TRANSPORT RESEARCH
FOURTH FRAMEWORK PROGRAMME
STRATEGIC TRANSPORT
DG VII -

SORT-IT

Strategic Organisation and Regulation in Transport

RESEARCH FOR
SUSTAINABLE
MOBILITY

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2 EXECUTIVE SUMMARY

2.1 *Background and Research Methodology*

The aim of this report is to bring together the work reported in the previous six SORT-IT deliverables:

D1 Summary of Country Reports;
D2 Model Specification, Data Requirements and Data Availability;
D3 Summary of National Reports;
D4 Final Report on Modelling;
D5 Sectoral Review of Strategic Organisation and Regulation; and
D6 Joint Report on the Rail Case Study

The aim of SORT-IT (Strategic Organisation and Regulation in Transport) has been to determine regulatory and organisational structures for transport that promote efficiency and that maximise external benefits. For the purposes of this project, efficiency was split into two elements. Production efficiency is defined as producing a given output at the lowest possible cost. Consumption efficiency is defined as being a point where the amounts of goods consumed is at a level that maximises consumers' welfare. In addition, external benefits include the network benefits that arise from the ability of passengers to connect between international, national, regional and local networks, both within and between modes (interconnection). It also includes the ability of national and geographically defined transport networks to provide operations and services across national borders and across physical and technical barriers respectively (interoperability). Finally, it includes the ability to make a seamless journey using at least two different modes of transport (intermodality). SORT-IT is co-operating with a parallel project, MINIMISE (Managing Interoperability by Improvements in Transport System Organisation in Europe).

In order to achieve this a three pronged methodological approach was adopted, namely reviewing the literature, interviewing and modelling. The literature review and interviews allowed us to determine the characteristics of each transport sector in the European Union countries. The list of characteristics included: legislation; type of regulation and organisation; type of ownership; the market structure; reasons for regulation and perceived market failure; and perceived barriers to interoperability and barriers to interconnection. The SORT-IT project carried out 152 interviews with government departments and major transport companies, whilst the concurrent project (MINIMISE) carried out a further 66 interviews, resulting in over 200 interviews in total.

From this work an overall picture of each transport sector has been derived. The road sector has seen the deepest significant changes. The disappearance of quantitative restrictions in most countries, the disappearance of compulsory tariffs and the ability of international hauliers to carry domestic traffic in countries they are travelling through (cabotage) have all taken place. Interoperability is not a major issue in this sector, with a large number of freight hauliers encountering very low entry/exit barriers. The reduction in haulage rates is a reflection of the substantial increases in productivity that have occurred in the industry, the result of technical improvements in

the infrastructure and equipment as well as organisational restructuring and innovations in the road transport production process itself. This liberalisation movement however, has been limited to goods transport. In many countries, inter-urban passenger road transport is still highly regulated. It is common practice in many member states for private operators to have to apply for a concession, whilst in others scheduled coach services are only provided by the national public railway company, often as a substitute for railway services.

Changes in the rail sector have been more recent and more difficult to implement, because rail is controlled by large national monopolies and because interoperability remains a difficult technical question for this mode. Infrastructure and rail operating systems have been, for a long time, completely integrated, even from an accounting point of view. The introduction of competition is generally related to a split up of the former monopoly at one of three different levels:

- Institutionally, through the creation of autonomous entities (e.g. Sweden, Great Britain);
- Organisationally, through the creation within the monopoly of distinct divisions (e.g. Germany); and
- Accounting, i.e. only unbundling, by separating infrastructure and services accounts within the monopoly (e.g. Ireland).

It is also noted that even if reforms of national railway organisations and implementation of the 91/440 Directives have common objectives (to reverse the trend towards the decline of the railways and the reduction of the State funded, large operational subsidies), the detailed implementation varies enormously from one country to another.

The liberalisation of the air sector has been very much organised on a step by step basis, with the third package of reforms completed in 1998 and with regular negotiation at both a European and a world wide level. The process has produced generally positive results, with all companies now under strong pressure from competition whatever their status, private or public. In general there has been a reduction in price, especially for certain routes where low cost, no frills operators have aimed particularly at the leisure sector. The remaining problems that exist are concentrated on slot allocation and on the dominant position of certain companies at particular airports (hub dominance).

The legislative reform of the short sea shipping (also known as coastal shipping) sector is a recent occurrence, probably because it is a field where fierce competition already exists for intercontinental shipping (also known as deep sea shipping) and where very protective national policies exist for safety reasons. It is however, felt that an open situation will prevail and that the market will open up to competition.

In inland waterways transport, the deregulation of the most traditional part of the sector (small, individual undertakings under tour de rôle organisation regulated by queuing) is occurring at the time of writing (to be completed in Benelux by the end of 1999). The objective is to reorganise and modernise the sector, to support the emergence of new actors able to provide high-performing transport and logistics

services to industrial and intermodal operators, before allowing increased competition. The traditionally organised part of the sector is contrasted with the highly competitive market situation that has prevailed on the major European inland waterway corridor - the Rhine – for a number of years.

The literature review and interviews allowed us to formulate six research questions that could be tested using empirical analysis, these were:

1) Are transport sectors efficient in terms of production?
2) Are transport sectors efficient in terms of consumption?
3) Is competition feasible?
4) Does competition increase efficiency?
5) Are barriers to interoperability limiting efficiency?
6) What are the main barriers to interconnection?

A number of models were used to answer these questions: including cost and productivity models; competition simulation models; interoperability models; and demand models. The cost models analysed the cost structures of the market using non-parametric index numbers and parametric cost models. The former highlight the differences in cost and productivity performances between firms in the market, e.g. vehicle kms per staff. The latter relates the production costs to the level of output and the input prices faced by individual companies.

Competition simulation models assess the impact of various forms of competition and related regulations on net social benefit. Two existing models were developed: an intercity rail model based on British experience; and a simulation model of long distance competition between public transport and the car in Sweden.

Interoperability models relate transport system performance to the existence, or otherwise of barriers to entry and exit. A taxonomy of barriers was identified that included technical, physical, institutional, capacity, strategic, innocent, organisational and environmental barriers.

Demand models relate demand to price, service, GDP and population. Although data problems (obtaining good, quality data) prevented us from estimating all of these models for each sector we were able to test a number of the hypotheses.

