performance and reduce operational costs. Modes where operators are confronted with a high threshold for access to their infrastructure tend to involve a monopolistic behaviour resulting in a lack of customer-oriented operations and sub-optimal use of capacity. Operators, who receive state aid and who are not challenged within a mode may be tempted to use the revenues from their dominant position to cross-subsidise their operations in another mode, thus distorting the competition on the market.

Because operators own their own fleets or even infrastructure, they often tend to stay to one mode of transport and disregard better options which may exist on other modes. They do not co-ordinate their information and marketing activities and in many cases are not fully able to control all the operations and activities that take place within the transport chain from door to door.

An added source of friction costs in intermodal transport is the unequal levels of working time in each mode. The problem is not only the effective duration of work, but also the lack of flexibility for arranging the working time of drivers and crews in ways which will match the operations between modes. This is particularly valid for terminals. As an interface between modes, terminals are not always able to respect the schedules of trains and ships which operate 24 hours a day.

Potential intermodal transport users may be discouraged by unnecessary delays in the transport chain due to the non-alignment of timetables between modes. A consignment which remains idle for several hours, even days, while it is waiting to be transferred to the next mode adds friction costs compared to unimodal transport.

6 The Relation between Modal-based Services and Regulations

The absence of a systematic network for data interchange along the entire intermodal transport chain is a source of high costs and service deficiencies. It has given rise to the progressive growth of modal and local systems, and in-house procedures.

Existing modal-based information transmission systems require users to re-enter similar data at each interface, possibly according to different message or EDI standards. The lack of generalised systems for electronic communication between the different partners in the intermodal chain prevents sufficient forward and just-in-time planning of operations. The absence of systems which enable tracking and tracing during the whole journey across modes, does not allow for a quick detection of errors and false routings.

In the event of damage to cargo, it is difficult for intermodal transport users to determine who in the transport chain is ultimately responsible for the failure, given that international transport in Europe is regulated by different liability conventions for each mode. Operators in one mode have a higher degree of liability than those in another mode. The situation is further complicated by the special liability regimes that countries still have in Europe for national transport.

The competitiveness of intermodal transport is also being hampered by administrative bottlenecks. Transport documents are to a large extent still based on paper and differ according to specific modes, as e.g. in maritime, rail, road or air transport. The rules for customs transit operations also differ according to the mode.

In order to guarantee that goods will arrive at their destination within the given timeframe, intermodal transport requires a full and effective management and control of the door-to-door chain. However, users claim that, since most transport operators are modal-based, they are not fulfilling this management and control function. This is partly explained by the competitiveness and flexibility of road transport in Europe.

Another reason is that new intermodal services may require more planning than alternative single-mode journeys, inter alia because of the need to ensure that sufficient demand is available to support regular services. A further reason is a possible lack of awareness of the potential benefits of intermodal transport and a desire of operators to optimise the use of their own assets and vehicles.

7 The Reasons for the ITIP “State of the Art” Analysis

Inland transport is increasingly involved in complex distribution chains which bring together the various modes of transport and interconnections between production and distribution systems.

The advantage of intermodal links is that they enable to select the most appropriate mode of transport to be used for any particular segment of the journey. The necessary intermodal transfer operations have a major impact on the quality and total cost of distribution and impose limitations on the efficient combination of means of transport. Research into ways of improving the quality and decreasing the cost of these intermodal transfer operations should make it possible to increase the productivity of all means of transport and distribution.

This project is part of the overall effort to promote intermodal transport and is directed at particularly weak links in the current intermodal system, namely terminal handling, and related intermodal transfer. This transfer has implications for intermodal transport wherever changes of transport mode occur in the rail-road terminals, seaports, or inland waterway ports as well as for rail-rail terminals yards.
The present report reflects the results of the activities developed within the Work Package 1 of the ITIP Project.

The objective was to perform an analysis of new technologies in intermodal transport, with a special attention on different areas covering:

- the innovative technology in transport means and equipment;
- the innovative technology in transhipment techniques;
- the innovative technology in load units;
- the information technology and telematics systems (inside the terminal).

Specific objectives of the analysis are mentioned below:

- The description of a generalised process model for intermodal transfer points with components. This task is the basis for the following analysis with a process model.

- The collection of the information on innovative intermodal systems. The technologies to be considered cover all modes as there are road, rail and waterborne with inland waterways and short sea shipping. Furthermore, the analysis considers dedicated infrastructure like the rolling road, the rail highway, but in any case with the view point of the terminal operation.

- The collection of the results of national and EC co-funded research projects at European level.

- The identification of the bottlenecks concerning the transport means and equipment; the transhipment systems adopted; the intermodal transport units (ITU) used including standardisation issues and the information and communication technologies, in particular on board systems and identification techniques

The activities within the work package that resulted in this report were split into five different subtasks. The present short report is closely linked to six technical annexes which are describing in detail the technical issues covered by the present report.

Task 1 was devoted to the definition of a generalised process model for the subsequent analysis of the intermodal transport technologies. The model was prepared and adopted to screen the different techniques (basic elements of the transport chain). As a result, a set of recommendations has been prepared.

