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INNOVATIVE RAIL INTERMODAL SERVICES

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	Freightliner (GB)	SeT (IT)
	P&O NL (GB)	IFB (BE)

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Stadtwerke Düsseldorf (SWD)	Germany
Voltri Terminal (VTE)	Italy
Interporto Bologna (INTBO)	Italy
Padova Container Service (PCS)	Italy
Italcontainer (ITALC)	Italy
Sistemi e Telematica (SeT)	Italy
Inter Ferry Boats (IFB)	Belgium

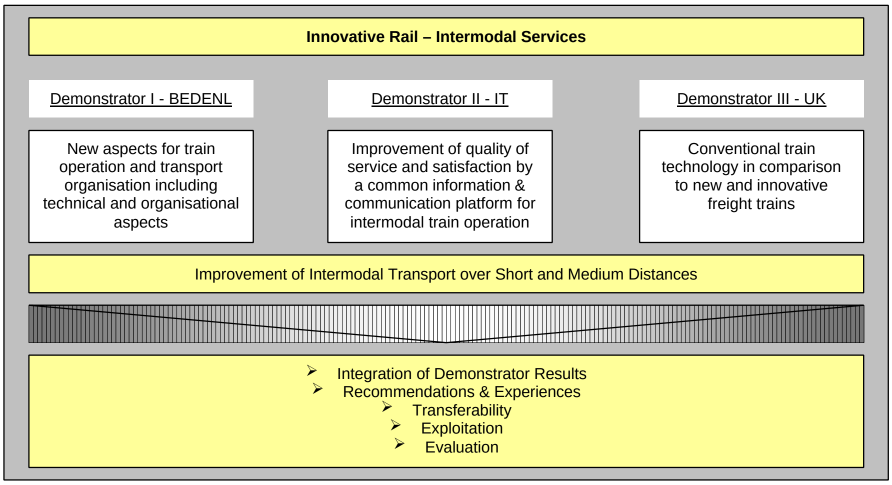
Executive Summary

Looking at the development of the market share of European freight railways it can be recognised that in 1970 32% (basis in tkm) were transported by rail while in 1996 this share decreased to 14%. One main target of European transport policy is to revitalise the EU rail sector by creating conditions in which rail freight transport can be efficient and competitive in the future. But, up to now there is a high degree of uncertainty in the measures to be applied to reverse the trend of the past. As for rail the same can be stated for intermodal transport on which no sustained break-through has been achieved in any European country. Intermodal transport has largely been considered successful on long distance with high consistent volume applications. However, with regard to an increase in market share of intermodal rail services it has to be considered that most of the transport on road is operated on distances below 400 km, like for example in Germany in 1997 70% (basis tkm) of all freight carried on road was on distances less than 400 km (in transport volumes the share is 95%). Therefore, it seems to be key to get more insight in this truck dominated market field from the view of intermodal transport. Core idea for the initiators and participants of the IRIS project (Innovative Rail – Intermodal Services) was to design, implement and demonstrate feasible intermodal transport services over short and medium distances - on the basis of three vital European demonstrators located in the hinterland of three European seaports – being well aware of the challenge to demonstrate such services in a model like, yet, viable way.

The IRIS project, a project supported by the European Commission DG VII (Transport) / DG XIII (Telematics), follows the overall objective to demonstrate the commercial, operational and technical feasibility of enhancing intermodal freight transport on short and medium distances and to derive aspects which make this kind of transport a success.

Nine partners together with eight associated partners from the transport industry (e.g. intermodal operators, public railway company, private railway company, terminal operators – sea port and hinterland), transport and information technology and the research and consultancy business co-operate to fulfil the tasks of this project. Three demonstrators characterised by different technical, organisational and administrative elements were implemented, demonstrated and evaluated in detail. The pilot demonstrators were developed on the basis of existing transport activities and business contacts of the operational consortium partners and on former project results. Each of the demonstrators comprised the development and application of practical and transferable aspects for the enhancement of intermodal transport on short and medium distances.

Following figure gives an overview of the three demonstrators and outlines their general contribution to the project results.



The IRIS demonstrators were carried out according to its objectives. Different rail operations such as feeder, hub as well as composite trunk haulage in the hinterland of seaports were considered. In particular the BEDENL and the UK approach focussed on the technical and operational demonstration of appropriate concepts to serve the region with a minimum part of road haulage. The Italian demonstrator followed the approach to increase the quality of intermodal services by the development and implementation of a common ICP (Information and Communication Platform) covering a complete intermodal transport chain in seaport hinterland transport. The three IRIS demonstrators have been designed closely to the recommendations derived from the OSIRIS project (Optimised System for an Innovative Rail Integrated Seaport Connection). In the following a brief overview on each demonstrator outcome is summarised

- The BEDENL site demonstrated an approach for border crossing intermodal services between Düsseldorf and Zeebrugge integrating public and private rail companies. The approach especially focused on a regional approach in order to attract this mode of transport for customers located in such areas. Therefore, the approach is complementary to the present strategy of the national rail company DB AG which focuses on large volume transhipment points and main routes. The technical, operational and commercial feasibility of the demonstrator was proved but as a conclusion from the demonstration partners needs for special marketing and follow up measures on the demand side. The particular characteristics and conditions of a selected transport site are key for the success of such short distance transport offers. Nevertheless this approach has potential being a template to set up future intermodal services by third parties.

- The Italian demonstrator demonstrated a telematics solution making pre and end haulage to and from seaports more reliable and therefore more competitive. The functions and messages applied were agreed upon by the different actors involved in the transport chain and have been therefore proven for further exploitation. It became clear that SMEs benefit from the ICP. Moreover, the larger the number of message exchanged the larger the benefits for SME. For large companies the integration effort into their system is high due to a often existing older and less flexible IT architecture.

- The UK site demonstrated on the basis of the Trucktrain technology an approach to attract small and medium volume transport for rail services. The whole concept aims at lowering the cost base of the rail freight offer and making the product/service combination much more attractive to existing shippers and to new entrants. As an outcome a clear concept to come to a purpose build Trucktrain technology was derived. The demonstration showed that rail goods transports has specific requirements that can not be met by a proxy solution. A further outcome of the demonstrator was to develop a clear path how this technology can be brought to a technical, operational and economic optimum. On the identified operation fields the Trucktrain showed a better commercial and ecological performance than the “traditional” ones.

Consolidated conclusions

As a general conclusion the three IRIS demonstration approaches proved their technical and operational feasibility. It became obvious that most of the problems occurred during the different project phases reflecting the actual situation in European (rail) transport markets. Therefore, it has to be distinguished between the technical and operational demonstrations in UK and Germany/Belgium and the development of an intermodal related IT infrastructure in Italy.

Obviously, the BEDENL and UK approach are a solution for particular niche markets in sea-port hinterland operations being complementary to the existing operations such as long haul direct trains. Nevertheless, attracting cargoes for intermodal rail operations in the regions means also to minimise road operations on the pre and end leg of intermodal operations. This is in contrary to the general strategy of public railway companies such as of the DB AG to concentrate their intermodal terminal network on main routes with high volumes. This strategy bears the risk that the road leg in intermodal transport chains will be enlarged or that cargoes are left to road completely with negative effects for the use of infrastructure, environment and society.

In more detail the following overall conclusions on the technical and operational feasibility of the IRIS demonstrators can be stated:

Different technical and operational standards in the European rail system are a barrier to set up intermodal transport, in particular for international border crossing operations. The BEDENL demonstrator showed that examples for successful intermodal services over short and medium distances in the hinterland of the Belgium seaports actually exist. Even the service from Zeebrugge to Bressoux is operated on a distance below 200 km. However, the political borders (equal to the borders of the national rail companies) are still a barrier for expanding services. The complexity and severeness of different political, technical and operational regulations inherent in the rail system cause high start up costs which require long and stable transport flows for coverage. Generally, attracting the region means consolidation of “small numbers” of container volume on the demand side and the provision of transport capacity with a high uncertainty in costs revenues on the supply side. For the demand and the supply side two success factors from the IRIS project can be stated:

- For the acquisition of load the BEDENL partners have identified the lack of an integrator acting as intermediary between the customer requirements in terms of time and quality and among the partners providing the transport service. In comparison, the UK demonstrator showed that the involvement of P&O Nedlloyd acting as forwarder for door to door container services has been a big advantage for the set up and operation of intermodal transport chains over short and medium distances.

- For the set up of intermodal services over short and medium distances the BEDENL demonstrator followed a flexible approach. Considering the uncertainties on the demand side intermodal services have to be designed according to the availability of load. The set up of direct trains or a co-operative approach supplementing existing (long distance) trains might be the task for an intermodal integrator. The application of existing technology is an additional measure to reduce high start up costs.

The availability of adequate transhipment facilities in the regions are a major prerequisite to set up and carry out intermodal services over short and medium distances. A limiting factor for the BEDENL demonstrator was that terminals planned to be used for the demonstration were closed by the DB AG (Aachen) or not build during the project life time (Düsseldorf, Düren). The UK demonstrator also identified the need to find appropriate transhipment technology allowing (the TruckTrain) to operate small volume transhipments apart from stationary transhipment facilities.

A crucial partner for private carriers (indifferent to the company size) to set up intermodal services are the public rail companies. The dominant position of public rail companies within the rail system and their influence such as in the field of providing rail access, additional services (shunting etc.) or operational regulations and bilateral agreements in international operations contains a high potential for discriminating against “external” competitors.

The BEDENL and UK demonstrators showed the different innovative approaches on the feasibility of intermodal transport over short and medium distances. For both in common the approaches focussed on new concepts beyond the existing block train philosophy of public rail companies. In particular, the BEDENL demonstrator showed that in Germany the integration of private rail companies in international transport chain without using the service of DB Cargo is “almost” possible under the present rail framework. Nevertheless the options for the private operator DKB (Dürener Kreisbahn) on the BEDENL site being a service provider are currently limited and will therefore make the participation of the DB AG still necessary. But the BEDENL demonstrator showed **how** the rail system as a whole can become more efficient and therefore more competitive by integrating third parties providing feeder and additional services (e.g. coupling, shunting or transhipment).

The IRIS demonstrators on the UK and BEDENL site were carried out under three different infrastructure access systems. In UK a completely independent and liberalised system, in Germany a commercially independent but integrated within the public rail company DB AG and in Belgium a state owned and controlled rail infrastructure institution were involved in the demonstrations. It can be stated that the access to the infrastructure for private operators was not a problem in Germany and UK. Whereas the infrastructure charges are one if not the crucial factor to jeopardise the success of intermodal rail operations over short and medium distances. In particular for the German and the Belgium system a lack of transparency for external parties can be stated.[1]

[1] The German infrastructure pricing system is under modification. The new system became into force by April 2001.

First priority in the transport market is “the price” for transport services. Therefore, a success factor is the market acceptance of the approaches even for the technical and operational evaluation of intermodal services over short and medium distances. Due to the integration of further users to the ICP the success of the Italian demonstrator from the market side has been proven. As well as the BEDENL and UK demonstrators who achieved a high acceptance for the specific concept with a severe willingness of the partners to further develop the approach.

1 Introduction

Looking at the development of the market share of European freight railways it can be recognised that in 1970 32% (basis in tkm) were transported by rail while in 1996 this share decreased to 14%. One main target of European transport policy is to revitalise the EU rail sector by creating conditions in which rail freight transport can be efficient and competitive in the future. But, up to now there is a high degree of uncertainty in the measures to be applied to reverse the trend of the past. As for rail the same can be stated for intermodal transport on which no sustained break-through has been achieved in any European country. Intermodal transport has largely been considered successful on long distance with high consistent volume applications. However, with regard to an increase in market share of intermodal rail services it has to be considered that most of the transport on road is operated on distances below 400 km, like for example in Germany in 1997 70% (basis tkm) of all freight carried on road was on distances less than 400 km (in transport volumes the share is 95%). Therefore, it seems to be key to get more insight in this truck dominated market field from the view of intermodal transport. Core idea for the initiators and participants of the IRIS project (Innovative Rail – Intermodal Services) was to design, implement and demonstrate feasible intermodal transport services over short and medium distances - on the basis of three vital European demonstrators located in the hinterland of three European seaports – being well aware of the challenge to demonstrate such services in a model like, yet, viable way.

The IRIS project, a project supported by the European Commission DG VII (Transport) / DG XIII (Telematics), is following the overall objective to demonstrate the commercial, operational and technical feasibility of enhancing intermodal freight transport on short and medium distances and to derive aspects which make this kind of transport a success. This follows the task objective as stated in the joint call documentation: 'to demonstrate the actual possibilities and limits of making intermodal freight transport more attractive on short and medium distances, and to identify the conditions for making it viable' (Task 1: ‘Integrated demonstration project of innovative intermodal door-to-door freight services on short and medium distances’ of the Joint Call for Proposals under the 4. Framework programme.).

Nine partners together with eight associated partners from the transport industry (e.g. inter-modal operators, public railway company, private railway company, terminal operators – sea port and hinterland), transport and information technology and the research and consultancy business co-operate to fulfil the tasks of this project.

Three demonstrators characterised by different technical, organisational and administrative elements were implemented, demonstrated and evaluated in detail:

- the Belgian-German-Dutch (BEDENL) demonstrator demonstrated and evaluated organisational and operational aspects of intermodal rail transport over short and medium distances in the hinterland of the seaport Zeebrugge and the region Düsseldorf/Düren/Aachen. Main focus of this demonstration was the development of an technical and operational feasible and economically viable offer of new rail services by private operators bundling volumes between the seaports Antwerp and Zeebrugge and the Düren region. Within the demonstration the feasibility of economies of scales (even in the region) were demonstrated by bundling the capacity of an (existing) long distance train at a regional transfer point with volume coming from the demonstration region.

- the Italian (IT) demonstrator showed the contribution of telematic systems integration to the improvement of the intermodal transport over short and medium distances through a better and more updated information on transport status and planning. Especially for intermodal transports over short and medium distances the availability of information has a direct impact on efficiency and reliability of the transport operation. For this reason there is a specific need to increase the efficiency of communication operations. The demonstrator focused on the implementation of a common Information & Communication Platform (ICP) which allows for a better planning between the partners involved.

- the UK demonstrator demonstrated the enhanced economic and operational performance of rail services using a small, bi-directional and self propelled train “TruckTrain” for container transport on several routes in the UK. The focus of this demonstration was to demonstrate the capabilities in terms of speed, control, security and reliability of transit and to derive a cost base for the TruckTrain comparable to road transport.

The pilot demonstrators were developed on the basis of existing transport activities and business contacts of the operational consortium partners and on former project results. Each of the demonstrators comprised the development and application of practical and transferable aspects for the enhancement of intermodal transport on short and medium distances.

A main result of the IRIS project showed that this truck dominated field of transport contains potential for intermodal services which need to be further explored. Intermodal services over short and medium distances can not be regarded as the core competence of large national railway companies. Moreover such services are located in particular niche markets which can mostly not economically covered by large national rail companies.

In this respect, the project approach contributes to the policy of the EC to liberalise the rail market and to harmonise interoperability of international rail operations. The IRIS project results and findings might become of further relevance as national research programmes in Germany and UK will also initiate research and demonstration activities leading to a modal shift from road to rail.

Following figure gives an overview of the three demonstrators and outlines their general contribution to the project results.

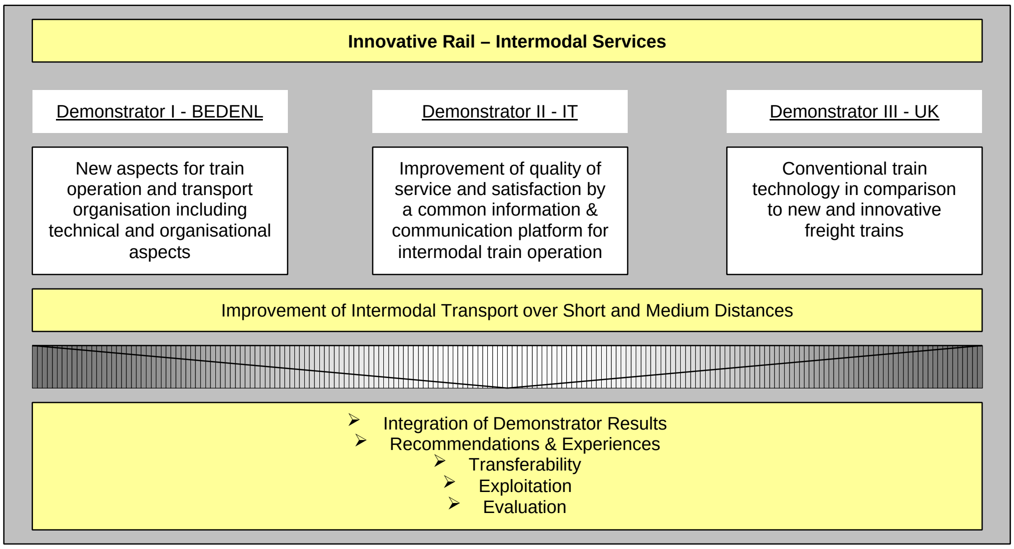


Figure 1/1 Demonstrator approach

The four main IRIS deliverables D 2 'Demonstrator specification and layout', D 3 “Final consolidated evaluation results”, D 4 “Integrated demonstrator description, conclusions and recommendations” and D 5 “Exploitation and transferability” create the basis for the results of IRIS project.

Within this report a clear description of the IRIS demonstration processes is given starting with a brief description on the objectives of the IRIS project and the means used to achieve these objectives (chapter 2). The main part of this report creates the scientific and technical description of the work packages (chapter 3). This is described according to the following structure:

- General description of the demonstrator, by giving a concept overview, describing the regional background of the demonstrator and the transport chain demonstrated.

- Detailed description of the demonstration activities by describing the technical layout of the demonstrator, the demonstrator set up, implementation process as well as the execution of the demonstration day.

- An detailed evaluation of the demonstration results right after the demonstration day (post event evaluation) including all experiences gained from the set up, implementation and demonstration process.

- For the BEDENL and UK demonstrator an approach for commercialisation of the demonstrator has been developed focussing of the development of a competitive service of these two demonstrators.

The chapter following thereafter highlights the influence of policy measures as described in the so called EC rail freight packages which were briefly assessed and commented (chapter 4). Finally the site specific conclusions from the demonstration sites were consolidated (chapter 5) and overall project results and follow up measures outlined (chapter 6).

2 Objectives of the project

The IRIS project aims to demonstrate the commercial, operational and technical feasibility of enhancing intermodal freight transport on short and medium distances and to derive aspects which make this kind of transport a success. Three separate demonstrators implementing three different aspects of intermodal transports on short and medium distances create the core of the IRIS project that will be executed on three different sites:

- The Belgian-German-Dutch (BEDENL) demonstrator focuses on the organisational and operational feasibility of intermodal freight transport chains on short and medium distances. The demonstration is to offer an innovative rail service by the co-operation of public and private operators bundling volumes between the seaport of Zeebrugge and the Belgian-German Hinterland in the region of Bressoux (Liege)/Aachen/Düren. Besides, within the demonstration the capacity of an (existing) long distance train was supplemented at a regional transfer point in Düren which is supposed to increase efficiency and competitiveness to that mode of transport. An innovative “Transterminal” was dealt with as “Add-on”-Demonstrator.
- The Italian (IT) demonstrator aims to improve intermodal transport services on short and medium distances by introducing a telematic system integration between different partners. Core is the implementation and demonstration of an Information and Communication Platform (ICP) for the electronic exchange of transport related EDI messages between a seaport terminal operator in Genova, the inland intermodal terminal operators in Padova and Bologna and the intermodal operator Italcontainer.
- The UK demonstrator demonstrates the enhanced economic and operational performance of rail services using an innovative small self propelled train, the so-called “TruckTrain”, for standard container transport. The technical and economical feasibility of this train concept is demonstrated on two routes between the seaport of Southampton and Birmingham and between Southampton and London/Barking.

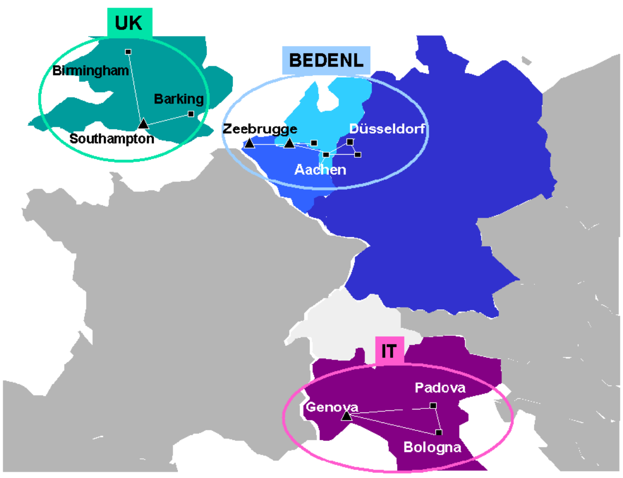


Figure 2/1: Map of Demonstration Projects

The demonstrations are developed on the basis of existing transport activities and business contacts of the operational consortium partners and of former project results. Each of the demonstrators comprises the development and application of practical and transferable aspects for the enhancement of intermodal freight transport on short and medium distances.

3 Means used to achieve the objectives

The IRIS project started in January 1999 with a duration of 26 months. By its contents it can be characterised as a demonstration project investigating the feasibility of different technical and operational concepts as well as a telematic application on intermodal transport in different European countries. Doing this on the basis of the existing circumstances and regulations in European rail market deeper insight into the current practices in European rail has been experienced and analysed by the project partners.

Referring to this topics, the project is subdivided into eight horizontal and vertical work packages as follows:

Horizontal activities

WP 0 Project management

WP 1 Dissemination and external communication

WP 2 Demonstrator design and follow up

WP 3 Evaluation

WP 4 Demonstrator integration and transferability

Vertical activities

WP 5 Demonstrator I (BEDENL)

WP 6 Demonstrator II (Italy)

WP 7 demonstrator III (UK)

Starting with the design phase in which the demonstrators specified their design and layout (described in deliverable D 2 “Demonstrator layout and specification), followed by a verification, set up and implementation phase the demonstrators were carried out in a so called demonstration day. In parallel the horizontal activities of the IRIS project accompanied these phases by carrying out a detailed evaluation of the demonstrator activities. Details on the individual demonstrators and tasks are described in the following chapter “Scientific and technical description of the project”.

In addition to the conclusions and the results within the Final Report several documents (reports, deliverables, newsletters and brochures) were produced describing the project progress. The publications have been distributed to interested parties. A list of all publications is given in the annex.

4 Scientific and technical description of the work package

4.1 Demonstrator I BEDENL

4.1.1 Demonstrator description

Concept overview

The demonstration of intermodal transport over short and medium distances with low and medium density volume flows is the core of the BEDENL demonstrator. "BEDENL" is standing for Belgium, Germany and The Netherlands in German language and localises the demonstrator, which covers the border regions of these three countries. The strategic objective of this demonstration is to attract more volume for intermodal rail road transport on distances of about 250 km.

Within the overall context of the IRIS project, the BEDENL demonstrator is a co-operation between SCI Verkehr GmbH (Cologne, Germany) as test site leader, rail operator B-Cargo (Belgium), the Port of Brugge-Zeebrugge (MBZ, Belgium), the intermodal operator Interferry Boats S.A. (IFB, Belgium), the regional railway company Dürener Kreisbahn GmbH (DKB, Germany) and the inland port Stadtwerke Düsseldorf – Hafen (SWD, Germany). It was also necessary to involve German Railways (Deutsche Bahn AG) in their two roles as infrastructure provider (DB Netz) and transport operator (DB Cargo). Intercontainer-Interfrigo (ICF) withdraw from the project due to an internal management decision.

Well aware of the disadvantages on transit time and costs in comparison to pure road transport operations, the demonstrator approach aimed at a suitable and attractive concept optimising and integrating existing technologies. Key factors for an improvement of intermodal transport over short and medium distances are the implementation of a flexible and cost effective (train) operation approach focussing on the customer requirements and service quality. In addition the fixed costs linked to terminal(s) and pre- and on-carriage has to be looked at carefully.

The intention of the demonstration partners was therefore to implement a new intermodal (train) offer in the hinterland of the port of Zeebrugge to and from the decentralised Belgium-German-Dutch border region of Liege(Bressoux)/Aachen/ Düren and Düsseldorf.

Therefore, an appropriate concept was developed focusing on the present situation by shifting parts of the transport flow from road to rail. The projected new train service links Düsseldorf and Düren to the Port of Zeebrugge. The demonstrator integrates all relevant partners of the transport chain including a regional railway company to set up an intermodal service. The new service is composed of a feeder train connection between inland terminals (Düsseldorf DCH and Krauthausen to Düren) and connection to an existing intermodal main haulage train from Cologne to Zeebrugge. From Düren onwards to Zeebrugge a better utilisation of the existing train is reached.

It was expected to create a win-win situation among the partners involved as the use of capacity on the main haulage train is improved and additional regional container volumes are attracted to rail transport operations. The win-win-situation would occur, because the existing train operator benefits from additional payload on the already scheduled regular public train (DB Cargo) runs, increasing the income without increasing the costs considerably. The regions can offer a direct train connection at low additional cost and without further detour on road.

The demonstration focuses on organisational and operational aspects rather than technical and environmental items, since the application of innovative technologies was not task of the BEDENL demonstrator. In this respect the demonstrator shows what is “feasible” under the current circumstances of regional border crossing intermodal rail transport.

The demonstrator culminated in the “demonstration days” and is part of a series of logical steps to set up an intermodal service. The train became operational and on May 8/9, 2000 the IRIS BEDENL Demonstration Days were carried out.

Regional background of demonstrator

The region in which the BEDENL demonstrator operates is characterised by decentralised industrial areas, considerable capacity of transiting rail and road infrastructures but a lack of intermodal terminals in the two towns concerned. Former terminals at Aachen-West and Düsseldorf-Bilk have been closed down by German Railways (Deutsche Bahn) recently, eventual sidings are served with very low quality (time, frequency, punctuality) profile by single wagon load transport.

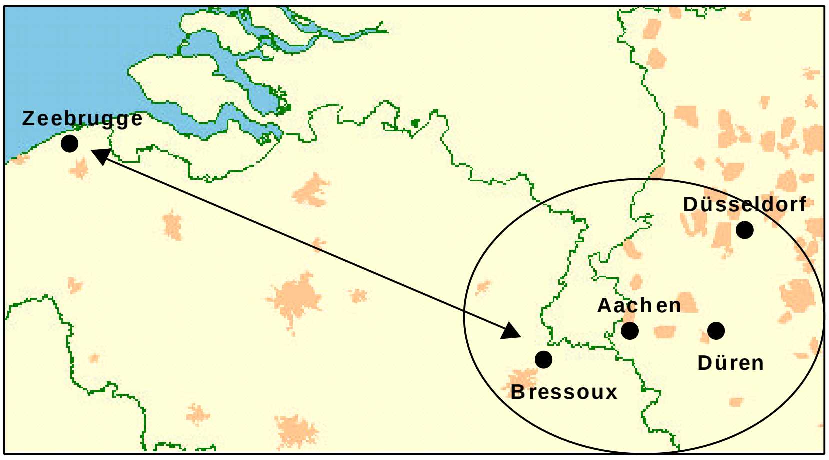


Figure 4.1/1: Geographical setting BEDENL demonstrator

The existing service of InterFerryBoats (IFB) between Zeebrugge and Bressoux imposes considerable on-carriage by road when travelling to the German hinterland; nevertheless it is an example of an intermodal operation on a very short rail distance (less than 200 km). Existing terminals at Cologne (e.g. Eifeltor) and Neuss (Hessentor) or Duisburg are not providing a real alternative since e.g. passing through Eifeltor would cause a detour of approximately 80 km or two hours for containers originating at Düren. In addition the port of Zeebrugge does not officially show up in the schedules of many shipping agents since usually the Bill of Lading indicates “Antwerp” although the vessels physically call at Zeebrugge.

The demonstration has to compete with existing road and inland waterway operations in terms of price, time windows and quality of service issues. Besides the pure road haulage, the competing services are a potential road-barge operation via the Port of Düsseldorf and a rail-road operation via the terminal at Bressoux (Liege). The latter implies a considerable on-carriage by road to and from German destinations.

Transport chain

The demonstrator integrates all relevant partners of the transport chain including a regional railway company to set up an intermodal service. The new service is composed of a feeder train connection between inland terminals and a connection to an existing intermodal main haulage train to Zeebrugge. The connection is secured at Düren station. The demonstration has to compete with existing road and inland waterway operations in terms of price, time windows and quality of service issues. Besides the pure road haulage, the competing services are a potential road-barge operation via the Port of Düsseldorf and a rail-road operation via the terminal at Bressoux (Liege). The latter includes considerable on-carriage by road to and from German destinations.

The following operational concept is underlying the demonstration:

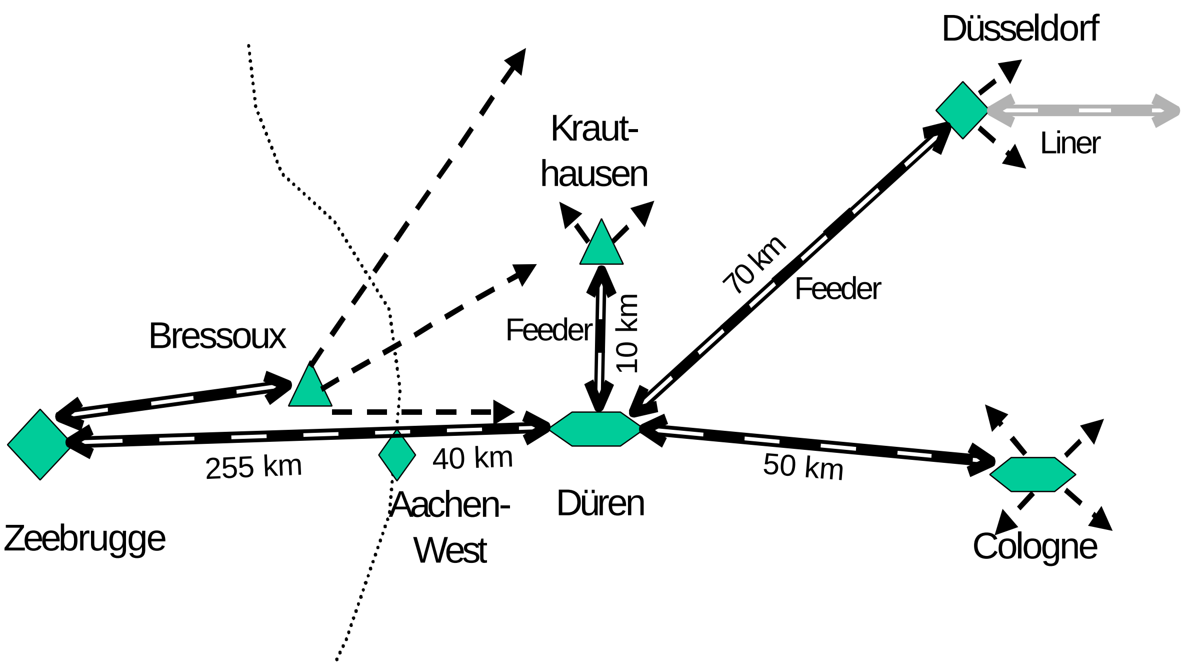


Figure 4.1/2: Operational Concept of the Demonstration Day

The demonstration is composed of two Feeder trains from local terminals (Düsseldorf DCH and Düren Krauthausen) which in Düren are coupled to another trunk haulage train from Cologne. From Düren onward to Zeebrugge a better utilisation of the train is reached.

The BEDENL demonstrator deals with two main aspects: On the one hand, the combination of technologies and primarily services is demonstrated focusing on available equipment. On the other hand, the demonstration includes a co-operative approach integrating the road and rail modes as well as rail operators both private and public. The aim of both approaches is to reduce operational costs of intermodal transport over short and medium distances and to offer better services. Therefore a major precondition of the attempt focuses on a reduction of transport and transhipment costs considering that in particular the transhipment costs will be a critical success factor for intermodal transport over short and medium distances. Further savings can be expected from a co-operative approach to eliminate problems at border crossing and due to the involvement of many actors.