2.2 *Recommendations*

2.2.1 Recommendations for Future European Transport Policy Covering All Modes

Our overall objectives with respect to policy recommendations were twofold:

1) To develop policy measures addressing the **organisation** of the European transport system in order to improve the efficiency of the transport sector and thus enhance the implication of the Common Transport Policy.
2) To design measures to promote **interoperability** and **inter-connection**, economic efficiency and spatial co-ordination of pan European transport policy.

These objectives are now discussed in turn.

2.2.2 Organisational Recommendations

Air

Our work suggests that there would be substantial cost savings if the remaining flag carriers were privatised. We would support, for example, the recent partial privatisation of Air France. Our work suggests that there are few economies of scale in the industry and so there is little scope for mergers. Competition has been shown to lead to higher frequencies and so more direct and indirect frequency competition and price competition should be encouraged.

Inland Waterway

Some excess capacity has been identified. It is believed that much of this excess capacity will be eliminated by the ending of the tour de rôle system, which will also result in lower prices. A significant shakedown in the industry might be expected, which may be ameliorated by pooling resources and risks through co-operation, work for chartering companies as sub-contractors or mergers with chartering and shipping companies.

Rail

This sector appears particularly problematic in terms of organisation. We believe that further commercialisation and liberalisation could increase efficiency in production. For the large railway companies, some horizontal separation would appear to be sensible. This might include a separate freight company and a number of regional or route based passenger companies. For small railway companies, mergers with neighbouring companies might be sensible, but would be politically sensitive. The concept of rail freightways appears promising and should be considered further. Vertical separation may also have some merit, although these are still to be proven. We would support the creation of independent track authorities as a necessary step to making infrastructure costs more transparent. If possible, these track authorities

should be designed so that vertical re-integration is feasible, should the market require it. National track authorities should have geographical sub-divisions that map on to the geographical configuration of train operations. This would also permit yardstick competition through benchmarking. In addition, we also suggest that off-track rather than on-track competition may be more effective for domestic passenger services, although this is less of an issue for freight where inter-modal, end product and on-track competition are all more effective. Finally, the issue of network re-configuration should be examined.

Road Freight

The industry appears to be competitive, perhaps too much so. There seems to be excess capacity at the European level, reflected by large fleets of relatively small vehicles operating at low load factors. Analysis is required to determine whether vehicle scrappage is at an optimal rate. The scope for harmonisation of entry standards (particularly with respect to vehicle specification) and the lifting of restrictions on own account operations (manufacturers' own haulage fleets) in some countries needs to be investigated.

Road Passenger

The unbundling and privatisation of bus and coach services from state railway and public transport companies should be encouraged. Our work supports the introduction of cabotage and the deregulation of domestic coach services. In addition, the establishment of a competitive inter-urban express coach market may be an important way of injecting competition into the rail passenger sector.

Short Sea Shipping

An important organisational issue is the continuing growth in importance of flags of convenience, which accounted for 60% of the tonnage of the EU merchant fleet in 1996. Countervailing measures such as subsidies, tax exemptions and cheap loans have not proved to be effective. Further research is required at the EU level to determine an effective package of measures. A further organisational issue is the emergence of shipping line alliances to replace the liner conferences (shipping cartels) in the deep sea market. A direct parallel exists here with the emergence of global alliances in the air industry. The impact of these shipping alliances should be monitored.

2.2.3 Interoperability and Interconnection Recommendations

Air

The main technical barrier in this sector is Air Traffic Control congestion, whilst the main organisational barrier occurs when the services of one airline dominate one airport (hub dominance). The former should be overcome through research and development whilst the latter may be solved by a review of existing slot allocation systems and the continued development of a high speed rail system linking key hubs (Heathrow, Charles de Gaulle-Roissy, Schiphol and Frankfurt).

Inland Waterways

Technical barriers in this sector result from variations in depth gauge, lock widths and handling equipment. The main barrier is an organisational one and it is believed that Government policy should concentrate on promoting inland waterways as part of an intermodal transport chain.

Rail

Our research indicates that organisational barriers may be more important than technical barriers such as, track gauge, load gauge, signalling systems and power supplies. There is an urgent need to develop a simplified system for shipping international freight, based on the principle of a 'one-stop shop'. In addition, the development of infrastructure access and pricing systems that are simple, transparent and equitable is a matter of urgency if vertical separation is to be pursued. The extent to which this can be achieved with vertically integrated ownership of operations and infrastructure also needs to be investigated, although the separation of accounts and balance sheets is clearly a prerequisite.

Road Freight

Interoperability would be improved through further harmonisation on technical matters (such as lorry weights), fiscal matters (such as standardising the Euro vignette system – road taxes, in the form of a license, on non-national goods vehicles) and on social matters (such as working time legislation). Interconnection might be improved by reducing customs formalities at border crossings, especially in Eastern Europe.

Road Passengers

Experience in the United Kingdom suggests that access to terminals might be an important barrier. In addition, the 100 kilometre per hour speed limit on coaches has been identified as a possible barrier to the industry competing effectively with other modes.

Short Sea Shipping

An important drawback to development in this sector is an environmental one. The sector is responsible for oil spills, grey water discharges and significant emissions of SO_2 and NO_x, which may be addressed by catalytic converters. Along with all other modes, charging mechanisms should be introduced which reflect these environmental externalities. Ports are also an important bottleneck, with ships spending up to 60% of their time in port. This might be solved through the development of new multimodal short sea shipping systems, such as the port hopper concept.

Informatics/Telematics

After assessing the impact of telematics on the interoperability and interconnection of transport systems, some generic issues were identified that needed to be addressed to ensure that telematics systems were themselves interoperable. These related to research and development, harmonisation and standardisation and evaluation. In addition four areas were identified where telematics might make particular contributions. Firstly, information systems, that are required to combine static and dynamic data on public and private modes (advanced transport information systems and trip planning systems). Secondly, Public Transport management systems are required that can assist in co-ordinating services and promoting interchanges. Thirdly, fleet management systems that can facilitate load consolidation and back hauls in the road freight industry and locate the nodal centres that are required for this. Lastly, traffic management systems are required for all modes that maximise the use of existing infrastructure whilst maintaining acceptable safety margins.

