ASSESSMENT OF THE POTENTIAL FOR MODAL SHIFT ON A EUROPEAN SCALE: THE SPIN PROJECT

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Abstract

Until recently, generic policies of improving the competitive position of intermodal transport have not always been successful. A supply chain specific or an even individual custom-made approach is probably more effective in identifying and subsequently attracting transport from road operation to intermodal operation. The aim of this paper is the development of a methodology to assess the potential for a modal shift in favour of intermodal transport and as a follow-up step, the proposal for a policy action plan. Through this, it would be possible to gain an insight on the impact of a modal shift on supply chains and on the potential for the modal shift on the EU-level. This is developed within the SPIN Research Project of the European Commission. The methodology includes three main steps namely the development of a toolbox called the macro-scan, which will assess the potential for modal shift, a sensitivity analysis and a policy action plan. The proposed Action Plan will be useful to Policy Makers at European Union and national level as well to the private stakeholders.

Keywords: Modal shift; Intermodal policies; Macro-Scan; Supply chain; Sensitivity analysis; Policy action plan
Topic Area: H8 EU Transportation Policies

1 Introduction

Until recently, generic policies of improving the competitive position of intermodal transport have not always been successful. A supply chain specific or an even individual tailor-made approach is probably more effective in identifying and subsequently attracting transport from road operation to intermodal operation.

If intermodal transport is to be enhanced, the opportunities and constraints of a modal shift must be evaluated from a supply chain perspective. Studies are carried out on decision factors and the role division of different actors in the supply chain. It appears that the division of the decision power of actors varies between different supply chains, and each actor has its own priorities and criteria in mode choice. The requirements, which customers have on costs and quality of the transport system, vary between supply chains. Therefore, intermodal transport operators, who want to exploit the opportunities of a modal shift, must follow different strategies in different segments. Furthermore, the promotion of intermodal transport is central in national and EU policies. Policy makers and market actors have always been convinced of the potential role intermodal transport can have in the transport market in Europe.

The aim of this paper is the development of a methodology to assess the potential for a modal shift in favour of intermodal transport and as a follow-up step the proposal for a policy action plan. Through this it will be possible to gain an insight on the impact of a modal shift on supply chains and on the potential for the modal shift on the EU-level. This is developed within the SPIN Research Project of the European Commission. Additionally, it aims to provide initial information to support a modal shift from pure road transport to more sustainable means of transport. It provides insight into the consequences of a modal shift. One of its first steps is to compare transport costs and duration between the origin and destination of goods transported with the available alternatives. Based on the results of this application a Policy Action Plan is introduced to help policy makers to take action towards intermodal transport.

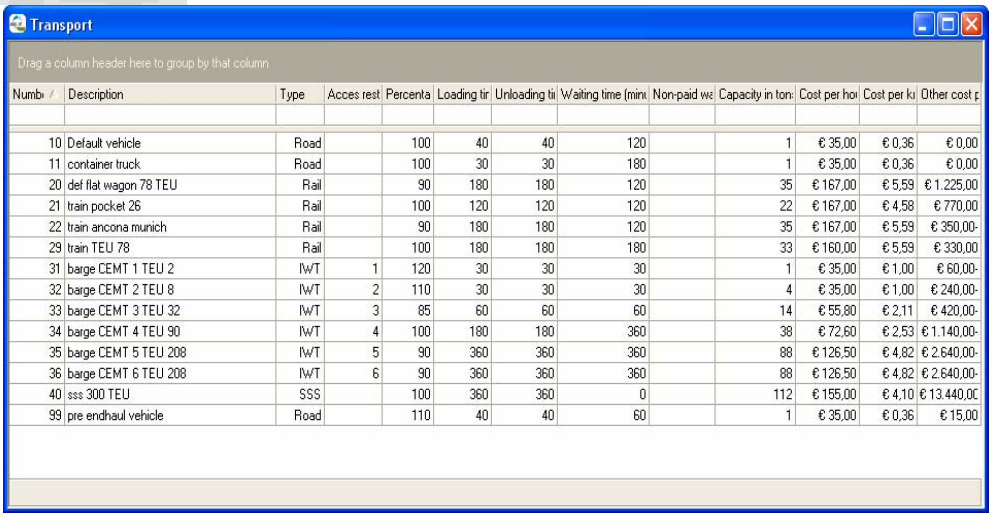
2 Methodology

The methodology includes three main steps namely the development of a toolbox called the macro-scan, which will assess the potential for modal shift, a sensitivity analysis and a policy action plan.

The assessment through the development of the toolbox (macro-scan) will identify the potential for modal shift on a regional level. The present road flows will be considered as potential demand for intermodal transport, i.e. the target market of intermodal transport operators. The macro-scan will compare characteristics on costs and on the level of service of transport modes, like frequency and transport time for different relations. The scan can serve as a “search mechanism”, meaning that it will be able to identify the most promising regions for modal shift. It is also a valuable tool in the assessment of the size of the market, which is affected by improvements in intermodal supply, and will be in particular interest for regional, national or EU policy makers *(Shiftan et al, 2003)*.