The demonstration is expected to provide important findings from the transport market perspective concerning an improvement of the efficiency and competitiveness of intermodal transport over short and medium distances and towards an exploitation and transfer of this kind of transportation to other regions and applications.

4.1.2 Demonstration activities

Technological layout of the demonstrator

The locations involved in the demonstration are the Port of Zeebrugge, the Port of Düsseldorf, the Terminal at Bressoux and the region of Düren/Aachen.

In detail, the Port of Zeebrugge (MBZ) owes its success to its claimed strategic position on the North Sea, at the delta of major rivers, the crossing of important cargo flows between a large hinterland and opposite coasts. Dependent on the vessel's cycle import cargo is available earlier and export cargo may leave the continent later, so that shippers would benefit from earlier availability and later closing. Zeebrugge offers all services of a transit port such as RoRo, container traffic, liquid bulk and niche activities. With respect to IRIS the Ocean Containerterminal Hessenatie Zeebrugge (OCHZ) is the (un-)loading facility. It offers transshipment between three modes of transport, depot, storage and reefer services on a surface of 42,000 m². The quay wall is 1,750 m long and equipped with 7 gantries which are supported by 22 straddle carriers. Although a couple of major shipping lines call at Zeebrugge and it is linked via intermodal networks to the hinterland, MBZ thinks that the service can still be improved by more dedicated trains between Zeebrugge and hinterland terminals. In this respect Zeebrugge differs from Antwerp which offers shorter continental routes.

A Map of the Port of Zeebrugge shows the railway junction (east of #58) and the container terminals OCHZ (#43) and Flanders Container Terminal (#42) and the projected Hessenatie terminal (#41) all located in the tidal area of the port with direct access for the vessels.

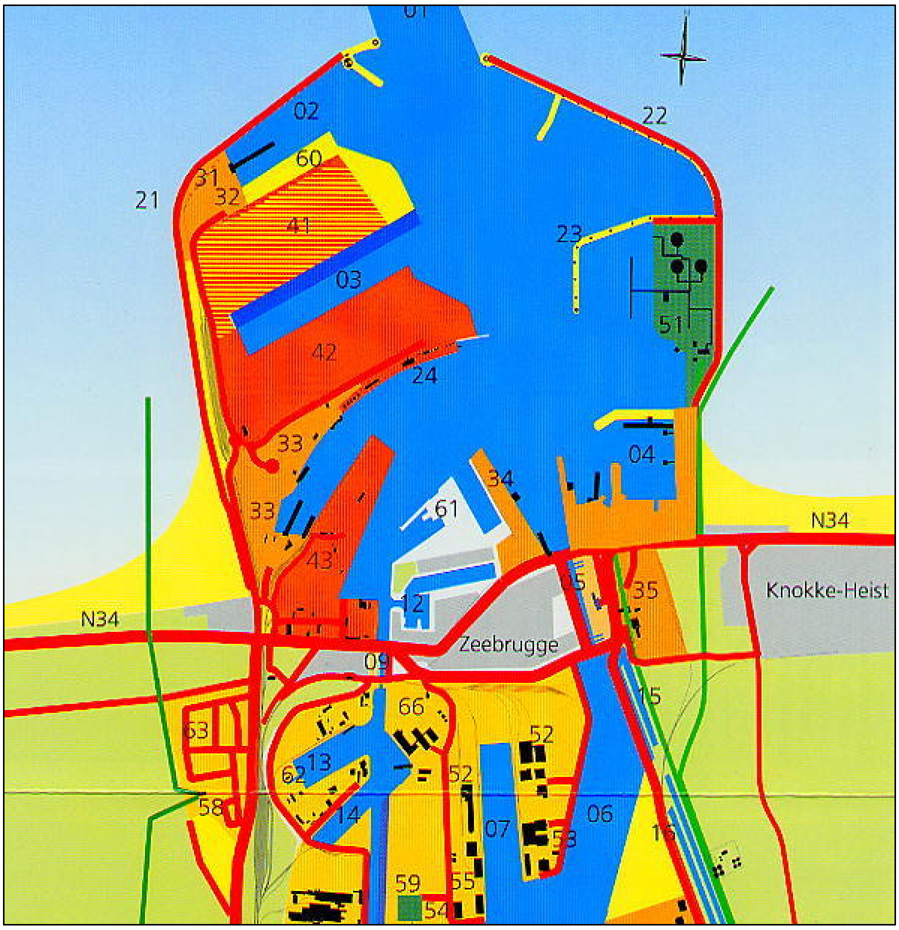


Figure 4.1/3: Map of Port of Zeebrugge

The Port of Düsseldorf offers a couple of inland port services in the centre of gravity of an important economic area. An advantage of the location is the vicinity to the city centre of Düsseldorf. With respect to intermodal services the operational company Containerhafen Düsseldorf (DCH) GmbH operates a terminal of 50,000 m² with quay wall for two barges, two gantries of 30/50 tonnes, mobile handling equipment (reach stacker, front lift-truck), 720 m loading track and additional services such as trucking and depot. In 1998 about 57,000 TEU have been transhipped, 85 % of which being barge-road service.[2] No regular intermodal rail services are offered. The port competes to the Port of Neuss approximately on the opposite bank of the river Rhine which offers trimodal terminal facilities and is part of intermodal networks, both on the river Rhine and the rail network.

A bird's eye view of the port showing the Port of Düsseldorf being located in a loop of the river Rhine with Containerhafen Düsseldorf (DCH) in the centre and the location of new Transterminal (TTD) in the junction Hafenbahnhof at the bottom.

[2] For more information see also the port's website at www.swd-ag.de.

Figure 4.1/4: Main Port of Düsseldorf

The intermodal rail-road terminal of Bressoux is owned by Terminal Euro-Combi-Est S.A., a subsidiary of B-Cargo and operated by IFB. On a surface of 40,000 m² it offers transhipment of all types of containers, swap bodies and semi-trailers up to 40 t by means of a rail-mounted gantry crane (RMG) and two reach stackers, road haulage “door-to-door” and container inspection/repair. The total length of rail track is 1,640 m. Recent relations are: a daily overnight shuttle to Antwerp and Zeebrugge, links to Italy and Spain via the ICF Quality Net (hub in Metz-Sablon) and the TRW Cortax system (hub in Brussels-Schaarbeek).

Figure 4.1/5: IFB Terminal Bressoux

The contribution of the Düren area is twofold; on the one hand cargo generated in the region is put onto rail, on the other hand the two feeder trains are coupled in Düren main station for further main haulage. A new intermodal terminal located strategically close to major clients and the rail line of Dürener Kreisbahn GmbH (DKB) is in the planning stage but did not become available during the time frame of IRIS. Therefore a temporary loading place had to be chosen which was sufficient for the demonstration purposes but is not comparable for commercial offers. Analysis of potential places in the region where railway lines and roads are close to each other and sufficient space allows for the transhipment have been selected by DKB in a small town called Krauthausen, just north of Düren. Train coupling can take place at the main junction of Düren, where DKB regional tracks and the main line of DB Netz are meeting.

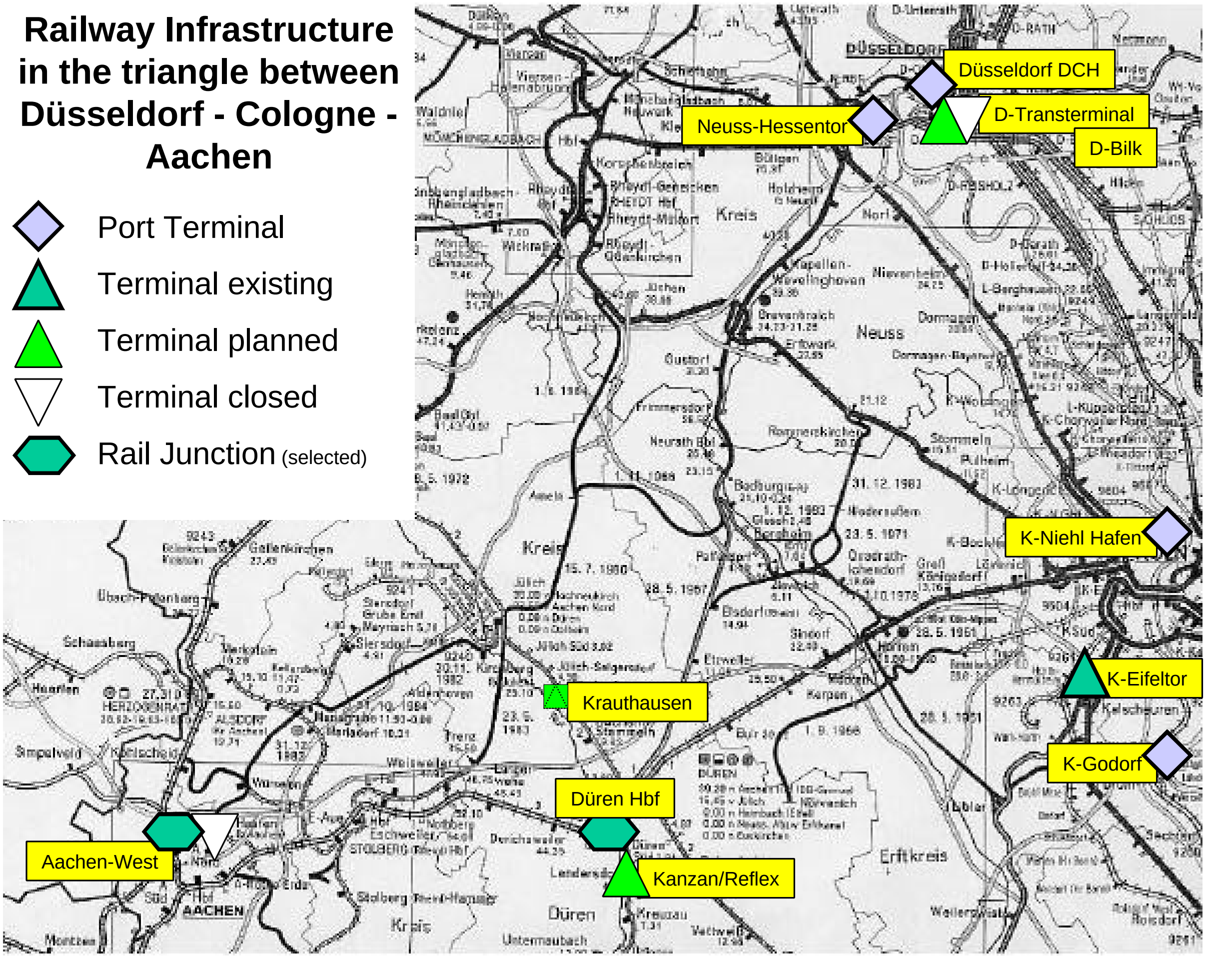


Figure 4.1/6: Railway Infrastructures and Intermodal Terminals in the Triangle Düsseldorf – Cologne – Aachen

The figure above shows the existing and the planned situation of intermodal transport transhipment points in the demonstration region Düsseldorf/Düren/Aachen. Presently Krauthausen is the only usable transhipment point on which Reachstacker can operate. The terminal at Kanzan/Reflex could not be build in the IRIS time frame.

The demonstration focuses on organisational and operational aspects rather than technical items, since innovative technologies did not become available during the demonstration. In this respect the demonstrator shows what is “feasible” considering the current circumstances of regional border crossing which intermodal rail transport has to face and which are discussed comprehensively in chapter 2.8.

The components are terminals, feeders trains and necessary railway equipment and finally operational partners and stakeholders which require to be integrated.

Demonstrator set up

The demonstration which is culminating in the “demonstration days” is part of a series of logical steps to set up an intermodal service. By means of the project also the problems and hindrances of setting up a new service can be experienced and demonstrated.

These steps, starting with conception work within OSIRIS, an intermediate phase in which the consortium was formed, and the execution of IRIS are shown in Table 2.4/1.

No	Activity	Time
1	Identification of potential demand (top-down statistical analysis) and need Creation of an innovative intermodal concept	OSIRIS
2	Team-building, Consortium, Contract	Intermediate
3	Outline time windows, costs and operational concept	IRIS 12/99
4	Select potential collaborators (to make / to buy)	IRIS 1/00
5	Marketing offer to potential customers in order to derive a specific demand (bottom-up approach) for the demonstration	IRIS 2/00
6	Select ports/terminals/junctions to be linked	IRIS 3/00
7	Set up a train service between these terminals including track/slot at a time existing or new train marshalling yards or junctions appropriate locomotive(s) appropriate wagon (type, number)	IRIS 4/00
8	Organise pre- and on-carriage by truck	IRIS 5/00
9	Organise transhipment at terminals	IRIS 5/00
10	Organise empty ITU/return of empty ITU and wagon	IRIS 5/00
11	Perform technical-operational demonstration day	IRIS 5/00
12	Analysis, improvement/modification and Commercial offer to Customer/Negotiation	IRIS 8/00
13	Validation/Demonstration of final Results	IRIS 9/00
14	Exploitation/generalisation	IRIS 10/00

Table 4.1/1: Steps to set up an Intermodal Service within BEDENL-Demonstration Site

The BEDENL Demonstrator must be seen as an ongoing iterative process in which - dramatically influenced by the changing environment of fringe conditions in intermodal market - a demonstration activity was set up. Due to the high importance of the commercial viability of the BEDENL demonstration approach for a successful demonstration the team dealt with technical-operational <u>and</u> with commercial issues.

Technical-operational issues

Talks to potential clients in the region have shown a general interest in an intermodal service but also highlighted that the transport industry is part of logistic concepts and existing transport chains which can not be changed for the period of a RTD Project only. In the end volume for one wagon from Düren and for seven wagons from Düsseldorf could be acquired for the demonstration. As a practical approach from that the partners decided to exploit an existing “open” train of DB Cargo/B-Cargo from Cologne to Zeebrugge which passes the region as intermediate solution to demonstrate the feasibility of the demonstration concept. Talks with the railways and own observation have shown that this train has sufficient free capacity and buffers in its schedule to be used for coupling additional wagons on selected days of the week. Indeed, one wagon group has been loaded in Düsseldorf, transported by regional railway DKB to Düren station. Another wagon group has been loaded in Krauthausen – a temporary loading place north of Düren – and transported to Düren station, too. Here DB Cargo has picked up the two groups, formed a complete far distance train and moved to Aachen-West where B-Cargo took over the train without further marshalling and proceeded to Zeebrugge (via Antwerp).

Scheduling of the demonstration day is limited by the availability of the new cargo locomotive of DKB (planned to be available including putting into practice and training of drivers by mid of April 2000) and availability of the open DB train. That train was terminated end of May 2000 due to low utilisation. However, DB Cargo agreed to open the train for the BEDENL-Demonstration at “normal” tariffs.

The stakeholder situation in the region of interest of the BEDENL demonstration project is rather complex and shown in the figure below.

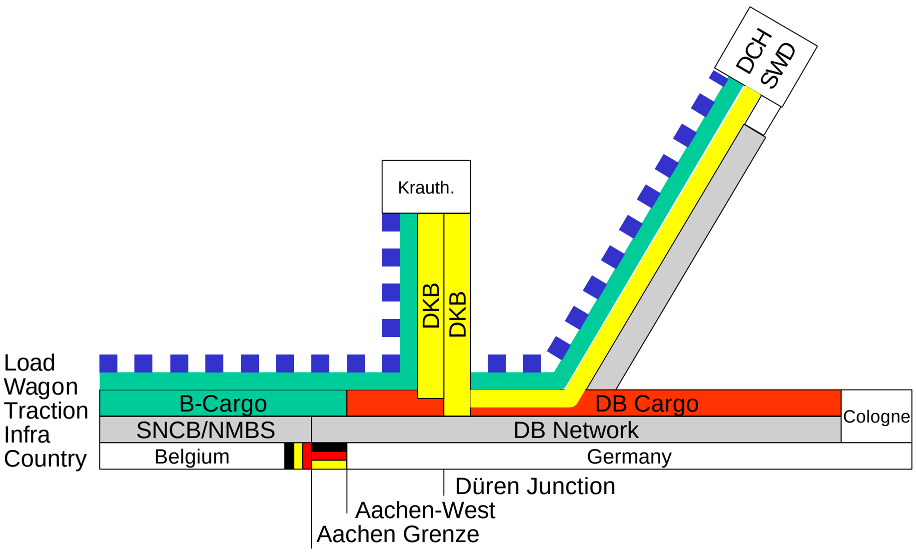


Figure 4.1/7: Stakeholder Situation for the Demonstration Day

The operational train crosses

- the German – Belgium national border
- the two infrastructure regimes of Belgium national railways SNCB/NMBS and German Railways' infrastructure unit (DB Netz AG) with still different access reglementation,
- their respective cargo unites B-Cargo (as partner of the project) and DB-Cargo (as necessary subcontractor) who provide traction facilities in their country as well as wagons (B-Cargo)
- Dürener Kreisbahn with partly own infrastructure (north-south line in Düren) and potentially own traction
- the Port of Düsseldorf with own harbour tracks and the terminal Düsseldorfer Container Hafen - DCH (subcontractor)

The selected region and partnership implies a couple of pecularities and challenges with respect to:

- Collaboration between stakeholders in intermodal transport
- Setting up a service for a limited time to gain operational experience
- Cross border operations
- Loading of a train at an intermediate terminal ("Krauthausen")
- Mixture between "real" transport and RTD approach
- Lack of commercially active intermodal integrator

Technically, it was neither possible to use the junction Aachen-West nor moving the train by DKB locomotive on the Belgium rail network. Aachen-West has become a simple border station where only complete trains are handed over from one railway company to the other without any further marshalling. Cross border traffic is still hampered by the need for driver training, equipment of different signalling systems and authority permission of equipment.

Commercial issues

It has been agreed to "sell" the new service at a favourable rate comparable to the existing market price the clients have to pay. This must be seen as a compromise between "no price – no service quality" and the considerable high demonstration costs. Therefore the mutual understanding is accompanied by a second decision which is to compare the costs of the demonstration to the anticipated costs of a commercial operational service, so that real improvement in terms of costs can be demonstrated and a hypothetical "market price" can be calculated (for details see chapter 2.7).

Also in view of the time window from "door-to-door", that is to say between e.g. a client in Düsseldorf and the seaport terminal in Zeebrugge, some particularities of the demonstration have to be neglected for a future daily operation and comparison to other transport cases.

When drafting the concept, the consortium partners have backed on the role of Intercontainer-Interfrigo (ICF) as intermodal integrator. Due to the strategic re-positioning and ICF withdrawal that position was vacant and has been replaced by SCI and the operational partners jointly. A considerable experience has been built up regarding practical problems of organising intermodal transport chains. These are e.g. relatively high railway infrastructure fees, disposition of empty wagons and ITUs, managing two national railways, organising on-carriage, providing transhipment equipment for a very small number of ITUs and finally the arrangement on sharing the costs.

Demonstration day

The IRIS-BEDENL Demonstration Days became operational on May 8/9, 2000. A visitors' programme accompanied the physical movement of the train according to the overall schedule as shown below.

Date / Time	Place	Physical Operation	Visitor Programme
8.05.2000			
17:00	Düsseldorf DCH	Loading of Feeder Train at DCH and technical inspection Departure to Düren	Welcome by the hosts Introduction into the project and the demonstrator Promotion "Transterminal" Dinner
17:00	Düren-Krauthausen	Loading of Feeder Train Transfer to Düren	./.
9.05.2000			
8:45 9:15	Düren	Arrival TEC 42174 Completion Train Departure TEC 42174	Explanation Promotion DKB
13:00	Bressoux	Terminal Operations Existing Services on short distance	Visit terminal and Explanation IFB-Services Lunch
17:00	Zeebrugge	Arrival TEC 42174 Unloading	Port Visit Promotion MBZ Resume Dinner

Table 4.1/2: Schedule Demonstration Day May 8/9, 2000

The demonstration train runs in the hinterland area of the port of Zeebrugge by linking a couple of terminals and strengthening the existing Bressoux offer. The demonstration includes two feeder trains from local terminals (Düsseldorf DCH and Düren Krauthausen) which are in Düren coupled to another trunk haulage train from Cologne. From Düren onward to Zeebrugge a better utilisation of the train is reached. On the demonstration day the pre-loading was six ITU.

The public demonstration on May 8/9, 2000 received considerable attention by shippers, transport operators, experts from ministries and authorities and the press. A major share of the more than 200 invited persons attended the four locations. A majority of them followed the whole process in the bus service provided.

The following pictures were taken during the demonstration at relevant locations of the programme.

The first station was the Düsseldorfer Container Hafen (DCH) where containers from the local operators were loaded on the feeder train to Düren during the visit.

Figure 4.1/8: Düsseldorf DCH – Loading of the IRIS BEDENL-Feeder

On the following morning, the two feeder trains from Düsseldorf and Düren-Krauthausen were present in the railway station of Düren (platform 5) and the DB-Cargo train TEC 42174 arrived so that bundling of cargoes could take place by coupling the groups.

Figure 4.1/9: Bressoux terminal

The Bressoux terminal (near Liège) was not part of the demonstration train but of the BEDENL demonstrator. The Bressoux terminal already provides intermodal services over short and medium distances by the demonstration partners Interferry Boats (IFB) and B-Cargo. The final step of the demonstration day was Zeebrugge where the demonstration train ended by unloading the wagon at the OCHZ-Terminal, inspection to the port and presentation of the Port Authority.

Figure 4.1/10: Zeebrugge OCHZ Terminal – IRIS BEDENL Demonstration Train Arrived on Time

4.1.3 Post event evaluation

Technical and operational evaluation

A technical-operational validation executed by the operational partners right after the demonstration showed that the chosen demonstration day concept is technically feasible, although “border crossing” transit between different non-traditional railways is still a difficult issue.

For the demonstration German railways accepted only a coupling at Düren and not at Aachen-West, therefore no direct connection between the two railways B-Cargo and DKB was possible. During preparation, the actual procedure how to cross the border remained a miracle. However, later it became clear that three stations have to be distinguished: Montzen or Hasselt in Belgium, Aachen-West in Germany where the locomotives can be changed, and Aachen-Grenze (= border crossing) which is only a post next to the track with no operational importance. Some DB Cargo locomotives and a few B-Cargo locomotives are able to run on both networks and are able to cross border. The two railway regimes have different electricity and signalling systems and beyond their knowledge of the track the

Belgian locomotive drivers have to speak French and Dutch. The special locomotives are normally not used beyond Hasselt and Aachen-West, but operate continuously between these stations, requiring another change of locomotive in Hasselt or Montzen on the Belgian side (from diesel to electric traction). A further peculiarity is the topography which requires double traction for heavy trains (> 1,500 gross tons).

The relatively small distance on which each of the railways involved is responsible for does not explore the whole benefits from the advantages of railway as a system (e.g. to run large volumes at considerable rates). Therefore the operational partners concluded to work with less partners in future and try to find a direct link between a German and the Belgian railway, e.g. in Aachen-West.

The concentration on fewer operational partners and thus the reduction of interfaces is essential if one considers the turn-round times and use of rolling stock and locomotives in case of multiple interfaces involved. The whole terminal-to-terminal train schedule can either respect the request of the terminals and their clients, e.g. with respect to loading time windows or the operational constraints of the railways, e.g. to meet at a border junction for locomotive change (but hardly can both).

Regarding the terminals, the temporary loading station as demonstrated in Krauthausen is totally out of range and needs to be replaced by a small-sized regional terminal to improve regional access to intermodal transport. Concerning the Düsseldorf terminal, SWD has the opinion, that the traditional port transhipment facility at DCH, which was used during demonstration, is not sufficient for economical rail-road services due to the relatively long time (approx. 1 hour) needed to move the wagon groups to the port railway junction for departure. The rail operators are sceptical about this and state that many terminals have similar access conditions and yet considerable success. It is regarded as more important to improve the overall cycle times of rolling stock than to save one hour in the terminal.

Since the operational partners had the opinion that the demonstration proved the technical operational feasibility of the concept further emphasis was laid on developing a “commercial case”. This is also justified as it seems sufficient to show that once to get an impression of the problems, risks and bottlenecks which can however be solved in a later commercial operation.

When speaking about “problems” one should differentiate between problems the concept is going to solve or which occurred during the planning and the practical problems which appeared during the demonstration day itself. The “problems” have been structured according to the following points:

- General fringe conditions such as liberalisation
- Practical issues related to the implementation
- Problems occurred during demonstration

General fringe conditions such as liberalisation

When putting the IRIS concept into practice a couple of problems occurred, i.e. that general fringe conditions of intermodal transport were experienced in their actual impact.

Liberalisation of freight transport, opening of Eastern European countries and further rationalisation in road transport has led to a very low road transport price level. In the particular demonstration region also barge transport competes with rail for the non-time-critical cargo. As barges can use the river Rhine free of infrastructure charge due to the "Treaty of Mannheim" this can be seen as competitive advantage for this mode of transport.

Transport demand is changing very fast regarding volume, time and frequency. This requires for a flexible employment of transport capacity. Generally, this favours road transport with its relatively small units and overall availability.

Reformation of the rail market is showing first consequences. However, the old thinking and new business units (sometimes even companies) co-exist, which leads to "strange" situations of internal competition. In consequence, the traditional co-operation in intermodal transport has been replaced by business relations in which each partner/unit is trying to define his "added value" and is negotiating for his "part of the cake". In fact there was no intermodal integrator for the BEDENL-trial who would have been able to subcontract all components, bundle them and transform them into an offer for potential clients.

Liberalisation of the railway institutional and legal framework progresses with different schedules in the European Member States: A quite open network in Germany is confronted with a moderate situation in Belgium.[3] Severe historical differences between the countries and railways regarding e.g. track accessibility, slot allocation and pricing as well as technical conditions remain.

Practical issues related to the implementation

With respect to the BEDENL-Project some other practical issues were critical.

According to MBZ the nominal Bill of Lading indicates "Antwerp" as transit port although vessels are physically departing or entering at Zeebrugge. That causes additional trans-shipment and transfer between the two ports which could be avoided by dedicated or at least group trains to and from Zeebrugge. A group train was chosen for the demonstration day, even though IFB operates a series of shuttle trains per day between Antwerp and Zeebrugge on a distance of only 143 km with good success.

The Deutsche Bahn strategy to "concentrate on major terminals" result in the closing of regional terminals (e.g. Aachen-West and Düsseldorf-Bilk) so that some regions (Aachen/Düren) are confronted with the situation of having no direct access to intermodal transport any more. If no regional companies can be found which operate the old terminals, new and smaller or more flexible loading points have to be developed. In both regions this is the case. In Düsseldorf the new terminal is subject to government financial support (pending) and in Düren the new terminal is in the planning phase. However, it was possible to find a flexible solution by using a temporary loading place for the demonstration.

In conjunction with the "concentration" the operational network is also reduced to fewer but better – in terms of time window and quality - services from terminal to terminal. Smaller

[3] In Belgium "third party" requests have to pass B-Cargo and the network department of SNCB (B-Reseau) to the Transport Ministry which then decides whether to grant permission to use the Belgian rail network.

terminals and sidings are not served at conditions that good and the number of “open” trains is reduced steadily. Open trains offer transport capacity for more than one operator. The BEDENL-Demonstration was able to benefit from such an open train which was filled by co-loading of the two IRIS feeder trains by 266%.[4]

As a consequence of the railway liberalisation track access will become possible for all rail transport operators. Unfortunately, the directive says nothing about “price-finding-mechanisms” so that smaller railways are discriminated against by the price and conditions of use. In the BEDENL-case the highest fee for single use had to be paid. This is reasonable and could only be compensated by sufficient cargo on the train. However, the barrier of slot allocation must be solved to facilitate real competition on rail infrastructure.

In order to ease European rail transport so called “Freightways” are under consideration. In our case the technical-operational conditions at the German-Belgian border remain the same and necessitate the change of locomotive. This can take place at Montzen (B) or Aachen-West (D). Only some Diesel engines of the two state railways are prepared for that section. In any case B-Cargo tariff or price regime ends in Montzen, so that DB has to be asked for the Montzen-Aachen section, too.

Technical solutions which overcome such requirements as well as other innovations – e.g. the new transhipment terminal TTD in Düsseldorf – require huge investment and thus have long realisation periods. The BEDENL-demonstrator therefore focused on existing and available technologies. In case of the loading at Düren-Krauthausen the price paid for the handling is not acceptable for longer operational periods and another terminal would be necessary for commercial service.

Customers demand alternative transport routes. Requested for actual loads for the demonstration, resistance to change logistics, transport contracts or just behaviour was experienced. In order to acquire load for the “demonstration train” a series of intensive discussions to rail-minded people were necessary. However, difficulties in getting commitment for the number of ITUs needed before a commercial activity can be established remains valid.

Two further issues became obvious: First road sets benchmark in terms of (low) price and transport time. While the set up of the demonstrator it was not possible for the partners to reach the road set price level. In order to compensate for the extra-costs of the demonstration, the transport needed to be subsidised.

Secondly, in the whole process of setting up the train the lack of an intermodal integrator defined as an institution that is able to realise customers needs by offering an overall door-to-door intermodal service, was seen. All activities which can not be performed by the integrator himself are sub-contracted and according to the one-stop-shop principle only one product is offered to the client. In the BEDENL-case integration was achieved by moderation of different players internal and external to the BEDENL partners.

[4] The Cologne section consisted of 3 wagons with 6 ITU and 8 wagons with 15 ITU were added by the BEDENL-Partners.

Problems occurred during demonstration

The demonstration day itself was executed according to the planned schedule. Problems occurred during the loading at the interim loading place in Düren as

- the DKB-owned locomotive was not available,
- the DB-Cargo train was delayed and
- co-ordination problems between DKB and DB Cargo staff occurred during the coupling at Düren station.

The intervention of the responsible operator solved the problem that arose from the mobile crane which was not suited to tranship a loaded ISO-container onto the wagon and which had no auxiliary tools (fix spreader, frame, chains). Although the aim was to demonstrate the role of a regional railway, the new DKB locomotive could not be made available for the demonstration because permission to run on public networks at operational speed is still pending so that a DB Cargo unit had to be hired for the day. The existing DB-Cargo train TEC 42174 was delayed on the demonstration day because priority was given to a delayed passenger train running on the same line track. Finally, DB cargo demanded to assemble trains in Düren with their own train locomotive but with shunting personnel of DKB. Since it was not clear who had the leading role during the shunting process about 15 minutes further delay were caused on the demonstration day.

4.1.3.1 Commercial evaluation

Situation without the demonstrator

The market penetration of the rail mode in the market segment of short and medium border crossing distances is almost not existing with respect to intermodal transportation. Truck transport has a dominant role in this market segment, because of its flexibility and because of cost factors. Currently, the existing trains are not used optimally and not loaded up to their full capacity. For example the existing DB-/B-Cargo train Cologne - Zeebrugge usually is loaded with only 25% of its 1200 tonnes capacity.

On the link Zeebrugge – Germany the road network is quite congested (ring of Antwerp, ring of Brussels, Aachen-Düren, approach to Düsseldorf). Inland navigation transport of containers is limited due to a lack of direct waterway connections (the quickest route allowing for larger barges is via Rotterdam using the Rhine). Therefore there are possibilities on the railway side. There are good railway connections with Zeebrugge, which have the capacity to handle large quantities of containers.

In the figures below, three reference cases show the transport alternatives to the demonstrator. The reference cases serve to evaluate the demonstrator case on the aspects of costs and time. The three reference cases are defined as follows:

1. Reference case 1: Transporting containers from the port of Zeebrugge to the German hinterland (in this case the area between roughly speaking Aachen-Köln-Düsseldorf) entirely by truck.

