Intermodal pricing and costing over time: towards cost-conscious service providers in Europe

J.F.F. Becker, A. Burgess

TNO Inro

The Netherlands

Delft, May 2004

Content Page

Samenvatting

Intermodale transportkosten en beprijzing:
Op weg naar kostenbewuste dienstverleners in Europa

De onbalans in de modal split groeit. De Europese Commissie stelt een aantal ambiteuse doelen om het wegtransport beter te integreren met alternatieve modaliteiten, zodat de prestaties van de intermodale transportketen verbeteren. Het verkrijgen van een verbeterd inzicht in de kostenstructuur van intermodale transportketens is één van de belangrijke factoren voor een effectief beleid om modal shift te bereiken.
Dit paper analyseert de implicaties actuele beprijzing van Short Sea Shipping diensten als intermodale transportmodaliteit in het intra-Europese containertransport. Dit paper is gebaseerd op de resultaten van het project 'Regional Action for Logistical Integration of Shipping across Europe' (REALISE) in het kader van het Vijfde Kaderprogramma voor Onderzoek en Ontwikkeling van de Europese Unie.
Wij concluderen dat partijen, betrokken in de intermodale transportketen, meer kostenbewust zijn geworden en meer besef hebben van de maatschappelijke behoefte aan kostenverlaging en serviceverbetering van intermodale diensten. Wij geloven dat geharmoniseerde wetgeving, inzake het internaliseren van externe kosten, noodzakelijk is om intermodaal transport, zoals short sea shipping, een eerlijke kans te geven.

Summary

Intermodal pricing and costing over time:
towards cost-conscious service providers in Europe

To counteract the growing imbalance between modes of transport, the European Commission sets a number of ambitious targets to ensure fuller integration of road transport with the alternative modes. Better insight in the cost structure of intermodal transport chains is one way to find necessary and effective policy actions for realising modal shift.
This paper analyses the actual pricing and cost implications of the deployment of short sea shipping as intermodal transport mode into intra-European container transport. It is based on the analysis and interim results of the project 'Regional Action for Logistical Integration of Shipping across Europe' (REALISE).
We conclude that parties in the intermodal transport chain have become more cost-conscious and aware of the need for cost reduction and service (time) improvement. We believe that harmonised legislation with the purpose to internalise external costs is required to give intermodal transport a valid change.

1. Introduction

There is a growing imbalance between modes of transport in the European Union (Commission of the European Communities, 2001). The increasing success of road and air transport is resulting in ever worsening congestion, while, paradoxically, the failure to exploit the full potential of short sea shipping (SSS), rail, and inland waterways (IWW) is impeding the development of real alternatives to road haulage.

To counteract these developments, the European Commission (2001) sets a number of ambitious targets to ensure fuller integration of road transport with the alternative modes. That integration should offer considerable potential transport capacity and should – if the transport chain is efficiently managed – lead to competitive alternatives to road transport.

In general, the Community priorities are technical harmonisation and interoperability between systems, particularly for containers. Under the 5th Framework Programme for Research and Development (FP5), the Community initiated many projects to study – among other issues – the intermodal market and to propose the policy strategy to promote a modal shift. In addition, the Community support programme ("Marco Polo") targeted on innovative initiatives, particularly to promote sea motorways, aims at turning multimodality into a competitive, economically viable reality.

Better insight in the cost structure of intermodal transport chains is one way to find necessary and effective policy actions for realising modal shift. This insight can be used to assess the competition between transport modalities and in particular the real competition between road haulage and the intermodal transport alternatives. Further, it can also be used to assess the development of this competition.

The project ‘Real Cost Reduction of Door-to-door Intermodal Transport’ (RECORDIT) investigated the current market conditions (costs and prices) of intermodal freight transport in Europe and the related policy implications (e.g. Cranfield et al., 2003). RECORDIT developed a methodology for the calculation of real costs (both internal and external) of intermodal transport, calculated real costs for three door-to-door European freight transport corridors, analysed the current imbalances in terms of prices versus costs, and identified policy actions to increase the competitiveness of door-to-door intermodal transport (ISIS, 2001).

Four years after the cost analysis of RECORDIT, the REALISE project has revisited the assessment of the present costs and prices of intermodal transport chains. In particular, that concerns the chains that can use SSS as alternative to road haulage, since SSS is still the only mode that has proved able to keep up with the growth of road transport between 1990 and 2000 (DG Energy & Transport, 2003). It is worthwhile to observe if significant changes have occurred in the competitiveness of intermodal transport over time, therefore we provide a comparison of RECORDIT and REALISE.