2.1 Macro Scan variables

This toolbox is based on OD-matrices of road transport flows, on NUTS-II level for transport demand and a matrix for transport supply. The actual potential for a modal shift is assessed by evaluating costs as well as quality variables of the alternative transport modes. It must be noted here that an estimation of the effects on external costs, will be assessed *(Choong, 2002)*. This will be accomplished through the estimation of reduction in road “tonnes kilometres” and in “carbon dioxide emissions”. The results could be presented through GIS, indicating for each of the regions in Europe, which share of the identified flows can be considered as real potential for a modal shift. A snapshot of the Macro Scan toolbox is presented in Figure 1.



Numb	Description	Type	Acces rest	Percenta	Loading tir	Unloading ti	Waiting time (min	Non-paid wa	Capacity in ton	Cost per hou	Cost per km	Other cost p
10	Default vehicle	Road		100	40	40	120		1	€ 35,00	€ 0,36	€ 0,00
11	container truck	Road		100	30	30	180		1	€ 35,00	€ 0,36	€ 0,00
20	def flat wagon 78 TEU	Rail		90	180	180	120		35	€ 167,00	€ 5,59	€ 1.225,00
21	train pocket 26	Rail		100	120	120	120		22	€ 167,00	€ 4,58	€ 770,00
22	train ancona munich	Rail		90	180	180	120		35	€ 167,00	€ 5,59	€ 350,00-
29	train TEU 78	Rail		100	180	180	180		33	€ 160,00	€ 5,59	€ 330,00
31	barge CEMT 1 TEU 2	IWT	1	120	30	30	30		1	€ 35,00	€ 1,00	€ 60,00-
32	barge CEMT 2 TEU 8	IWT	2	110	30	30	30		4	€ 35,00	€ 1,00	€ 240,00-
33	barge CEMT 3 TEU 32	IWT	3	85	60	60	60		14	€ 55,80	€ 2,11	€ 420,00-
34	barge CEMT 4 TEU 90	IWT	4	100	180	180	360		38	€ 72,60	€ 2,53	€ 1.140,00-
35	barge CEMT 5 TEU 208	IWT	5	90	360	360	360		88	€ 126,50	€ 4,82	€ 2.640,00-
36	barge CEMT 6 TEU 208	IWT	6	90	360	360	360		88	€ 126,50	€ 4,82	€ 2.640,00-
40	sss 300 TEU	SSS		100	360	360	0		112	€ 155,00	€ 4,10	€ 13.440,0C
99	pre endhaul vehicle	Road		110	40	40	60		1	€ 35,00	€ 0,36	€ 15,00

Figure 1. Snapshot of the Macro Scan toolbox

The variables presented in the above Figure 1 are explained analytically below:

1. *Number: code of the transport means. In the default matrix the default codes are*

a. 10 mainhaulage vehicle road in continental flows
b. 20 mainhaulage by rail in continental flows
c. 29 mainhaulage by rail in continental flows
d. 40 mainhaulage by shortsea.
e. the code for the inland barge depends (30 – 36) on the accessibility of the region (capacity of the waterways)
f. 99 for pre-and endhaulage road vehicle.
g. Other vehicle types are added and vehicle types can be overruled in the macroscan specification matrix.

2. *Description:* name of the vehicle
3. *type*: transport means (indicates which distances and travel times should be read)
4. *access restriction*: indicated restrictions, if any, to avoid that large capacity vehicles are used in regions in which they are not allowed or technically impossible. (This variable is only activated for inland waterway transport.)
5. *percentage*: this is a speed parameter. E.g. the value 90 means that the travel time is reduced to 90% of the default value for the part of the chain in which this mode is used.
6. *loading time* is the time the vehicle is at the place of loading. This can be the customer (road transport, prehaulage vehicle) or the terminal (other modes). The values are in minutes and are totals for the complete vehicle.
7. *unloading time*: see loading time.
8. *waiting time*: these are business hours of the vehicle (and vehicle operator), however without operation. It is time which is relevant for the costs. Examples are waiting time at customer, at terminals, at border crossings. These values are indicative for the utilization of the vehicle.
9. *non-paid waiting time*. This is idle time during the transport operation, which is included in the lead time calculation and is not included in the cost calculation. Examples are resting times in road transport and a share of extreme border crossing times.

10. *capacity in ton*. This in fact is not capacity, but the number of units carried. The units are expressed as truck loads equivalents. If the transport unit carries containers, a 40feet container is used as reference. (E.g. a barge with 90 TEU capacity carries 38 units, implying a utilization of about 85% (=2*38/90).
11. *Cost per hour* is the fixed operating cost component of the vehicle. It is the average annual fixed costs divided by the average number of hours in operation per year.
12. *Cost per kilometer* is the variable operating cost component. It is expressed in € per kilometer. It consist of energy costs, a variable maintenance cost and variable depreciation costs.
13. *other costs per trip*. This includes all other costs related to the trip. E.g. it includes transshipment costs, port taxes and could include e.g. management costs. The variable can have negative values if there is reason for a reduction of the chain costs. This is e.g. the case if there is phase of prehaulage or endhaulage in the total trip.