2. Reference case 2: Main haul by train shuttle from Zeebrugge to Bressoux with end haulage by truck.

3. Reference case 3: Main haul from Zeebrugge to Düsseldorf by barge with end haulage by truck.

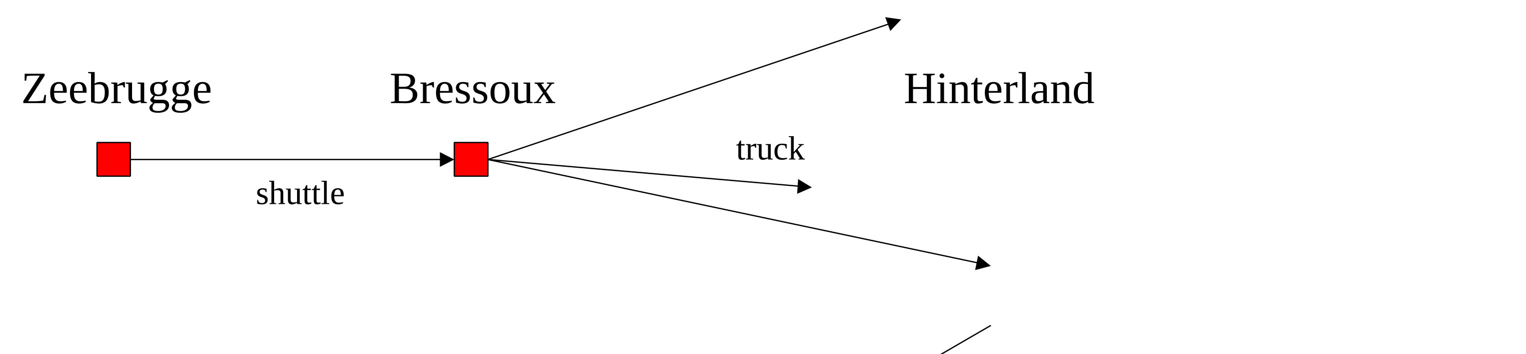
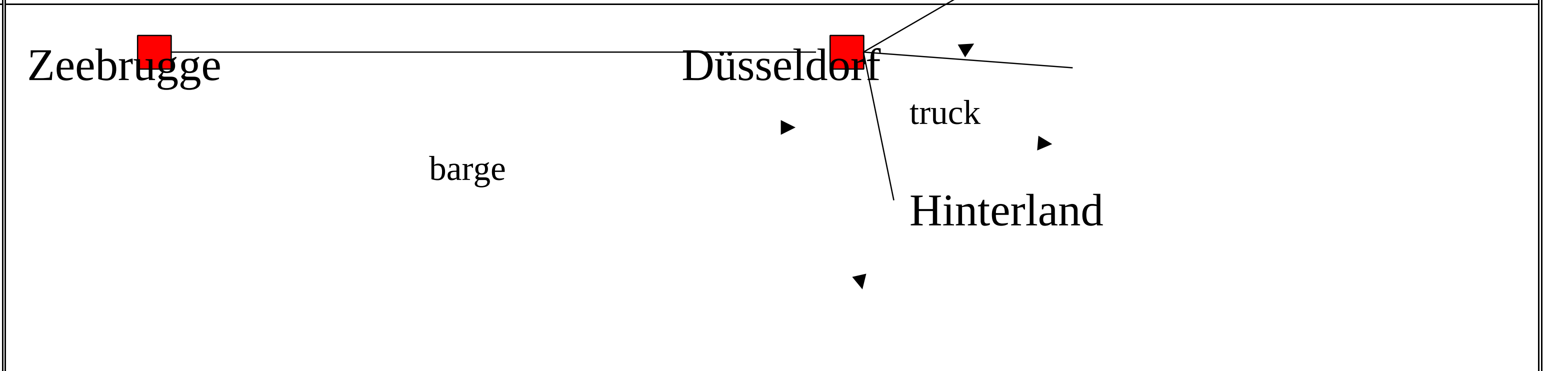
Reference case 1	
Reference case 2	
Reference case 3	

Table 4.1/3 : BEDENL reference cases

Delivery performance

During the demonstration – of course – 100% of the cargo was delivered to customer's expectations. No containers were delivered with delay. The reliability of container delivery on the rail reference case 2 shows that on average, 1 on every 10 containers (in the relation Zeebrugge – Bressoux) is delivered with delay at the customers destination. The average delay per delayed container is 24 hours. Statistics on the number of delayed containers by road are not available, a comparison with the reference case situation is difficult. Port of Zeebrugge claim that normally their road gates have good accessibility. According to the port authority on average (for all transport modalities), 1 on every 300 containers is delivered with delay at the customer's destination. The average delay per delayed container is also 24 hours. In order to calculate the delay of an intermodal service the time window door-to-terminal has been defined and the delay (with a margin) should be recorded over a couple of days, weeks or even months.

Occupation rate performance

The overall increase of utilisation during the demonstrator on the section between Düren and Zeebrugge is 266%. This is a quite substantial increase in occupation rate, resulting from a very low occupation rate of the existing train service. The prevented number of main haulage truck cycles replaced by the demonstrator was 20. The service, which is derived from that experience, would be capable to replace about 20.000 lorry cycles per year or 64 Mio tkm[5].

Transport time performance

The whole journey of the demonstration lasted 1440 minutes compared to an estimated road time of 360 (Düren) and 420 (Düsseldorf) minutes, whereas the demonstrator concept leads to 840 minutes as transport time door-to-terminal for both regions. This is identical to the current Bressoux transport times (reference case 2), despite the fact that the Bressoux case composes of longer and thus less reliable road transport.

4.1.3.2 Financial performance

This paragraph covers both the main cost elements of the demonstration itself, and a comparison of transport costs per ITU between the reference cases and the IRIS demonstrator case.

Cost elements of the demonstration

Significant cost drivers in the demonstration were the track and traction costs of German railways (DB AG) which seemed to be unreasonably high for such a short section. However, they had to be paid and were subject to lengthy discussions, trying to exploit the beneficial role a regional railway could have to bring down these costs. Another cost driver has been the incredible high transhipments costs for the intermediate place at Krauthausen, which

[5] Basis: 28 wagon x 3 TEU x 66% capacity use x 1,5 TEU/ITU = 40 ITU train; 40 lorries x 2 directions x 252 days per year = 20.160 lorry trips per year: 20.160 lorry trips x 290 km = 5,8 Mio km x 11 t per ITU (loaded and empty) = 64 Mio tkm per year.

could easily be avoided by using a purpose built small sized intermodal terminal for the region as it is planned.

Finance costs do occur for the owner of equipment. In case of intermodal transport a complex mixture of investment, funding, leasing and other issues are influencing the final market “price”. In the demonstration no direct finance costs occurred since no equipment was purpose built for the demonstration by one of the partners.

The manpower costs were similar to the reference cases since it was not an option to operate with “lower than tariffs” costs for the highly qualified staff. A reduction can indeed be achieved by improving the schedule and train assembly procedures. Improving the schedule means to rationalise the train schedule and optimise the turn round times of rolling stock and by that reduce the time in which loc and driver remain idle. Another “cost saver” is to simplify the train shunting and assembly procedures – while respecting the safety regulations – by using a driver who also acts as shunter rather than working with two or more specific workers.

For the demonstration, transhipment was funded by the ports of Düsseldorf and Zeebrugge, the traction was hired at DB Cargo by DKB, the wagon were provided by B-Cargo. All other equipment was hired.

Due to the low rate of finance costs there were no failure costs involved in the demonstration. For intermodal transport, the risks of finance are however a major element in the decision to provide an intermodal transport service and in particular to decide on terminal investment.

4.1.4 Approach for commercialisation

Demonstrator revised concept

The test site leader has made a comparison of costs between reference cases and the BEDENL offer. There is little value in evaluating the actual cost of the demonstrator, which faced unusually high transhipment costs and infrastructure charges because of its exemplary character. A commercial train offer operating on a regular basis would probably be able to negotiate much more favourable rates. Therefore, it was decided to compare the transport costs per ITU for each reference case with the estimated costs of a commercially viable BEDENL concept. Because of this, there is of course an interrelationship between the financial evaluation and the commercial exploitation calculations. The calculation needs to take into account several assumptions regarding costs, prices and time required; a real “commercialisation” is therefore depending on the mutual understanding of these assumptions and an agreement of the operational parties on at least the basic elements, their ratio and the final “price”.[6]

[6] This methodology of adding-up part costs – of different sources – can – of course – not replace market behaviour of operational parties and their business transactions. In reality business strategies, particularities of cost accounting and a couple of other factors are influencing the final or market price. However, the BEDENL operating partners actively contributed to and finally agreed upon the assumptions made.

All calculations are in full cost and not in marginal cost, as marginal costs are hard to isolate. Still, it can be expected that if only the marginal costs would be taken into account, the outcome would be more favourable for the commercial demonstrator concept's feasibility.

The cost components of the calculation include the following:

- pre- and on-carriage by road
- transhipment including port fees
- wagon, and rail inspection
- move to main line
- main-line haulage including track and traction
- overall management fees.

The price indications on the handling charges in Germany are "normally accepted market prices" for small to medium rail – road terminals. In order to achieve these prices, the terminal owners/investors demand the necessity to receive state subsidy as a contribution to the infrastructure development costs.

For the joint IRIS train schedule the following configuration has been calculated: a standard night jump of two train formations which are remaining to be unloaded and reloaded in either terminal throughout the day. The actual choice of the transport mode depends on a variety of factors, cost and time normally being the crucial ones. A model calculation considers only the transport costs for the described alternatives, although knowing that alteration of the time and moreover the "quality of service" is worth to be regarded, too. The detailed assumptions can be found in Annex 1.

The transport cost calculations is set up according to the following steps:

1. Description of the alternatives in terms of combinations of transport modes (see below).
2. Assessment of the cost elements that apply to the alternatives. The cost elements have been mentioned above.
3. Assumptions on the value that each cost element has. The value might be fixed or dependent on the alternative.
4. As a last step, the values of each cost element are summed up for each alternative. This gives the total costs per alternative. For the sake of comparison, each alternative is indexed, taking the pure truck transport alternative as a reference (Index = 100).

The following table and figure show the result of the comparison. The model assumes that Düsseldorfer Container Hafen (DCH) offers barge services to Zeebrugge, the new Transterminal Düsseldorf (TTD) is built as a new facility sitting close to the main railway line and using the Mannesmann crane which is called “Transmann” and finally that also in Düren a real terminal (“Ubf Düren”) comes into operation and offers market prices and service.

In case of Düren/Aachen

- a pure truck transport (Reference case 1, #1 in table 3.1),
- an intermodal transport rail/road via the existing IFB-terminal at Bressoux (Reference case number 2, #2) and
- the intermodal transport via the planned terminal at Düren (#3)

can be compared.

In case of Düsseldorf

- a pure truck transport (#4)
- an intermodal transport barge/road via the existing DCH port terminal (Reference case 3, #5) and
- the intermodal transport rail/road via the planned “Transterminal” (#6)

can be compared.

Finally, the IRIS concept of a combined intermodal offer from Düsseldorf via Düren to Zeebrugge similar to the already performed demonstration day schedule can be calculated in order to compete to the other services (#7). In this case freight originating in Düsseldorf TTD terminal and the Düren terminal is merged by means of feeder trains operated by DKB.

In order to favour intermodal transport the calculation is done for an average train of 40 ITU. According to previous information a 40 ITU train can not be filled by neither Düren nor Düsseldorf alone, so hat they jointly contribute with 40 ITU to the IRIS Concept train (row #7) whereas their share of the costs is generated by only 20 ITU each (rows # 3 and #6).[7] This would mean a win-win situation for both terminals, since it would still allow them to offer an intermodal service, even with their relatively small cargo potential, by simply splitting the costs of a 40 ITU intermodal offer.

[7] This model disregards from the third train section (Cologne – Zeebrugge) which we have had during the demonstration day, since the open train was terminated by the operator.

	Export Düren/Aachen – Zeebrugge				Export Düsseldorf - Zeebrugge			
	#1 Truck	#2 via Bress-oux	#3 via "Ubf Düren"	#7 via IRIS "Düren"	#4 Truck	#5 Via Port/ Barge	#6 via "TTD"	#7 via IRIS "TTD"
Pre-Haulage	23.4	Incl	35.1	35.1	33.4	33.4	33.4	33.4
Terminal(s)	2.3	2.3	7.0	7.0	2.0	18.2	10.0	10.0
Main Haulage	74.3	Incl.	47.6	27.0	64.6	14.3	53.4	33.1
Management Fee	Incl.	Incl.	9.0	6.9	Incl.	6.6	9.7	7.7
Variation of Barge Price	-	-	-	-	-	23.3	-	-
All-in Price	-	77.3	-	-	-	-	-	-
Total	100.0	79.6	98.7	76.0	100.0	95.8	106.5	84.2

Table 4.1/4: Comparison of cost for different operational concepts in the BEDENL-region

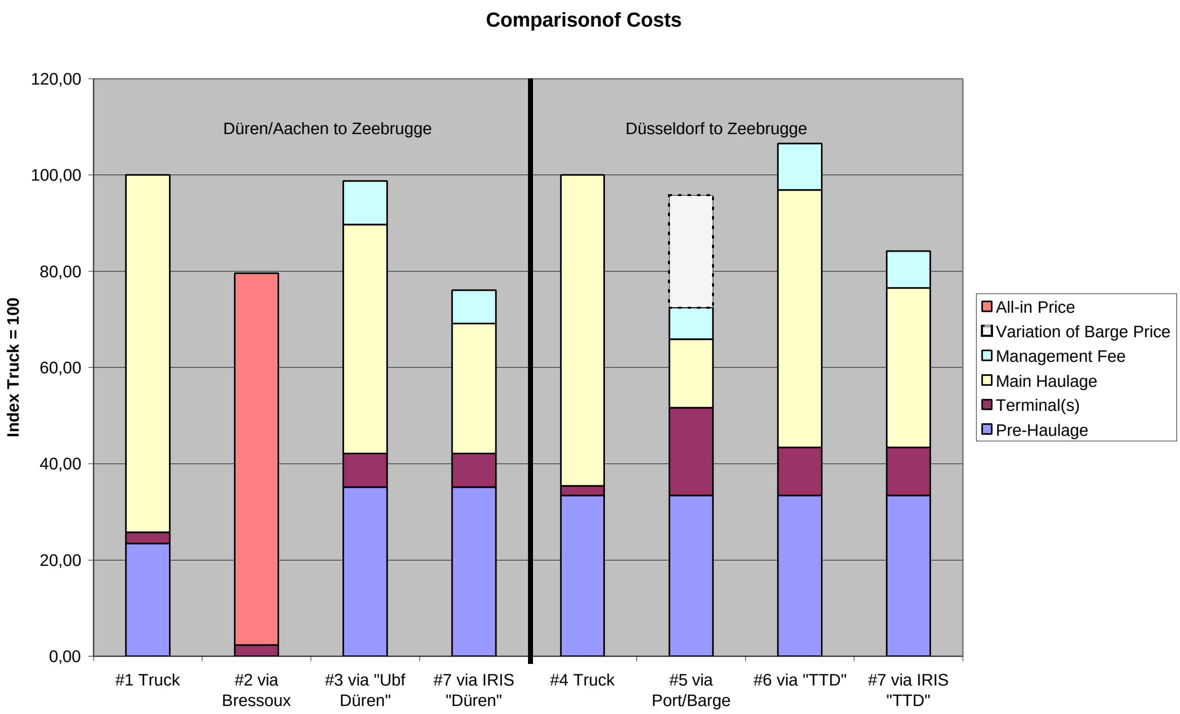


Figure 4.1/11: Comparison of Cost for Different Operational Concepts in the BEDENL-region

A result of the model calculation, is that the existing services “via Bressoux” from Düren/Aachen to Zeebrugge and “via Port/ Barge” from Düsseldorf to Zebrugge are cheaper than road transport (“Truck”) in both cases, in particular if the lower – and more realistic - barge rate is used. Dedicated but short trains from either Düren or Düsseldorf are more expensive. Considerable savings can be achieved with the merged volumes of the two sites which are transported by the IRIS-Feeder Concept and which can then compete with pure road transport in terms of price. This clearly shows the win-win-situation of the two terminals involved if their assumed volume is merged for a considerable part of the journey.

Customer reaction on the revised concept

Besides the direct reaction of the customers in supporting the BEDENL demonstration with their load and the positive reaction of the experts which attended the demonstration day, a stated preference analysis was carried out to test the market acceptance of a “commercialised” product.

A stated preference analysis is an appropriate tool to test the market acceptance of a theoretical but realistic offer; a couple of reference cases were outlined and the resulting time and cost indications displayed in a transparent sketch (see figure below) which was explained to the potential clients.

The figure shows the resulting time frame for each of the regions and transport modes, e.g. Truck day A 18:00 to day B 1:00 and overall price for one export cycle, e.g. 250 Euro. [8] In case of TTD Düsseldorf using the IRIS-Concept two time/price variants are given: a more expensive night jump relation (Day A-B) and a cheaper day A-C service. The differences are one day or 15.40 Euro.

[8] Initially calculated prices have been converted from national currency into Euro.

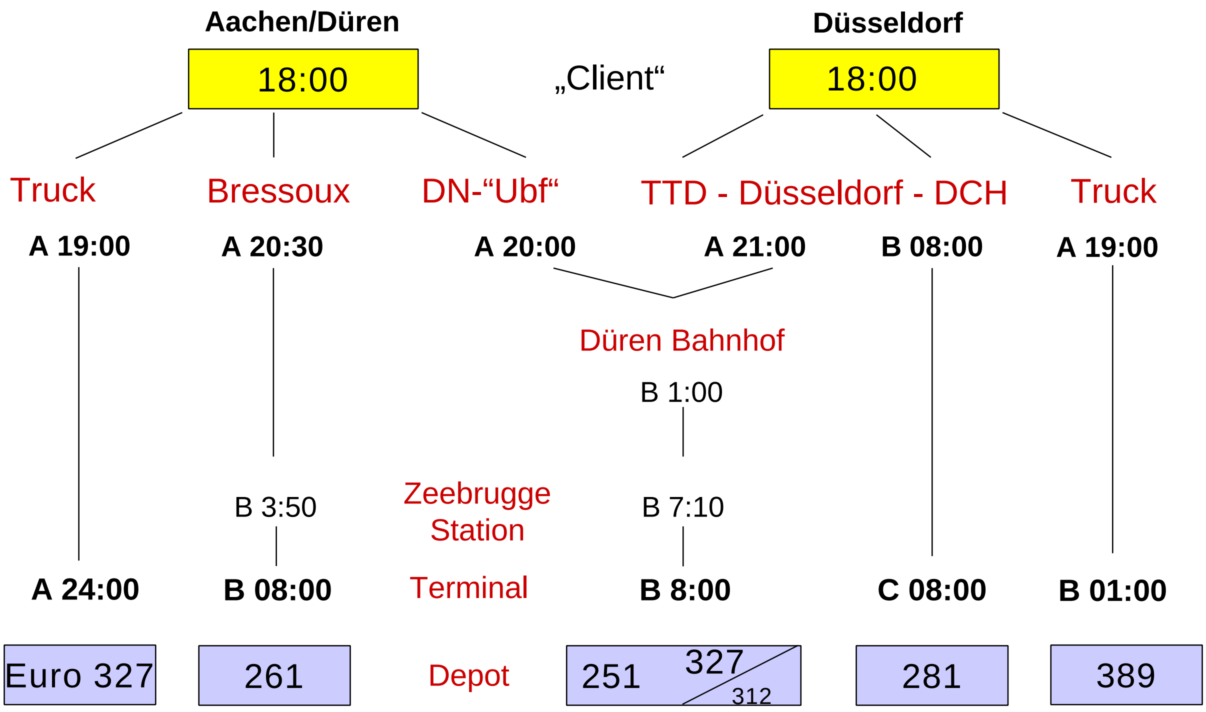


Figure 4.1/12: Alternative offers for Aachen/Düren and Düsseldorf to Zeebrugge (one way export)

The statement of the potential clients, e.g. shipper, road haulier or other stakeholder, on the most preferred, second choice and further alternatives gives a strong indication of the competitiveness of the new offer. Furthermore generic data on the transport decision are collected. The stated preference analysis was carried out to prove the commercial validity of the BEDENL demonstrator in order to complete the technical and operational feasibility of the demonstration.

The analysis was performed by MBZ, B-Cargo, IFB, SWD, DKB and SCI at each edge of the transport region namely the Port of Zeebrugge, Düsseldorf and Düren/Aachen for both import and export containers in October 2000.

For each of the customer interviews the following information exchange was considered (see next figure).

Expert Interview Sheet

1. Organisational issues:

Interviewer: MBZ, B-Cargo, IFB, SWD, DKB and SCI (please mark)

Interviewee:

____
Company Name:

____
Branch (e.g. shipper, forwarder, agent, transport operator)

____
Name and Function within Company

Date/Time: ______________

2. Explanation of BeDeNl-Concept and purpose of the interview

3. Explain Time/price alternatives for the region

4. Ask for priorities

		Time	Price [DEM]	Price [EUR]	Priority (1-2-3)
	Aachen/Düren				
	Truck	A19 - A24	640	327	
	Bressoux	A18 - B08	510	261	
	Düren	A18 - B08	490	251	
	Düsseldorf				
	Truck	A19 - B 01	760	389	
	Barge/Road (DCH)	A18 - C08	550	281	
	Rail/Road (TTD)	A18 - B08	640	327	
	Rail/Road (TTD)	A18 - C08	610	312	

5. Ask for additional information of company

____
Volume in tonnes or ITU in-bound/outbound per day, week, month or year

____
Number of ITU in relation via Antwerp/Zeebrugge per day

____
Potential for intermodal service in ITU/day

6. Thank you for the information

7. Signature

Fax back to SCI Cologne Office Fax-N° +49.221.931.7878 by 16.10.2000

Figure 4.1/13: Expert Interview Sheet (blank)

The interviews were carried out in the months of September/October 2000 and the following response was received:

For Düren region 26 answers were received: 13 favour road, 8 prefer the service via Bressoux and 3 would benefit from the IRIS-Concept.

In case of Düsseldorf 12 answers were collected: 8 prefer a service via Bressoux (although that alternative was not asked for in the questionnaire) and 4 see a clear advantage of the IRIS service composing of the TTD (day A-B-relation). Above that the interviews resulted in two global statements on transport intermodality .

It must be noted that the statements show a tendency but not a full representation of the market, which is – at least for the door-to-door services – segmented into many potential users, demands, relations and time windows, which must not necessarily be met by a daily train service. Nevertheless, the following result appeared:

- In intermodal transport B-Cargo does not sell to end clients like shippers or forwarders but to intermodal operators like IFB, ICF, TRW, TFGI, etc. They sell only full trains and not single ITU places. Capacity risk is carried by the operator. B-Cargo do not offer trains without request or order of an intermodal operator or other client in case of full-load traffic. Therefore they were not able to participate in the analysis themselves.

- MBZ replied on talks with deep-sea shipping lines Evergreen, Lloyd Triestino and SMA/CGM as well as Short sea operators ECS, P&O Ferrymasters, Dartline, P&O Northseaferries and IBF. They were generally interested to have regular (daily ...) services to ship containers to the hinterland but would prefer having the wagon on their terminal according to their ship arrivals/departures. The deep-sea operators do not have their hands on the full door-to-door transport chain and do therefore not control the hinterland services.[9] For the short-sea operators the additional "handling costs and larger transit times (of rail-road services) does not allow them today to ship intermodal equipment on the relative small distance on rail" to the West German regions. This seems to be reasonable because in case of short sea shipping and short hinterland connections there is no long-haul on which economies of scale could compensate the additional moves.
  However, none of the interviewees was able to indicate a number of containers or preference for one of the proposed transport cases ("commitments on volumes are never given").

- Three shipping lines who offer Zeebrugge relations were identified by SWD. K-Line would be interested in a service including pre-and on-carriage for day A-B- relations at a rate of about 327 Euro and would contribute with 5 ITU per week, scheduled to their ship departure in Zeebrugge. CMA appreciates a late departure from Düsseldorf and arrival according to their ship departure (on Wednesday). The contribution would be 15 ITU per week. Evergreen based on their existing traffic of 50 ITU per week would be interested in a weekly service to their ship departures. They expect only export via Zeebrugge because import is organised through Rotterdam. SWD resumes that above all only the new TTD – which was basis for the commercial case - would be able to serve these requirements. On the other hand the volumes are far from justifying a daily (5 days per week) service and the weekly service of the three operators is impossible to be harmonised, because their ships depart on different days and sometimes even earlier than scheduled.

- SCI/DKB reported on the Düren/Aachen region where 15 interviews were carried out and 12 replies could be achieved. These, mostly shippers, favour direct road transport due to flexibility and price ratio. Only two companies favoured a rail/road service with a terminal close to their facility, but claimed the need to serve Antwerp, too. Generally, on the level of individual companies in the region the stated intermodal traffic flows to and from the Belgian seaports are very small and irregular. However, they seem to be too small to justify an own daily (feeder) train.

[9] This was proven by SWD who found two different departments and billing principles in charge of deep-sea - and hinterland operations.

- IFB carried out 9 interviews for each region (in total 18 replies) with forwarding companies. Only one road haulier was positive for the TTD solution as a logistics service. All other favoured services via Bressoux – for both the Düren and Düsseldorf regions, due to several reasons. Among others the daily service to Antwerp and Zeebrugge, the existing and proven “competitive rates for both one-way and round-trip” were mentioned but also as the presence of shipping agents on the terminal.

Above all SWD argued that the cost accounting of shipping lines is not very transparent and that in particular the deep-sea and the hinterland service are calculated separately. The advantage of the BEDENL-service can therefore not really be valued by agents. It is also too theoretical to be judged by a practical expert who wants to “see” the terminal and train he is going to use.

Both IFB and B-Cargo argued that based on the stated volumes a dedicated service for each shipping line would not be commercially viable and that a weekly service is more expensive and less interesting than a daily train. The figures which have become known so far would not encourage an intermodal operator to buy a train and offer the service.

However SWD sees sufficient volume in their region and is interested in further market analysis. Nevertheless, due to the low volume of Düren/Aachen, the feeder train could not be offered at the calculated conditions which were based on 20 ITU per day in each region.

4.1.5 Evaluation results

Technical and operational

The initial aim of the BEDENL-demonstrator to demonstrate intermodal transport over short and medium distances has been fully met. Above all, it was possible to demonstrate what is feasible under the current framework conditions rail freight and the intermodal market has to face today.[10]

The BEDENL-Demonstrator succeeded in bringing together the relevant stakeholders including a regional and state rail operator for the operation of a complete intermodal transport chain using existing technology. By this approach the project monitored all the actual bottlenecks that occur when trying to establish new services to compete with road transport. The lesson learned by the participants in this demonstration is that there is still a long way to go before the financial but in particular the organisational and operational obstacles are tackled and a commercial product can be presented. Until a suitable solution for the concept demonstrated can be implemented the Terminal Bressoux will be an alternative for the operation of intermodal transport services over short and medium distances.

[10] The intention to manage and supervise the whole terminal-to-terminal chain through an Information and Communication System could not be performed since Intercontainer-Interfrigo (ICF), who possesses such a system, withdrew from the project. For demonstration day purposes communication through cellular phones was regarded to be sufficient.

In the Bressoux case railway operation is limited to Belgium and the SNCB networks, whereas the border crossing is done by truck.

For Düsseldorf there are two options:

- Exploit the road-barge option as obviously very cheap transport alternative,
- Co-operate with a closer port, e.g. Neuss, to exploit trains transiting by the Transterminal Düsseldorf aimed at.

Düren is currently trying to get an own loading place/intermodal terminal.

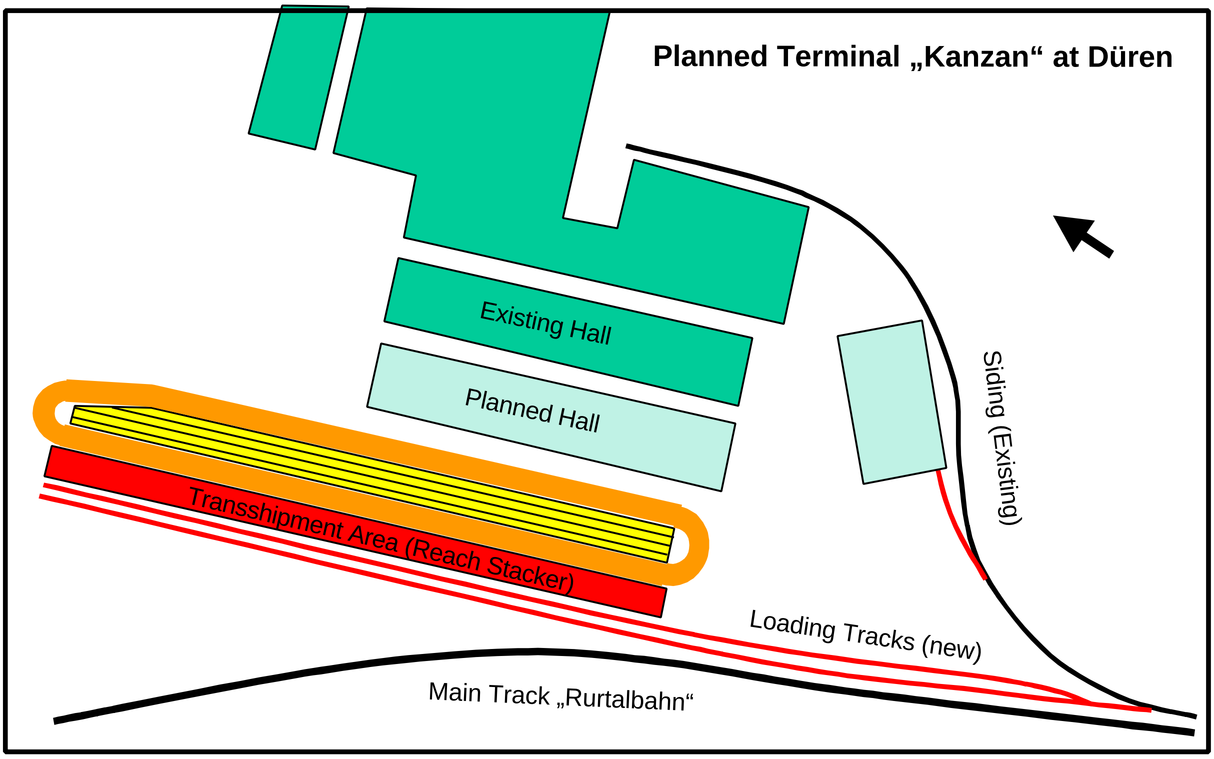


Figure 4.1/14: Planned Terminal “Kanzan” at Düren

One of the main outcomes of this demonstration are recommendations on how to use the infrastructure in a more optimal way in order to offer services that can help transfer freight from road to rail in congested areas if they have a high intermodal potential like the Ruhr and Benelux region.

Such recommendations with special emphasis on intermodal transport on short and medium distances are:

- Co-loading to merge cargo and share the fixed costs by a maximum number of ITU
- Clear definition of roles (duties and rights) of actors involved
- Concentration to a limited number of railways
- Professional body (forwarder, integrator or intermodal operator) to organise a whole integrated transport chain

- Small and cost effective terminals operated flexibly also for small volumes
- Harmonised infrastructure access rules and equal conditions for users

These actions might have an important impact on the freight transport efficiency and the congestion problems in Europe.

Commercial

The BEDENL demonstrator, containing a new intermodal transport concept for cross-border transport, was developed in an environment with a high level of driving forces in terms of market power and with difficult technical and operational conditions due to (amongst others) the cross-border situation. The demonstration has shown that the concept is feasible from an operational and technical point of view.

The evaluation concluded that under specific circumstances, compared to other modes of transportation a financially attractive tariff could be offered. The service in terms of transit time, and reliability is considered as adequate for less time sensitive container cargoes. The main bottleneck in ensuring commercial success is however the access to enough cargo potential for offering a daily service. This can only be reached if a high train utilisation (on a daily basis) can be achieved. Therefore, other regions should be integrated into the demonstrator approach to create enough volume for a true hub and spoke system. Future follow-up of the BEDENL demonstrator is uncertain until more cargo potential can be found.

In case the efforts to secure enough cargo potential prove to be successful, the impact on short and medium distanced intermodal transport will be positive.

4.1.6 Site specific conclusions

The BEDENL Demonstration has shown that intermodal transport over short and medium distances is generally feasible. IFB services for instance, with a couple of weekly trains between Antwerp and Zeebrugge (143 km) and Zeebrugge/Antwerp and Bressoux are examples that fixed threshold distances for economically viable intermodal services.

However, it must be noted that port shuttles benefit from a tremendous volume of cargoes as well as deviations of stated (bill of lading) and physical call port, whereas the Bressoux connection benefits from its network integration and in particular its vicinity to the Belgian / German border, where border crossing is still easier by road than by rail. Based on data available for November 2000 16 containers per day are transported between Antwerp/Zeebrugge and several German relations via the rail-road terminal Bressoux. The German locations are widely spread from the Ruhr area, several towns at the Rhine and in particular Trier.