Task 2 was devoted to the survey of the existing conventional and innovative technological solutions involving both vertical and horizontal transhipment techniques for most of the transport modes. This task was focussing on the technologies (technological bricks), adopting the model for the screening of the different solutions available.

Task 3 was devoted to the identification of the innovative solutions based on the combination of the different techniques into specific transhipment system both vertical and horizontal, providing an inside analysis of the relevant technologies and the consequent logistic solutions available within the transfer points. Specific attention was paid to the maritime transhipment technologies for intermodal transport.

Task 4 focussed on the analysis of the ITU as common element of the different technologies involved. The load units, as imposed in Europe by the maritime transport mode, become the only common element for the different techniques and transhipment solutions. The analysis of its interpolation with the different elements of the transport chain is analysed in this task.

Task 5 focussed on the analysis of the information technologies available and adopted within the intermodal transport chain. Telematics and information sciebces become a key element in the improvement of the intermodal transport chain through location and positioning systems that allow enhanced logistics for the different transport modes.

Additionally, a comprehensive analysis of EC and National supported R&D projects was prepared to complete the overview of the intermodal transport chain.

The report resulting from the analysis was structured in text and annexes so as to separate the analysis and comments from the relevant but necessary detailed description of the different technologies.

8 The Conclusion Achieved within the “State of the Art” Analysis

There are still margins for the improvement of the attractiveness of Combined Transport. Most of the factors are related to the improvement of the quality of service; others are directly linked to cost saving connected to a better utilisation of terminal capacity.

The first recommendation is to consider the terminal as just one element of the complete door-to-door intermodal chain, and therefore to evaluate terminal issues within the general framework of the complete integrated transport chain, especially as far as costs are concerned. For this reason the external operational environment in which the terminal is situated was always considered. The connection to the railways system is extremely important because on the one hand it influences the terminal configuration by imposing operational constraints and on the other hand it itself is influenced by terminal performance.

Recommendations can be grouped under three different sub-headings:

- Recommendations for terminal operators
- Recommendations for rail operators
- Recommendations for road transport operators

The distinction was mainly due to the need of organise our suggestions under three homogeneous groups of issues, which have the above mentioned operators as their main actors.

8.1 Recommendations for terminal operators

The recommendations to terminal operators are mainly linked to terminal design.
There is no single optimal design, but there are many different terminal designs (layout and handling equipment configurations), each one of them being effective in a certain cargo volume range and restricted by its capacity limitations.

The capacity limitation of the intermodal transport terminal is defined by its weakest sub-system. The two major sub-systems that usually affect the terminal capacity are:

- The capacity of the (rail-side) transhipment tracks,
- The capacity of the terminal's handling system.

The basic result of the simulations carried out in the framework of the earlier EC-funded IMPULSE project was that the terminal's capacity limitations are imposed mainly by the capacity limitations of the sidings/transhipment track sub-system rather than by the handling equipment capabilities, at least for the majority of terminal configuration with limited rail-rail transhipment.

A more effective utilisation of siding tracks can dramatically improve the performance on the rail side, but it imposes additional costs, which vary according to the different handling technologies adopted. The major disadvantage of this system is that the incoming train has to be unloaded totally before it can be taken out of the transhipment area.

A truck pattern arrival linked to loading unit availability rather than train arrival could be of help. This can be achieved by an improvement of the communication between pre- and end haulage operators and the terminal. The other limiting factor, the capacity of the terminal's handling system, depends on the type and amount of equipment used.

8.2 Recommendations for Rail Operators

As already pointed out, the main benefits of an improved terminal design based on automated facilities are to be seen in the overall impact on the complete door-to-door chain. The rail operators therefore play a key role in the development of new terminals. The choice of alternative technology and terminal design are mainly linked to the chosen operational forms over the rail network.

The enhancement of the rail sector should be based on advanced rail forms since the technology is able to provide the required support (advanced/fast handling systems, advanced/improved rolling stock, advanced access systems, identification / location / positioning systems).

The future improvements of the rail sector should be based on the complimentary and comprehensive use of all operating forms (direct trains, feeder systems, shuttle-shuttle forms, liner trains, hub-and-spoke systems, full-load traffic).

8.3 Recommendations for Road Transport Operators

The benefits deriving to road transport operator are linked to two groups of issues:

- Savings of time at the terminal gate
- Improvement of the quality of service

The additional improvement in terminal performance will have only limited impact on time savings at the gate, since the time requirements are almost always met by present terminals. The main advantages are therefore linked to quality factors such as reliability of delivery time, completeness of information, wider time windows for the delivery of ITUs, etc..

The only recommendation to road transport operators is to pursue an efficient development of communication systems for the connection to terminal operators. Only in this way an optimal arrival pattern can be assured, with advantages for both the overall performance of terminal and for the individual shipment.

As a final, general consideration on these items, we have to highlight that number of technologies are available and adaptable to the needs, but the main problems lie in the following:

- The needs have to be defined at a global level in a realistic manner (think global, act local) by the actors of the chain and not only by the operator.

- Obtaining synergies between technology, organisation and procedures is fundamental.

- Human factors are essential, so make it simple (information is good, communication is better).