This paper analyses the actual pricing and cost implications of the deployment of SSS as intermodal transport mode into intra-European container transport. It is based on the analysis and interim results of the project 'Regional Action for Logistical Integration of Shipping across Europe' (REALISE). The overall objective of this project – taking account of what has already been achieved by the European Commission, national activities and projects – is to develop technological strategies, methodologies, and tools for the European business community and decision-makers in order to encourage the use of short sea shipping. That is to assist policy makers and business actors to achieve a substantial modal shift of incremental freight from road to sea and a development of multimodality during the next decade. The paper is built on the findings of work package 4 – as part of six in total – called 'Intermodal pricing issues'.

2. Structure of Paper

The remainder of this paper is structured as follows. *First*, we discuss the methodology used in the REALISE project on which we base this paper. *Second*, we make three comparisons based on the analysis of four transport corridors. These comparisons summarise the total costs for intermodal and all-road transport trips per corridor, and then analyses the cost development by comparing the REALISE results with the RECORDIT results for the two comparable transport corridors. *Third*, we focus on the competitiveness of short-sea shipping compared to the all-road transport solution. *Finally*, we conclude the paper with a recommendation to concentrate on other factors than just price competitiveness. We have observed that the relative price of intermodal transport has decreased over time but that the market demand in the recent past is not matching this decrease in price.

3. Methodology

We primarily focus on short-sea shipping transport. RECORDIT, on its own admission, did not adequately cover the short sea shipping mode. However, we take also account of the two other intermodal modalities, viz. rail transport and inland waterways (IWW), because these modes may be preferred above SSS on certain transport corridors in Europe. Pipeline transport has its own particular character and can hardly be seen as substitute to road haulage.

The corridors examined in the REALISE project were selected on the basis of the representation of (a combination of) actual freight transport route segments and because of the likely development of trade flows. Two RECORDIT corridors (see TNO *et al.*, 2001) – of three in total – included SSS opportunities and have thus been used for cost comparison. In addition, two new corridors have been identified to obtain additional insight in the transport costs of European corridors. The development of trade flows has been based on the results of the Trilateral Logistics Europe project (TNO *et al.*, 1999).

Since REALISE aimed to survey real costs born at segment level, every effort has been made by the research team to obtain bottom-up data. The examination distinguished two types of loading unit, viz. 20 and 40 feet containers (i.e. 1 TEU and 2 TEU). In line with the bottom-up approach of the cost analysis methodology of the RECORDIT project (TNO *et al.*, 2001), the cost structure was divided into eight separate cost elements to enable an accurate assessment of the transport costs. The cost elements are: depreciation, personnel, energy consumption, maintenance, insurance, tolls and charges, terminal costs (depreciation, personnel, and maintenance), and third party services. These elements were each priced, via contact with the relevant operators, computed to costs per loading unit and then combined to produce the final price per loading unit (including a profit margin). In addition, costs have been calculated per phase in the intermodal transport chain. This methodology also enables an analysis of the key cost elements per transport modality.

What is not included in the REALISE work at this stage (key aspects will be covered in the next phase) is an estimation of the value of time (VoT). The VoT includes the users preferences and

the usual transport time; it does not, however, include the incidental delay costs. Valuation of time is difficult, because it depends on specific circumstances (such as type of good, logistical organisation, economic climate, and so on). Determining the VoT is usually done through advanced analysis (stated preference, revealed preference techniques or a combination of both, see for an overview Tavasszy et al, 2004). Hence, a VoT study takes a lot of effort and is consequently used for a long period of time in evaluation studies (although adapted for price changes). For example, such a study is carried out in the Netherlands about every 8 years. Besides the costs of transport also the VoT, or the perception of VoT, is of importance in determining the selection of road only transport over intermodal transport.

4. Intermodal market analysis

The United Nations (UN), European Conference of Ministers of Transport (ECMT), and European Commision (EC) jointly defined (2001) intermodal transport as the "movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in transhipment between the modes". The definition – also in line with the REALISE and RECORDIT projects – implies three different conditions:

1. Carriage of goods by two or more modes of transport, which has been defined by UN *et al.* (2001) as 'multimodal transport';
2. The goods remain in one and the same transport loading unit for the entire journey. An intermodal transport (loading) unit (ITU) refers to containers, swap bodies and semi-trailers suitable for intermodal transport (UN *et al.*, 2001);
3. When intermodal transport is used, it replaces road haulage for long-distance transport, except for the local distribution by lorries.