The concrete situation of the linked areas Zeebrugge and the Belgian/German and Dutch border region is a high but theoretical potential. The OSIRIS-Project derived a high potential of volume for the regions concerned by a prognosis based on statistical data. Confronted with small, specialised and irregular flows on the particular route between Düren/Aachen and Düsseldorf to/from the port of Zeebrugge the stated preference analysis resulted in only a few containers for the joint IRIS service which does not allow the operational partners to continue to offer a commercial service.

A continuation of any kind should address the need of stakeholders to co-ordinate the demand and to attract an intermodal operator who could then order a train if railway(s) will offer at a compatible price. In order to do so the intermodal operator will have to bear the risk that he will have to pay for track, wagon and locomotive independent of the number of ITUs on a particular train, whereas he is paid only for the actually transported containers. A proposal would be to share this risk with forwarders, shipping agents or intermodal terminals/ports which want to be a link in the chain. This would also help to overcome the lamented "chicken-and-egg" situation: no terminal - no load - no train - no terminal - ...

Another conclusion which could be drawn from the demonstration is related to the actors: the total price that can be achieved on a small distance does not justify the involvement of many partners with their multiple desires to earn money, in particular if also the interface and friction costs are considered. In fact, one should exploit the technical possibility of directly linking the two railways (Belgian and German) and eventually cross the border with one locomotive, which is technically equipped for both railway regimes (e.g. signalling, radio, ..)

In order to allow considerable cycle times for such a more expensive locomotive, short turn round times in the related terminals are necessary and justify the consideration of technically ambitious handling technologies. However, it is mandatory also for the terminals to respect the market needs. In particular the access to and the management of cargo volumes are decisive factors for intermodal services especially over short and medium distances.

4.2 Demonstrator II Italy

4.2.1 Demonstrator description

Concept overview

The Italian demonstration activity operates in the field of the electronic exchange of information and data, which is of particular importance in intermodal transport to make it more efficient and customer oriented. In particular it concerns the development of an "Information & Communication Platform (ICP)", that is an information and communication system for the exchange of structured EDI messages among the Italian demonstration partners involved in the project. A specific need to increase the efficiency of communication operations exists.

The Italian demonstrator aims to show the contribution of the telematic system integration to the improvement of the intermodal transport on short and medium distances through a better and more updated information supply on transport status and planning. Its objectives are:

- to increase the intermodal operation efficiency and reliability;
- to improve the quality of service to customers by more transparent and updated information;
- to improve the level of satisfaction of the users;
- to realise a better use of the yard capacity through a faster transfer of containers to the inland terminals.

The IRIS partners involved with the Italian demonstrator have been segmented in three groups. These are the Demonstration site leader (CSST), the information technology service provider (Sistemi e Telematica S.p.A, SET) and the users of EDI-communication, which are the terminals and multimodal transport operators Interporto Bologna S.p.A (INTBO), Voltri Container Terminal Europa S.p.A. (VTE), Italcontainer S.p.A. (ITALC) and Padova Container Service S.r.l (PCS). Other actors involved with the project are European and national authorities active with stimulation of intermodal transport and shippers as final customers of the intermodal operators.

Background of demonstrator

The main relationships considered in the demonstrator are those described in the figure below, among the seaport terminal of Genoa, the inland terminal of Bologna, the inland terminal of Padova and a Multimodal Transport Operator located in Milan. Before the demonstration, the partners in the intermodal transport system communicated among themselves using various traditional standards of communications and interfaces. The relationships between the partners are complex and there is a high number of messages/information exchanges on a daily basis. Messages are exchanged with traditional means (phone, fax, mail) and this way of communication is subject to certain deficiencies such as a long throughput time for information, a high number of mistakes, a redundancy in administrative activities, etc. These deficiencies are especially important in intermodal transport over short and medium distances, as in these cases the information flows are even more complex than for mono-modal transport and the timeliness of information is even more important.

Figure 4.2/1: Geographical setting of IT demonstrator

The geographical setting of the physical transport operations and the exchange of related transport data and information is shown in the picture above. The port of Genoa and the hinterland terminals in Bologna and Padova acting as hub for the regarded seaport hinterland operations. These locations as well as the head quarter of Italcontainer in Milan are linked to the ICP.

Goods and information flows

The structures involved in the physical goods handling are:

- two freight villages located in Bologna and Padova (i.e. structures where goods, usually containers, are brought by truck, discharged, stocked in yards and successively reloaded onto train, and vice-versa). An intermodal terminal is included in both of these Freight Villages.
- a sea-port container terminal located in Genova

The goods flow is described by the following points:

- ***export cycle***: the goods are collected in the surroundings of Bologna and Padova, and brought (already containerised) to Bologna and Padova inland ports; here they are loaded onto trains, and sent to Genova to be loaded onto vessels;

- ***import cycle***: the goods are discharged from the vessels in Genova, and then loaded onto the trains and sent to Bologna or Padova inland ports; here the trains are discharged and the goods are delivered to their final destination by truck.

In addition there is a container (or swap body) flow by train between the two inland terminals. These flows are graphically represented by the following figure:

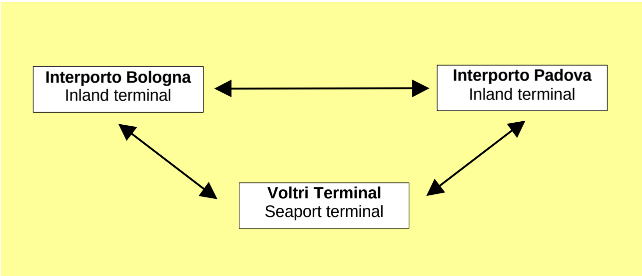


Figure 4.2/2: Goods Flows

Concerning the amount of containers moved, the following table describes the data related for the year 1998. The quantities are expressed in TEUs and are related to the movement of block trains. Some other containers are moved with local composite trains, but their number can be considered as negligible.

The rows show the origin while the columns represent the destination: e.g., 6121 TEUs were moved from Genova to Padova in 1998.

From/To	Genova	Padova	Bologna
Genova	-	6121	4433
Padova	20540	-	62
Bologna	777	290	-

Table 4.2/1: Origin/Destination Matrix (1998)

Due to the fact that the demonstrator is treating an information exchange problem, the flow of documents among the parties is a relevant question.

In the context of this project an "exchange of information" is an exchange of a set of structured or un-structured information (eg. fax.). Telephone calls for confirmation/inquiry and signed or stamped pieces of paper are not included in this definition. Signed/stamped pieces of paper must in any case be exchanged in order to respect the actual laws.

The base line information flow is (this is the present situation without demonstrator and the base line for the demonstration):

- ITALC headquarter should be informed about the train and traffic flow in order to ensure the tracking of the movements and to supervise billing activities.

- The communication between the two inland terminals is not relevant in the context of the present demonstrator, which is focused on the import and export via Genova.

Due to problems related to space availability and geographic constraints (particularly strong in the Genova region) sometimes the train is split into two or more parts at the destination, even when it is operated as a “block train”: for this reason, a detailed information about the actual container arrival is essential.

In this context:

- Italcontainer is responsible for the whole transport
- The Maritime Agency/Freight Forwarder decides to go intermodal
- The Maritime Agency/Freight Forwarder orders the transport
- Italcontainer, based on the requests, decides which train must be used
- PCS decides which place on the train must be used.

Stating this, the information flow among the partners involved can be summarised as follows:

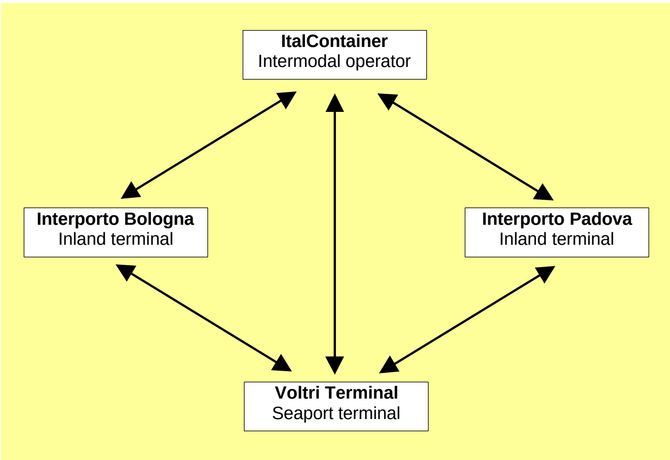


Figure 4.2/3: Flow of Documents or Information

Architecture and functionalities of the ICP

Taking into account the situation described above, a specific need to increase the efficiency of communication operations exists. In this context, an “Information & Communication Platform” which means an information and communication system for the exchange of structured EDIFACT messages among the demonstration partners involved, was implemented, demonstrated and evaluated within the Italian demonstrator.

EDIFACT messages were used as they show some specific aspect that improve considerably the way of exchanging information via the ICP. Reliability, flexibility, traceability and security are four important reasons for using EDIFACT standard messages. Anyway the ICP has some more important features for which EDIFACT messages has been chosen:

- the ICP is absolutely open. One can connect with it through internet or through a FTP file transfer. The first way is not recommended because you cannot certify that the message has been really transmitted. On the contrary, the FTP is a standard “de facto” and the certification is ensured. The “certification” aspect is an important issue (the Internet based systems don’t ensure certification; there is no real proof that the messages have been received).
- a second important aspect is that the ICP accepts both EDIFACT and other non-proprietary standards. Thanks to some conversion facilities other message formats can be translated into EDIFACT standard. This is an important step for achieving a higher performance in terms of more suitable services for those companies with low IT capabilities.
- The ICP has flexible and low cost

The type and description of the EDIFACT messages exchanged via the ICP are given later in this document. The system is also able to exchange structured non-EDIFACT messages by file transfer through an “Application”. In this case the users can communicate through flat file transfer.

To ameliorate the Italian demonstrator situation (described in Figure 3.2), an Information and Communication Platform (ICP) was designed. The ICP is an integrated EDI system which ensures the exchange of messages among the partners on a common basis. This is an important step towards improving the information flows in intermodal freight transport.

The figure below explains the general approach to the problem:

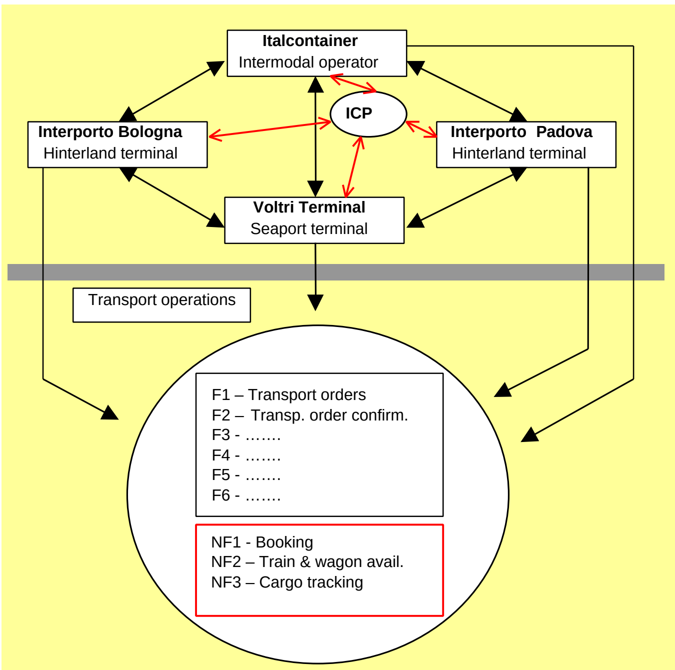


Figure 4.2/4: New Situation after the ICP Installation.

The light grey (red in colour version) arrows represent the situation after the ICP implementation (during the IRIS project), while the dark black arrows show the actual situation.

The designed system is integrated in an architecture where the information flows converge into the ICP and then diverge towards the actors: the four partners send messages to the centralised EDI system and take from it the information that they need. Therefore the ICP represents the gravity centre of the communication network.

Some main points must be outlined here:

- The designed system has a centralised architecture. It will be able to assemble information coming from each partner; this fact will allow to implement functions that otherwise would not be effectuated;
- The designed system has an open architecture. This is a crucial point as it provides the possibility for further companies to be linked to the ICP.
- Links to specific software applications for companies with smaller Information Technology capabilities are possible in the designed system.

EDIFACT systems for the exchange of information in the transport sector have existed for many years. The main innovative aspect of the Italian demonstrator is that a system gives the possibility to exchange structured EDIFACT messages also with those companies with low IT capabilities. This is a very important step towards the competitiveness of:

- the small-medium sized transport companies on the one hand;
- the intermodal transport on short and medium distance on the other hand.

Technologies and components Involved

The demonstration aims at introducing a central ICP (Information and Communication Platform), an integrated EDI system which ensures the exchange of messages among the partners on a common basis. This chapter describes the technical and operational aspects of the demonstrator.

Connections and Architecture of the ICP

Each end user (INTBO, VTE, ITALC, PCS) will be connected to a central platform (physically located in INTBO premises) which will, first of all, supply a 'store-and-forward' facility. The information exchanged will be structured data, i.e. no pseudo-EDI (e.g. printouts saved on disk, faxes run by PCs, etc.) will be allowed.

The connection with the ICP is based on standard communication protocol (TCP/IP), independent of the connection used (LAN or remote access). In the demonstration INTBO is connected through a LAN, while ITALC, VTE and PCS are connected through remote access via switched phone calls (“modem”).

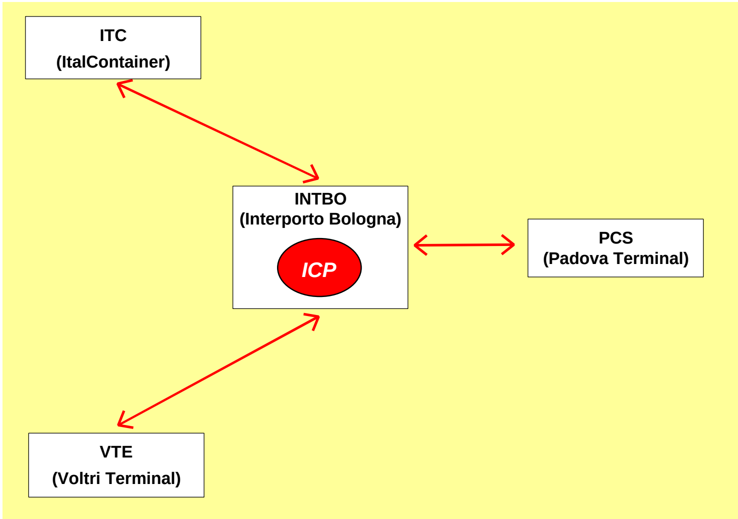


Figure 4.2/5: User Connection to ICP

Each partner is able to handle and distribute structured messages (the agreement on the structure and kind of message has been defined at an early stage of the IRIS project during the WP6.1 “Demonstrator preparation”).

This is realised in the following ways:

- ITALC uses its own proprietary IT system;
- PCS and INTBO use a Windows95-based application, realised by SeT, expressively designed to support the handling of structured documents and their EDI exchange with ICP;
- VTE mixes the two functions: some messages are handled with the above mentioned tool, and some others are handled directly with VTE’s proprietary system.

This implies that VTE and ITALC use specific software in order to extract/insert the data from/to their systems, or to manage some information actually not yet handled.

The data are exchanged using a standard EDIFACT format. The ICP platform includes a converter, called “Application”, which can be configured in order to support an 'any-to-any' translation, and can be run automatically whenever a message arrives at the system.

Each partner can decide whether to implement the conversion by himself, i.e. sending/re-ceiving the file in structured format (EDIFACT or flat file - e.g. the left envelope in the diagram), or to use the application given by the system to do this job (lower envelope).

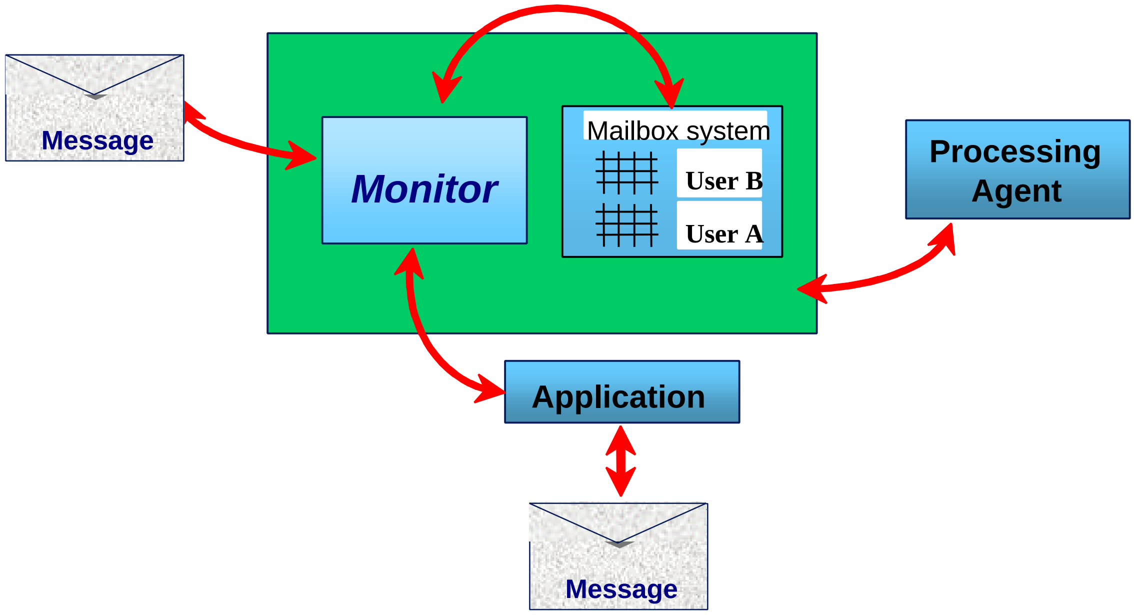


Figure 4.2/6: System Architecture

The system architecture is characterised by the fact that it is flexible. Companies with large as well as with small IT capabilities can be involved in the demonstrator and linked to the system. This way of operating is in particular relevant for small companies with no resources available to develop an own I&C system or to dramatically change their system.

The system is formed by the following components:

- a software, represented by the box "monitor", the mission of which is to manage the system and its functions,
- a mailbox system, i.e. a set of mailboxes (one for each user);
- a "processing agent" system: this is an internal application whose role it is to perform various operations during the transfer of a message from a user A to a user B (for example a data extraction from the message and the data input into a web site).
- an "application" system: it effectuates the format conversion of the messages (EDIFACT/ internal format and vice-versa) for those linked companies which do not support the EDI standard; it also provides a data entry routine.

The actual situation obtained after the implementation of the ICP is described by the following figure in which all the Italian companies which take part in the demonstration activities are represented.

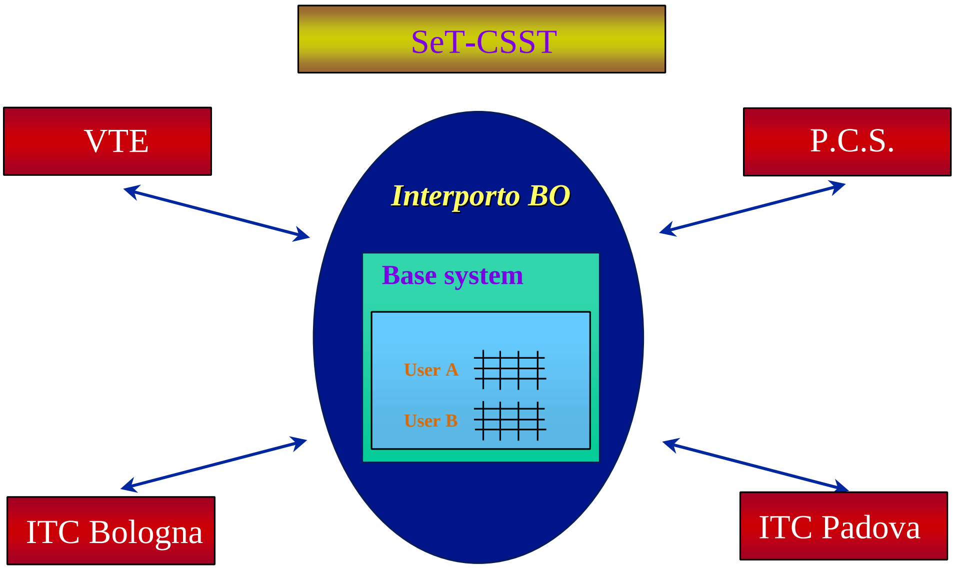


Figure 4.2/7: Situation after the ICP Installation

Distinction of the ICP to the CESAR approach

The main relevant aspect of the Italian demonstrator is that the ICP gives the possibility to exchange structured EDIFACT messages among all the partners involved even with those companies with low IT capabilities. This is a very important step towards the competitiveness of:

- the small-medium size transport (but not only) companies on the one hand;
- the intermodal transport on short and medium distance on the other hand.

The ICP covers the whole transport leg to and from seaports. Shipping lines on the “wet” side and road hauliers or shippers (logistics companies and producers) on the “dry” side are considered as “final” clients of the system. An example of this approach is the company CATBO, located inside the Bologna Freight Village, already linked to the system.

The overall objective of the CESAR project (CO-OPERATIVE EUROPEAN SYSTEM FOR ADVANCED INFORMATION REDISTRIBUTION) is the improvement of intermodal transport performances and quality, with a further view to attract more transport volume for intermodal transport and increase efficiency of transport in the European Union. The CESAR project established the basis of a common Internet based Standard interface for information and data exchange and distribution between combined transport operators on one European corridor. CEASR II is presently to open the first successful pilot system to other corridors.

The CESAR system provides information exchange mainly between different combined transport operators with links to road hauliers on the pre and end leg. Other partners active in the combined transport chain such as terminals, sea ports, railway infrastructure companies and railway undertakings (traction providers) are presently not connected to the system, but might be connected in the mutual interest of exchanging defined information, for example status messages.

Therefore, the relationship between the ICP and the CESAR system can be regarded as complementary. It will be a further research task to evaluate the possibilities to integrate the ICP with the CESAR system.

Transport chain

Within the following chapter the message exchange is divided in two scenarios: one for the export and one for the import cycle. Each flow is described in a diagram, representing the actors and the documents exchanged. In this diagram, letters indicate the time sequence of document exchange. The diagram is followed by a brief description for each message.

Export cycle

When a train is made, Italcontainer being the MTO (Multimodal transport operator) sends to the Interporto (A) a short notice containing the types and the amount of wagons to be used for this train. In the meantime, the carrier(s) (trucker(s), in this context), executes the transport of the containers as required by an agent or by the MTO (being responsible for the land based part of the transport). While the transports takes place, a copy (B) of the transport instructions is sent to the MTO, in order to give him the full details of the transport (with a particular regard to the container number, the correct ISO code and the exact gross weight).

When the MTO receives this information, and before the arrival of the container at the Interportos' gate, the MTO sends the consignment order (C) to the Interporto. This document allows the Interporto to download the container from the truck and to accept it.

While the containers arrive at Interporto premises, they are downloaded from the truck and uploaded on the wagons. This operation is constantly supervised by the Interporto, which sends the updated train consist to the MTO.

After all the containers are loaded the train is closed. The final train consist (D) is sent to the MTO which forwards it immediately to the Voltri terminal (E). The train start from the Interporto(s) is confirmed with the gate out message (F), sent to the MTO and to the Voltri terminal.

As far as the train arrives to Voltri terminal, the unloading operations take place. After its completion, i.e. when the Terminal can be sure of the real arrival of the containers, it sends a gate in message (G) to ITALC, in order to confirm that the unloading operations have occurred. The containers are now ready to be loaded on a ship.

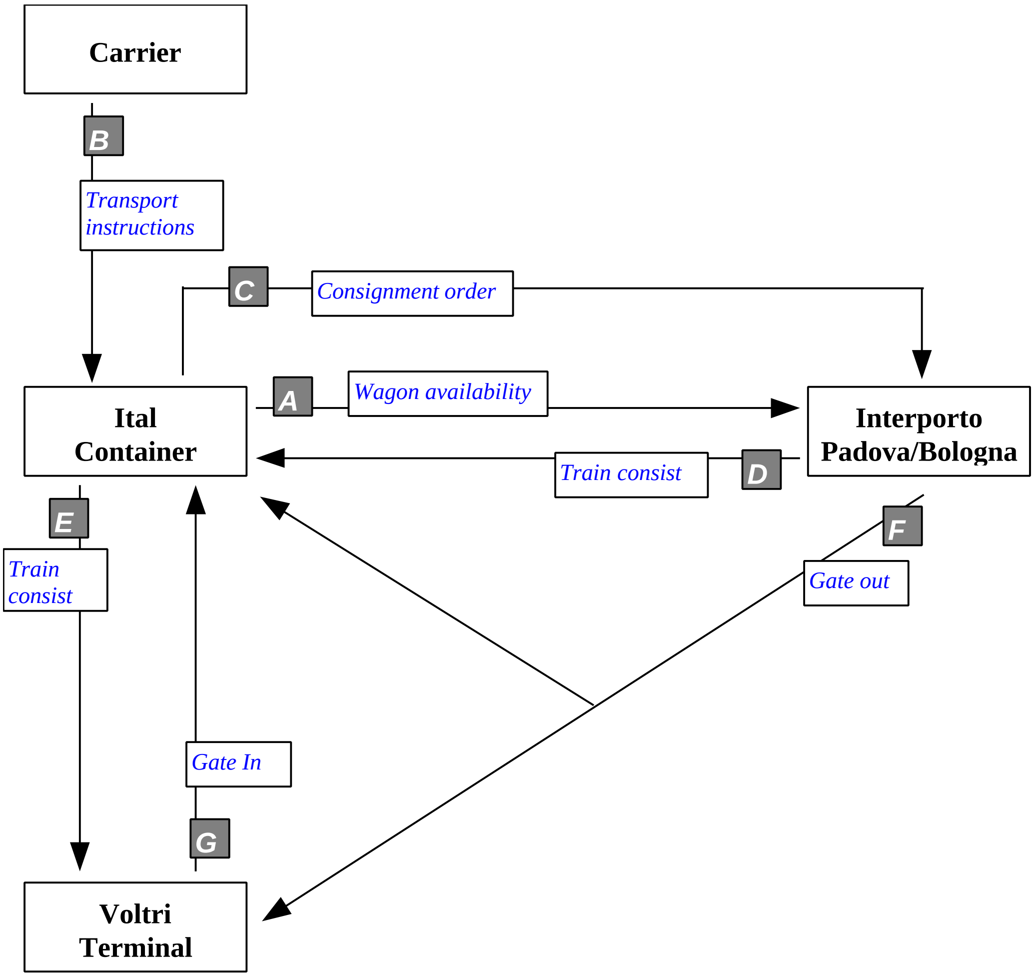


Figure 4.2/8: Export Flow Diagram

Flow description:

Seq.	Message	Content	Sender	Receiver
A	Wagon availability (EDIFACT code: IFTSAI)	Availability of or request for a certain amount of wagons, with the specific indications of type and quantity (FS should manage the empty wagon)	ITALC	Int
B	Transport instructions (IFTMIN)	Instruction for a specific transport of given containers, each reported in detail	Carrier(s)	ITALC
C	Consignment order (COPARN)	Permission to accept, and discharge from truck, a given container(s), described in detail, including the next destination (by train) and the ship where it is to be loaded. (* see comments at the end of the table)	ITALC	Int
D	Train consist (BAPLIE)	Full description of a train, including the list of all the wagons forming the train, each of them identified with its number – unique for each wagon -, and, for each wagon, the list of the containers carried by that wagon, with all the relevant data (id number, type, port of loading/discharge, ship of loading/discharge, etc)	Int	ITALC
E	Train consist (BAPLIE)	Same message as above	ITALC	VTE
F	Gate out (CODECO)	In this context, the notification that a certain train, fully described in a previous train consist message, has left the sender's premises	Int	VTE/ITALC
G	Gate in (CODECO)	The list of all the containers that arrived at sender's premises in a certain period of time (e.g. one day)	VTE	ITALC

Table 4.2/2: Message description for export cycle

ITALC is in charge to balance the transport orders of their clients and the availability of wagons. The Interporto fulfils the real shunting of available empty wagons to one train and the transhipment of arriving containers onto that particular wagon. It finally confirms that the job was done (train consist).

Import

The train is handled and created by Voltri terminal, which decides upon the wagons and the containers to be loaded on them (according to the instructions received by its partners). Once the train is completed and loaded the train consist (A) is sent to Italcontainer.

Italcontainer as the MTO forwards (B) the document to the Interporto, which will have to unload the train: this document is used also as an unloading order. In order to confirm the start of the train, Voltri terminal sends a gate-out message (C). The dispatching is (approximately) contemporary with the train start from Voltri terminal.

As soon as the train arrives, the unloading operations take place. After its completion, i.e. when the Interporto can be sure of the real arrival of the containers, it sends a gate in message (D) to Italcontainer, in order to confirm that the unloading operations have occurred.

The containers are then ready to be consigned to final destination, usually with a truck.

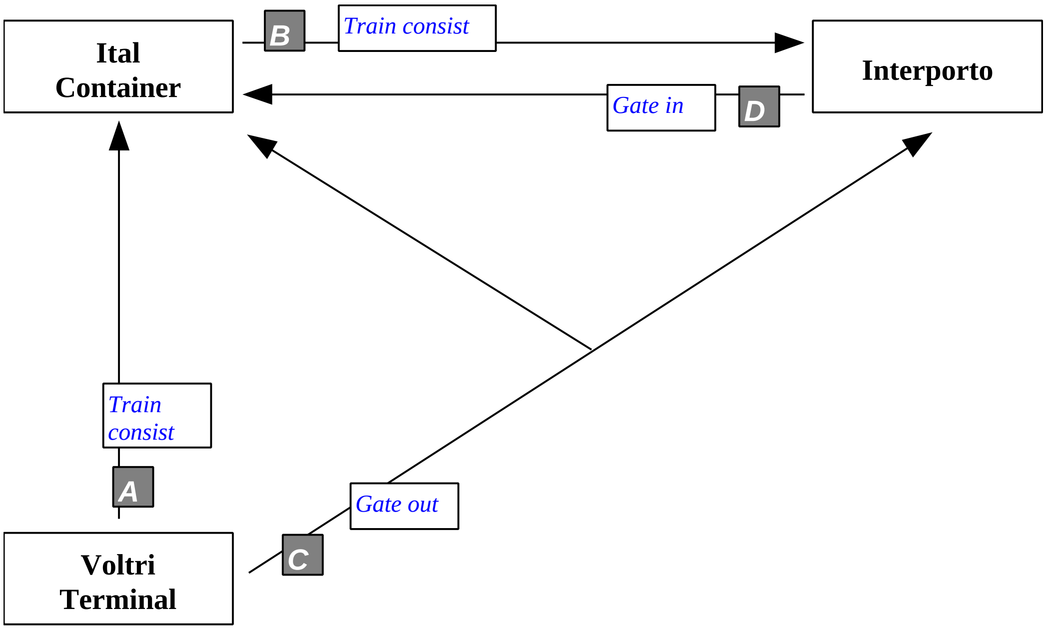


Figure 4.2/9: Import Flow Diagram

Flow description:

Seq.	*Message*	*Content*	*Sender*	*Receiver*
A	Train consist (EDIFACT code: BAPLIE)	Full description of a train, including the list of all the wagons forming the train, each of them identified with its number - unique for each wagon -, and, for each wagon, the list of the containers carried by that wagon, with all the relevant data (id number, type, port of loading/discharge, ship of loading/discharge, etc)	VTE	ITALC
B	Train consist (BAPLIE)	Same message as above	ITALC	INTBO
C	Gate out (CODECO)	In this context, the notification that a certain train, fully described in a previous train consist message, has left the sender's premises	VTE	INTBO / ITALC
D	Gate in (CODECO)	The list of all the containers that (actually) arrived at sender's premises in a certain period of time (e.g. one day or one shift).	INTBO	ITALC

Table 4.2/3: Message description import cycle

4.2.2 Demonstration activities

Layout of the demonstrator

The graphical interface (see the masks below) is the same for each user. This latter can introduce the data through this interface manually, just filling in the electronic forms, directly transferring data from paper format to electronic format. Although the ICP offer this manual facility, one of the main features of the ICP is that it has a direct electronic interface with the information systems of the users. It is therefore possible to import electronic data from these information systems without manual operations. At the time being, VTE and PCS use only the electronic import functionality, while ITALC use both manual and electronic data input functionality.