2.2 Procedures for Macro Scan application

The Macro Scan aims to provide a regional assessment in terms of service quantities and qualities as shown in Table 1. The main function of the macro-scan is to calculate costs and door-to-door travel times of road transport and intermodal alternatives between regions. This assesses the competitive position of intermodal transport compared to road transport on individual origin-destination pairs in Europe, which enables to draw conclusions about the potential for a modal shift between these regions *(Ehmer, 1999)*. The macro-scan is a flexible tool, which can use input data, which considers specific circumstances in transport supply.

Table 1. Macro-Scan

	Purpose	Approach	Level	Tool-Basis	Implementation
Macro-Scan	Analysis of the potential of a shift on regional and European level	Conventional potential analysis	Region (aggregate of data)	Freight transport model and GIS	Consultant

The methodological procedures of the Macro scan are implemented through four main steps:

First step: Reads the so-called default SPIN-matrix.

This data file contains about 90,000 records. Each record represents an origin-destination. It contains distances and travel times for each of the four modes (road, rail, short sea and inland waterway transport), default values for pre- and end haulage distance and time within a region, indicators for the transport types which are used on this connection, the road transport volume which is indicator for the maximum potential for modal shift.

For rail and for road transport it also contains distances covered per country passed in order to assess impacts of infrastructure charges. The O-D pair only contains distances and travel times, if both regions are directly connected to the network of the respective modes (e.g. a record contains a short sea distance only if both regions are located at the sea).

Second step: Reads a database with transport type.

Each transport type is defined by parameters about: capacity (number of standard load units or tons); travel speed (i.e. deviation from average); time needed for loading and unloading; other waiting times which are relevant for costs; waiting time which is not paid for, but relevant for lead times; fixed cost amount per hour utilization; variable cost amount per kilometer distance covered; and an "other cost" component, which is meant for adding cost which are fixed per trip.

Third step: Reads a database.

The data base contains values for infrastructure charges per kilometer traveled in all European countries for road transport and for rail transport.

Fourth step: Reads specifications entered by the user of the tool, which overrule default values in the matrix.

These specifications can be of the following nature:

- Redefining terminal region. In the default situation the region of origin (destination) also is the region in which the terminal of origin (destination) is located. This can be overruled. One can specify a different region for transshipment for rail, inland waterways or short-sea. If so, distances and travel times of pre- and/or end - haulage and for mainhaulage will be recalculated.
- Redefining transport types. The default transport type can be overruled by a transport type with a different profile. (applied e.g. if different vehicle capacities are common, if different cost or utilization profiles are more appropriate or in testing impacts of changes in these profiles, (sensitivity analysis))
- Redefining a route by adding a "via-region". (applied e.g. to simulate additional costs of hub and spoke above shuttles)
- Defining a formula which relates market share of intermodal transport with costs and time advantages
- Calculating door-to-door travel times and costs for road transport and for intermodal chains (rail / road, shortsea / road and inland navigation / road).
- Writes output to an EXCEL-sheet.

2.3 Procedures for sensitivity analysis

The sensitivity analysis will include the effects of infrastructure charges on the potential for modal shift, as well as, the impact of generic efficiency improvements. Infrastructure charges will affect the competitive position of intermodal transport versus road transport and for segments of the potential demand, which will be identified and qualified, the impact will reach critical values. Generic efficiency improvements on the other hand, will both reduce the cost level and increase the level of quality. Also, the impacts of the generic improvement on the competitive position will be assessed and the segments, which are most affected, will be identified and quantified.

2.4 Policy action plan

The third and final step of the methodology includes the policy action plan. Through the development of the policy action plan, it will be possible to identify the opportunities and barriers for modal shift. The methodology of the policy action plan will:

1) Compile the opportunities for modal shift
2) Identify the major barriers of incorporating intermodal transport in supply chains

3) Identify the major barriers for modal shift towards intermodal transport from the viewpoint of the supply side
4) Identify measures for the enhancement of intermodal transport and assess their effectiveness
5) Relate the legal competences of the European Union to the policy recommendations for enhancing intermodal transport
6) Provide policy recommendations for enhancing intermodal transport for the cases when critical public measures fall outside the legal competence of the European Union. These recommendations could be addressed to other public levels (Member States or regional levels) as well.
7) Identify measures addressed to the stakeholders in the private sector, i.e. intermodal transport operators, shippers, forwarders and logistic service providers.

The most important innovation from a methodological point of view is the emphasis on the demand side of the market of intermodal transport, since most research in the past has been concentrated on the supply side of the market.