Performance

Road transport and SSS realise almost the same performance. The other modalities perform much less. From the 3,102 million tonne-kilometres (tkm) in total, road performs 1,395 tkm, SSS 1,254 tkm, rail 242 tkm, and IWW 125 tkm (DG Energy & Transport, 2003). That means in 2001, 45%

of the intra-E.U. traffic was by road, whereas SSS, rail, and IWW transport took respectively a 40.4%, 7.8%, and 4.0% share.

Despite the governmental efforts to realise modal shift, road haulage is increasingly leading in the modal split. Although the almost equal performance of SSS compared to road, road transport was the only growing transport mode in 2001. Road transport realised a 1.3% average annual growth, where SSS, rail, and IWW decreased respectively 1.3%, 3.2%, and 0.2% (DG Energy & Transport, 2003). Intermodal transport has grown from 117 tkm in 1990 to 246 tkm in 1998 (comprising sss, rail and iww), more than a doubling in 8 years. In terms of volume the intermodal had a share of 5,0% in 1990 and 8.8% in 1998 in total transport measure in tkm.

Break-even distance

The break-even distance indicates the transport distance for which the intermodal transport costs equal the road haulage costs. Based on NEA (2002), TNO (2003) calculated the costs per tonne for intermodal transport for different modalities including access and egress by road transport. TNO assumed an average gross weight of a loading unit of 20 tonnes and an average access and egress distance of 50 kilometres (km). From Figure 1, we can conclude that the costs per tonne for SSS and IWW are in the same order, whereas the costs per tonne for rail transport are substantially higher. The costs per tonne for road haulage have a higher gradient than the other modalities. Consequently, the break-even distance for road-SSS is 141 km, for road-IWW is 153 km, and road-rail is 609 km.

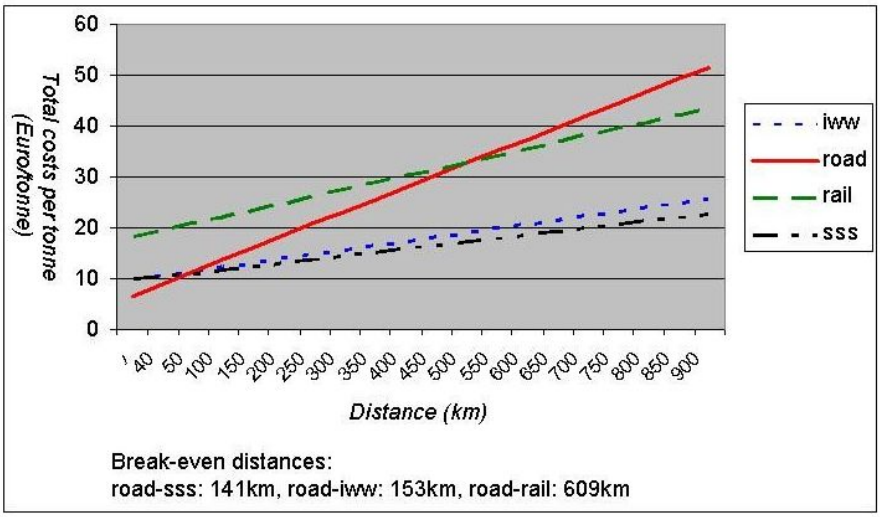

Figure 1: Break-even distances of intermodal transport alternatives in Costs per tonne for 2002 (TNO, 2003)

Figure 1 explains why railway transport is taking considerable share in the cost of intermodal solutions. However, it can be noted that in the past 7 years a considerable increase in efficiency in railway transport has taken place, the break-even distance for rail/road was reduced with 17.5% from 738 to 609 km and for road/IWW with 23.5% from 200 to 153 km. Since TNO used data of the Betuwe transport corridor analysis (TNO, 2003), data of SSS for 1995 was not included in intermodal study (TNO Inro, 1995). The costs per tonne for road transport remained in real terms unchanged within the observed 7 years. This efficiency gain of other modes relative to road transport has lead amongst others to an increase of intermodal transport in terms of tkm as presented in the previous section.