2.2.4 Overall Conclusion and Recommendation

The liberalisation of the European Transport market, which has been implemented in stages since the mid 1980s, is nearing completion. The measures introduced so far appear to have been successful and the policy priority should be to complete this work, particularly in the inland waterways, rail, road passenger and short sea shipping sectors. This will eradicate the distortions that previously existed as a result of parallel regulated and deregulated markets and the migration of economic activity from the regulated to the deregulated markets (referred to as Goodhart's law). When the strategic organisation of the transport market has been rectified, attention should turn to improving interoperability and interconnection. The air and road freight sectors may have reached this stage already.

3 INTRODUCTION

SORT-IT has undertaken research into strategic tasks 1.4.23 and 1.4.24 of the European Commission's 4th Framework Programme. The overall objectives of these tasks were respectively:

To develop policy measures addressing the organisation of the European transport system in order to improve the efficiency of the transport sector and thus enhance the implementation of the Common Transport Policy.

To design measures to promote inter operability and inter connection, economic efficiency and spatial co-ordination of pan European transport systems.

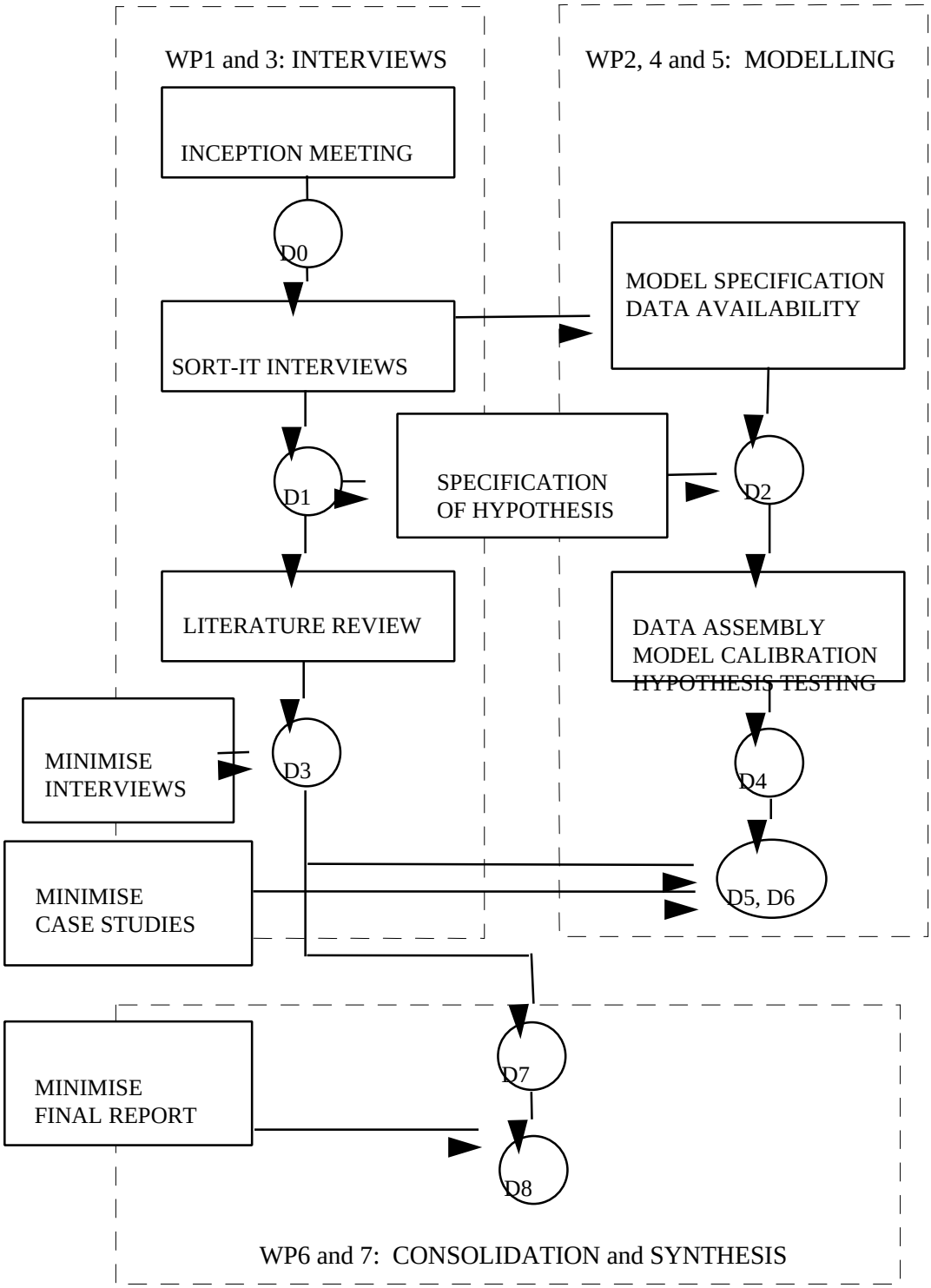
This work began in January 1996 and was due to be completed in August 1999. SORT-IT's work in the inter-urban field has been complemented by the work of the ISOTOPE (Improved Structure and Organisation for Urban Transport Operators of Passengers in Europe) consortium, which has already reported (European Commission, 1997, Preston, 1998).

SORT-IT studied the effects of the organisation and regulation of transport systems on their performance, with particular reference to the European Union's Common Transport Policy and the development of Trans-European networks. The project considered all major inter-urban modes, for both passenger and freight traffic i.e. road freight haulage, public road passenger transport, railways, inland navigation, aviation, short-sea shipping and inter-modal transport. Private car transport has not been considered except for the case of competition simulation of passenger transport. The dominant rationale of the project was to determine how changes to the ownership, organisation and regulation of transport sectors could affect the overall transport system, and then to propose measures to promote economic efficiency, interoperability and interconnection and spatial co-ordination of trans-European transport systems.

In order to address these issues, the project took an empirical, inductive approach. Figure 1.1 outlines the project structure. Data has been collected by means of interviews and desk research, with 218 interviews having been completed. Preliminary results are given in deliverable D1 (Beaumont et. al., 1996) and final results in deliverable D3 (Arbault et. al., 1998). The project has undertaken modelling exercises to provide particular insights into the relationship between the transport system's structure and its performance. These models focus on productivity and cost efficiency measurement, the impact of competition on producers and consumers and the impact of barriers on prices.