3 Macro-scan application

Meeting the goal of sustainable transport is a challenge that could be achieved with the promotion of intermodal transport. For that reason European Commission through research projects supports advanced tools aiming at the promotion of intermodal transport. The macro scan toolbox satisfies the needs of those desicion-makers interested in assessing whether their decisions or policies will have a positive impact on the modal shift towards intermodal transport *(Tsamboulas et al, 2003; LOGIQ, 2000)*.

The main function of the macro-scan is to assess the competitive position of intermodal transport compared to road transport on individual Origin-Destination pairs in Europe. This enables to draw conclusions about the potential for a modal shift between these regions. The macro-scan is well equipped to assess impacts of changes in levels of services and costs on the competitive position of intermodal transport.

3.1 Corridor analysis

The Macro Scan has been used for the evaluation of two selected corridors covering most modes of transport:

1) Lerida – Karlsruhe, using rail-terminals of Barcelona and Mannheim
2) Halkida – Ingolstadt, using shortsea terminals in Patras and Ancona, including a variant in which rail terminals in Ancona and Munchen are used as well.

For each of these corridors a wider region around the terminals is defined, which can be considered as “influenced by a service between the terminals. The regions around the terminal are part of the corridor. They will be considered in the competitive analysis as well as in the sensitivity analysis that will follow.

<u>Corridor A: Lerida - Karlsruhe</u>

The relation Lerida – Karlsruhe produces the following values:
Road costs: € 1196
Combined transport costs: € 797 + € 119 = € 916
Road time schedule: evening day A - morning day C
Combined transport time schedule: morning day A – morning day C

The ratios of the costs (intermodal versus road transport) of transport between the wider regions vary roughly between 65 and 100. Therefore, a service can be considered as quite competitive with respect to costs. Also door-to-door travel times are within the same ranges for road and intermodal transport. Only for the regions Pais Vasco, Navarra and Lorraine the advantage of the service is not convincing. Figure 2 below indicates the cost competitiveness per region.

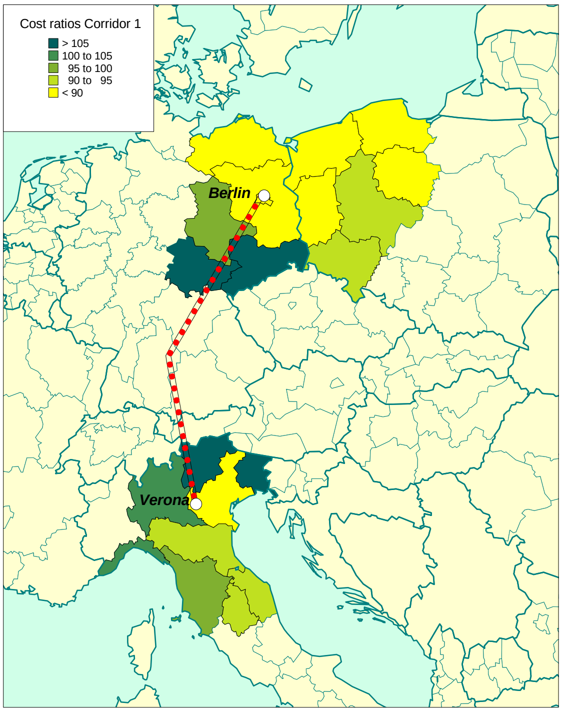


Figure 2. Cost ratios Corridor A: Lerida – Karlsruhe

<u>Corridor B: Halkida - Ingolstadt</u>

The relation Halkida – Ingolstadt produces the following values:
Road costs: € 1826
Intermodal transport costs shortsea/road: € 1224
Road time schedule: evening day A - morning day D
Intermodal transport time schedule: evening day A – morning day E
Intermodal transport time schedule, including rail: evening day A – morning day F

The ratios of the costs (intermodal short sea versus road transport) of transport between the wider regions vary roughly between 65 and 90. If railways are integrated, cost ratios drop to between 55 and 75. A service can be considered as quite competitive with respect to costs. Door-to-door travel times are longer for chains including short sea. The difference is between half and a full day. If railways are included an additional day is added. The competitive position of intermodal transport is not good in relations with Western Czech republic.

Figure 3, indicates the cost competitiveness per region. The first graphical representation of Figure 3 indicates the cost ratios between the short sea / road alternative and road transport, whereas the second graph indicates the cost ratio between the short sea / rail / road alternative compared to road transport.