5. Cost comparison of intermodal and all-road corridors based on REALISE results

An analysis of actual corridors particularises the door-to-door cost structure of freight transport. The REALISE project identified four corridors in its first phase (AMRIE, 2003). In the second phase of REALISE other SSS segments (more than 20) are being analysed and compared (also in terms of door-to-door transport time and the probability to meet time windows) with the other transport modes available covering the same segments. This paper builds on the findings of the first phase through the following four corridors:

1. From Gioia Tauro (Italy) to Manchester (UK):
   - Multimodal route: Gioia Tauro to Genova (by SSS) to Basel (by rail) to Rotterdam (by IWW) to Felixstowe (by SSS) to Manchester (by rail and final egress by road);
   - All-road route: Gioia Tauro to Genova (by SSS) to Rotterdam (by road) to Felixstowe (by SSS) to Manchester (by road);
2. From Athens (Greece) to Gothenburg (Denmark)
   - Multimodal route: Athens to Patras (by road) to Brinisi (by SSS) to Gothenburg (by rail);
   - All-road route: Athens to Patras (by road) to Brindisi (by SSS) to Gothenburg (by road);
3. From Lisbon (Portugal) to Rostock (Germany)
   - Multimodal route by REALISE: Lisbon to Bilbao (by rail) to Antwerp (by SSS) to Rostock (by rail);
   - Alternative multimodal route: Lisbon to Setubal (by road) to Rostock (by SSS);
   - All-road route: Lisbon to Rostock (by road);
4. From Le Havre (France) to Rostock (Germany)
   - Multimodal route by REALISE: Le Havre to Rotterdam (by SSS) to Duisburg (by IWW) to Rostock (by train)
   - Alternative multimodal route: Le Havre via Hamburg (by SSS) to Rostock (by road);
   - All-road route: Le Havre to Rostock (by road).

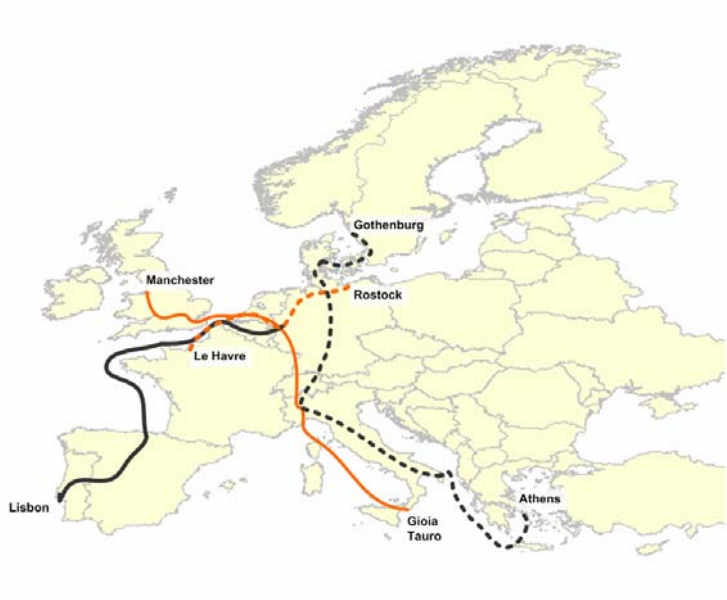

Figure 2: Multimodal transport corridors identified in the REALISE project

The intermodal transport costs are lower than the all-road solution in all four cases. That is without taking account of the transport time (including waiting time at terminals) and the related VoT. If rail transport is used, the transport time is two to four times larger than the transport time of road haulage in pan-European transport. Despite of the political emphasis on intermodality the last couple of years, we did not find a significant change in the transport time.

Another study that supports the view that intermodal solutions could be more cost effective (and not looking at the valuation of the time component and other determining factors) is a study carried out by the Dutch Ministry of Transport (AVV, 2003) where 8 corridors from Rotterdam to the Baltic and Mediterranean were investigated. In all cases the intermodal solutions were more cost effective than road transport; the different combinations of intermodal chains did not vary much in costs. The time required for intermodal solutions was considerably higher.

Table 1 : Comparison of Intermodal versus all road solution in terms of quoted prices for 40 ft containers (AMRIE & TNO, 2003)

Corridor 1		Corridor 2		Corridor 3			Corridor 4		
Inter-modal	All-road	Inter-modal	All-road	Inter-modal 1	Inter-modal 2	All-road	Inter-modal 1	Inter-modal 2	All-road
€ 2713	€ 4533	€ 2499	€ 3568	€ 1491	€ 1200	€ 4009	€ 1100	€ 500	€ 1700

Table 2 : Comparison of Intermodal vs all road solution in terms of quoted prices for 20 ft containers (AMRIE & TNO, 2003)

Corridor 1		Corridor 2		Corridor 3			Corridor 4		
Inter-modal	All-road	Inter-modal	All-road	Inter-modal 1	Inter-modal 2	All-road	Inter-modal 1	Inter-modal 2	All-road
€ 1950	€ 2880	€ 1348	€ 1920	€ 1070	€ 950	€ 2015	€ 910	€ 450	€ 975

6. Cost comparison between REALISE and RECORDIT

An inter-temporal comparison between 2003 (REALISE) and 2000 (RECORDIT) is interesting to observe how on micro – corridor - level changes in costs have occurred. The comparison is made on the basis of the door-to-door cost as anticipated by the shipper/consignee (the actual tariff as is the “market price”, on the same basis as REALISE figures have been estimated). The cost categories have been chosen so that RECORDIT and REALISE can be compared.