Thanks to this flexibility new potential users can continue using their own information systems. This aspect seems quite important and is coherent with the philosophy of the entire Italian demonstration, which intends to provide the access to transport data/message exchange facilities at low costs also to those companies with low IT capability.

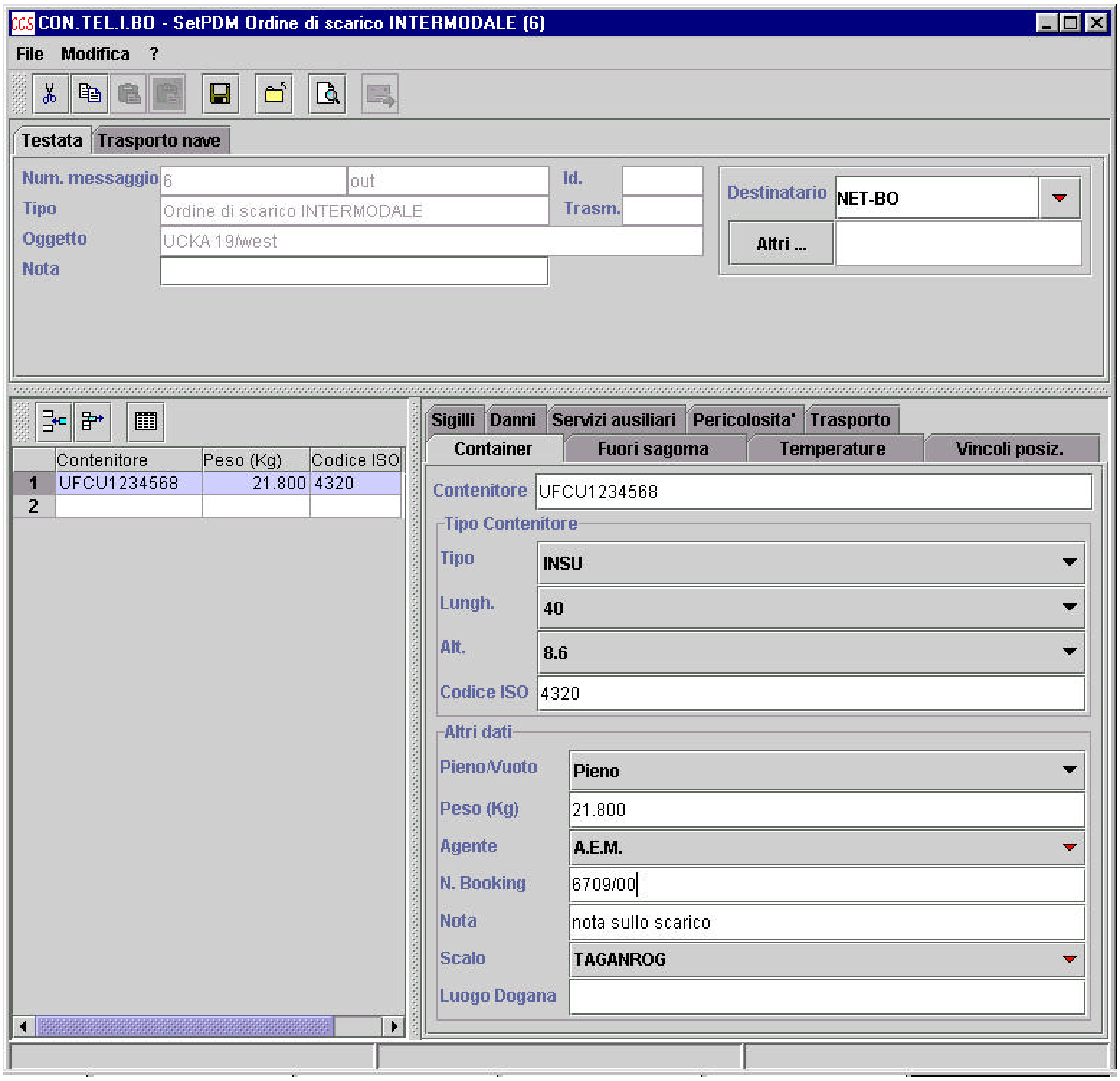


Figure 4.2/10: Consignment Order

Figure 4.2/10 represents a screen shot appearing on the computer of a user when a "consignment order" ("Ordine di scarico intermodale") message is exchanged. This document is the order to unload a container (or more) from a truck that is going to arrive; the container is described in detail, including the next destination (by train) and the ship where it will be loaded, e.g. container code UFCU1234568 in our example.

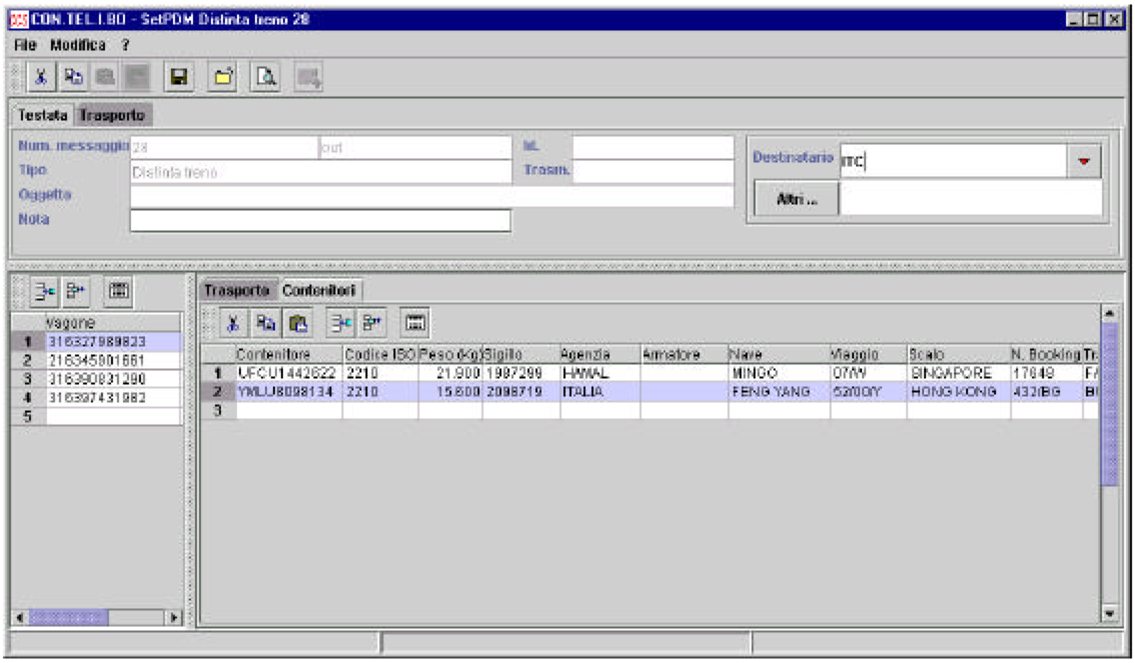


Figure 4.2/11: Train Consist

Figure 4.2/11 refers to the "Train Consist" message ("Distinta treno"), that is the full description of a train, including the list of all the wagons forming the train, each identified with its number - unique for each wagon -, and, for each wagon, the list of the containers carried by that wagon, with all the relevant data (ID number, type, weight, ship of loading/discharge, port of loading/discharge, etc), e.g. the first wagon number 316327989823 carries two 20' containers, one for Singapore and the other for Hong Kong.

Finally, Figure 4.2/12 represents an example of the mailbox system, with some mailboxes opened to show the contents of the folders. The tool which offers this view is the one reserved to the system administration, in order to manage the entire system: on the screen, some messages have been logically deleted (the ones marked with a tag), so that the final user will not be able to see them.

When filling the masks or the database behind them, the user is assisted. There is mandatory and optional information to be entered. The software checks the information typed into the system: e.g. accepting only figures for length and no letters or using the check digit of a container ID number.

Two different ways of checking the information are included in the system:

- for the un-structured data entry (through the "application") the system checks the information typed into the system type and the number of characters, obligatory fields etc.;
- for the structured data the system checks the formal aspect of the messages and, if an error occurs, sends out an error message.

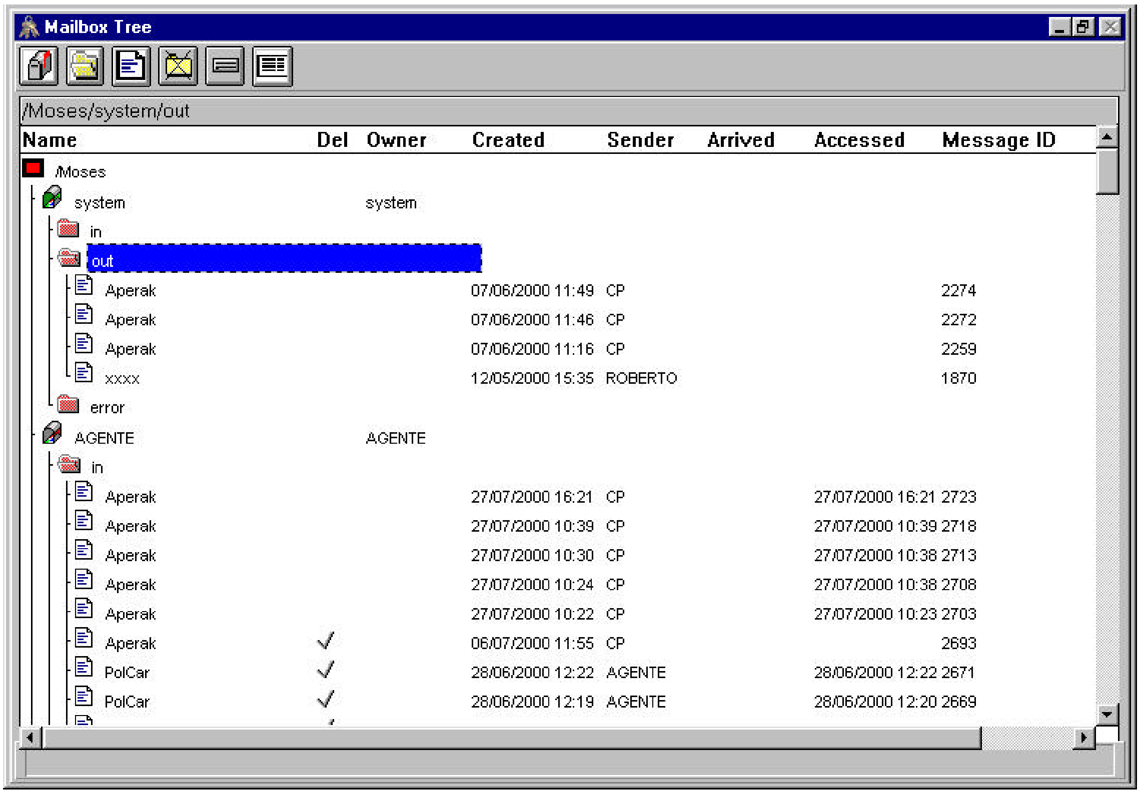


Figure 4.2/12: Mailbox System

Demonstration day

In the Italian demonstrator the system operation is continuously, because all messages (EDI and manual messages) are exchanged every day. Thus, in this case the partners receive and send messages continuously.

Intermediate measurements (which are part of the evaluation activity) have been foreseen in the work programme. Questions to the participants have been prepared to see if any of their expectations is being met by the system, if any changes are required or what further expectations exist. The results of such an activity are now available and have been integrated in the evaluation work package results.

During the IRIS project a gradual process has taken place: first the ICP has been adapted and installed; then the users have begun using it. Small adjustments have been done during operations. By the end of this process the users have become familiar with the use of the ICP.

For this reason, during the IRIS project a gradual transition into day-by-day operation has been already done and will continue in the next future, after the IRIS project. This way of operating the system is now limited to the IRIS Italian partners. It will be further consolidated after the project and possibly extended to new partners.

Concerning the place where the demonstration takes place, a precise punctual location (e.g. a city) does not exist. The demonstrator covers a wide area represented by the Italian square Genova-Milano-Bologna-Padova. Anyway, it can be stated that the "main centre" of the

Italian demonstration activities is represented by the Interporto Bologna premises, which is the ICP – gravity centre, where the central computer and some main applications are located.

The main event during the demonstration activity has been the demonstration day. The demonstration day (one day) took place at the Interporto Bologna premises on 7th July 2000.

The demonstration day included:

- a general presentation of the system. In particular the ICP users took their time for presenting their companies, explaining in detail their specific involvement in IT activities, describing their objectives and expectations.
- a technical description of the system. Both the test site leader and the technical staff of Sistemi e Telematica was involved in the functional and technical detailed description of the exchange message system and of its functionality.
- a visit of the premises where the ICP is located. During the visit some additional features of the ICP hardware/software were explained. The system operated in a real life environment and some standard messages were exchanged. A description of the intermodal operations related to this message was effectuated and a comparison with the previous situation (without the ICP) was given.
- a visit of the Interporto Bologna including the presentation of the future development plans both in terms of infrastructure and services. The latter appear very important in view of the future exploitation of the IRIS results.

A more specific and dedicated "dissemination" activity has been organised at the end of November 2000 – beginning of December 2000, addressed to freight village managers and transport operators (they are supposed to be the final users of the system) together with journalists and local authorities. The public and official announcement about the existence and the features of the ICP has been given and widely disseminated at the 'Intermodal 2000' exhibition (29th November – 1st December 2000).

The dissemination activity mentioned before took place at the 'Intermodal 2000' exhibition in Genoa. The ICP was presented at the stand shared by Assointerporti (the Italian Freight Village Association), Interporto Bologna and Interporto Rivalta Scrivia. The official presence of Assointerporti has given a wide window for dissemination purposes at national level. Furthermore, taking into account that the 'Intermodal' exhibition is a very important international event, the European dimension has also been covered.

A specific presentation was done during the Technical Workshop which was part of the congress programme in parallel to the Intermodal exhibition on Wednesday 29th 2000. The text of this presentation has been included in the official proceedings of the conference. The main issue treated during the presentation concerned the relationships existing between maritime terminals and intermodal inland terminals; the presentation showed in particular how the ICP can contribute to optimise the integration between maritime transport and intermodal rail / road transport.

4.2.3 Evaluation results

Situation without the demonstrator

The problems and deficiencies of the traditional way of exchanging information (phone, fax) are well known by the transport operators and can be summarised within the following points:

- long time for the information transfer;
- high number of mistakes;
- redundancy in administrative activities;
- lack of reliability in the information exchange;
- lack of updated information;
- lack of transparency in the information exchange;
- co-existence of numerous transport operations and commercial book-keeping systems;
- existence of independent information-links and lack of a common platform.

These deficiencies are amplified both because it concerns intermodal transport and, in addition, short/medium distance transport. Furthermore one of the main customers objections to intermodal transport today is that this information requirement is not satisfied and that intermodal transport is not reliable. From this point of view, electronic and information solutions appear to give important benefits. The information exchange and the tracking and tracing technologies probably are good solutions for reducing the gap still existing between road haulage and intermodality. These technologies should therefore be promoted in order to achieve a higher performance in terms of more suitable services for specific user needs.

It is not very clear what the future expectations of the Italian partners would have been if the IRIS-project would not have been implemented. Some companies might have considered to implement a data exchange of their own. The situation without the IRIS demonstrator is defined as the mode of message communication among the demonstration partners before the IRIS project, distinguishing between the reference cases export cycle and import cycle.

The following table concerns both the previous situation (without the ICP) and the new one. The main difference is that in one case the messages are exchanged with traditional means of communication, while in the new situation the ICP is used. A more detailed description of the type of messages sent during the demonstration is given in annex 2.

Message	Frequency	# of info	Previous means of Communication
Wagon availability (IFTSAI)	1 / 2 per day	20-30 wagons per train	Fax
Transport instructions (IFTMIN)	30-50 per day	1 per container	Fax / Phone
Consignment order (COPARN)	30-50 per day	1 per container	Fax / Mail manual (*)
Train consist (BAPLIE)	1 per day	30-50 containers per train	Fax
Gate out (CODECO)	On request	1 per train	Phone / none
Gate in (CODECO)	On request	1 per train, specifying the exceptions	Phone / none

(*) this document consists of a simple paper sheet, that must be signed and dated in order to have the container accepted at Interporto's premises. Since this is simply an agreement among parties, one of the objectives of the IRIS demonstrator is also to change this procedure, moving to an electronic document.

Table 4.2/4: Messages sent during demonstration

Technical performance

The technical feasibility, as shown at the beginning of the demonstration, has not been a problem. The system requires some computers (PCs) and communication links (hardware side of the Information and Communication Platform, ICP) plus specific software already tested during the demonstration. Few days of work were necessary for implementing the system at a partners premises.

Operational performance

The operational feasibility has required some effort from the users, in order to acquire the necessary experience in the use of electronic format messages exchange. The most important effort has been to abandon the traditional (used for many years) manual way of operating. Once the system was installed and the minor initial “friction problems” solved, the operational feasibility has been acquired.

The operational and technical success of the demonstrator can be measured by the number of messages sent by EDI, compared to the overall number of messages sent relating to the “demonstrator container flow”. As detected during the demonstration phase (from October 1999 to June 2000), the table below shows both the total number of EDI messages and the number of messages sent otherwise on the container flows relevant to the demonstrator during this period. The last column shows the coverage by EDI communication. In Annex 2 more details can be found on the message statistics.

Type of message	*# msg by EDI*	*# msg by traditional communication*	*EDI coverage*	*Notes on EDI usage*
Wagon availability	10	20	33%	This message has been abandoned, since it has been considered not relevant in the day-by-day operation, at least as far as it cannot be exchanged with FS (Italian Railways)
Transport Instructions	30	> 1000	<3%	This message is currently under test with a partner external to IRIS project. This message is usually used in gate-in operations, handled by hand at the gate, and confirmed, as a Consignment Order, by the MTO
Consignment order[11]	180	na	Na	See also above message. After a heavy utilisation at the beginning (until February 2000), this message has been less used due to some problems in accepting its legal validity
Train consist	70	100	41%	Quite exclusively from Bologna to Genoa: the opposite route is very poorly represented
Gate in/out	250	10	96%	It isn't possible to make a distinction between gate in and gate out. Some of the messages concern the arrival (gate-in) by road. Telephone is only used in cases of irregularity.

Table 4.2/5: Overview of EDI messages on total messages sent during the demonstration phase[12]

The table shows that the operational success of EDI implementation is dependent on the type of message sent. The most successful message is the gate in-gate out message cycle. Other types of messages have proved to be less (or not yet) successful, for instance because of the impossibility to exchange EDI with the FS,the Italian railways or because of consequences in legal validity of the documents sent.

[11] It must be noted that actually this message does not exist: the trucker arrives at the gate and an "acceptance form" is compiled on the fly. The message helps to obtain data in advance, so the registration should consist only in a control and should be done in a very short time.

[12] The demonstration period started Nov. 1999 and ended Jun. 2000. It must be noted, however, that during Nov. and Dec. 1999 the communication platform has not been operated in a continuous manner.

In the below paragraphs below the most important operational evaluation elements with respect to the Italian demonstrator are put to the attention of the reader.

Tracking and tracing functionalities

Regarding „tracking and tracing" it is up to now limited to the gate-out / gate-in confirmation – the crucial railway section with „splitting the train exercise" is not mirrored yet. The Italian Railways are not equipped with a system for controlling the train splitting. The status information on containers are covered by the ICP as follows:

- The confirmation that a container has been loaded onto a wagon is given through the train consist message (draft version).
- The confirmation that a container has been loaded onto a train and has left the terminal is contained in the train consist message (final version).
- The confirmation that a container has arrived at the terminal is contained in the gate-in message and is based on a physical inspection of the train consistency after its arrival.

As explained above the ICP is designed to integrate a larger number of transport operators. The figures above show that the carriers are more than one. This is commercially desirable and technically possible for the future exploitation of the ICP. Furthermore two more types of actors could be linked to the system: the maritime agencies and the freight forwarders. In the near future, when the Italian State Railways will have a suitable information system, a direct interaction with FS will be possible, so that also the rail part of the journey can be monitored.

The main difference between orthodox internet-based or e-mail-based systems and the chosen ICP- architecture is the following: In the Internet/e-mail based architecture the information exchange process is not controlled. Nobody can say that the messages have been received properly. Nobody can have the role of a "trusted third party" to arbitrate possible problems. The ICP offers the possibility of solving all these aspects.

Integration in administrative organisation

The exchange of the EDI messages has been in particular challenging since the implementation requires a gradual procedure. As a first step companies have to move from non-standardised (verbal or free format paper) to standardised or structured ways of exchanging messages. In a second step they can be convinced to use electronic data formats and as the final step to exchange EDI(FACT) type of messages.

The introduction of EDI did not have a very visible effect on the companies' organisation, i.e. the structure and the role of the personnel remains unchanged. The main effect is the different amount of time dedicated to data handling. Generally speaking, people find data already introduced in their own IT systems, so the traditional time spent in data entry decreases.

As an example, it must be taken into account that the "train consist" is typed in manually at least three times in three different companies. EDI has reduced this introduction only to the company that handles the data for the first time.

The only possible negative side effect is that, if in a company there are some people in particular dedicated to data entry, this particular office will disappear. This is not the case for the companies involved in the Italian demonstrator, but Voltri Terminal has calculated that people in some offices actually spend half of their time (from 45 to 55 %) in data entry.

Changes in responsibilities

No changes in task responsibility have been effectuated. The electronic documents have simply substituted the paper ones, but this did not imply any change. Of course, all the partners have agreed to consider electronic documents as a correct substitution for paper.

Legal documents, for the moment, have not been taken into account and don't enter in the EDI chain, so there has been no impact from a legal point of view. If legal documents will enter the EDI system, additional measures have to be undertaken with respect to liability, legal validation, etc.

Reliability, flexibility, traceability & security

The presence of the real-time information has a heavy impact on the time spent in awaiting the necessary information before unloading a container (minus 25 to 35%), which is also due to the quicker preparation of the final train consist. However, the speed of transferring containers is strongly dependent on the speed of the train, so the impact of EDI on the overall average transit time can be considered as neglectible.

The adoption of EDI has led to a quick response and a quicker and more reliable information exchange among the partners: this means that in the new situation, a container can be traced with an increased accuracy compared to the past, particularly in terms of time. As a side result, it can be considered that approximately 10% of the containers, that were delivered with delay, are now sent out in due time.

In fact, with a paper exchange, the status of a container was known in the IT system only after the data entry by the recipient of the information, while in the new situation it is (or, at least, it could be) known as far as the information is typed in by the originator. With EDI this is now possible, the elapse of time due to the connection being neglectible, the file transfer and the processing by IT systems.

4.2.4 Financial evaluation

The financial evaluation for the IT demonstrator consists of a comparison of cost and benefits for each partner. The costs identified with the demonstrator consisted of exploitation costs (costs related to the use of the ICP), training costs (costs of man-hours spent on getting to know the system) and investment costs (costs of investment in hard- and software, depreciated over 5 years).

The benefits of EDI include prevented costs of mistake reduction, reduction in communication costs and labour costs. The reduction in communication costs relate to the reduced use of fax and telephone. As indicated before, the implementation of EDI has led to a reduction in delay (10%) and a decrease in time spent awaiting information (25-35%) and fewer mistakes within the messages. This results in prevented costs of setting mistakes right and prevented costs of penalties.

Furthermore, EDI exchange leads to some reduction in the labour time, for the receiving partner has not to re-key all the data but should simply control them before acceptance. It is difficult to estimate this reduction, mainly because it depends on the amount of data (from few seconds to several minutes), and anyway it can be considered as not relevant for a single document. But, if the number of exchanged document becomes meaningful (say at least 30 % of the total), the time spare can reach significant values. For example, a 100 % EDI exchange for train consist message could lead to a spare of 10 % of total labour time of a person.

The reference cases of import and export cycle were put together in the figure below because it is impossible to split the costs of communication activities between import and export containers. The figures show all assembled information in percentages. The reason for this is the commercial sensitivity of the necessary information, which the demonstrator partners do not want to have in the public domain. Therefore the relative contribution of each element is presented as a percentage of the total, for both benefits and for costs. Comparing the proportion of the two columns gives an indication of benefits versus costs. The relative proportion of costs to benefits is 1 to 2.4 for Voltri, 1 to 2.1 for Italcontainer and 1 to 3.7 for PCS.

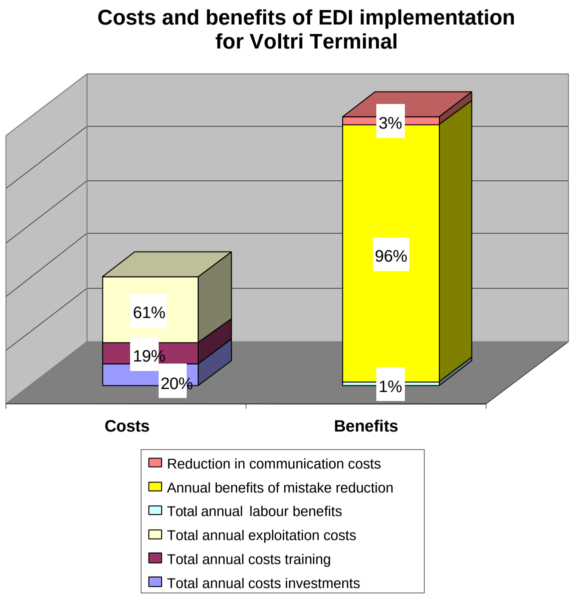


Figure 4.2/13: Comparison of annual costs and benefits for Voltri Terminal (VTE)

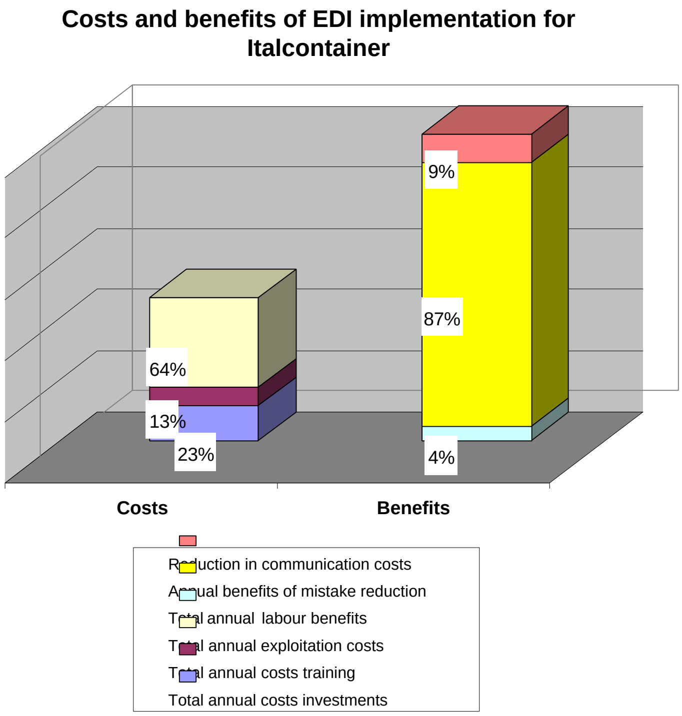


Figure 4.2/14: Comparison of annual costs and benefits for Italcontainer (ITALC)

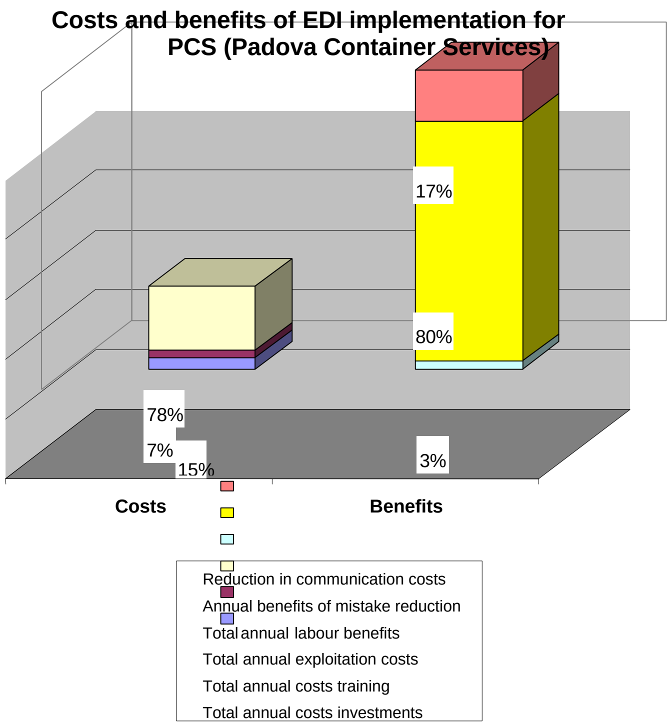


Figure 4.2/15: Comparison of annual costs and benefits for PCS

It can be concluded that for each demonstrator the financial results are positive. It can be seen that the major benefit is always the mistake reduction, followed by the reduction in communication costs, that is directly proportional to the reduced amount of information actually exchanged by fax and phone. Concerning the costs, the most relevant is the exploitation: it is important to note that this cost is estimated to decrease in the next years, so the total benefit will become greater than now.

4.2.5 Site specific conclusions

The Italian demonstrator has been focused on the optimisation of existing intermodal services rather than on the development of a new intermodal service. The Italian demonstrator addresses the limitations for intermodal transport caused by the complexity of information exchange.

EDIFACT systems for the exchange of information in the transport sector exists since years. The main innovative aspect of the Italian demonstrator is that a system gives the possibility to exchange structured EDIFACT messages also with those companies with low IT capabilities. This is a very important step towards the competitiveness of:

- the small-medium sized transport companies on the one hand;
- the intermodal transport on short and medium distances on the other hand.

From the technical point of view the demonstrator has been successful. The electronic data interchange system has been implemented and operated successfully. The demonstrator has shown that EDIFACT and non-EDIFACT messages can co-exist in this application. A threat to further expansion of EDI based communication may be formed by emerging new information systems, such as Internet.

From the operational point of view on message exchange, not all types of messages were equally successful. For some messages, the IRIS partners completely switched over to EDI. The use of some type of messages were (temporarily) discontinued because of legal complications or because of the lack of EDI facilities at the receiving end (partner outside the IRIS project).

The financial and commercial evaluation shows that the costs of the service improvement should be recovered from the acquired improvement of internal organisational efficiency rather than from an increased tariff levy on the customers. This implies that from a financial point of view the demonstrator has proved to be feasible.

It is certain that the partners will continue and further expand upon the demonstrator work. The Italian IRIS demonstrator will not remain just an exercise. It will be promoted and expanded to new users, in order to become a very widespread operational system.

4.3 Demonstrator III UK

4.3.1 Demonstrator description

Concept overview

The UK demonstrator centred on the technical, operational and commercial feasibility of operating a small bi-directional self propelled freight train formation (TruckTrain) in commercial service between the port of Southampton and terminals in Birmingham and London (Barking). The primary objective of the demonstrator was to operate an innovative rail freight technology with the intention of identifying the core strengths and weaknesses of such an innovative concept in relation to existing rail and road transport technologies and services.

The derived objectives centre on the assessment of the capability of the train to transport the cargo provided by one of the partners (P&O Nedlloyd) in an operational and technical format, thus demonstrating the use of a small train configuration as a valid means of transporting high value time sensitive cargoes.