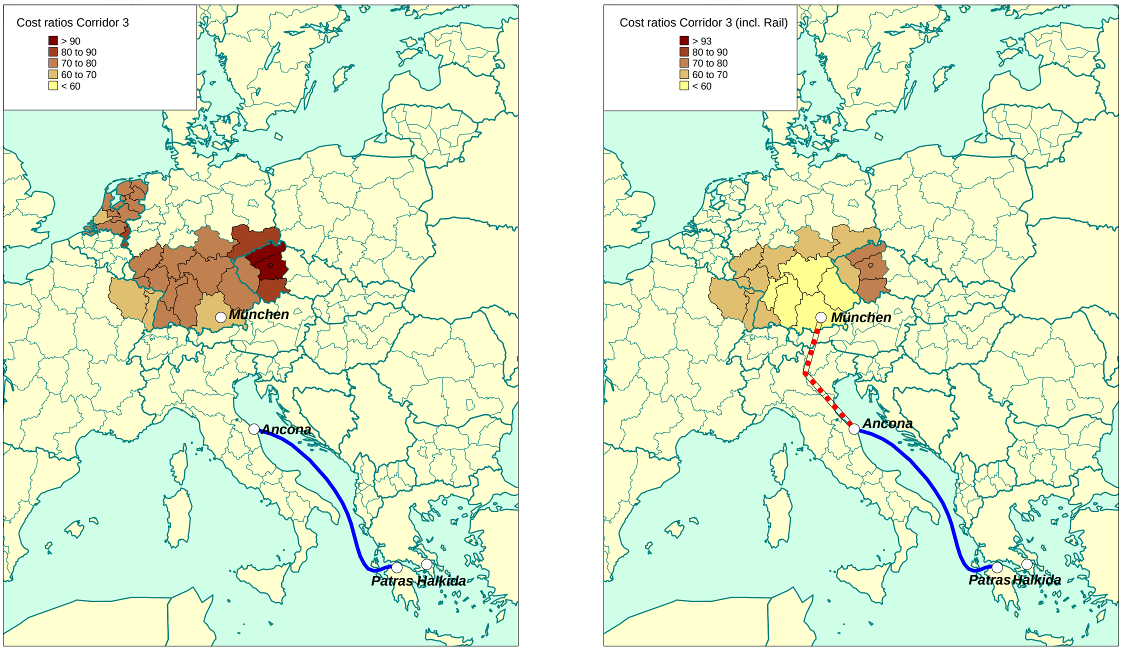


Figure 3. Cost ratios for Corridor B: Halkida-Ingolstadt (short sea - short sea / rail versus road)

4 Identification of policy actions

4.1 Properties of policy actions

Policy actions regarding implementation are needed in order for the EU to introduce measures to overcome the identified barriers for the creation of new intermodal services and operators. These barriers refer to commercial, social and operational issues *(ECMT, 2003)*. For the development of the policy actions and in order to make them appropriate for application, the following “check items” list has to be elaborated:

- Consensus issues among interested parties for a new intermodal service.
- Added value from the introduction of such a service.
- Barriers for implementation
- Risk assessment
- Data requirements
- Budget restrictions

As the planning of a policy action proceeds, the stages and linkages between the ”checklist items” need to be established. The actions suggested are related to the general transport policy and they address issues that include among others *(European Commission, 2001)*: Environmental, Economic and Social integration of Europe

Therefore, an action (regardless of the area it is applied) has the following general objectives:

- *Transport objectives*: These aim to ensure the effective functioning of the Community’s transport system and the protection of the environment. They also aim at advancing the state-of-the-art of an intermodal transport system or creating a new one.

- *Sector objectives*: They refer to objectives, which lie within a single transport sector.
- *Area objectives*: They refer directly to the areas of major policy interest within each transport sector. They support a policy decision and they aim at implementing a new concept.
- *Application objectives*: These address the implementation of an action and they also aim at building a consensus among different actors of intermodal transport chains.

The basic origins of an action are:

- A transport measure solution to an existing situation (Top-down approach)
- The existence of a policy implying the introduction of a transport measure (Top-down approach)
- The development of a technology, technique or other transport measure (Bottom-up approach)

4.2 Policy actions considered

Based on the above the following six policy actions were selected for the application of the sensitivity analysis of the two corridors presented above and the development of the policy action plan.

Action No 1: Increase of speed of railways

Increase of the average gross speed of railway transport. This generic improvement will most likely driven by improvements in capacity management, by priorities for freight transport or by rail innovations. The increase is assumed to be 20%. The increase reduces the net travel time and waiting times of trains on the route to the same extent.

Action No 2: Introduction of LKW-Maut in Germany

Introduction of € 0.15 road kilometer charge in Germany. It was expected that in a first stage a charge of € 0.124 would have been introduced in Germany in August 2003, but introduction has been postponed to 2004. In a next stage the charge would have been raised to € 0.15. Of course, this measure only influences O-D relations, which run via Germany.

Action No 3: Railway liberalization

Liberalization of the railway industry. Several types of measures will be implemented in the next years, which will improve market access and revitalize railways. Implementation will affect performance of railways on trip level (less waiting times in particular at border crossings) and increase utilization of railway assets and therefore reduce the fixed costs per hour of these assets and it will avoid the repositioning costs of traction and drivers, which is related to border crossing.