When comparing REALISE and RECORDIT on the same basis in the figures below, the REALISE figure should be compared with the RECORDIT exclusive the time valuation (indicated as “RECORDIT excl.time” in the figure). In the figure also the RECORDIT estimate of value of time has been included (to be recognised with “RECORDIT incl.time” in the figure). RECORDIT has introduced the concept of time costs, which includes cost items inventory costs and loss of value (see ZEW *et al.*, 2000).

It can be derived from the figures below that for Corridor 1 the intermodal solution is less “expensive” than the all-road solution for the REALISE results. In the RECORDIT case, the

intermodal solution is only less expensive for 40 feet containers. For 20 feet containers, the intermodal solution is slightly higher than the all road solution.

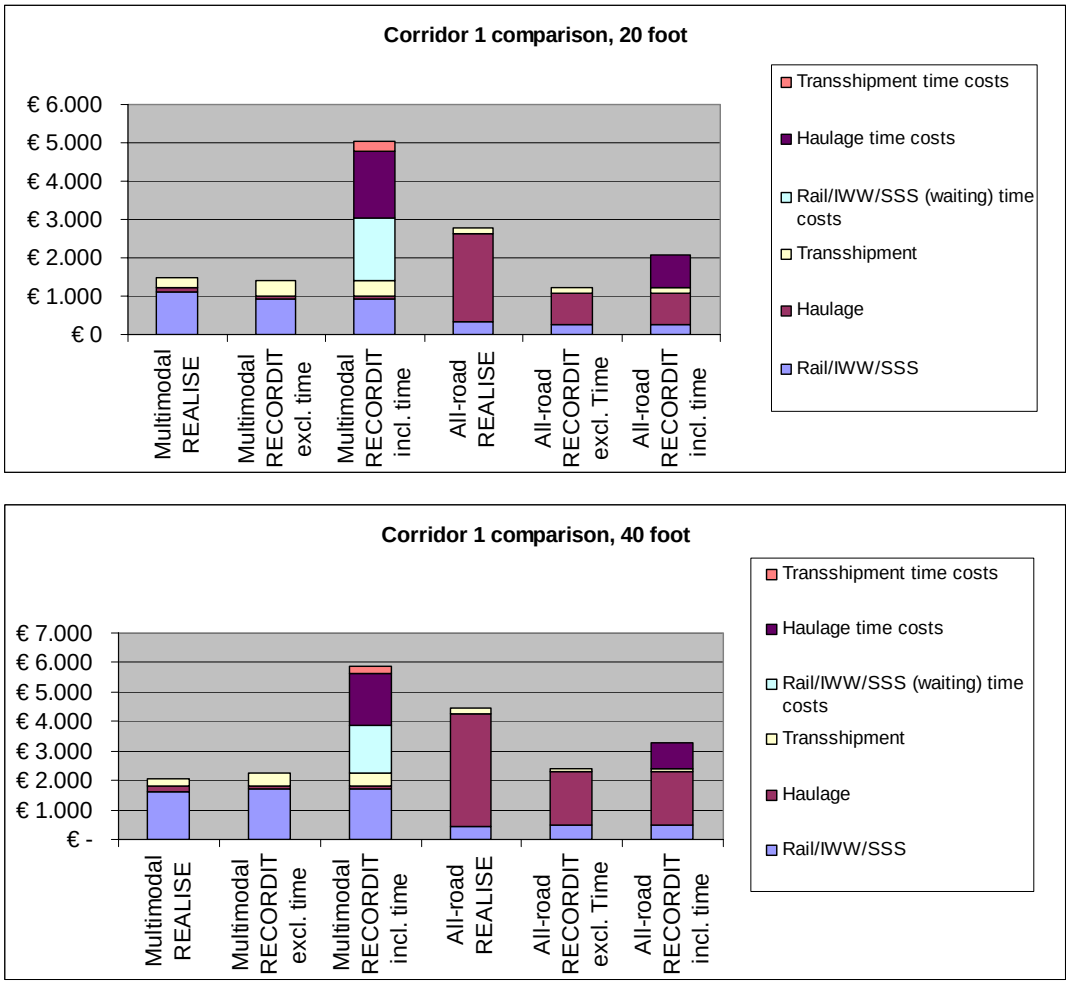

Figure 3: Cost comparison between the RECORDIT and REALISE cost results of corridor 1 (AMRIE & TNO, 2003)

For corridor 2 the findings of REALISE are that intermodal is less “expensive” than the all road solution for both 20 feet and 40 feet containers The RECORDIT data show the opposite, the price as valid for the shipper is lower for the all road solution than the intermodal solution.