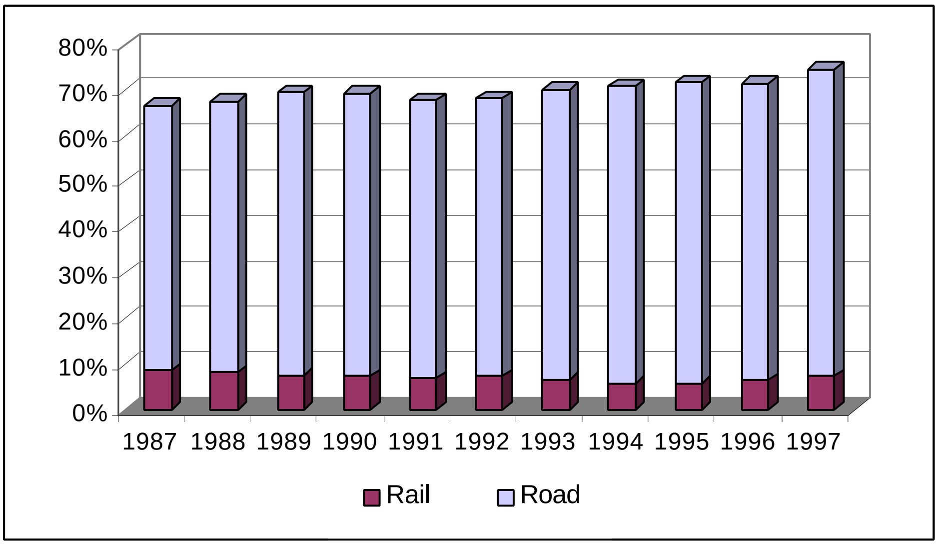


Figure 4.3/1: UK domestic freight transport: 1987-1997

Rail has 1997 only a modest share of 7% on the whole domestic freight transport. This can be traced back that orthodox rail services are not appropriate on cost and service grounds for intermittent or less than train load volumes particularly if these are operating or terminating at a significant distance away from a major intermodal terminal. Block container trains of 20-25 wagons (60-75 TEUs) operated between ports and inland terminals are an attractive option for shippers/shipping lines/receivers whose traffic aligns well with that type of inland transport offer. Few intermodal trains of 15 wagons or less are operated regularly with commercial success. Rail services are mainly provided by Freightliner (FL), a privately owned and operated intermodal company with it's own traction, wagon fleet, terminals and road transport capability.

For smaller flows which account for over 75% of the intermodal market the use of road transport is currently the only option on service and cost grounds. The availability of road haulage is becoming a constraint on the dominant market share of the road transport industry and new systems of transport will be needed to service growing traffic flows.

One of the fundamental strengths of rail is the high transit speed potential and this is valuable as a means of attacking markets driven by tight time, reliability and quality imperatives. The small-self propelled, high speed, high productivity train formation, the so-called "TruckTrain", has been developed as a concept to be able to exploit this by the use of a high level of installed power for rapid and sustained acceleration commensurate with good ride qualities and minimal track attrition. In terms of cost profile the TruckTrain concept has to be competitive with road transport services as the primary competing mode. Making the train self propelled effectively achieves the lowered cost target by removing at the outset the high capital and operating cost of a locomotive. The ability of the train to move itself also endows great operational advantages in terms of availability, utilisation, productivity and flexibility. To fully realise all of these advantages following fleet deployment would imply some other profound changes to the overall direction, scheduling and management of capacity on the rail network.

For intermodal rail operations in the UK the generic problems centre on the economics of train operation and the cost of terminal operations at the inland terminals prior to final delivery or as part of the collection cycle for export traffic.

Road transport using trailers and operating directly between customer and deep sea port avoids the cost of inland terminal operations. Whilst this is attractive for some shippers and receivers the cost of operating small blocks of cargo (6-8 units) by road can become expensive. This threshold is however, using current rail equipment and terminal equipment, below the minimum service or product offer that FL regularly operates. By lowering the cost of train operations through the use of the smaller train formation (TruckTrain) the competition with road is made more readily achievable.

In all, there are three groups of participants in the IRIS UK demonstrator. The demonstration site leader is the Advanced Railway Research Centre (in short: ARRC). The users are the intermodal operator Freightliner (FL) and the door-to-door container shipping company P&O Nedlloyd (P&ONL). The service providers are Railtrack, as owner of the British rail infrastructure, and the rail servicing company Amec Rail (AMEC).

Regional background of demonstrator

The primary hub for the demonstration was the Port of Southampton, which acts as a major export and import point for various deep sea shipping services. The terminals used for the demonstration were the main Maritime FL terminal and the smaller Millbrook terminal in Southampton. At the main terminal the train was prepared technically for the demonstration and physically loaded at the beginning and end of the trials.

Figure 4.3/2: Geographical setting of UK demonstrator

The destination hubs were the Birmingham FL terminal and the Barking terminal in East London both of which are used to receive and dispatch container traffic. Birmingham is approximately 220 kilometres by rail from Southampton. Barking is 160 kilometres from Southampton. All the terminals are linked to the main UK rail system.

Transport chain

The primary location of the demonstration was Southampton where the train was based for the operational trials and for the static review. The train was originally assembled from the two Multi Purpose Vehicles (MPV's) into the demonstrator configuration at Freightliner's terminal and wagon repair yard where commissioning and fuelling were completed. The train was loaded on the main pad at the Maritime Terminal for the two outbound journeys. The FL terminals at Birmingham and Barking completed the discharge and re-load procedures for the return sectors. All the train loading operations were completed using gantry cranes at the respective terminals.

The route for the Birmingham trial involved the link to the London (Waterloo) main line from Southampton to Basingstoke then over the link to Reading West, Didcot, Oxford, Leamington and then to Birmingham Freightliner terminal which required a change of direction as the unit was moved into the terminal area. The return sector was a reciprocal of the outward journey.

The demonstration to Barking followed the same route closer in towards London on the main line and then switched to the route around the North side of London to access Barking. The return journey was not a complete reciprocal due to operational problems. The train was diverted from the North London line to Reading and then South to Basingstoke where it resumed its planned path. This diversion was not a major problem in terms of time keeping.

Figure 4.3/2 shows both technical and operational demonstration routes between Southampton and Birmingham and Southampton and Barking and the triangle Southampton Cardiff Manchester which is part of the commercial evaluation (dotted lines).

The demonstrator involved terminal road transport at the Port of Southampton, the small train formation for the rail line haul operations, terminal road vehicles to move the containers away from the train at the receiving terminals in Birmingham and Barking with final local deliveries being made by conventional road transport.

The containers used in the trials were all selected by P&O Nedlloyd as being required commercially at their respective destinations and represented a genuine requirement for intermodal transport between the Far East and the UK.

Time windows for demonstration

The time windows for the demonstration were restricted to two sectors. These were Southampton to Birmingham Freightliner terminal and return on January 29th 2000. This was followed by an operation between Southampton and Barking (East London) and return on February 5th 2000. A further round trip operation between Southampton and Birmingham was cancelled due to external circumstances. All three planned sectors were scheduled to be completed in a week as a result of limitations imposed on the whole demonstration by contractual positions relating to the delivery of the train formation to its ultimate owner, Railtrack.

Further trials were originally planned as part of the IRIS project but these had to be deleted from the programme when the limitations on the availability of the train for the trials became seriously constrained. These additional trials would have involved operation on secondary lines in a feeder role and also operation with an additional un-powered trailer in the formation to determine performance capability in this configuration.

The trials were effectively completed by February 5th 2000 when the vehicles were released back to AMEC Rail for conversion back into their original configuration.

4.3.2 Demonstration activities

Technical and operational layout

The train demonstrated was a four vehicle formation assembled from two MPVs acquired by Railtrack for infrastructure support services. It was not purpose built for cargo operations. Two power cars were used with two intermediate container flatcars loaned by Freightliner. Because of the high deck height of the power cars it was not possible to load 8’6” high containers on these without exceeding the UK loading gauge. Each power car was loaded with 2x20’HH (Half high) units provided by P&O NL. The intermediate cars were each capable of accommodating three TEUs with a maximum load of 20.5 tonnes per TEU. A control loop was added to allow the train to operate safely in the new temporary configuration. A safety case had to be made to the UK rail authorities before the trials were undertaken. The train was limited to a maximum speed of 95 kph for the duration of the trials.

Figure 4.3/3: TruckTrain on the Route

Each power car was fitted with two Volvo diesel engines driving the inner axle of each bogie on the power car (ie 50% of the axles were powered). There were concerns that this particular drive train might prove to be a limiting factor under low adhesion conditions. There was some recorded loss of traction during the trials on the trailing power car. The high cargo deck and the use of only half of the axles to drive the train remain the fundamental limitations to this technology.

The train was operated under UK railway operating rules and controls. Drivers were provided by Freightliner as ‘conductors’ for the routes over which the train operated. Railtrack inspection personnel also accompanied the train to validate safety aspects throughout the transits. Representatives of the train manufacturer and the UK agent for the manufacturer were involved in the formation of the train, technical monitoring and any fault analysis. They also accompanied the train throughout its operational deployment.

The train was loaded at Freightliner’s terminals in Southampton, Birmingham and Barking. There was no use made of any new or mobile lifting equipment due to the short duration period of the overall demonstration.

Demonstrator set up

The objective of demonstrating the feasibility of operating an innovative train formation in commercial service on the UK rail network was completed within a two week period from the release of the MPV's from delivery commissioning to the point of being handed back to Rail-track. This limited period of availability was a consequence of contractual issues between the procurement agent (AMEC Rail) and the ultimate owner, Railtrack. The intended operation as a feeder from a terminal in Manchester and as a specialist cargo feeder from Tilbury to Swindon had to be cancelled as a consequence of this position. The demonstration was both a pilot operation and a commercial operation with cargo assigned to the train by P&O NL.

The feasibility of the UK demonstrator will be demonstrated according the following aspects:

- Demonstrable proof of the concept of a small self propelled train being able to operate technically with commercial cargo on the main railway infrastructure with minimal technical risk or associated delay to other rail traffic.

- Validation of the economics of the small train in comparison with road transport and orthodox rail freight services particularly in relation to small and intermittent traffic flows.

- Identification of any major technical or operational limitation in the concept, technology or operation shown up as a result of deployment into the demonstration programme.

Problems faced during the set up phase

The most difficult problems encountered during the demonstration were connected to the actual acquisition of the train for the purposes of the demonstration and the complications arising from external contract issues that came very close to undermining the whole demon-stration programme. That these were resolved by Amec Rail with Railtrack Freight Com-mercial by some very robust behind the scenes negotiation should not go unrecognised.

The limited availability of the units drove the profile of the trials into a more limited time span than originally intended and cut across other proposed demonstration activities.

Other problems arose from deck height and propulsion (traction). The MPV deck height was 'inherited' as a design fix from the Cargo Sprinter upon which the MPV is closely based. At 1200mm the deck height on the power cars used for the IRIS trials was too high to accommodate a standard 8'6" high international shipping container within the UK loading gauge. To accommodate such cargo units on the MPV cargo platform requires that the cargo deck is lowered to < 900 mm. The deck height problem could not be solved in the context of the IRIS project. Talks with the vehicle manufacturers made clear that a reduction on such a target deck height might not be possible by modifying the MPV as used in the demonstrator.

To test the technical and operational feasibility of the small train unit a proxy version derived from the MPV was chosen in order to test the appropriateness of this technology for the operation in P&O NL transport processes.

Demonstration day

The demonstration day held at Barking involved an invitation to thirty plus journalists from the freight industry trade press, railway technical press, radio journalists and journalists from other general freight transport media. They were invited to inspect the train at Barking as loading operations were being undertaken. Press and TV interviews were given by members of the UK IRIS project partners for local and national consumption.

The ‘Trade Day’ held at Southampton on February 5th was a more locally focused affair with local and regional radio and TV present together with freight industry representatives, trailer leasing companies and EC representation.

Figure 4.3/4: Loading TruckTrain at Freightliner’s Barking Terminal by RMG

Press releases were made on both occasions describing the concept and the IRIS trials in detail. A video of the Barking operations was made by AMEC Rail.

4.3.3 Post event evaluation

Reliability, flexibility, traceability & security

The reliability of the TruckTrain concept was not realistically tested due to the limited nature of the trials. Assuming the commercial operation is planned on the same basis as existing orthodox rail services there is no reason to suggest that the reliability of the train should be any worse than that of the existing services. The availability of multiple engines in the small train format should enhance rail’s reliability, in the event of a single or multiple engine failure the remaining operable power should provide a measure of security or at least the ability to move the train to a point to which external aid could be summoned without a total train failure.

In terms of flexibility the capability of the TruckTrain to be deployed without scheduling locomotives and wagons and the inherent capability of the TruckTrain to move under it’s own power endow it with a massive advantage. Assuming a widespread adoption of the technology there is every reason to suggest the owners and operators would be intent on maximising availability, utilisation and productivity to maximise returns and profits. The ability to schedule and operate trains on routes more rapidly than orthodox practice currently allows is a further advantage to be played on to maximum effect. Issues such as maintenance, fuelling and crew rostering will all need adaptation to maximise the earning and production potential of the new train technology.

In terms of cargo tracking and traceability the cargo was loaded on within the secure terminal areas and the train was tracked by Railtrack's own train monitoring systems. There was no tracking of individual shipments or consignments within the containers. This is a facet of future developed versions of the TruckTrain concept to be incorporated with more advanced engineering, location and cargo condition monitoring systems. There are commercially available systems that can significantly advance this aspect including track and trace, security and cargo condition monitoring with other enhancements as base products.

Certification

Regulation impacted on the UK demonstrator in several ways. The first was in the requirement to have a Safety Case for the operation of the temporary TruckTrain formation on the UK rail network as a composite vehicle. This was required despite the fact that the MPV power cars and the intermediate wagons had their own safety acceptance certification but were not allowed to operate in formation. This requirement meant that an entirely new position had to be established. This was done by Freightliner within the terms of their certification as a train operator.

Operating regulation

For the demonstration trials Railtrack required the presence on board of a supervisor to monitor the performance of the train throughout the sectors operated. An additional driver was also required for the operation. The train was required to operate within the normal regulations of train operation in the terminal areas and on the lines over which it ran in relation to signalling, speeds, speed restrictions, cargo handling and security. The UK demonstration was completed within this regulatory framework and was compliant with requirements.

Environmental impacts

Because the TruckTrain makes use of new train technology, contrary to the other two demonstrators, a comparison of fuel consumption between conventional train technology and the TruckTrain concept needs to be made. Fuel consumption was approximately 0.34 litres per train unit and kilometre, higher than expected but probably explained by the relative newness of the engines. For comparison: conventional rail takes about 2,6 litres per kilometre, whereas trucks need between 0,30 and 0,35 litres per kilometre. Per tonne kilometre (assuming 12 tonne per TEU average weight), this would be about 3,6 litres per 1000 tkm for conventional rail (60 TEU) and between 12,5 and 15 litres per 1000 tkm for road (2 TEU), whereas TruckTrain (6 TEU) would need 9,4 litres per 1000 tkm. In all cases, consumption is influenced by driver skills. Rail seems not to be influenced by weight and speed as much as road. This implies that the TruckTrain is slightly less energy efficient as orthodox rail, but at least about 40% more energy efficient than a comparable road transport.

The TruckTrain is conceived to operate initially as a diesel powered train to afford maximum network coverage. The engines selected for the trains are compliant with existing and planned exhaust emission standards. These exceed the requirements at which existing locomotive and road vehicle fleets operate. The use of electric traction is entirely feasible and would remove the concerns regarding emissions to the point and type of power generation technology deployed. There is, however, no data available on the possible use of electric power.

Noise limits are met as well. The trains operate with exhaust silencers and a system that shuts down the engine automatically if the train is stationary for >15 minutes. The noise footprint of the train would be significantly less than an orthodox locomotive hauled train due to the reduced train mass and the removal of the noise generating locomotive. Therefore, a reduction of energy consumption and on the related CO_2 is possible by the TruckTrain concept.

Safety

The TruckTrain demonstrated is fully compliant with the host railway‘s safety requirements governing construction and operation. Those safety issues that appear to constrain the capability of the train (e.g. route knowledge) will need to be challenged and replaced by systems that liberate the railways from onerous constraints that are an anachronism in commercial and operating terms.

The increased movement of cargo by rail could have a corresponding knock-on effect on safety in terms of reduced traffic accidents attributable to trucks. Trucks are involved in proportionally more accidents than their aggregate numbers would suggest and any diminution in this should be welcome. The increased traffic speed resulting from the reduction in road transport numbers could however raise the speed of the remaining traffic with a corresponding rise in accident rates.

To conclude, in socio–economic terms the ability of rail to win back traffic from road on a sustained basis has some interesting prospects. The reduction of environmental pollution (noise, fumes, structural attrition on roads and bridges, accident reduction and related costs) could be significant. Using rail’s inherent energy efficiency to good effect in a commercial application would enhance energy efficiency. There could be trade-off‘s in employment if rail succeeded in winning traffic from road. Loss of employment in the road sector may not be made up in the rail industry if the productivity potential of the trains was really driven up.

4.3.4 Follow up approach

Technical and operational issues

The demonstration indicated that the basic small train concept was a feasible option for further development and refinement. In technical and operational terms the demonstration unit performed largely in accordance of expectations despite some obvious limitations posed by the train technology employed. It is paramount to recall that the train was not a purpose built freight carrying unit but a compromise ‘proxy’ to the TruckTrain that was created specifically for the trial.

Wider deployment on a large scale of the small train concept raises some as yet unresolved issues regarding train scheduling, slot availability, route knowledge requirements, servicing and maintenance regimes. The prioritisation of small trains at terminals where they may be in competition for space and crane service time is an issue that arose from the trials. The development of a simpler, cheaper and more rapid system of loading/unloading containers by the train or with truck mounted kit is a possible area for further deliberation.

Train Scheduling

Train scheduling for a fleet deployment of TruckTrain type self propelled freight trains will require a radically modified approach if the full capability of the new concept trains is to be attained. The demonstration trial operations were completed on already available schedules on the Barking route and did not require new route or schedule filing to be made. For the Birmingham sectors a new schedule had to be planned in advance by Freightliner as the train operator with Railtrack the infrastructure owner and manager. This was an elaborate process that took some time to establish as a 'one-off' using specialist equipment.

For a developed network of services the availability of routes and schedules on a much more compressed availability will be a mandatory requirement. It would be possible to run a net-work service between ports and terminals on a network schedule basis to service consistent and largely unchanged levels of traffic. In reality this is unlikely as traffic flows are very volatile and require adaptation and modification on an almost constant basis. This plus the continuous deployment and re-deployment of trains as core assets suggests the need for a train planning process that can maximise the potential of the train to move itself and escape from the limitations of matching locomotives and wagon requirements. The ability to deploy quickly across the network in response to short lead times or changed traffic patterns is a real advantage to be built on compared to orthodox locomotive hauled train formations.

The availability of a means of requesting route options for traffic flows on a 'must go now' basis, at 2hours-4hours etc with a price offer for the slot on the network is a real requirement to allow operators and shippers to select their preference. It tackles head on the issue of peak track occupancy times and access charges. Traffic moving through congested territory at peak hours would have to pay the going rate for this. Such a system would need to operate in near real time with the option to fix routes, times and access charges as a composite transaction. The ability to swap or trade slots with other operators would be a key requirement as would the inclusion of a mechanism to ensure slots are correctly used and not utilised as a predatory or blocking device on other competing services.

Added to this is a requirement to book terminal slots, cranes and the pre/end haulage to ensure a seamless service presentation to the shipper/receiver on a one-stop shop basis for the complete transaction. This enhancement of the product is vital to support the core train concept.

Route Knowledge

Regarding route knowledge this is currently a mandatory requirement on train crews in the UK. Train crews must be certified to have passed over the route with full familiarisation of the route geometry, speed limits, gradients and signal locations. It is a hangover from past operating regimes which operated without intelligent systems to aid train crews in moving across the rail network. The continued use of this device means that train services can be hostage to fortune in terms of available and competent crews being in the right place at the right time with the desired route knowledge to operate the service. The difference in approach compared to the trucking sector and to aerospace is very marked and is a major constraint on the railways' generic ability to respond to market requirements to the same degree as its primary competition.

Systems exist and are in place that allow drivers to operate trains without specific or recent route knowledge in full safety. The adoption of this technology is a major liberating factor in the development of a competitive rail product and supports the aspirations to maximise the operational flexibility and commercial potential of the new concept trains. Allying this to the ability to order, schedule and route the trains in real time or near real time reinforces the capabilities of the rail product and brings it closer to the capabilities of the major competitive mode.

Some systems are already in limited operation on a trial basis in parts of Europe to allow the operation of trains without route knowledge as a mandatory pre-requisite. Systems such as these are also the subject of a separate research exercise in the UK. They are an imperative to the success of the TruckTrain concept for fleet deployment or the concept runs the risk of being constrained by the limitations of prevailing methods of operation. The further development of this technology with an 'in-cab' command, control & communications capability bridging the commercial and operational aspects of train services is a vital requirement.

Servicing and maintenance

Regarding **servicing and maintenance** the ability to bring servicing to the train rather than the orthodox alternatives is seen as a desirable development to ensure the trains are available for commercial operations to the maximum extent. Technical servicing and the replenishment of consumables (Liquids/fluids/brake pads etc) could be undertaken as the train is loading or unloading cargo.

More substantial time or distance related heavier service checks would require release of the trains to a maintenance depot or base for mandatory checks. The ability to use other (passenger) operators depots at times when these are less intensively used is an option for consideration. The need for purpose built train maintenance and storage facilities to support TruckTrain operations is not seen as a primary requirement. The TruckTrains have been designed to achieve at least 240,000 km per annum as part of the product concept. It is imperative that they are able to attain this target or exceed it as part of the fundamental economics underpinning the overall vehicle concept.

The possibility of fuelling trains at the track side during cargo operations and light servicing is a further possibility to be determined. There are safety and environmental aspects to accommodate to allow this plus the information and planning systems to align the availability of the tanker vehicles with the train in terms of location and time. This concept is drawn from aviation practice where the intensity of use of the major assets is vital to commercial success and the operational support is created around this core need.

Terminal operations and scheduling

This point has already been touched on briefly in the preceding paragraphs and was one of the findings that emanated from the IRIS demonstration in the UK. The IRIS train was able to operate into the terminals without serious conflict with other train operations going on around it. In this respect this was an artificial or 'protected' position. In reality the ability of small high productivity trains to operate into and out of terminals around larger conventional trains that are also loading or discharging cargo is an operational planning issue to be addressed. Where the TruckTrains are required to operate into port terminal areas or large inland terminals the timing of train operations and the availability of siding space, cranes and terminal transport will need to be planned to minimise the dwell time of the trains. This again points to the need to link, plan and control in real time the deployment and utilisation of the train assets to a much more intensive degree than is undertaken with orthodox train services.

This equally applies at smaller 'neo' terminals where the smaller trains could operate. The TruckTrains will be able to operate into smaller terminals, sites & sidings which are inappropriate for orthodox trains either operationally or commercially. For intermodal cargo there will need to be careful co-ordination of the availability of lifting equipment (trailer mounted cranes or purpose built lifting equipment such as front end loaders or mobile cranes) and local haulage for delivery/collection duties. This points to the need for planning systems and the active involvement of service providers to enhance the competitiveness of the total product chain as a means of making the offer to the market as cost effective and as competent as the primary competition.

The use of train mounted equipment to load and discharge containers is a possibility using the TruckTrain type vehicles. It holds out the prospect of high levels of flexibility and the ability to load/unload without recourse to terminals or hired in crane capacity to service the trains. This flexibility is however achieved at a price. This comes in the form of the additional cost of mounting the cranes onto the rail vehicles, the additional tare weight this implies and the corresponding loss of cargo weight. The essential geometry of the trains would need to be a specialist adaptation to accommodate the crane mechanism and would probably imply the use of three cranes per vehicle if a mix of 20' and 40'/45' containers were to be used. The alternative would be to develop a vehicle that was optimised on 40'/45' containers to simplify the rail vehicle. This would entail a significant re-engineering of the whole vehicle platform and moving large components to different positions in the overall design. It would be a highly specialised vehicle for markets that need such capability and could support such investment. The core small, self propelled, bi-directional high productivity objectives that have driven the entire concept would still be in place but the train architecture would be significantly modified. A further option that do not require specific modifications at the vehicle might be to test transhipment technology suitable for small and medium volume flows like the RTS-500 Furmia (horizontal transhipment technology) or the ACTS (Abroll Container Transport System) as demonstrated at the Zürich site within the IDIOMA project (Innovative Distribution with Intermodal freight Operation in Metropolitan Areas).

Government Policy

UK government policy (announced after the UK demonstrator was completed) is to double the amount of rail freight in the next ten years. There is no indication as to whether this means revenue, originating volume or some measure of tonne kilometres. With the decline in the level of bulk traffic arising from external developments (eg changes in UK power generation from coal to gas, etc) there is some doubt as to how the new targets will be achieved other than by modifying rail's product and service offers away from large orthodox locomotive hauled trains into train formations that are more appropriate to JIT type traffic. This is what the purpose built TruckTrains are designed to achieve.

Government policy over the past years has not generally favoured rail (which has not helped itself by some very poor commercial, technical and operational performances in the same period). Rail has been underinvested or has spent money on projects that have had minimal commercial impact in the market place. By comparison other modes have received direct or indirect support, investment etc.

The playing field has not been level (back to the tax and access charge element in the cost analysis) but rail has not been an active operator. The current UK rail freight operators both now receive some form of access support grants, but are both tottering on the brink of collapse or failure and are unlikely to survive long in their present form without government support or subsidy and a fairly major restructuring. The present players do not offer a spread of products or services that are attractive to end users who see rail as a marginal player.

The changes in technology, systems, methods of operation, marketing etc., that the TruckTrains are designed to bring into play address these points by trying to get train operations down to truck cost levels but with the capacity and speed advantage of rail.

Expectations with respect to developments in intermodal transport volume

The contribution of TruckTrain to intermodal transport is potentially very significant. The whole basis of the concept is founded on the premise that the use of an innovative vehicle concept using automotive and aerospace derived technologies linked to truck industry concepts of flexibility, cost effectiveness and productivity could make intermodal transport a competitive player.

The use of the TruckTrain could lead to a change in haulage patterns and their respective costs. It is possible that TruckTrains could substitute for some traffic which is entirely road borne at present. The part substitution of the road trunk movement by rail could reduce the whole life cost of local haulage by applying trucks to short distance collections and deliveries more efficiently and effectively. For those new flows that could be secured for traffic that originates or terminates within a private siding or industrial complex it is also possible that there could be a net reduction in total haulage movements or that the length of these journeys could be reduced.

When taking the figures used for the commercial calculation as a base case, it can be calculated that the introduction of 1 TruckTrain would involve an additional annual intermodal volume of 3.000 TEU (50 weeks * 2 trips per day * 2 directions* 50% occupation rate*6 TEU per TruckTrain). The total impact on intermodal transport volume is then dependent on the number of TruckTrains to be deployed.

Regarding the further enhancement of intermodal transport the big cost items such as terminal handling costs, road collection and delivery costs etc. will need to be investigated. This needs to be done in order to identify where these can be cut back or eliminated altogether with the deployment of different technology (eg horizontal transfer mechanisms/air cargo type handling gear).

In terms of reduced congestion on the road the impact here will be dictated by the acceptance of the concept commercially by interested parties and by the capability of the infrastructure operator to accommodate the additional traffic they are capable of attracting to the rail systems from road.

4.3.5 Evaluation results

Intermodal cost comparisons have been undertaken to evaluate the cost effectiveness of the various land based modes competing in the market for intermodal traffic between ports and inland cities in the UK. These have been performed at two distinct levels. First is an annual cycle cost analysis and comparison between a two vehicle TruckTrain configuration carrying 6 TEUs and road transport required to move the same volume (3 tractors and 3 trailers). The second level of evaluation was on integrated transport costs and was undertaken to determine the cost effectiveness of a small train type operation within P&ONL's UK transport arrangements.

Annual cost analysis

In relation to the first level generic cost evaluation (which has underpinned the core concept of the small self propelled train from the outset and prior to the IRIS demonstrator), the purpose of the exercise was to determine in whole life cost terms where the balance of TruckTrain advantages might lay. This was achieved by the modelling of the major cost components (capital cost, maintenance, operating costs, and fuel) across the known or projected life of the vehicles. No access charge and cost elements from taxes (fuel tax, vehicle tax etc.) and insurances were included at this stage in order to get a clear view on the cost performance of the new concept vehicle.

The use of the model has allowed the various cost elements to be tested for sensitivity and to determine at what point the various modes become less attractive to operators, users or investors. The whole life cost approach used for this exercise is focussed on commercial cost elements and ignores any social cost or external cost items. Lifting costs have been stripped out as these are of marginal interest in this particular exercise focussed on the core cost elements of each modal system. Fuel costs reflect the same commercial price of fuel (excluding fuel tax) to truckers and TruckTrain operations (it should be noted that in UK a tax exempt status of fuel supplied to rail operators exists).

The finance costs of a purpose built TruckTrain have been investigated in detail. The major problem for the purposes of analysis has been the derivation of comparable data with integrity from the demonstration. The MPV's as has been indicated elsewhere were a temporary arrangement for the purposes of the trials and not a purpose built unit. The MPV's in their primary form cost Euro 2.2 million. This equates to an ownership cost of roughly Euro 315 per day. The intermediate wagons deployed into the formation were on a 'free issue' basis for the trial. A purpose built two car TruckTrain in series production is estimated to cost Euro 1.16-1.25 million with a life of 20-25 years. This would correspond to 2-3 generations of road transport vehicles but is significantly less than a conventional locomotive and wagon combination. The operational costs derived from industry and public domain sources are calculated on the basis of the P&O NL and Freightliner cost structure. Within the following the results of a cost comparison based on a model calculation for the TruckTrain and road is shown.

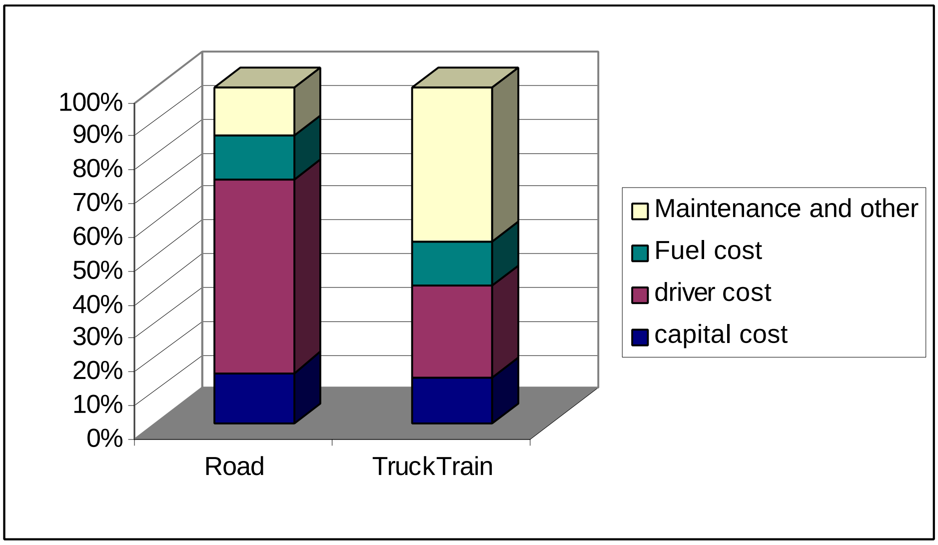


Figure 4.3/5: Comparison of major cost components for road and TruckTrain

As regards the TruckTrain the cost analysis had to be conducted on an array of cost and performance assumptions because there is no experience of operating this version (not the MPV used in the IRIS trials) of the train in intensive service cycles. The cost inputs are conservative to give no advantage to this technology. It was considered that it is possible to run the TruckTrain on 300 days on average per year. Due to legal restrictions heavy road transport operations are limited to 230 days on average per year. Therefore, within a model calculation an average annual TruckTrain kilometrage of 160.000 km and an average annual truck kilometrage of 100.000 km were considered. The annual capital cost were derived from the whole life span of the vehicles considering an average interest rate of 7% per year. In man power terms the small train formation would require a driver/operator as with a conventional train. For the TruckTrain an average employment of 2 drivers and for road an average employment of 1.3 drivers per year and vehicle were assumed within the calculation.

As regards the TruckTrain maintenance costs the stable and realistic average figures of Freightliner trains have been applied. Maintenance costs are made up of a weekly, monthly and quarterly inspections and maintenance activities. There is also an element of distance in the inspection regime and high kilometrage units would be subject to more intensive regime to ensure vehicles are in full safety and operational compliance. For the annual calculation an average figure of 1 Euro per km has been applied that is a conservative assumption for a purpose build TruckTrain operation that is considered with less maintenance costs rates.