Action No 4: Directive on working hours

Wide spread application of Directive on working hours, to maximize average working time on 48 hours and to have an absolute maximum of 60 hours. This policy is implemented in all industries. Its background is to create healthy and safe working conditions. The implementation will affect long-distance road transport. In this segment, road transport companies have to design new production methods, because the directive sets a limit to the length of roundtrips of drivers. In rail transport average working times do not exceed 48 hours (working agreements between company and employee). In inland waterway transport and short sea transport more than one crew is on board. However, also in these segments an impact can be expected. The impact, which is envisaged in the sensitivity analysis, is an impact on fixed cost per hour.

Action No 5: Internalising CO2 costs

For the internalization of external costs, only external costs of CO2-emmissions will be considered. This emission is directly related to fuel consumption. Therefore the impact will be only on the variable cost per hour. The internalization has an impact on all modes.

Action No 6: Terminal reliability

The impact of improving terminal reliability is on different modes in the chain. A more reliable terminal handling can decrease waiting times for pre-/end road vehicle, it can decrease the (scheduled) terminal dwell time for the mainhaul vehicle and related to this, it can decrease the cost per hour of the mainhaul vehicle, because of a reductions of the idle hours per year of this vehicle (higher utilization). The reference values in the macro-scan assume a more or less reliable intermodal operation. Therefore, the sensitivity analysis will simulate as if reliability is decreased.

4.3 Impact quantification of policy actions

Table 2 provides an overview of the quantification of the impacts in the analysis related to policy actions.

Table 2. Assumptions on quantitative impacts of policy measures

	Action	Impact on	Impact size	Corridors
1	Speed railways	Net travel time rail and hence on fixed cost rail	20% (-)	A and B
2	LKW Maut	Variable road cost (per driven km)	€ 0,15 (+)	A and B
3	Rail liberalization	Waiting time rail Fixed cost per hour rail Fix amount per border crossing rail	15% (-) 15% (-) € 525 (-)	A and B
4	Working hours	Fixed cost per hour, road	10% (+) 20% (+)	A
5	Internalize CO2 (€ 50 / 1000 kg)	Variable cost per vehicekm road Variable cost per vehiclekm rail Variable cost per vehiclekm iwt Variable cost per vehiclekm sss	€ 0,048 (+) € 0,72 (+) € 1,51 (+) € 2,3 (+)	A and B A and B None B
6	Terminal reliability (reverse analysis)	Waiting time pre end vehicle Waiting time mainhaul Fixed cost per hour rail Fixed cost per hour iwt / sss	90 min (+) 90 min (+) + 10 % + 5%	A and B

5 Sensitivity analysis

5.1 Increase of speed of railways

An increase of speed of railways by 20 percent reduces the time railway assets are being used on a trip. The impact is considered to be only on the rail route itself. Terminal dwell times and border crossing times are not affected. The impact on door-to-door costs and door-to-door time increases if the share of rail transport in the chain is large. It gave the following results in the three rail corridors (Table 3):

Table 3. Impacts due to the increase of speed of railways

Corridor	Cost core relation				Impact on cost rate		
	Road	CT reference	CT scenario	Impact scenario	Highest	Average	Lowest
Lerida-Karlsruhe	1196	797	770	- 3.4%	3.41	2.20	1.71

Of course the increase of speed reduces door-to-door time as well. This time reduction appeared to be significant for the competitive position in the corridors, as shown in Table 3.

Lerida Karlsruhe: The share of O-D's for which combined transport is significantly slower decreased from 29% to 11%. In 44% of the O-D's combined transport now is faster, compared to 9% in the reference scenario.

The impact of the speed increase on the cost of the trimodal corridor Halkida-Ingolstadt via Ancona is between 1.4% and 1.9% of the total door-to-door costs.

5.2 Introduction of LKW-Maut in Germany

The introduction of LKW-Maut in Germany variable costs of road transport via Germany. This impact is on road transport and also on combined transport chains with pre- or endhaulage over German roads, as shown in Table 4. Of course the impact depends on the distance covered in Germany.

Table 4. Impact of the introduction of LKW-Maut for the railway corridors

Corridor	Costs core relation				Impact scenario		Impact on cost rate
	Road reference	Road scenario	CT reference	CT scenario	Road	CT	Average
Lerida-Karlsruhe	1196	1220	797	809	2%	1.5%	-2/2,2 (-0,1)

The impact on the corridor Lerida-Karlsruhe is limited, because of the fact that the terminal is relatively close to the border crossing for road transport. Impacts on costs of both modes are in the same range.

On Corridor B the competitive position compared to road transport will be further improved. The competitive position of road versus rail/road between Ancona and Munich is hardly affected.

5.3 Railway liberalization

The liberalization of Railways has the following impacts on the railway corridors (Table 5):

Table 5. Impacts due to liberalization of railways

Corridor	Cost core relation				Impact on cost rate		
	Road	CT reference	CT scenario	Impact scenario	Highest	Average	Lowest
Lerida-Karlsruhe	1196	797	737	- 7.5%	7.5	4.9	3.8

Impact increases with distances (or in fact travel time) by rail and with the number of border crossings by rail. In these corridors the range of change in cost levels as well as in cost ratios (i.e. comparison to road cost) is in the same order of magnitude. There is also an impact on time, due to the reduction of waiting times. This impact is neglected.