One of reasons is that transport firms (especially in a “buyers market”) operate at a loss (see Gruppo CLAS, 2002), once the real cost is determined (including a sound profit margin), the

price of transport presented to the shipper/consignee should be considerable higher. This is more the case in road transport than in other markets, if one includes this element in the RECORDIT the costs are more in line with the findings of REALISE. Hence, road transport in RECORDIT is more “expensive” than presented in the figures above.

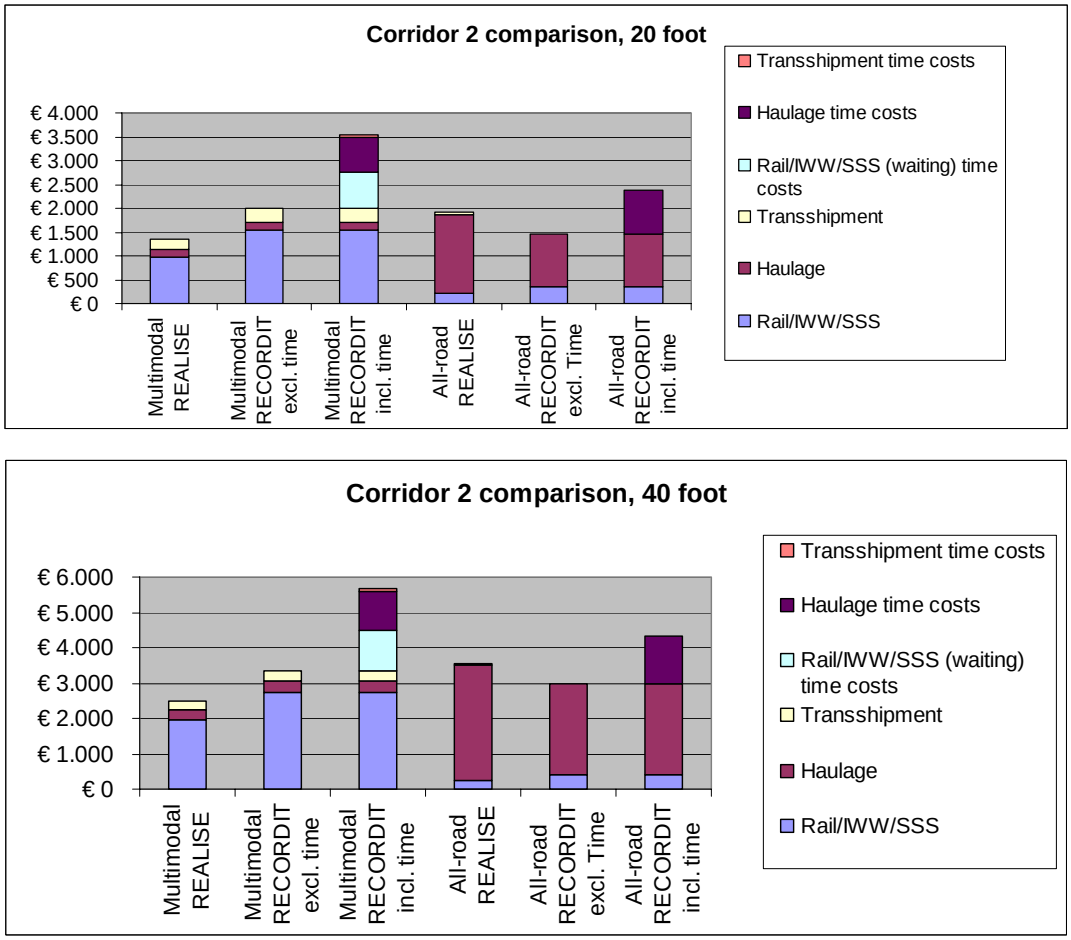

Figure 4: Cost comparison between the RECORDIT and REALISE cost results of corridor 2 (AMRIE & TNO, 2003)

Based on the results of REALISE and RECORDIT it can be concluded that over the last years intermodal transport has become more competitive than the all-road solution (by comparing REALISE with RECORDIT excl. time costs). It can be stated that the all road transport has

become “more expensive” over time (notably on corridor 1). Intermodal transport has been stable in price development or has become “cheaper” on corridor 2.