Details of the model structures, data requirements and availability were given in deliverable D2 (see Edwards et. al., 1997). Deliverable, D4 (Edwards. and Berglund, 1999), gave the preliminary results and policy conclusions from this modelling work. The models and conclusions were further refined to provide the final report of the sector studies, D5 (Martin-Hernandez et al., 1998) and the joint railway case study, D6 (Shires et al., 1999).

Figure 1.1 SORT-IT Project Structure



This empirical approach complemented the rational, deductive approach adopted by the parallel research project MINIMISE (Managing Interoperability by Improvements in Transport System Organisation in Europe). The MINIMISE project has also investigated measures to improve the interoperability and economic efficiency of the trans-European transport system and a co-ordinated approach, particularly for the interviews, was taken by the two projects to avoid major duplication of research

effort. The conclusions of SORT-IT and MINIMISE has been combined in a joint final report, deliverable D8, which has benefited from the comprehensive but distinct scientific approaches adopted by the two projects.

The overall emphasis of SORT-IT has been on economic efficiency, that is the impact of transport regulation and organisation on producers, consumers and society as a whole. We see economic efficiency as involving three issues: the achievement of the efficiency in production, the achievement of efficiency in consumption and the optimisation of external effects. We are thus concerned with maximising welfare (W), which we define as the sum of producer surplus (PS), consumer surplus (CS) and external benefits (E). We are also concerned with equity issues in the way that changes in transport regulations and organisation may affect different producers, users and non-users and the regional distribution of these impacts and hence spatial co-ordination. Our approach is typical of the neo-classical micro-economic framework that has dominated recent analysis of privatisation and deregulation (see, for example, Armstrong et al., 1994, Bishop et al., 1994, 1995, Button and Pitfield, 1991). In making the distinction between production and consumption efficiency we draw on the ideas of ISOTOPE (see, for example, Preston, 1997).

This report brings together the work reported in the previous 6 deliverables (and appendices) which includes:

1. Deliverable 1 - Summary of Country Reports;
2. Deliverable 2 - Model Specification, Data Requirements and Data Availability;
3. Deliverable 3 - Summary of National Reports;
4. Deliverable 4 - Final Report on Modelling;
5. Deliverable 5 - Sectoral Review of Strategic Organisation and Regulation; and
6. Deliverable 6 - Joint Report on the Rail Case Study

The report is divided into seven sections. The first section outlines both SORT-IT and the MINIMISE projects. In section two we outline the methodological approach taken by SORT-IT and in section three we summarise the present state of inter-urban transport sectors on a country by country basis. In section four we examine each sector in turn and present summaries of the literature reviews undertaken, summaries of the interviews undertaken and summaries of the modelling work undertaken. Finally, in sections five and six we outline our recommendations for ‘future European transport policy’ and the implications of our findings for the Fifth Framework. In addition a number of conference papers, journal articles and other publications have already been produced and are planned as part of the dissemination process and are listed after the references.

4 METHODOLOGICAL APPROACH

4.1 Interview Approach

The basic aim of the interviews carried out by SORT-IT was to determine the characteristics of each transport sector in the European Union countries. The list of characteristics included: legislation; type of regulation and organisation; type of ownership; the market structure; reasons for regulation and perceived market failure; reasons for deregulation and perceived regulatory failure; barriers to interoperability and barriers to interconnection. To this end, SORT-IT partners carried out interviews with the main policy makers and organisations of each transport sector in most of the European Union (EU) countries. Table 4-1 details the interviews proposed and those carried out by both SORT-IT and MINIMISE. Of the 218 interviews, 16 were undertaken in the air sector (7%), 25 in the inland waterways sector (12%), 45 in the road freight sector (21%), 39 in the rail sector (18%), 18 in the road passenger sector (8%), 40 in the short sea shipping sector (including intermodal freight) (18%) and the remainder (35 interviews - 16%) could be classed as general. Table 4-2 gives a more detailed breakdown of the organisations interviewed by SORT-IT. The opinions of policy makers and organisations highlighted the problems of each sector, which were then made into testable hypotheses for the modelling stage of SORT-IT.

Table 4-1 Proposed and Completed Interviews

Country	SORT-IT Partner	Proposed Interviews	SORT-IT Actual Interviews	MINIMISE Actual Interviews	Actual Total
AT	IWW	10	10	0	10
BE	ECTAL	12	27	0	27
CH	IWW	12	8	0	8
DE	IWW	15	17	8	25
DK	VTI	10	4	0	4
ES	LISITT	15	15	0	15
FI	VTI	10	5	0	5
FR	INRETS	15	12	15	27
GB	ITS	15	8	0	8
GR	-	10	0	17	17
IE	ITS	10	8	0	8
IT	-	15	0	1	1
LI	IWW	1	1	0	1
LU	ECTAL	2	3	0	3
NL	ECTAL	12	12	25	37
NO	VTI	10	5	0	5
PT	T-P	10	10	0	10
SE	VTI	15	7	0	7
TOTAL		199	152	66	218

The interviews were designed to link up with some of the key concepts of SORT-IT, including interoperability, interconnection, intermodality and multi-modality, all of which are fully defined in the Glossary.

The importance of these concepts stems from the advent of the Single Market in 1992 and the ensuing abolition of frontiers and liberalisation measures applicable to international intra-community transports and cabotage (Arbault et al., 1998). The situation facing EC member countries was one of paradox, goods and services could be traded freely without being subject to administrative barriers, whilst at the same time experiencing severe physical transport infrastructure barriers.