5.4 Directive on working hours

Impact of the directive on working hours is that costs of road transport on long distances will increase. Transport operators have to adjust their production systems. In road transport for example, the ratio between the number of drivers and the numbers of trucks is likely to increase. The impact was assessed for two corridors:

- Corridor Lerida-Mannheim: The fixed costs per hour are assumed to increase by 10% for road transport, which leads to an increase of between 5 and 10% for road. There is no impact on rail transport nor on its pre- and endhaulage. The consequence is that the cost advantage of combined transport increases. The average ratio of combined transport costs compared to road costs is 77%, compared to 81% in the reference scenario.
- Corridor Halkida-Ingolstadt: The assumed fixed costs rise of 20% for road transport leads to an increase of around 11% for road transport, while other modes remain unaffected. The competitive position of road transport is further weakened, for the advantage of the shortsea alternatives.

5.5 Internalizing CO2-costs

It appears that the impact of the internalization of external costs of CO2 emissions on transport costs is about equal for both means (Table 6). The cost rise by between 3.5 to 5.5% on each of the transport relations in these corridors. The impact on the competitive position therefore can be neglected (note that the internalization only concerns CO2-emissions).

Table 6. Impact for the railway corridors due to internalization of CO2 costs

Corridor	Costs core relation				Impact scenario		Impact on cost rate
	Road reference	Road scenario	CT reference	CT scenario	Road	CT	Average
Lerida-Karlsruhe	1196	1253	797	827	+4.7%	+3.8%	-0.9/-0.1 (-0.5)

The internalization gives similar results in the corridor Halkida-Ingolstadt. The shortsea alternative shows cost rises around 4.7%, compared to around 5.7% for road. The costs of the shortsea/rail alternative increase by around 4.5%.

5.6 Terminal inefficiency

The reference values in the macro-scan assume a more or less reliable intermodal operation. Therefore, the sensitivity analysis will simulate as if reliability is decreased. This reverse analysis is indicative for the relative importance of reliable operations on costs. Table 7 shows the impact of an unreliable system on the costs and competitive positions of the transport modes.

Table 7. Impacts of terminal efficiency on costs and competitive positions of transport modes

Corridor	Cost core relation				Impact on cost rate		
	Road	CT reference	CT scenario	Impact scenario	Highest	Average	Lowest
Lerida-Karlsruhe	1196	797	961	20.5	20.5	15.0	12.9

The above impacts on costs are quite severe, due to the fact that all elements of the chain are affected by the disturbances in the transport chain. Cost disadvantages can be reduced if unreliability is anticipated on. The waiting times can be reduced if assets can be deployed in a flexible way. For example, if delays are announced, the allocation of trucks to trips for end haulage can be reconsidered.

In the corridor Halkida-Ingolstadt the impact on costs was around 15% for the short sea-road transport and more than 20% for the short sea-rail chain. The trimodal alternative is not competitive anymore for the connection between Greece and Czech republic.

The sensitivity analysis shows that measures to improve reliability have a substantial impact on costs. In practice, often the additional cost for pre and end haulage due to additional waiting times are not reflected in prices or only “average unreliability” is reflected. Therefore, the cost impact of improved reliability may not be visible for customers.

6 Development of policy action plan

The promotion of intermodal transport entails massive shifting of freight movement from road to more environmental friendly modes (rail, inland waterways, short sea shipping). In this respect, intermodal transport has been recognised as a priority in the European and National Transport Policies *(Tsamboulas, 2000)*. Policies and actions must therefore be designed and implemented to:

- Increase the productivity and efficiency of the intermodal sector (notably through technological and organisational enhancements)
- Reduce the imbalances currently observed between intermodal and road transport

The Policy Action Plan is a systematic procedural framework for the readjustment of the intermodal transport policy by the EU, with the objective to overcome the barriers and enhance opportunities for increasing the share of intermodal transport. The overall implementation plan refers to the organisation for applying the actions identified. It is a general overview of the process that should be followed by policy makers in order to apply the suggested actions. It leads to the Policy Action Plan, which is a decision tree for policy makers in order to enable for rational decision-making as far as new and improved services and actors in intermodal transport market is concerned. The actions are also concerned with the target group of customers for the new opportunities (intermodal services), as well as with their implementation period *(Konings, 1996)*.

In the context of the Policy Action Plan and in order to decide if an action needs to be taken the following steps have to be followed:

First step

Choice of targets – where policy actions should be addressed- need to be made. Initially four can be considered: Transport market, geographical area, intermodal transport market actors and commodity types. This selection is not necessary to take place for all four targets at once. Any necessary combination can be undertaken, depending on the case.

Second step

The second step is to examine whether intermodal transport services and actors exist in the identified target clusters.