As it can be observed for RECORDIT including the time cost (which covers some elements of a VoT estimation) still the cost for intermodal solutions are substantially higher than the all road solution. However we lack these estimations for 2003 as this was not included in REALISE. Nevertheless, it can be assumed that ratios between intermodal and road have not changed drastically over time, both sectors have made considerable gains in efficiency and productivity.

7. Cost comparison of SSS and all-road transport routes

The summary tables presented below show the comparison of the applicable SSS segments included in the four selected corridors against the road solutions for the same segments. The tables distinguish the costs made for SSS only and the total costs for using the SSS service including the additional transhipment costs.

The tables illustrate that the all-road solution is considerably more expensive than the SSS solution in the two longest corridors: from Gioia Tauro to Genova is circa 1125 km, while from Bilbao to Antwerp the route takes circa 1260 km. The shortest route of the three, from Le Havre to Rotterdam is circa 550 km, still has lower transport costs. But when including the transhipment costs, the SSS solution is more balanced with the all-road solution. When regarding 20 ft containers, the all-road solution has even lower costs.

Table 3: Comparison of Intermodal vs all road solution in terms of quoted prices for 20 ft containers (AMRIE & TNO, 2003)

Gioia Tauro - Genova			**Bilbao - Antwerp**			**Le Havre - Rotterdam**		
SSS	SSS & Transh.	All road	SSS	SSS + Transh.	All road	SSS	SSS + Transh.	All road
€ 190	€ 465	€ 648	€ 210	€ 270	€ 590	€ 180	€ 285	€ 235

Table 4: Comparison of Intermodal vs all road solution in terms of quoted prices for 40 ft containers (AMRIE & TNO, 2003)

Gioia Tauro - Genova			Bilbao - Antwerp			Le Havre - Rotterdam		
SSS	SSS & Transh.	All road	SSS	SSS + Transh.	All road	SSS	SSS + Transh.	All road
€ 385	€ 650	€ 1300	€ 380	€ 445	€ 1175	€ 350	€ 470	€ 480

8. Conclusion

As is shown in this paper the break-even distance of intermodal transport services relative to road transport appears to be improving. Also over time we see that intermodal solutions, as observed in a number of corridors, have become more competitive in terms of transport costs. However as identified in this paper, on other service factors (which may be substantially expressed in a VoT measure) in 2000, intermodal transport is still in an adverse position when including time costs.

Concerning the performance of intermodal transport, an increase was observed to up to 8.6% of total transport (in 1998). What is observed until recently is that the increase in intermodal transport is quite modest as compared to the period of 1990-1998 despite a considerable improvement in the price competitiveness of intermodal transport.

Hence, we can conclude that a change in the intermodal transport costs today does not (yet) lead to a further increase in the demand for multimodal transport since 1998. The growth in intermodal transport until 1998 mainly concerned the shift in the first market segment. Since 1998 the intermodal market is focussing on a following segment in which shippers have more transport requirements in their demand. That makes that policy on intermodality should focus, next to price changes, on other aspects that are important in the mode choice for intermodal transport (service aspects which are partly reflected in VoT).

We recommend an extension of the research into corridors. This research appears to be a good “thermometer” for the situation concerning intermodal transport. Further we recommend an extended research into service aspects and, related to that, a “between modes” VoT estimation for intermodal transport and/or high valued commodities. This may unveil the determining factors in modal choice which are necessary for a prolonged growth of intermodal transport as is wished by

the Commission. Some of this work may be possible under the REALISE project, but the project resources and targeting will not provide sufficient resources for the detailed research work required.

There are still dominant factors hindering the competitiveness of intermodal freight transport. First, infrastructures are not equivalent, with inefficiencies present at and around transhipment points. This factor constraints the selection of transport modes. Further, intermodal freight transport involves a high number and wide variety of market players and service suppliers. So far, just a very limited level of cooperation between them has been established. Next, there is a strong competition from the all-road solutions, which is generally *perceived* to be a more flexible and less costly alternative. Finally, there are market imbalances generated by the lack of internalisation of external costs, e.g. congestion.

We conclude on our findings – from the REALISE project (REALISE has a further 16 months to run) – that a shift in culture by the market players involved in intermodal freight transport is taking place. Players have become more cost-conscious and aware of the need for cost reduction and service (time) improvement. Innovation is needed by logistics networks to boost intermodal freight transport. Innovation in logistics networks will mean much increased cooperation by the parties involved. Innovation is needed in transport and transhipment equipment, but more particularly in the logistics management field. Innovation here will positively affect the service characteristics. In this context, there are a number of questions which need to be addressed, such as: How to enhance transport services (including e.g. transhipment time, and so on) provided by multimodal chains? How to control the goods flows that make use of the various infrastructure segments? How to fairly share the operational costs and profits between players?