Table 4-2 Organisations Interviewed by SORT-IT

Country	Organisations
Austria	Committee of Transport; Ministry of Transport; Ministry of Trade and Commerce; OBB (Austrian Railways)
Belgium	Ministry of Transport; Ministry of the Flemish Region; Ministry of the Walloon Region; Spoorwegen; FEBETRA; De Lijn; Shipowners Organisation and SNCB
Denmark	Danish Ministry of Transport; Danish National Road Administration; Danish Office for Free Competition; Kastrup Airport and DSB
Finland	Finnish Autobus Association; Finnish Civil Air Administration; Finnish Ministry of Transport and Communications; Finnish Office of Free Competition and Finnish Rail Administration
France	Conseil General des Ponts et Chaussees; Direction des Transports Terrestres; Conseil National des Transports; Directeur des Affaires Economiques et Internationales; Union des Transports Publics; Directeur Plate-forme Multimodal; Fret de Bordeaux (SNCF); NOVATRANS; PDG Road Company; Air France; CFNR (waterways); CCAF (maritime companies).
Germany	Ministry of Transport (3 interviews); DB-AG (German Railway Company); Association of German Airlines; German Association of Inland Navigation; Lufthansa; Association of German Long Distance Haulage; KALAG Haulage Contractor; Association of Transportation Companies; Association of Carriers.
Ireland	Department of Transport, Energy and Communications (5 interviews); Iarnrod Eireann; Bus Eireann.
Italy	Ministry of Transport and FS (covered by MINIMISE);
Luxembourg	Ministry of Transport; Chemins de Fer Luxembourgeois (national railway); Confederation du Commerce Luxembourgeois (transport employers organisation).
The Netherlands	Ministry of Transport (3 interviews: public transport division, freight transport division and sea transport division); RLD (air, transport authority); Railned (rail infrastructure); Port of Rotterdam; NS (Dutch railways) (2 interviews: passenger division and cargo division); KNV (Royal Dutch Transport - employers' organisation) (2 interviews: passenger division, freight division) and CBRB (inland waterways - employers' organisation).
Norway	Norwegian Civil Air Administration; Norwegian Competition Authority; Norwegian Ministry of Transport; Norwegian Road Administration and Norwegian State Railway
Portugal	Social Equipment Ministry (transport - 4 interviews); General Administration of Land Transports; Civil Aviation General Administration; Portuguese Rail Operator (infrastructure); Portuguese rail operator (operations); Portuguese Road Authority; Portuguese airports and traffic control company; Regional Public Transport (bus operator); Portuguese private flight company and Private national – international road hauliers.
Spain	Directorate of Terrestrial Transport; General Directorate of RENFE; General Directorate of Terrestrial Transport; Generale Directorate of Roads (AVMAR); several passenger and freight haulage firms; General Directorate of Civil Aviation; General Directorate of AENA; General Directorate of Iberia Air Nostrum; General Directorate of Water Transport; National Association of Harbours; Several firms related to freight haulage and passenger transport.
Sweden	Swedish Competition Authority; Swedish Ministry of Communications; Swedish National Air Administration; Swedish National Road Administration; Swedish National Rail Administration; Swedish National Sea Administration and Swedish State Railway.
Switzerland	Ministry of Transport; International Airport, Zurich; SBB Railway Company of Switzerland; Association of Road Traffic Companies; Astag and SwissAir.
United Kingdom	Department of Transport (4 interviews), British Railways Board, Railtrack and the Office of the Rail Regulator

4.2 Modelling Approach

From the literature review we were able to identify a number of hypothesis that could be tested using empirical analysis. These hypotheses are outlined below, with the possible answers indicated by the interviews also given.

1. **Are sectors efficient in terms of production?** (i.e. is output produced at minimum cost?)

Yes - road freight.
Yes - deregulated interurban road based public transport.
No - regulated road based public transport.
Yes - privatised/reformed railways.
No - publicly owned railways.
Yes - Rhine inland navigation.
No - tour de rôle inland navigation.
Yes - privatised airlines/airports.
No - publicly owned airlines/airports.
Yes - short sea shipping.
No - publicly owned ports.
Yes - privately owned ports.

2. **Are sectors efficient in terms of consumption?** (i.e. are output and prices so that the level of consumption maximises net economic benefit?)

Yes - road freight.
Yes - deregulated road based public transport.
No - regulated road based public transport.
No - privatised railways (due to economies of scale in the infrastructure).
Yes - publicly owned railways.
Yes - Rhine inland navigation.
No - tour de rôle inland navigation.
Yes - deregulated air systems.
No - regulated air systems.
Yes - short sea shipping.
Yes - publicly owned ports.
No - privately owned ports (due to economies of scale in the infrastructure).
No - intermodal (due to organisational constraints).

3. **Is competition feasible?**

Yes - infrastructure.
Yes - operations.

4. Will competition increase efficiency?

No - infrastructure (due to economies of scale)
Yes - operations.

5. Are barriers to interoperability limiting efficiency?

Yes - road haulage (fiscal constraints (e.g. vignettes), quality regulation).
Yes - road public transport (quantity and price regulations, organisational).
Yes - railways (technology, organisational, capacity, strategic constraints).
Yes - inland waterways (technological constraints, some quantity and price regulations).
Yes - air systems (technological, capacity, strategic constraints, some quantity and price regulations).
Yes - short sea shipping (technological, some quantity and price regulations).
Yes - intermodal (technological, institutional).

6. What are the main barriers to interconnection?

Road haulage - transhipment centres, distribution centres.
Road public transport - terminals, ticketing, timetables.
Railways - terminals, ticketing, timetables.
Air - ticketing, timetables.
Water - ports, transhipment centres.
Intermodal - missing links, poor quality links.

To further test these hypotheses a number of models were estimated, which focused upon productivity and cost efficiency, the impact of competition on producers and consumers, the impact of barriers on prices and demand models. The models estimated included:

Cost and Productivity Models

These models analysed the cost structures of the markets to determine whether a competitive market existed or was feasible and whether there was a need to regulate or deregulate the market. The following models were used.

Non-parametric index numbers

These indices helped to highlight the differences in cost and productivity performances between the firms in the market. The basic form of the model was as follows:

$$\frac{\text{Total revenue}}{\text{Total cost}} = \frac{\text{Total revenue}}{\text{Total traffic units}} \times \frac{\text{Total traffic units}}{\text{Total vehicle kms}} \times \frac{\text{Total vehicle kms}}{\text{Total no. of staff}} \times \frac{\text{Total no. of staff}}{\text{Total staff cost}} \times \frac{\text{Total staff cost}}{\text{Total cost}}$$

Parametric cost and productivity models

The parametric cost function relates production costs with the level of outputs and input prices faced by individual companies. In the model the total cost was measured as a function of several important variables. The general form was:

total cost = f(total traffic units carried, (and/or traffic unit kms), total vehicle kms, total network size, labour price, fuel price, material price, capital price, length of haul, load factors, ownership, regulation, subsidy level, organisational type)

Productivity models

This model measured the total output from the transport sector. It took the following form:

total outputs = f(total staff numbers, total fuel consumed, total number of vehicles used, total track kms operated, total terminals operated)

where *total outputs* is measured in terms of *total traffic units* or *total vehicle kms*.