Third step

If intermodal transport does not exist at all, the various barriers to its operation have to be examined. Institutional, infrastructural, commercial, economic, technical/operational and social barriers should be investigated. If one or a combination of these barriers exist, then action should be taken for their alleviation. If they do not exist, one should proceed to the next step.

Fourth step

If intermodal transport exists, the objectives for promoting it further and increasing its share in the freight transport market should be set, i.e.transport, sector, area and application objectives.

Fifth step

This step is the final one and constitutes the implementation plan. The necessary groups of people should be involved for consultation before any action is taken. The necessary data for comparing the possible alternatives to the action should be gathered carefully and analysed. Before the full implementation of the action, a pilot implementation should be undertaken. If the action leads to the creation of a new service or the establishment of a new intermodal transport operator, this should be carefully monitored in order to examine its rate of success. If it is not proved to be successful, then it should be withdrawn.

Table 8. Implementation of policy action plan

No	Policy action	Barrier	Action to lift barrier	Supplementary actions by policy makers	Expected results
1	Increase of speed of railways	Different rail gauges between terminals and network, or between neighbour countries	Construct new/improved infrastructure to homogenise rail gauges across Member States	Enforce Member States to change rail gauges	Faster services and lower operational costs
2	Introduction of LKW-Maut in Germany	Freight pricing system is not harmonised across Member States especially for rail/terminal/port operations	Create harmonised pricing system for freight transport in EU	Promote the new pricing system as a fair and transparent one among potential users	Fair and efficient pricing system. New operators will enter the market
3	Railway liberalisation	Railway operation and management is not always effective under the control of the government and the operational costs are also high	Partnership between public and private sector in the railway development, management and maintenance.	Advertise the benefits to private companies in owning and/or managing intermodal terminals	Optimisation of railway development and management.
4	Labour hours	Different labour practices are followed in terminal operations across Member States	Harmonisation of pan-European labour hours and practices at terminals	Promote the harmonised labour system in terminal operations to potential users	Knowledge of standard operating hours
5	CO_2 costs	Diesel fuel tax different in different EU countries	Harmonisation of diesel fuel tax between Member States	Set a minimum reasonable fuel taxation in all Member States	Reduction of emissions and total transport cost
6	Operations at terminals	Lack of flexibility regarding the cut-off-time of the services	Increase of the terminal opening hours and days	Enforce terminal operators to follow the new rules of opening days and hours.	Improvement of flexibility with regard to the cut-off-time and pick-ups of boxes
	Terminal location	The terminal location is not always financially and operationally viable	Identify the optimum relationship between viable intermodal traction provision, terminal density and network	Promote the strategic location of terminals to potential operators Offer training to terminal operators on choosing the right terminal location	Optimisation of operations Reduction of time and cost

Based on the above the selected policy actions are presented in Table 8. The proposed actions to lift the barriers refer to actions for the alleviation of the respective barrier by any actor, public or administrative body, etc *(PROMOTIQ, 2000)*.

7 Summary and conclusions

Intermodality lies at the core of the European Union's policies for a sustainable transport development. The European Union has to cope with a steadily increasing demand for transport services, at a speed that it cannot be accomplished simply by infrastructure expansion. What is more, the demand for freight mobility concentrates on one particular mode, road transport, which does not contribute to sustainable development, due to its negative impacts on the environment and traffic congestion. To help remedy this situation the European Union is willing to provide the policy tool for a systems approach to transport in view of integrating the different modes into one coherent transport system, which caters for the needs of Europe’s citizens and industry *(European Commission, 1997)*.

The Macro Scan is valuable for political decision maker and can be used to:

- assess the competitiveness of intermodal transport to and from a specific region
- identify the regions for which the service is competitive to road transport.
- carry out an impact assessment of changes in intermodal transport supply characteristics, by comparing values related to the amended transport supply with reference values.

The Macro Scan is a versatile tool, which assesses whether certain policy measures could affect a modal change in favour of intermodal transport. The tool aims to provide a regional assessment in terms of service quantities and qualities. The main function of the macro-scan is to calculate costs and door-to-door travel times of road transport and intermodal alternatives between regions. This assesses the competitive position of intermodal transport compared to road transport on individual origin-destination pairs in Europe, which enables to draw conclusions about the potential for a modal shift between these regions. The macro-scan is a flexible tool, which can use input data, which considers specific circumstances in transport supply.

The present paper provides an analysis of all relevant dimensions affecting the promotion of intermodal transport, through the Macro-Scan and, in addition, it identifies these market segments that are more suitable for intermodal transport, and for these the intensity of the policies are introduced. Consequently, with this ex-ante evaluation of the proposed policies, it could be advantageous to identify these measures that will produce the greater impact and pursue them on a priority basis.

Consequently, the Decision Makers, when setting up their priorities regarding policies implementation, they could apply the presented approach to estimate the expected impacts and effectiveness of the followed approach. It is evident that a large number of political measures and instruments will be needed to launch the process which, over a long time period could lead to a sustainable transport system.

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