Finally, we believe that harmonised legislation is required to give intermodal transport a valid chance. The current proposal from the European Commission on the revision of the Eurovignette is a move in this direction. Further work on internalising external costs, such as that done in RECORDIT and being updated in REALISE, are required. Recommendations on the first steps towards developing the policy required (ISIS, 2004) need to be implemented. The recent EU

enlargement provides both a need and an opportunity to move towards a larger European intermodal transport network, based on innovation, infrastructure development, and policy initiatives..

9. Acknowledgement

The paper is based on the analysis and interim results of task 4.2 of the project 'Regional Action for Logistical Integration of Shipping across Europe' (REALISE). The overall FP5 project is carried out by 26 project partners from 13 European countries. Especially, we thank AMRIE and ISIS for their constructive comments on this paper.

10. References

Adviesdienst Verkeer en Vervoer, (2003) Shortsea, MAUT en Baltic, Wat is de betekenis van invoering van de Duitse LKW-MAUT en de toetreding van Baltische staten en Polen voor de aantrekkelijkheid van shortsea-vervoer?

AMRIE (2003). *Report on Multi-modal Pricing and Cost Structures,* Realise project, Deliverable 4.1 Inception report, Brussels.

AMRIE, TNO (2004). *Intermodal Pricing and Costing Comparative Report*, Realise project, Deliverable 4.2, Brussels, Delft.

AMRIE (2004). *Price and Service Delivery*, presentation for the REALISE workshop, 25/26-03-2004, Lisbon.

Commission of the European Communities (2001). *White Paper on European Transport Policy for 2010: time to decide*, COM(2001) 370, 12-09-2001, Brussels.

Cranfield University, ISIS, Gruppo CLAS, IER, ZEW (2003). *Final Report – Actions to promote intermodal transport*, RECORDIT project, Cranfield.

Directorate-General Energy and Transport (2003). *Statistical Pocketbook 2003. European Union: Energy and Transport in Figures*, Brussels. Most of the data cover the period 1970-2001.

Gruppo CLAS (2002). *Deliverable 3 – Resource cost calculation for selected corridors*, RECORDIT project, Milan.

ISIS, Ricci, A. (2001). *Recordit: overview of objectives and key findings*, presentation by Recordit coordinator for Transport RTD Programme Committee, 12-20-2001, Brussels.

ISIS, Ricci, A. (2004). *The real costs of intermodal transport: some sensitive issues*, presentation for the REALISE workshop, 25/26-03-2004, Lisbon.

NEA (2002), *Vergelijkingskader Modaliteiten*. Rijswijk. On behalf of the Dutch Ministry for Transport, Public Affairs, and Water Management.

Tavasszy, L.A., Bruzelius, N., (2004). *The value of freight transport time: a logistics perspective*, draft version of working document, The Netherlands/Sweden.

TNO Beleidsstudies en Advies / INRO (1995), *Spoorvolumes op de Oost-West as onder verschillende scenario's*, bijlage bij Commissie Betuweroute, Delft.

TNO Inro, Heriot-Watt University, Chalmers University of Technology, NEI, Cranfield University, Baker Rose, Latts, ENPC (1999). *TRILOG-Europe End Report*, Trilateral Logistics Project, TNO-Report 99/NL/333, Delft.

TNO Inro, Gruppo CLAS, ISIS, ZEW, Cranfield, LATTS-ENPC (2001). *Deliverable 2 – Methodology for the analysis of mechanisms of cost and price formation at corridor level*, RECORDIT project, Delft.

TNO Inro (2003), *Actualisering schattingen vervoerspotentieel Betuweroute*, TNO-Report 2003/NL/1, Delft.

United Nations (Economic Commission for Europe), European Conference of Ministers of Transport (ECMT), and the European Commission (EC) (2001). *Terminology on combined transport*, New York and Geneva.

ZEW, IER, ISIS, Gruppo CLAS, Tetraplan (2000). *Deliverable 1 – Accounting framework*, RECORDIT project, Mannheim.

Websites of relevant FP5 projects:

- *European Commission - Directorate General Energy and Transport*
  http://www.europa.eu.int/comm/dgs/energy_transport/index_en.html
- *REALISE* : http://www.realise-sss.org
- *RECORDIT* : http://www.recordit.org
- *SPIN HSV* : http://spin.mettle.org