Competition Simulation Models

These models assessed the impact of various forms of competition and related regulations, on net social benefit. Two existing models were developed: an intercity rail model based on British experience (Preston et al., 1999); and a simulation model of long distance competition between public transport and the car in Sweden. In addition, an econometric model for maritime transport and port throughput was developed, as well as a fare model of the impact of air competition.

Interoperability Model

This model relates transport system performance to the existence, or otherwise, of barriers to entry and exit. A taxonomy of barriers was identified that included technical, physical, institutional, capacity, strategic, innocent, organisational and environmental barriers. The basic form of the interoperability model was:

Generalised cost = f(distance, demand, market concentration, barriers)

and was estimated for both the rail and air sectors.

Demand Models

Demand models for both passenger and freight sectors were estimated for the rail sector only. The basic form of both models was as follows:

Passenger kms = f(fare, train kms, GDP, population)

Tonne kms = f(price, train kms, GDP, population)

In the next section we present reviews of each country based on the interviews and literature reviews carried out.

5 NATIONAL REVIEWS

In this section we review the state of each transport sector on a national basis, highlighting the market structure and the regulation/deregulation each is subjected to. Our overall findings are summarised in Table 5-1.

5.1 Benelux

In all the sectors that have been reviewed (road haulage, inland navigation, short sea shipping, air transport and rail transport), infrastructure is publicly owned and financed. Private terminals in short sea shipping are one of the few examples of private ownership. In the Netherlands, infrastructure charges are quite common for nodes (ports) but not for links. The main exception is road haulage in which national levies and Eurovignette are charged. In Belgium there are also user charges for inland waterways and rail track.

The market structure in freight cargo transport tends towards perfect competition. An important tendency towards monopolistic competition can be witnessed as companies try to specialise in certain specific cargoes or clients. Ownership of the companies is private. Road haulage and inland navigation are characterised by small, family owned, companies. The market structure in passenger transport is one of monopoly in the rail sector and (heterogeneous) route oligopoly in the air sector. Companies in the rail and air sectors are publicly and privately/mixed owned respectively.

Access to the market has been liberalised by European legislation in the road haulage, inland navigation and air transport sectors. Entry into the air passenger market however, is severely restricted by the capacity of airports (i.e. the availability of landing slots) particularly at Schiphol. Whilst the criteria for access to the road haulage industry are standardised throughout Benelux, the national interpretations differ. Monitoring and enforcement of the requirements appear to be difficult and, on average, professional competence is considered too low. The same difficulties are seen when observing working and operating conditions that are EU standardised. Most problems can be attributed to the market structure, which is dominated by many, small family owned companies. The sector also faces fierce competition from low cost (Eastern and Southern) countries in the price-elastic segments of the market.

Regulations on working and operating conditions in inland navigation, short sea shipping and air transport originate from national laws, treaties and EU law. Consequently, transparency is lacking and the effectiveness of the regulations is questionable. In rail transport, access to the profession, access to the market and working and operating conditions are nationally determined with the exception of EU-directive 91/440 which has led to a slight improvement in access.

In all sectors companies have commercial freedom in terms of setting prices, except for passenger rail transport in Belgium where basic prices are regulated by contract between the government and NMBS/SNCB (the national operator).

5.2 *France*

The road freight haulage sector has been deregulated since the abolition of road tariffs in the early 1980s. The sector is dominated by many small private companies. With increased competition, the profits of firms have decreased, with prices dropping by almost 15% during the last 15 years. In 1995 measures were taken to ensure fair competition between firms (e.g. to improve roadside checks and promotion of "contrats de progrès" within companies).

Air carriers have been subjected to more open competition than previously experienced and following European agreements, subsidies and restrictions on slot allocation have progressively disappeared. There is free competition on domestic and European markets and liberalisation has resulted in the disappearance of the national airline's monopoly with the opening up of main national routes. Services on routes carrying low traffic continue to be guaranteed through national legislation (Territorial Planning Law 1995) which provides for public utility services. There has recently been a change in ownership of the national airline (the Air France/Air Inter group) with around 20% of the airline opened to private capital in February 1999.

In the shipping sector, both passenger and freight services are now deregulated and competition between shipping companies has increased. Safety standards still need to be improved to equal European best practise, particularly for ferries. The French shipping fleet has been considerably reduced and the deep-sea national fleet is now owned by private companies. There remains however a difference in the level of competition between long distance services (which has had strong competition for some time) and short distance services to islands where liberalisation has only just begun.

The road infrastructure network is owned by public authorities under the responsibility of respective national, regional or local authorities, and is managed directly by either the public administration or by a company, which has obtained a concession contract. In recent years, most of the motorway companies have moved from mixed ownership towards a public company status, due to financial difficulties and the increased importance of a financial assessment mechanism in regional planning. A tax has recently been set on road tolls for the purpose of regional policy and intermodal transfer (Territorial Planning Law 1995). Toll systems for suburban traffic are being developed in Paris, Lyon and Marseilles.

The inter-urban passenger road transport market for *non-regular* bus services is highly competitive, whilst *regular* inter-urban bus/coach services remain at a low level, despite being officially authorised.

The separation of rail infrastructure and rail operations into two separate companies SNCF (operations) and RFF (infrastructure management) occurred in 1997. The two public firms have joint responsibility for the national railway and have applied directive 91/440 in a fairly restrictive way as regards liberalisation. Political control over RFF is likely to continue given the importance of rail in Government transport policy. The debt of SNCF has now been cleared so that the company can start on a new commercial basis. Two freeway projects have recently been proposed, requiring

co-operation between national companies, but the French approach is more cautious than that of many other Member States. For passenger transport, long term contracts have now been agreed with the regions which are considered to be in a better position than the national authority to determine regional transport needs.

Inland waterways infrastructure is owned by VNF a government agency that has existed since 1993. The network is fragmented with four great interconnected basins, although the links have insufficient gauge for present technical requirements. Inland waterway ports are the responsibility of either public companies (e.g. Port Autonome de Paris) or local public authorities (with private support from the Chamber of Commerce management).