Within the following figure the derived annual costs for the TruckTrain and a comparable road operation is shown on different annual kilometrages.

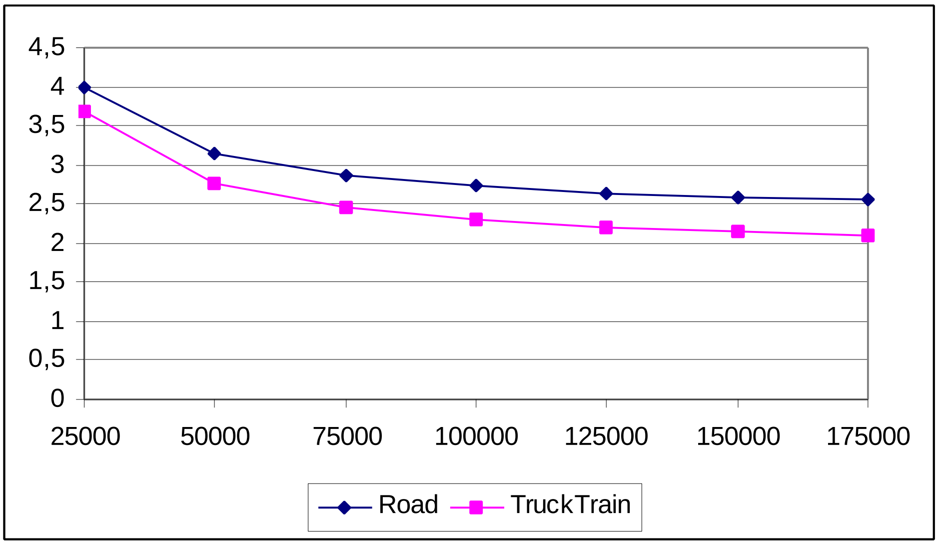


Figure 4.3/6: Transport cost comparison TruckTrain and Heavy Truck

The relatively low capital cost of the TruckTrain and the higher levels of utilisation are the key elements in its' favour in relation to the competing modes. Carrying out a cost comparison with road it become clear that to transport the same container volumes the pure vehicle costs (neglecting access charges) of the TruckTrain are significantly lower than those for conventional rail and road. Therefore, it can be concluded that TruckTrain operator's expectations in terms of efficiency gains will be given. Within the following chapter a transport cost comparison over the whole transport chain will be carried out in order to analyse the competitiveness of this concept in a "real" life environment.

Transport cost comparison

For rail the problem is the 'product' or service offer. For regular high volume traffic in and out of the main ports the use of large locomotive hauled block trains of up to 75 TEUs and operating at speeds of up to 120 kilometres per hour is an adequate market offer. The contractual position between the high volume generating shipping lines with options to operate with a considerable degree of flexibility on routes, schedules and the possible release of space on the contract train to third parties is a powerful commercial proposition where these consistent volumes are available. Where this option falters is in the provision of rail services to lower volume and more intermittent points. Spreading the high cost of traction provision across <15 wagons/45 TEUs makes this sort of option less attractive to operators thus leaving a significant volume of traffic with no real alternative other than to use road transport. Ironically this lower and intermittent volume element of the total container traffic is much larger in aggregate than the rail share. Rail has therefore to find a means of penetrating and retaining traffic flows which are denied to it by the limitations of present day rail vehicle and transfer system technologies. For this it needs a major revision of the core cost base for its services.

An analysis was made of the competing conventional rail services using block trains (i.e. where the cost of the traction is spread over a larger volume of traffic) with local pre or end haulage, direct road borne services between the port and the inland point and the new train technology. Port costs are applicable to all modes but rail has to bear the additional cost of a lift from the port shunt (MAFI) operation, the inland terminal lifting charge and the corresponding inland pre or end haulage. The key point is that the aggregation of these cost elements into a market offer is put at risk if the prevailing road transport 'price for the job' is lower than the minimum rail cost position with or without a margin or return element built in. This lack of economic 'logic' in the market place where trucking rates can oscillate wildly depending on availability, return load options, cargo incidence patterns sets the market 'price' against which the (currently) less flexible rail commercial and operational position must compete with particularly for spot or short term traffic.

For the purposes of the analysis three options were examined in detail by P&ONL on the route sector Southampton-Cardiff. This was done after discounting the routes over which the demonstrator trials were operated as this would have meant comparing the cost of a full block train for which detailed cost elements were available, with the small and less precise cost base of the new TruckTrain). The Southampton-Cardiff route sector is a relatively short distance (184 kilometres) by rail but no regular train is operated between the two points. Rail borne containers are moved to Crewe on other long distance services and re-positioned to trains originating elsewhere in the UK moving to or from Cardiff. This awkward arrangement means that the transit time is over 24 hours. For priority traffic road transport is used either directly to/from the shipper or receiver or is moved into/from the Cardiff FL terminal by a road trunk vehicle for local delivery or collection. A transit time of <4 hours is entirely feasible.

Taking these points into the position from P&ONL's perspective was that the use of a small train formation of 8-10 TEUs would be a potentially interesting proposition operated perhaps on two round trips per day. More round trips would in all probability be feasible in more developed service patterns with more TruckTrain formations operating on a networking basis. This was then compared with the existing rail service costs and the cost of trucking (effectively prices set in the local Southampton area) on this route.

The P&ONL traffic volume for the year 1999 between Cardiff and Southampton (import and export) was taken as the base with the split of container types unchanged. For the TruckTrain, on which no direct operational cost experience has been gained, a cost model-derived train cost per kilometre for a train set achieving 160,000 km per annum was included with a track access charge of Euro 2.30 per 1000 tonne kilometres for a 12 TEU train (4-vehicle self propelled) formation. Port and terminal lifting costs were built in from information drawn from within P&ONL together with trucking charges for direct movement and local operations. Provisional data from Railtrack on the prevailing level of access charges were then built into the cost comparison.

The transport cost comparison was carried out on the basis of two reference cases developed to compare the commercial situation with and without UK demonstrator:

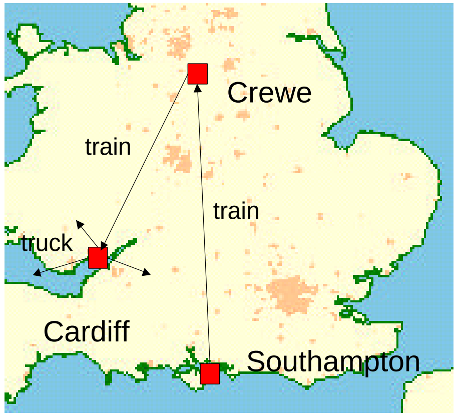
1. Southampton-Cardiff-Newport delivery with MT (empty) return to Cardiff FL depot.
2. Southampton-Cardiff-Swansea delivery with MT return to Cardiff FL depot.

The reference cases serve as comparison material for the demonstrator case on the aspects of costs and time and each are considered for four transport options:

a) Transporting containers from the port of Southampton to Cardiff with conventional train, end haulage by truck.
b) Direct truck service to customer in Newport or Swansea.

c) Main haul to Cardiff by truck, end haul to customer by local road delivery (road-road).

d) Main haul by TruckTrain, end haul by local road delivery.

<table>
<tr>
<td>Reference case 1a/2a: conventional FL service with local road delivery

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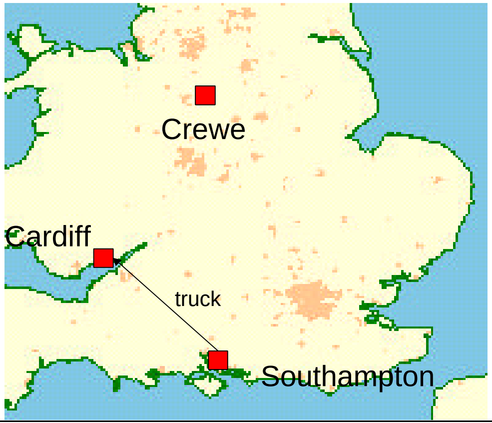
<td>Reference case 1b/2b: direct trunk road service direct to customer.

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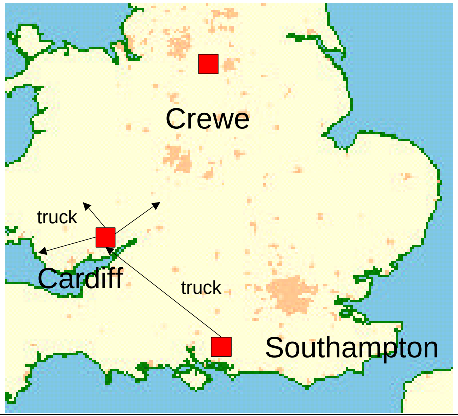
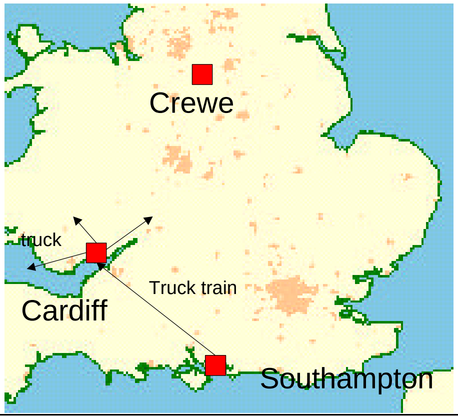
<tr>
<td>Reference case 1c/2c: road trunk to Cardiff with local road delivery

</td>
<td>Reference case 1d/2d: TruckTrain to Cardiff with local road delivery

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Table 4.3/1: UK reference cases

The cost breakdown of the Southampton-Cardiff cost analysis is given in figure 4.3/7. The detailed calculations are given in annex 3. The various reference cases were modelled on basis of available P&O NL cost rates for door to door services for rail and road modes. It would be entirely feasible for other container operators to develop a similar cost model to validate the use of the various modal choices on offer. The choice is basically between the two modal options (rail and road) and the container operator may elect to use either option depending on the traffic imperatives, availability of services and slots and a wide range of other commercial, technical and operational variables.

The results of the analysis indicate that the use of a small train formation in a stand-alone type application could achieve economies in operation when compared to the existing train and truck operations. The conservative assumptions on train utilisation (two round trips per day only) limit to some extent the competitive advantage that has been claimed. Recognition must also be made of the margin included in the calculation for the train operator (15%) which may be too high for a prototype operation.

The TruckTrain even at this modest level of performance and utilisation (not a situation that an owner would realistically accept) appears to be capable of at least matching and in some cases under-cutting the other competing modes. A more intensive use of the vehicles and refinement of the technical and operational aspects of the concept should improve the competitive position of the TruckTrain by reflecting a lower cost per kilometre or cost per container kilometre performance.

For conventional rail the high cost of the locomotive in capital terms and the cost of operations and maintenance (O&M) really are a limiting factor. The road operation is cost effective at lower annual threshold kilometrage but is outperformed at higher annual activity levels by the TruckTrain (above 70-85.000 kilometres per annum). It is believed that a TruckTrain should be able to operate up to 250-340.000 kilometres per year.

In order to set a competitive tariff, a target annual kilometrage of at least 250.000 kilometres is required with a developed and properly supported TruckTrain vehicle formation in a fleet network operation rather than a single point to point application.

Elements not taken into account in terms of the cost analysis on the Southampton-Cardiff routing include the following:

- The scheduling of movements more in line with shipper and receiver requirements rather than on the ‘supply side’ of the railways own scheduling;

- The competitive advantage to the shipping line of more flexible and timely delivery windows compared to other lines;

- The ability to transfer traffic from the more expensive alternatives and improve TruckTrain utilisation and cost competitiveness;

- More timely transits than the present rail options. This is dependent on the willingness and capability of the infrastructure to offer slots and schedules on a more rapid response basis;

- The general environmental benefits of transferring traffic from road to rail through better energy efficiency, emissions etc.

The following figure gives a comparison costs between the reference cases:

1a. Southampton-Cardiff by Freightliner service (via Crewe), road delivery to Newport and empty box returned to Freightliner's Cardiff depot.

1b. Direct trunk road service from Southampton to customer in Newport, with empty box returned to Freightliner's Cardiff depot.

1c. Road trunk service from Southampton to Cardiff, local road delivery to Newport and empty box returned to Freightliner's Cardiff depot.

1d. By TruckTrain from Southampton to Cardiff, road delivery to Newport and return of empty box to Freightliner's Cardiff depot.

2a. Southampton-Cardiff by Freightliner service (via Crewe), road delivery to Swansea and empty box returned to Freightliner's Cardiff depot.

2b. Direct trunk road service from Southampton to customer in Swansea, with empty box returned to Freightliner's Cardiff depot.

2c. Road trunk service from Southampton to Cardiff, local road delivery to Swansea and empty box returned to Freightliner's Cardiff depot.

2d. By TruckTrain from Southampton to Cardiff, road delivery to Swansea and return of empty box to Freightliner's Cardiff depot.

Each time, the cost of transporting 6 TEU is compared, divided in 2 20' boxes and 2 40' boxes. The main haul includes lifting charges in Southampton and, if applicable, also in Cardiff. End haul (or main haul in case of direct trunk road service) includes return of empty to Cardiff depot. Shunt Southampton are the costs charged for transport from the P&O terminal in Southampton to the rail terminal in Southampton. Access charges have been included for all options, but it should be noted that this entails a risk of distortion. Rail access charges are negotiable and road access charges are charged as a yearly flat rate regardless of kilometreage.

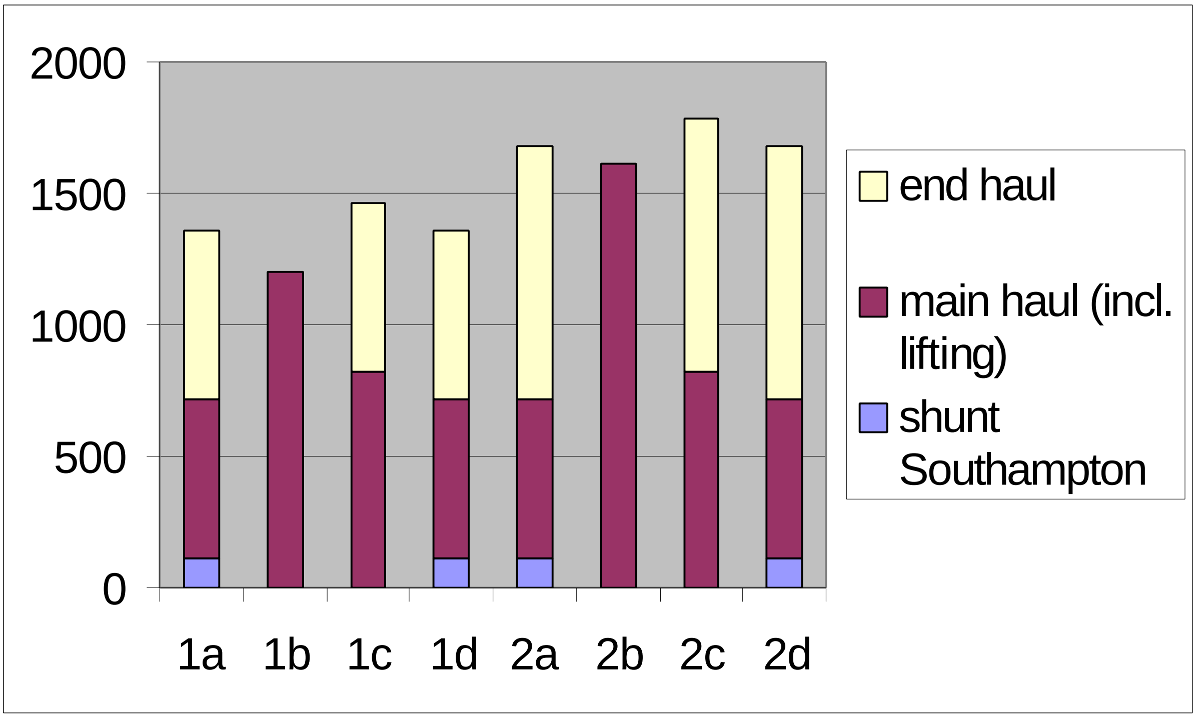

Figure 4.3/7: Cost comparison TruckTrain concept with reference cases 1a-2d in Euros

It can be concluded that the financial analysis undertaken by ARRC and P&ONL has identified that in certain applications and niche market opportunities the small train technology can be cost effective against orthodox rail services and against direct road services. Added to this direct commercial advantage there are value advantages that a shipping line or shipper could secure by using the train in terms of speed advantage, dispatch and delivery at times more appropriate to shipper's and receivers individual needs. It is difficult to put a monetary value on these but they could accrue through market share penetration and additional revenue. The case for the small trains looks capable of being significantly enhanced by the use of purpose built equipment which would be significantly less expensive than the equipment used for the IRIS trials. This advantage is further reinforced by the possibility of much more intensive use of the assets by moving towards a totally different operating, scheduling and routing methodology. In this respect the TruckTrain begins to emulate the generic characteristics of road transport but in the context of more flexible and intensive rail freight operations.

4.3.6 Techncial design of a purpose build TruckTrain

Solving the deck height and propulsion (traction) problems is the key to come to a purpose build TruckTrain. The MPV **deck height** was ‘inherited’ as a design fix from the Cargo Sprinter upon which the MPV is closely based. At 1200mm the deck height on the power cars used for the IRIS trials was too high to accommodate a standard 8’6” high international shipping container within the UK loading gauge. To accommodate such cargo units on the MPV cargo platform requires that the cargo deck is lowered to < 900mm. This then has consequences on the ‘architecture’ of the vehicle as the main power units would need to be moved to an above deck location which then limits the overall longitudinal platform length to 2 TEUs only on the leading and trailing vehicles of any formation. The loss of two TEUs of cargo space could jeopardise the economics of the concept. One design option that has been developed 'optimised' on the transport of high cube heavyweight refrigerated (reefer) containers. This used a cranked frame, a single power bogie under the leading and trailing driving cabs and above deck engine position for this specific traffic application. Because of its specific application and the need for a high cube carrying capability the trailing bogies (i.e. the inner bogies of a two car formation) used wheel sets of a much smaller diameter to accommodate the bogie centre pin maximum length design limit all of these design compromises and concessions are a consequence of the limitations of the UK loading gauge height, width and length limits.

The preferred way to maximise the payload of the TruckTrains is to be able to accommodate three 20' 8'6" cargo containers on each vehicle 'platform' and lower the cargo deck height to allow these to be carried over the greater part of the rail network inside the permitted loading gauge. This entails the lowering of the cargo deck to < 900mm as described before but retaining the capability to mount the engine(s), alternator, control and cooling equipment, fuel tanks and auxiliary systems in the limited space permitted in this configuration. The limitations of the maximum length permitted between bogie centres and the maximum over-throw on curves are further constraints to be absorbed into the design.

The use of this simple platform core configuration has many advantages including simplicity in manufacture, certification and maintenance compared to more complex cranked frame configurations. The core platform could also be used as the basis for TruckTrains operating in markets other than intermodal such as logistics applications and tanker derivatives.

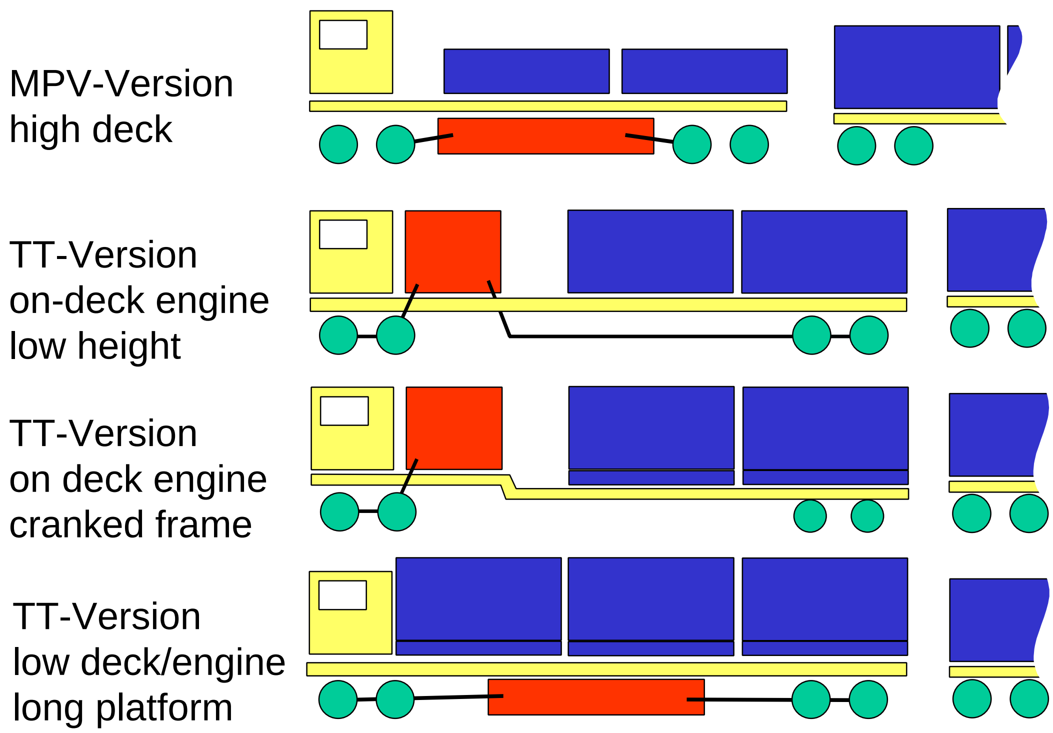

Figure 4.3/8: TruckTrain Alternative Configurations

The limitations of the MPV configuration has the added complication of only having traction applied to the inner axles of the bogies on the power car. This limits the adhesion available for traction purposes and is a direct result of the configuration adopted for the MPV's for their proper (non cargo) application in the UK. The MPV has been used as a 'template' by one other logistics company to move small formations of non-standard containers in purely domestic traffic applications. The use of the non-standard container has been adopted because of the deck height limitation.

The one big advantage of the MPV configuration is that it can potentially be used to move a range of traffic other than intermodal. The ability to marshal the intermediate vehicles (logistics/tanker/ etc) between the two power cars offers a high degree of flexibility and high potential utilisation of the powered units. The power cars would be analogous to tractor units on large road vehicles and be commercially indifferent to the rail vehicles (trailer analogy) marshalled between them. The use of this approach is compromised by the need to marshal the power cars, split the train formations and occupy parallel tracks whilst this is undertaken with associated time penalties. This approach may find favour with operators who can plan and control their operations to minimise these 'downside' issues.

The MPV in the trial was limited to 60 mph/96kph. This limit was imposed by Railtrack as part of the conditions of the demonstration. There is no reason why the MPV could not be developed to operate at higher speed levels although the lack of adhesion may be a limiting factor and become an issue if the acceleration potential was consequently low. The MPV's in their delivered configuration have been tested to 130kph. A purpose built TruckTrain has a 90mph/145 kph capability at maximum payload built into the core specification.

4.3.7 Site specific conclusions

The UK demonstrator has shown the technical and operational possibilities for the use of a small self propelled freight train. This has been done in a situation where the orthodox rail product and services are not in alignment with customer expectations or requirement at a price they are willing to accept and where the truck offers very low tariffs and a high service level.

The demonstration phase was limited by external constraints to a more limited deployment period and route network than originally intended. The imposition of these constraints limited the scope of the trials to two live operational trips from Southampton to Birmingham and London (Barking) and precluded trials with lifting equipment other than large gantry type cranes. The demonstration is regarded as a success from the commercial and operational viewpoint in that the IRIS UK demonstrator was the first use of self propelled modern rail technology in service in the UK.

The TruckTrain concept is capable of much more intensive and productive service than orthodox rail equipment. The competition with the road will remain tough because of their very low costs of transport in combination with adequate service. However, the response from potential users of this generic type of equipment since the demonstration has been significant and possibilities for future commercial application of the concept are available.

For future commercial deployment, the UK demonstrator now needs to move beyond the limitations of the demonstrator technology (for which a Multi Purpose Vehicle was used) to purpose built units. The cost of further development are estimated with 10 Mio Euro.

The TruckTrain needs cheap transhipment technology. This is also true for general intermodal services. Further research into limitations caused by exploitation of the TruckTrain concept by orthodox railway operators is also necessary. Also different safety and other acceptance requirements should be examined.

5 Changes in EC rail policy

Various regulations on national level as well as agreements among the national rail companies exist in the European rail system that create a variety of barriers for (regional) services like those over short and medium distances of the IRIS demonstrators. These barriers are a reason for a limitation of the scope of action as well as for delays at the BEDENL and the UK demonstrator in the set up and operation of the IRIS demonstrations. In comparison to road transport these barriers are a hindrance for private operators in an unacceptable way and hence a reason for extra costs – especially for new market players in intermodal transport. In more detail, the following barriers in European rail system were recognised on national but in particular at the crossing of the national borders during the different IRIS project phases and the influences on the demonstrators on different scales:

Existing barrier in the rail system	Influence on IRIS demonstrators
Lack of uniform minimum standards in infrastructure, train and wagon technology	High
• Vehicle sizes/height	High
• Track size	Low
• Power systems	High
• Signal-, safety and operational systems	Moderate
• Employment of drivers (language barriers, route knowledge)	Moderate
• Servicing and maintenance	Low
Duration of certification process of vehicles and technical and operational components	High
Lack of transparency in information flows	High
• Tracking and tracing	High
• Pass over of transport documents across borders	High
Prioritising passenger transport	Low
Lack of transhipment infrastructure	High
Lack of transparency in charging	High
Duration for bid making from service and infrastructure provider	High
Duration of train scheduling	Moderate
Hindrance in infrastructure access National slot allocation	Moderate Low
Border crossing slot allocation	Moderate/high
Access to service facilities	Moderate/high

In order to open the rail market for liberalisation the Council and the European Parliament have adopted a freight railway package at the beginning of 2001. This package includes the

- amendment of the Directive 91/440 on the development on Community's railways to open access of the railway to national freight services and to international passenger services;
- the amendment of the Directive 95/18 on the licensing of railway undertakings and
- the replacement of the Directive 95/19 by the Directive 2001/14/EG on the allocation of railways infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification.

Essentially the three Directives provide a framework that defines measures for the use of European railway infrastructure, a non-discriminatory treatment of railway companies by setting a framework of principles for infrastructure charging and infrastructure access. In particular barriers in border crossing rail services should be minimised by the new regulation framework. After an intermediate period of 7 years the limitation on a particular European (priority) network will fall away and access to a wider European rail network will be given.

From a general view point it can be stated that the measures proposed in the Directives are beneficial to reduce the/part of the barriers depicted above by creating more transparency into the access and charging process in European railways. Nevertheless it should be outlined that the IRIS demonstrators (especially the UK and BEDENL site) did not experience large problems getting access to rail infrastructure. A major problem at the BEDENL site was the lack of transparency in infrastructure and additional service charging.

Within the following brief statements on the changes in the Directives will be given, based on the experiences from the IRIS demonstrations:

- Under the charging point of view the rail package provide principles on which rail infrastructure can be charged. Charging issues are of fundamental importance for intermodal services over short and medium distances. Therefore, a common framework will be helpful to promote such services in particular, in border crossing operations. But the described principles allow no conclusions on the market influences of these principles as the price levels compared to alternative services can not be derived.
- Of major impact on the IRIS demonstrators could be the definition of services to be supplied to the railway undertakings described in Annex II of the Directive 2001/14. The clear definition of such services is a big step to create transparency in border crossing rail services. The lack of such a regulation became concrete in the set up phase of the BEDENL demonstrator when the possibilities to cross the German-Belgium border at Aachen were analysed (see chapter 3.1.2).
- From the technical and operational point of view uniform minimum standards in train and wagon technology would be recommended for the whole network (comparable to road transport). The possibility to run a "through locomotive" between Düsseldorf and Zeebrugge would have been the optimum solution in the BEDENL demonstrator. But considering the intermediate period of 7 years to open the complete national network as described in the amended Directive 91/440 and the existing problems in interoperability

within the European rail system such an option can not be realised within the short term even under the new framework.

With regard to intermodal services over short and medium distances the direct impact of the Directives are hardly to assess. Basically, IRIS demonstrated that intermodal transport over short and medium distances are technically, operationally and economically feasible and that potential in volumes for such services exists. Presently, the problem is to explore and co-ordinate such goods flows and processes. One explanation might be that to market such potentials cause high effort (especially for large national rail companies) that might not be covered by the expected revenues for such services. A key to explore these potentials might be the employment of personnel responsible market players located in the region as demonstrated by the BEDENL demonstrator who:

- adapt the regional market and circumstances;
- have low overhead cost due to small business units
- show a high degree of flexibility in order to be able to react on customer requirements, accordingly.

Supported by the IRIS results European rail system needs to break down overcome structures which leave space for new and innovative services and solutions in intermodal transport. As depicted by the UK demonstrator the idea is to drive up rail's productivity to levels well above that achieved by orthodox operations and achieving parity with the best road transport operators. To do this means operating the infrastructure system in a more active and intelligent way to allow trains to be moved at short notice on routes required by shippers. To have the option to deploy trains on routes, slots and at schedules requested will mean much more flexibility in the whole planning and control process is required.

Therefore, it is not sufficient that the whole restructuring process remains a process to be transferred among the existing national rail companies. Moreover, an active role from the EC is needed to introduce and secure competition in European rail market, e.g. by the provision of incentives to newcomers in rail market. From this point of view the EC rail package includes target leading aspects, but needs for a fast and consequent transformation by the member states, following the vision to create “real” competition in European rail market.

6 Results and follow up measures

Even though the IRIS demonstrators were quite different in nature, some observations could be drawn that are valid for all three of them. The first concerns volume. Even for intermodal services on small and medium distances and for small and intermittent flows volume counts. As a second result it can be stated that the more concrete a demonstrator, the easier it can be implemented and transferred to other situations. The Italian demonstrator or the TruckTrain could readily be transferred to other locations, whereas the BEDENL concept needs to take into account specific local circumstances, such as the availability of a regional railway.

Overall, there is a potential for intermodal transport on short and medium distances, but under specific conditions only. A major advantage of the IRIS demonstrators is that the concepts in itself are not difficult to implement, what is more needed is to find the right circumstances.

The following table 7/1 provides a survey on how each of the three sites has treated one of the main research and development criteria.

Criterion/Site	BEDENL	IT	UK
Intermodal Transport	●	●	●
Innovative	❍	●	●
Improvement compared to the state-of-the-art	●	●	●
Integration of operators	●	●	●
Short-and-medium Distance	●	❍	●
Border crossing	●	-	-
Faster Train	❍	-	❍
Demonstration Day	●	●	●
Dissemination Day	●	●	●
Commercial Validation - Lower operation cost	●	-	-
Information & Communication Technology	-	●	-
Tracking & Tracing	-	●	❍

Dealt with "●" fully, "❍" partly, "–" not at all

Table 7/1: Comparison of Demonstrators

Within the following the main themes, which occurred in the demonstrators, are discussed and segmented by

- market players
- barriers to be lifted.
- information and communication technology and
- technological aspects

Issues related to market players

The attitude of transport market players towards intermodal transport is still an important hindrance for the implementation of effective intermodal services. National railway companies are not able to perform up to shipper's requirements and lack a market-oriented attitude. Liberalisation of the rail freight market has a long way to go, and meanwhile it is difficult to set up competing intermodal offers. The transport market is highly price driven and it is difficult to improve services with technology oriented solutions. What is really needed is a new generation of transport managers that take up the market challenge of organising seamless intermodal transport services.

In many cases, it was found that an integrator is lacking. An integrator would be a party willing to take the commercial risk of setting up an intermodal service, thereby keeping an overview of the total door to door chain and co-ordinating all parties involved into an integrated logistics chain concept. This would also allow shippers to profit from an one stop shopping intermodal transport services. Yet, no party is willing to act as such an operator for fear of becoming responsible for other parties' incompetence's. Risk sharing in the form of co-loading could be a solution here. Therefore, an integrating party is an absolute must to get intermodal transport going on short and medium distances a real market approach for all participants involved in such transport chains will be necessary which is presently not given within EU rail system.