For inland waterway operations, the tour de rôle system still exists although it is gradually being phased out with liberalisation and restructuring of the sector. Many companies are likely to disappear or face financial difficulties with increased competition from larger Northern harbour based competitors.

Major maritime ports are managed by independent public companies (Ports Autonomes) or are under the responsibility of the local public authority (with private support from the Chambers of Commerce). A major reform in 1982 resulted in a « land-lord » port authority model with superstructures and stevedoring operations under the responsibility of private operators.

Airports, like maritime ports, are managed by independent public companies or are under the responsibility of local public authorities. Air traffic control is the responsibility of a central administration (DGAC). The liberalisation of the air market has required measures to deal with airport congestion; for Paris this has involved a new co-ordinator for slot allocation (COHOR) to improve slot supply.

The role and obligations of operators, regulators and infrastructure suppliers

Private ownership prevails in road, shipping and inland navigation transport operations, whilst other transport sectors come under public ownership as does all transport infrastructure. All transport sectors are subject to quality regulation. Entry regulation is differentiated according to infrastructure (all infrastructure sectors have entry barriers) and operations (entry barriers are maintained in rail operations but are being questioned for inland waterways and services to islands).

Use of performance criteria

Performance criteria vary according to the type of ownership. Financial and commercial indicators (e.g. level of profit, liquidity, gearing) may be relevant, but quality indicators are also considered where there are public service obligations in a contractual public/private authority, a public company scheme or in a concession scheme, (e.g. targeted reduction of SNCF's deficit). In addition, indicators specific to political authorities (such as regional development or accessibility criteria in infrastructure planning), regulatory authorities and professional organisations may be used.

Barriers

Barriers to interoperability are most apparent for rail. Barriers to interconnection appear principally at nodal points, especially for freight intermodal transport although also for passenger connections between transport terminals and urban transport.

Information distribution

In the privatised and highly competitive road freight haulage sector, free access electronic freight markets are used for information distribution to the large number of small road haulage companies and shippers. In rail freight transport, SNCF aims to improve the commercial response of rail information distribution. Improvements have recently been made concerning user access to information about timetables and incidents in the rail sector. In the road transport sector, certain telematic technologies are not yet harmonised (e.g. electronic user information on travel conditions and route choices or electronic toll payment systems) which may lead to interoperability problems.

Progress towards a single European transport market

Restructuring strategies, often stimulated by international demand, have improved the European coverage of the French road, forwarding and air transport sectors. French rail combined transport operators have recently, developed hubs in neighbouring countries to provide European coverage of their transport systems. Trans-European Network developments are assisting traffic along North-South transit routes and developing the high-speed train network towards northern and southern Europe. The road and air sectors are now almost fully deregulated, although liberalisation is still creating social tension in these two sectors. In the short sea shipping and inland waterway sectors deregulation is being introduced gradually to allow time for restructuring and modernisation before full competition. The rail directive 91/440 has been implemented, although the operation and infrastructure companies remain closely linked with importance being placed on the concept of public service.

5.3 Germany, Austria, Switzerland

Given their central location the most salient feature of these countries is the increase in North-South and East-West transit traffic. Transport to the east is becoming increasingly important, not only because of transport volume development, but also because of increasing competition amongst carriers in regions bordering neighbouring countries.

Transport in Germany is characterised by the recent reorganisation of public transport. An enormous shift of responsibilities has taken place during the last few years, namely the ongoing privatisation process of the former national railway company Deutsche Bahn and the German Lander receiving responsibility for regional public transport, with the latter having considerable consequences for passenger transport organisation in this area. Communication processes between transport organisations have been totally restructured, however it would be premature to give some final statement regarding changes in efficiency because reorganisation has still not been completed and reliable empirical data is not yet available.

In contrast, Austrian reorganisation of public transport has been limited. Emphasis has been placed upon changing the internal structure of the federal railway company to improve transport organisation and to realise European legislation (directive 91/440). The most important transport trend in Austria is the huge amount of traffic that flows through the Alps Region, especially freight transit traffic that induces enormous pressures on this very sensitive mountainous region. It must be recognised that the Alps Region itself is a most important barrier to interoperability and the removal of transport bottlenecks has important natural, technical, and financial effects. Road pricing or other direct measures have been put forward as ways of coping with the enormous external costs of transport but it is likely that inner political pressure against the removal of high regulatory barriers will remain.

Switzerland has similar problems with its role as an important transit country in Europe. It is also in the unique situation of being a political isle surrounded by EU member countries. Switzerland's transport plan is geared towards harmony with EU directives that aim to remove technical and some organisational barriers within the organisation of European transport flows. Switzerland however, it not legally bound to carry this out and their policies may occasionally be out of line with those for the EU.

5.4 Great Britain

Our review of Great Britain concentrates on the extent of privatisation and deregulation of transport infrastructure and operations.

Deregulated Sectors

Road Haulage has been deregulated since the 1968 Transport Act, with qualitative standards to be met for safety (UK operator's license). Drivers' hours are subject to Article 7 of EC Regulation 3820/85 whilst the Vehicle Inspectorate carry out roadside checks. There are a large number of owner-operators but the industry is dominated by a few highly competitive large firms who set the market rates. These large hauliers provide high quality services through a series of national depots and are very difficult to compete against.

Coach services (both scheduled and non-scheduled) were among the first to be deregulated, under the Transport Act of 1980. The principal operator, National Express, was deregulated in 1980 and privatised in 1988, and continues to dominate the all-year-round scheduled market. Quality control was tightened through the Operator Licensing procedures.

There are several UK air carriers operating in the UK and European markets. By far the largest (operating some 90% of services) is British Airways but, since the implementation of the 3rd Package, competition on certain routes has increased considerably, e.g. London-Paris and London-Brussels. Most of the UK's secondary/regional airports are unregulated (if turnover is less than £1 million for 2 of the previous 3 years) and owned by local authorities, private business or partnerships between both. The airports cater for UK scheduled inter-urban services, occasionally European scheduled services (often to other European regional/secondary airports) and charter services.