The interests of shippers are not always totally clear when it comes to intermodal transport. However, throughout the project, it once again became clear that two things really matter for shippers as far as transport is concerned: service and cost. For intermodal transport, it is not different. Service should improve and cost should be cut, by introducing new service offers and smartly combining new and existing technologies.

Intermodal transport on short and medium distances can be considered as a niche market, but still, transport volumes are significant. The niche market aspects of it are rather related to its specific characteristics than to its volume. These niche market characteristics require particular conditions to be economically successful. Niche users should be identified and there needs carefully analysed, to be able to effectively address these.

Some national railways need to adopt a more commercial mindset, taking customer requirements as a basis instead of operations. This will allow private parties to exploit the niches of intermodal transport on short and medium distances. These could be complementary to the services offered by the large national railway companies and thus strengthen the rail product as a whole. IRIS provides useful basic insight in private rail operations and covers the major aspects of private or innovative rail services, however, the commercial impact on company level needs to be further identified.

As a resume on these issues related to market players it can be stated that any successful intermodal approach should take the shippers needs and requirements as its basis, and perform up to these requirements. Succeeding in doing so highly depends on the presence of an integrating party, acting as a single spokesperson towards shippers and organising the many parties involved into a seamless intermodal transport chain. Furthermore, the cargo potential for a service should allow threshold volumes to be reached to set up intermodal services for short and medium distances. The demonstrators have shown that concepts can be successful serving relatively small cargo flows.

Barriers to intermodal transport on short and medium distances

One of the most striking barriers to intermodal transport are cross-border issues. Cross-border rail freight transport faces such high costs and time losses, that it becomes hardly possible to compete with road, especially on short and medium distances. There are three important barriers to cross-border rail transport:

- *Technical barriers*. In different countries, different systems are used, and not all equipment is compatible in multiple system situations. For instance different voltages exist throughout Europe, requiring locomotive unit changes at borders or the use of relatively expensive multiple voltage locomotives.
- *Operational barriers*. Even if multiple voltage or diesel locomotives were used, in many cases operating crews are not allowed to operate under different systems or regimes. Many railways still have a myriad of rules dating back to the early days of the railways in the first half of the 19^{th} century, which make complying with different railway regimes a difficult task.
- *Commercial barriers*. Since so many technical and operational barriers exist, border crossing is a time and money consuming operation. This makes it commercially very hard to compete with road freight transport, which at least within the EU is not hindered by border crossing at all.

The issues of *standardisation, liberalisation and harmonisation* form other barriers that need to be overcome. Unfavourable conditions remain, especially in the fields of legislative and technical differences between member states. The three demonstrators showed that technical solutions exist and are not the main problem. Relatively cost efficient technical solutions are available on the market. It seems that technical barriers are used as economic barriers.

In many European countries, cross border issues are important. Solutions to solve these have therefore a high potential for transferability. The same holds for financial issues, which are a universal key issue. Transferability highly depends on the costs and tariffs of the services, in combination with reliability. Liberalisation of the European railways should take place at a much faster pace, as it is a prerequisite for efficient implementation of the demonstrated solutions. There is an urgent need to link equipment, infrastructure (slots and allocation) with commercial systems to facilitate exploitation. Furthermore, a mechanism for economically successful exploitation of train and systems concepts should be actively initiated and moderated by the EC.

In general, financial barriers are quite an obstacle when setting up rail services. Investment in train components brings along a big financial burden, which needs to be covered by sufficient exploitation levels. Many parties operating in the intermodal transport business cannot or will not take such risks.

Another difficult issue is tariffs for transport. There is no real market price for a transport service that can be calculated. Tariffs depend on the available alternatives to the shipper and on top of that they are usually negotiated rates. This makes it hard to compare between different modes.

Pre- and end-haulage costs still are a major limitation for intermodal transport, this is even more so in intermodal transport on short and medium distances. Using services that require no or hardly any pre- or end-haulage could solve this, an example would be a TruckTrain coming to a customers private railway sidings. The current intermodal terminal structure however is not suitably set up with its high volume terminals covering relatively large geographic areas. The same holds for terminal charges, which often incur a significant proportion of inland transport costs. These could be brought down by using self loading/unloading equipment.

Some railway companies do not have a commercial mindset and are not ready for open access yet, resulting in slow response times. This makes it hard or even impossible for private companies to start up economically viable services. In order to beat the competition from road transport, rail will have to upgrade its services in terms of response time and reliability.

Tariffs of services are so important, that the viability of other issues (reliability, possibility to plan, flexibility, etc) can hardly be assessed before the pricing issue is solved. It seems that price is the first issue to be tackled, only then will potential users become interested and can other requirements be addressed. IRIS demonstrators have failed to mention market prices for the demonstrator services, which is due to the fact that the price composition of existing intermodal services is not very transparent. The conclusion is that cost-effective solutions for short and medium distance intermodal transport solutions exist, but they will be constrained to specific situations.

Information and communication technology

Information and communication technology has a key role to plan, operate and monitor inter-modal services over short and medium distances. Beside the positive acceptance of the Information and Communication Platform (ICP) at the Italian demonstration site aiming at an enhanced quality service of intermodal transport, information and communication technology can be the key to overcome technical and operational barriers within the rail system. Examples for activities are given by the UK demonstrator that identified the enhanced employment of rail based information and communication technology (for slot allocation, route knowledge etc.) as further field of research.

The approach as demonstrated by the Italian site needs to be extended to a door-to-door approach by integrating the transport operators carrying out the final delivery of the containers. In this respect research on the development and integration of existing software application into an intermodal planning application representing the whole transport chain to/from the seaport and the final consignee/customer is highly recommended. This application should consist the following functionalities:

- Allowing the planning of intermodal transport operations and providing decision support which mode of transport should/can be used (according to specific parameters) most efficiently.
- Allowing real time tracking and tracing information for the containers over the whole transport chain and providing this information to both the operator as well as the customer/consignee (via internet).

Technological aspects

The IRIS demonstration showed that the TruckTrain concept could realise cost savings for shippers such as P&O Nedlloyd on a short sector route currently wholly operated by road transport. This is a starting point to be developed much further with more customer oriented train technology, support and operating systems and cargo handling technologies. The demonstration partners believe that the TruckTrain is capable to achieve a shift of traffic to rail by offering a more attractive service at a lower cost in particular in the market for small and intermittent volume flows and over short and medium distances. There is a need to get funding into a refinement of the concept into purpose build cargo train units to allow shippers, operators and owners to get experience on the new technology (comparable to the AIRBUS idea). The investment costs for the development of such two prototypes are estimated at 10.4 Million Euro.

The notion of developing a common European design platform is an attractive concept as this could reduce total production costs, significantly. The alternative of a local design for UK domestic use and a common European dimensioned version may be more practical and this would exploit the larger loading gauge in Europe for all the traffic applications foreseen. The lower loading gauge is certainly of benefit in accommodating higher cube containers without the need for a complex frame modification.

Further research on the development of a multi-voltage electrically powered version of the train is needed to achieve international inter-operability. This could be supported by the use of batteries or fuel cells for short distance operation where no overhead power supply is available. The use of a fuel cell or hybrid engine for the TruckTrain suggests further environmental benefits.

7 Consolidated conclusions

The IRIS demonstrators consider different rail operations such as feeder, hub as well as composite trunk haulage in the hinterland of seaports. In particular the BEDENL and the UK approach focussed on the technical and operational demonstration of appropriate concepts to serve the region with a minimum part of road haulage. The Italian demonstrator followed the approach to increase the quality of intermodal services by the development and implementation of a common ICP covering a complete intermodal transport chain in seaport hinterland transport. The three IRIS demonstrators have been designed closely to the recommendations derived from the OSIRIS project.

As a general conclusion the three IRIS demonstration approaches proved their technical and operational feasibility. It became obvious that most of the problems occurred during the different project phases reflecting the actual situation in European (rail) transport markets. Therefore, it has to be distinguished between the technical and operational demonstrations in UK and Germany/Belgium and the development of an intermodal related IT infrastructure in Italy.

Obviously, the BEDENL and UK approach are a solution for particular niche markets in seaport hinterland operations being complementary to the existing operations such as long haul direct trains. Nevertheless, attracting cargoes for intermodal rail operations in the regions means also to minimise road operations on the pre and end leg of intermodal operations. This is in contrary to the general strategy of public railway companies such as of the DB AG to concentrate their intermodal terminal network on main routes with high volumes. This strategy bears the risk that the road leg in intermodal transport chains will be enlarged or that cargoes are left to road completely with negative effects for the use of infrastructure, environment and society.

In more detail the following overall conclusions on the technical and operational feasibility of the IRIS demonstrators can be stated:

Different technical and operational standards in the European rail system are a barrier to set up intermodal transport, in particular for international border crossing operations. The BEDENL demonstrator showed that examples for successful intermodal services over short and medium distances in the hinterland of the Belgium seaports actually exist. Even the service from Zeebrugge to Bressoux is operated on a distance below 200 km. However, the political borders (equal to the borders of the national rail companies) are still a barrier for expanding services. The complexity and severeness of different political, technical and operational regulations inherent in the rail system cause high start up costs which require long and stable transport flows for coverage. Generally, attracting the region means consolidation of “small numbers” of container volume on the demand side and the provision of transport capacity with a high uncertainty in costs revenues on the supply side.

For the demand and the supply side two success factors from the IRIS project can be stated:

- For the acquisition of load the BEDENL partners have identified the lack of an integrator acting as intermediary between the customer requirements in terms of time and quality and among the partners providing the transport service. In comparison, the UK demonstrator showed that the involvement of P&O Nedlloyd acting as forwarder for door to door container services has been a big advantage for the set up and operation of intermodal transport chains over short and medium distances.

- For the set up of intermodal services over short and medium distances the BEDENL demonstrator followed a flexible approach. Considering the uncertainties on the demand side intermodal services have to be designed according to the availability of load. The set up of direct trains or a co-operative approach supplementing existing (long distance) trains might be the task for an intermodal integrator. The application of existing technology will be an additional measure to reduce high start up costs.

The availability of adequate transhipment facilities in the regions are a major prerequisite to set up and carry out intermodal services over short and medium distances. A limiting factor for the BEDENL demonstrator was that terminals planned to be used for the demonstration were closed by the DB AG (Aachen) or not build during the project life time (Düsseldorf, Düren). The UK demonstrator also identified the need to find appropriate transhipment technology allowing the TruckTrain to operate apart from stationary transhipment facilities.

A crucial partner for private carriers (indifferent to the company size) to set up intermodal services are the public rail companies. The dominant position of public rail companies within the rail system and their influence such as in the field of providing rail access, additional services (shunting etc.) or operational regulations and bilateral agreements in international operations contains a high potential for discriminating against “external” competitors.

The BEDENL and UK demonstrators showed the different innovative approaches on the feasibility of intermodal transport over short and medium distances. For both in common the approaches focussed on new concepts beyond the existing block train philosophy of public rail companies. In particular, the BEDENL demonstrator showed that in Germany the integration of private rail companies in international transport chain without using the service of DB Cargo is “almost” possible under the present rail framework. Nevertheless the options for the private operator DKB on the BEDENL site being a service provider are currently limited and will therefore make the participation of the DB AG still necessary. But the BEDENL demonstrator showed **how** the rail system as a whole can become more efficient and therefore more competitive by integrating third parties providing feeder and additional services (e.g. coupling, shunting or transhipment).

The IRIS demonstrators on the UK and BEDENL site were carried out under three different infrastructure access systems. In UK a completely independent and liberalised system, in Germany a commercially independent but integrated within the public rail company DB AG and in Belgium a state owned and controlled rail infrastructure institution were involved in the demonstrations. It can be stated that the access to the infrastructure for private operators was not a problem in Germany and UK. Whereas the infrastructure charges are one if not the crucial factor to jeopardise the success of intermodal rail operations over short and medium distances. In particular for the German and the Belgium system a lack of transparency for external parties can be stated.[13]

[13] The German infrastructure pricing system is under modification. The new system became into force by April 2001.

First priority in the transport market is “the price” for transport services. Therefore, a success factor is the market acceptance of the approaches even for the technical and operational evaluation of intermodal services over short and medium distances. Due to the integration of further users to the ICP the success of the Italian demonstrator from the market side has been proven. As well as the BEDENL and UK demonstrators who achieved a high acceptance for the specific concept with a severe willingness of the partners to further develop the approach.

Glossary[14]

? ***Actors:*** The decision makers involved in the project who have the (market) power to influence demonstrator solutions in a positive or negative way.

? ***Activity Based Costing***: A quantitative Business evaluation with the ability to fashion outputs that can be used in comparisons.

? ***Actual impacts***: Measured changes following the implementation of a policy, strategy or measure.

? ***Analysis***: Identification of relevant impacts of changes in the intermodal railservices in the technical/operational, financial and socio-economic field.

? ***Application***: A telematics system or service as installed and operating in a real-life environment.

? ***Assessment category***: Type of assessment, used to validate or evaluate (an) ATT system(s) in Transport. The European Committee suggests the following types of assessment

- Technical assessment (system performance, reliability)
- User acceptance assessment (users' point of view, preferences, willingness to pay)Impact assessment (transport efficiency, environment)
- Social-economic evaluation (effectiveness, benefits and costs of system implementation)
- Financial assessment (rate of return, payback period)
- Other types of assessment (e.g. analysis of legal and institutional aspects)

? ***Assessment objectives***: Objectives used to evaluate and make choices among alternative options. They stem from the stated objectives and the anticipated goals of the P/D project).

? ***Assessment***: The process of determining the performance and/or impact of a policy, strategy or measure, usually in comparison with a reference case (i.e. an existing situation). It often includes (as in the case of P/D projects) an experimental process based on real-life or other trials, often involving users.

? ***Assessment tools***: Quantitative and/or qualitative methods to determine the performance or impact of a given policy, strategy or measure.

[14] Based on SURFF, MAESTRO

- ***Core impacts***: Those impacts of a scheme that correspond directly to its objectives.
- ***Cost/Benefit analysis (CBA):*** A methodology that measures the impact of introducing a system using identifiable costs and benefits, with respect to operational goals. Typically, emphasis is placed on quantitative elements, expressing the costs and benefits in monetary terms. However, qualitative benefits can also be indicated by a users' assessment.
- ***Cost-effectiveness analysis***: A methodology used in the final stage of an evaluation, in which all impact categories are used: those which can be directly expressed in monetary terms, those which can only be indirectly expressed in monetary terms (e.g. through experts' opinions), and purely qualitative impact categories. Positive and negative monetary expressed impacts will be weighted against the positive and negative non-monetary expressed results.
- ***Demonstration***: A validation stage involving real-life applications of the policy, strategy or measure being tested. A sufficiently large sample of users is used in real-life conditions to assess cost-effectiveness, user friendliness and market acceptance as well as the feasibility of the system
- ***Demonstrators***: Projects dealing with different aspects of rail services demonstrating the success/failure of innovative rail concepts.
- ***Design***: The process of refining the functional operational and technical characteristics of the schemes to be deployed.
- ***Environmental impact***: Actions of a demonstrator on all or some elements of the surrounding physical and material world
- ***Estimated impacts***: Expected, modelled changes prior to the full deployment of a scheme.
- ***Evaluation***: The process of determining the value of a policy, strategy or scheme to the users and to the community in comparison with a reference case
- ***Expected impacts***: The expected or desired changes underlying the use of a policy, strategy or measure.
- ***External effects***: All impacts of transport activities on persons other than those engaged in the activities or on the society as a whole, for example, pollution, noise or uncovered infrastructure cost.
- ***Feasibility analysis***: Analysis investigating whether the goals for the field trial in the pilot are attainable and practical in terms of, financing, competence, organisation, resources, time available etc.
- ***Financial assessment***: The process of determining the performance and/or impacts of initial and running costs, rate of return, pay-back periods, etc.
- ***Framework***: A model which forms the basis of specific customized derivatives.
- ***Freight transport***: The transport of goods.

? ***General evaluation scheme***: A common framework evaluation plan with consolidated methodologies.

? ***Goal***: An attainment level of system performance. A prerequisite of goal evaluation is the establishment of measurable target levels.

? ***Impact assessment or analysis***: Procedure of determining the performance and/or impacts of the policy followed with regards to the safety, the environment, the user behaviour, etc.

? ***Impact:*** Change or effect brought about by the implementation of a policy, strategy or measure, in real-life, simulation or other experimental conditions.

? ***Indicators:*** Parameters, measured directly or derived from measurements or modelling, that indicate the performance or impacts of a policy, strategy or scheme

? ***Initial evaluation***: The evaluation of a scheme prior to its development based on anticipated, forecasted or desired impacts

? ***Instrument***: A data collection method that is used to evaluate the pilots.

? ***Intermodal transport***: The movement of goods in one hand and the same loading unit or vehicle which uses successively several modes of transport without handling of the goods themselves in changing modes.

? ***Interurban transport***: A transport system connecting two or more urban areas

? ***Interview:*** Open questions, asking for the relevant specific information or data needed for the evaluation.

? ***Judgmental assessment***: Assessment based on experts' views rather than on quantified data.

? ***Market assessment***: Procedure to determine the performance and/or impacts of the demand and supply.

? ***Measure***: A procedure, or set of procedures, of quantification of a notion through the application of a reference unit. It can be ordinal or cardinal.

? ***Measurement:*** The outcome of measure in an acceptable unit, which corresponds to the notion.

? ***Methodology***: Development of the identified evaluation types with methods to be used in order to reach a quantitative or qualitative assessment.

? ***Monetary valuation***: The deriving of a monetary value from other measurements

? ***Multi Criteria Analysis (MCA)***: The study of decision making problems in which multiple criteria are considered simultaneously without being necessary to convert them to a common unit of measurement.

? ***Non-core impacts***: Indirect effects of a scheme, not corresponding to its immediate objectives.

? ***Objectives of assessment***: Criteria which may be defined at different levels for making judgement about the candidate system.

? ***Operability assessment***: Evaluation analysis methodology with respect to the man-machine interface, e.g. the co-ordinated operation between man and machine, taking into account factors such as user-friendliness of the system, etc.

? ***Operational evaluation***: All aspects of the day-to-day organisation of the system.

? ***Overall user acceptance***: A combination of several elements of overall sorts of evaluations.

? ***Parameter***: A variable that is used to describe an aspect of a specific demonstrator pilot.

? ***Physical measurement***: Data provided by measurements on an actual system rather than by simulation.

? ***Pilot project:*** A project intended to test the feasibility of an innovative concept, technology or technique under real life conditions.

? ***Policy goals/objectives***: General aims to which the policies, programmes, plans and projects are intended to contribute.

? ***Ranking:*** The placing of objects in order of importance, either increasing or decreasing.

? ***Score card***: An ordinate scale that points out the relative changes as a result of the innovative services.

? ***Socio-economic evaluation***: A category of evaluation in which a candidate system is compared with alternative system(s), usually including a "base" or "reference" case scenario, in terms of a set of defined, socio-economic, indicators.

? ***Stakeholder:*** Any party involved in the demonstrator project, either with or without means of influence on the project.

? ***Strategic assessment***: combinations of results of other evaluation types in a long term perspective.

? ***Strategy***: Set of measures arranged in a certain time frame and directed at certain target groups intended to contribute to meeting specific goals.

? ***SWOT analysis***: Evaluation methodology for strategic assessment, analysing Strengths and Weakness (SW) of pilots and Opportunities and Threats (OT) which can affect their results. This analysis is mostly of qualitative nature and will elaborate on the possible influence the new ATT applications could have on the total road transport market and ultimately, on the society as a whole.

? ***System analysis***: An analysis carried out by operators in order to check the performance of the system and ensure that the requirements are met; it is thus concerned with the technical operation of the system itself.

? ***Tailor-made evaluation scheme***: A customisation of the general evaluation scheme for the gathering of the relevant information of the very different aspects in rail services at the three specific sites.

? ***Technical evaluation***: Evaluation determining how far a system meets technical requirements and expected objectives with regard to system performance.

? ***Traffic management:*** Set of measures to influence the traffic situation. Traffic management is a subset of TDM.

? ***Transport policy:*** Policy aiming to reduce the negative effects by either increasing transport infrastructure or managing transport demand.

? ***User group***: Demonstrator partners with similar purpose(s).

? ***Validation:*** The use of real-life trials involving users to verify that a telematics application or service performs as expected.

? ***Value function*****:** Function to convert measured or derived quantities into (one-dimensional) units of evaluation.

? ***Verification:*** A limited validation process to justify a scheme's proceeding to a full demonstration. Key users and sufficient impact analysis to assure key actors about the likely impacts concern verification with testing the operating performance, acceptance of the system.

? ***Weights:*** Parameters indicating the relative importance of evaluation objectives.

? ***Zero-state analysis:*** Collecting information about the reference unit of evaluation (e.g. the transport company) concerning technical, economical, operative and social status, before the introduction of the system to be evaluated. The data can be collected from documentation, data sources (written, from computer-files etc.), interviews and from personal knowledge.

Annex

Annex 1: Assumptions of the BEDENL cost calculation

- Maximum Number of wagon: 590 m train length / 21 m/wagon = 28 wagon/train
- Realistic Number of ITU: 28 wagon x 3 TEU x 66% capacity use x 1.5 TEU/ITU = about 40 ITU/Train
- (pre- and On-) Road Haulage costs per hour according to background information: about 75-80 Euro/hour
- Accepted transhipment price road-rail in small terminal including state funding: < 15 Euro/ITU
- Wagon costs based on investment of 45,000-55,000 Euro, 20 years depreciation, 7% interest, 2 % maintenance: 15-20 Euro/day
- Shunting loc cost and Inspection cost based on experiences of the rail operators: 140-150 Euro/hour
- Main line loc costs based on 3-3.5 Mio Euro investment, 25 years depreciation, 7% interest, 5 % maintenance and one loc driver at 30-35 Euro/hour: 150-160 Euro/hour
- Main line Track costs due to experience of demo day in Germany transferred to Belgium as well: 5 Euro/train x km[15]
- Transhipment price road-barge at DCH according to Port of Düsseldorf: 23 Euro/ITU; 2 costing moves per ITU: e.g. barge to depot + depot to truck
- Loading empty as per information of Port of Düsseldorf: 107 Euro/ITU
- Transhipment price road-rail at TTD as per information of Port of Düsseldorf (including state funding): 17-18 Euro/direct move
- Factor of double handling at TTD: 1.75 (25% of trucks have to be next to wagon when train arrives!)
- Port Fee according Port of Düsseldorf for 1 TEU multiplied with 1.5 TEU per ITU: 11.50 Euro
- Road Price Düsseldorf - Zeebrugge confirmed by Port of Düsseldorf
- Price for intermodal transport via Bressoux to Düren according to IFB "formula 1" 254 Euro (to Düsseldorf 291 Euro)

[15] When using the demanded “reduced” track fee of e.g. 50% the total costs for Düren IRIS case would be reduced by 8% and the TTD Düsseldorf case by 12%.

Annex 2: IT evaluation information

Table A3.1 Messages import cycle

Seq.	***Message***	***Content***	***Sender***	***Receiver***
A	Train consist	Full description of a train, including the list of all the wagons forming the train, each of them identified with its number - unique for each wagon -, and, for each wagon, the list of the containers carried by that wagon, with all the relevant data (id number, type, port of loading/discharge, ship of loading/discharge, etc)	VTE	ITALC
B	Train consist	Same message as above	ITALC	Int
C	Gate out	In this context, the notification that a certain train, fully described in a previous train consist message, has left the sender's premises	VTE	Int / ITALC
D	Gate in	The list of all the containers that are arrived at sender's premises in a certain period of time (e.g. one day)	Int	ITALC

Table A3.2 Messages export cycle

Seq.	***Message***	***Content***	***Sender***	***Receiver***
A	Wagon availability	Request for a certain amount of wagons, with the specific indications of type and quantity	ITALC	Int
B	Transport instructions	Instruction for a specific transport of given containers, each reported in detail	Carrier	ITALC
C	Consignment order	Permission to accept, and discharge from truck, a given container(s), described in detail, including the next destination (by train) and the ship wher it is to be loaded	ITALC	Int
D	Train consist	Full description of a train, including the list of all the wagons forming the train, each of them identified with its number - unique for each wagon -, and, for each wagon, the list of the containers carried by that wagon, with all the relevant data (id number, type, port of loading/discharge, ship of loading/discharge, etc)	Int	ITALC
E	Train consist	Same message as above	ITALC	VTE
F	Gate out	In this context, the notification that a certain train, fully described in a previous train consist message, has left the sender's premises	Int	VTE/ITALC
G	Gate in	The list of all the containers that are arrived at sender's premises in a certain period of time (e.g. one day)	VTE	ITALC

Table A3.3 General indicators IT on information flows import and export before and during demonstration

Messages import flow	*Frequency*	*# of info*
Train consist	1 per day	30-50 containers per train
Gate out	on request	1 per train
Gate in	on request	1 per train, specifying the exceptions
Messages export flow		
Wagon availability	1 / 2 per day	20-30 wagons per train
Transport instructions	30-50 per day	1 per container
Consignment order	30-50 per day	1 per container
Train consist	1 per day	30-50 containers per train
Gate out	on request	1 per train
Gate in	on request	1 per train, specifying the exceptions

Table A3.3 Messages sent during demonstration

	Evaluation criterion	*Indicator*	*Measurement*
1	**Number of messages sent by EDI:**		
	Type of message	*# msg*	*NOTES:*
	▪ Wagon availability	10	This message has been abandoned, since it has been considered not relevant in the day-by-day operation, at least as far as it cannot be exchanged with FS (Italian Railways)
	▪ Transport instructions	30	This message is currently under test with a partner external to IRIS project
	▪ Consignment order	180	After a heavy utilisation at the beginning (until February 2000), this message has been less used due to some problems in accepting its legal validity
	▪ Train consist	70	Quite exclusively from Bologna to Genova: the opposite route is very poorly represented
	▪ Gate in/out	250	It isn't possible a distinction between gate in and gate out. Some of the messages concern the arrival (gate-in) by road.
2	**Containers per message**		The number represents the average amount of containers contained in each message, unless otherwise specified
	Type of message	*# pcs*	*NOTES:*
	▪ Wagon availability	200	In this context, the number means "Wagons"
	▪ Transport instructions	1,2	There is a transport instruction for each truck, usually carrying only one container
	▪ Consignment order	1,2	Same as above
	▪ Train consist	50	
	▪ Gate in/out	50	A message includes usually the containers entered or exited during one shift (8 working hours)
3	**Number of messages using traditional means of communication within the demonstrator context**		**Total number during the demo phase**
	Type of message	*# cnt*	*NOTES*
	▪ Wagon availability	20	In this context, the number means "Wagons"

	Evaluation criterion	Indicator	Measurement
	▪ Transport instructions	> 1000	This message is usually used in gate-in operations, handled by hand at the gate, and confirmed, as a Consignment Order, by the MTO
	▪ Consignment order	0	See above
	▪ Train consist	100	
	▪ Gate in/out	10	This message is currently exchanged by phone only if something irregular happens
4	**Number of messages handled using EDI between IRIS partners, outside the demonstrator context**	0	
5	**Generated error**	2	The terms "error" refers to irregular communications or corrupted data. It is NOT counted the errors due to an incorrect data entry by the first element of the chain
7	**Throughput time (in minutes)**		
	a) before implementation		
	Type of message	*Time*	*NOTES:*
	▪ Wagon availability	5	
	▪ Transport instructions	15	Considered together with the consignment order
	▪ Consignment order	-	See above
	▪ Train consist	20	
	▪ Gate in/out	-	
	b) after implementation		
	Type of message	*Time*	*NOTES:*
	▪ Wagon availability	-	
	▪ Transport instructions	2	
	▪ Consignment order	1	
	▪ Train consist	10	
	▪ Gate in/out	5	

Annex 3: UK evaluation information: reference case comparison

IRIS Cost Comparison Exercise

Base Cases.

1) Southampton-Cardiff-Newport delivery with MT return to Cardiff FL depot.
2) Southampton-Cardiff-Swansea delivery with MT return to Cardiff FL depot.

Modal Options:

a) By conventional FL service via Crewe with local road delivery MT to Cardiff.
b) By direct trunk road service direct to customer with MT to Cardiff.
c) By road trunk to Cardiff with local road delivery and MT to Cardiff.
d) By TruckTrain to Cardiff with local road delivery and MT to Cardiff

1. Southampton-Cardiff-Newport and empty return to Cardiff FL depot
Case (a)

Rail rates based on 1999 wagon utilization indices contracted to P&ONL
Euro 604 per round trip per wagon /Euro 302 one way/Euro 100.70 per TEU (100% load factor and including lifting charges at Southampton FLT and Cardiff FLT

@ 83% load factor the rail rate moves to Euro 20.85 per TEU.

Euro 18.80 per TEU terminal shunt at Southampton to FL terminal.
Euro 189.10 local road transport from Cardiff FL to Newport and MT to Cardiff FL depot.

Cost summary

	20’	40’
(100% LF)	Euro 280.43	Euro 399.92
(83% LF)	Euro 300.58	Euro 440.22

Total Cost for 6 TEUs (2x20’+ 2x40’) @100% Load factor

Euro 1360.70 (Euro 226.78/TEU).

Total cost for 5 TEUs (1x20'+ 2x40') @ 83% Load factor

Euro 1181.01 (Euro 236.20/TEU)

Total cost for 5 TEUs (3x 20' + 1x 40') @ 83% load factor

Euro 1341.95 (Euro 268.39 TEU)

Case (b)

Direct delivery by road from Southampton to customer and MT to Cardiff FLT
Includes terminal lifts and bridge toll charges.

20' & 40' container rate per unit	Euro 299.48
Total Cost for 2x20' +2x40'**.**	**Euro 1197.92**
Cost per TEU	Euro 199.65

Case (c)

Road trunk to Cardiff FLT with local road delivery and MT to Cardiff FLT.
Includes terminal lifts and bridge toll charges.

Trunk rate per unit	Euro 205.08
Local delivery	Euro 160.93
Total Cost per unit	**Euro 366.00**
Total cost for 6 TEUs	**Euro 1464.05**
Cost per TEU	**Euro 244.00**

Case (d)

TruckTrain

313 kilometres
Rail haulage rate from cost model @160,000 kilometres pa/100% LF with 6 TEUs.

(2x20+2x40’) Euro 2.12 per train km.

Rail haulage	Euro 339.27
Terminal Moves at Southampton	Euro 112.72
Road delivery	Euro 643.73
Access Charges @ Euro 2.30/1000 tkm	Euro 63.32
Lifting charges at S’ton & Cardiff Flt.	Euro169.07
Total Cost	**Euro 1328.11**
Cost per TEU	**Euro 221.35**

2. Southampton-Cardiff-Swansea with Empty return to Cardiff FL depot

Case (a)

Rail rate Euro 302.14 one way (per wagon) Euro 100.71 per TEU based on 100% load factor Euro 120.86 @83% load factor

Euro 18.79 per TEU terminal shunt at Maritime terminal

Euro 240.77 per unit road rate for delivery and empty return

	20'	40'
100% LF	Euro 360.27	Euro 479.76
83% LF	Euro 380.42	Euro 520.06

Total Cost for 6 TEUs (2x20' + 2x40')	Euro 1680.06 (100%LF)
Cost per TEU	Euro 280.01
Total cost for 5 TEUs 1x20'+ 2x 40'	Euro 1420.53 (83% LF)
Cost per TEU	Euro 284.11
Total cost for 5 TEUs (3x20' + 1x 40')	Euro 1661.31
Cost per TEU	Euro 322.26

Case (b)

Direct Truck Euro 402.80 per unit

For 2x20' + 2x 40'	Euro 1611.21
Cost per TEU	Euro 268.53

Case (c)

Trunker rate to Cardiff plus local delivery	Euro 445.85
For 6 TEUs 2x20' + 2x 40'	Euro 1783.42
Cost per TEU	Euro 297.23

Case (d) TruckTrain

Rail rate (184 km @ Euro 2.02/km)	Euro 367.58
Access Charges Euro 2.30@1000 tkm	Euro 63.28
Terminal Cost Southampton	Euro 112.72
Lifting charges Southampton/ Cardiff	Euro 169.07
Road delivery	Euro 963.09
Total for 6 TEUs	Euro 1675.81
Cost per TEU	Euro 279.30