Rail freight operations were reorganised into six companies following the 1993 Railways Act. Five of the companies were bought by English, Welsh and Scottish Railways (EWS), a subsidiary of the Wisconsin Central Transportation Corporation, giving it around 84% of the total UK rail freight market. Open access is possible and there were two important own account hauliers in operation, i.e. National Power (recently bought out by EWS) and Direct Rail Services. In addition, rail rolling stock has been reorganised into three companies (ROSCOs). By November 1995, the ROSCOs were privatised, raising some £1.65 billion.

The UK passenger shipping market is deregulated according to EU law. Private operators dominate the market, namely P&O Stena Line, although they do face stiff competition on some routes from Brittany Ferries (French owned), Sea Containers (Bermuda based) and Sally Line. The UK freight market is, similarly, deregulated. Two private companies dominate the market, P&O Containers and MAERSK (a subsidiary of the Danish Group, AP Moller). A further 50 smaller private firms exist in the coastal and short-haul markets, many specialising in niche markets.

Two pieces of legislation deregulated and privatised government and trust owned ports, the 1981 Transport Act and the 1991 Ports Act. Competition between the ports is intense, with around 600 commercial ports, 70% of which are in private hands. The other 30% are under the control of local authorities or mixed ownership. Two of the largest group holdings are ABP and Sea Containers.

Regulated Sectors

Following the1993 Railways Act the industry reorganised into an infrastructure authority (Railtrack), 25 Train Operating Companies (TOCs) and 3 Rolling Stock Companies (ROSCOs). Railtrack was privatised in May 1996, raising around £1.88 billion. Its performance is regulated by the Office of the Rail Regulator (ORR). The 25 TOCs were franchised out by OPRAF between 1996 and 1997 (the majority to bus and coach companies).

All of the UK's major airports are subject to regulation from the Civil Aviation Authority (CAA). The largest airport operator is BAA, with around 90% of the UK market. BAA was privatised following the 1986 Airports Act. The following airports are under BAA stewardship, Heathrow, Gatwick, Stansted, Glasgow, Edinburgh and Aberdeen. Heathrow is the EU's most dominant airport, particularly for passenger traffic but, congestion and poor surface transport links are threatening this position in the long term, although this has been partly remedied by the opening of the Heathrow Express rail link.

Road infrastructure is provided by central and local government, although recently, a number of schemes have been commissioned along Design Build Finance Operate (DBFO) principles, with revenue provided by a system of shadow tolls.

5.5 Ireland

Our review of Ireland will similarly, concentrate on the extent of privatisation and deregulation in that countries transport sector.

Deregulated Sectors

Road haulage has been deregulated since 1988, although qualitative standards have to be met for areas of safety (including driver hours), environmental impact and financial resources. Haulage rates are low and this encourages a high turnover of operators. The majority of operators are small companies, who lack the facilities to offer good intermodal transfer and may have poorer access to information.

The Government owned Irish Bus Company has about 67% of the express coach inter-urban public transport market. The rest is operated by unlicensed private operators, providing competition on a number of routes.

Four air carriers provide European services to/from Ireland and competition on some routes exists. Air services are still dominated by Aer Lingus, which is 95% state owned. Some routes/destinations, particularly to the UK, are shared between Aer Lingus and Ryan Air, so there is no direct competition. The six regional airports are all privately owned and operated.

The market for sea passenger ferries is open to competition, but is not a large market given the strong competition it faces from air. Freight services are similarly very competitive and operate in a much larger market. Port services are privately owned and generally subject to perfect competition or oligopolistic competition.

Regulated Sectors

Irish Rail is a subsidiary company of Coras Iompair Eireann (CIE - the public transport holding company) which is wholly owned by the Irish Government. Irish Rail has a mandate to be much more commercially driven and customer focused.

The two main Irish airports, Dublin and Shannon are state owned and operated.

Sea ports are publicly owned with the exception of one small private port. From 1997 they have had a commercial focus.

5.6 Nordic Countries

5.6.1 Sweden

During the 1990's, many Swedish public enterprises have been privatised including transport. The Swedish National Road Administration (VV) has been divided into one purchaser and one producer of infrastructure. The road network is mainly publicly owned, with some low-capacity roads under private ownership. Road freight operations and passenger traffic are performed by private operators. The freight market is competitive and the passenger market has a concession system on inter-county bus lines, whilst bus line services within a county are is provided through tendering. Long-distance coaches were fully deregulated from the 1 January 1999.

Rail infrastructure ownership is separated from operations with the Swedish State Railways (SJ) carrying out most operations and several smaller private companies responsible for some county services. Whilst, there is no real competition on any line (since all lines constitute local monopolies), the freight long distance market on the main railroads was open for competition on 1 July, 1996.

Ports are municipal and/or privately owned, whilst seaways are owned and administrated by the state. Freight and passenger shipping services are both performed by private companies operating in competitive markets.

The majority of airports are publicly owned, by either the state or by municipalities and in some cases together with private companies. The domestic aviation market is open to competition, but the state airline (SAS) has a dominant position.

5.6.2 Norway

The majority of roads are under public ownership, whilst some low-capacity roads are privately owned. Road freight and passenger operations are performed by private operators but under different market structures. Freight operations are characterised by monopolistic competition, whilst passenger operations operate on a concessions system.

The Norwegian State Railway Company (NSB) is publicly owned and operates as a monopoly supplier. To meet the requirements from EU directive 91/440 the responsibilities for infrastructure and operations have been separated.

Norway has no inland navigation of note. For international sea traffic, Norway has a special international ship register. Passenger sea traffic is arranged through a concession system and is publicly owned, whilst freight shipping services are under private ownership.

The air transport sector is arranged in a hub and spoke system, with Gardermoen representing the hub. The two main operators are SAS and Braathens. There are two passenger air travel markets; one covers the scheduled route network airports, and the other covers non-scheduled destinations. The former market is competitive, whilst services in the latter are supplied by one operator.

5.6.3 Finland

The road infrastructure in Finland is publicly owned. There are many freight operators, making up a more or less competitive market. Passenger traffic is mostly carried out by privately owned operators with concessions for specific lines. There are also some publicly financed services, provided by other private operators. Apart from these bought services, there are barely any subsidies to the long distance bus operators.

Railway operations are separated from infrastructure ownership. Both the state owned railway operating company (VR) and the Finnish Rail Administration are publicly owned. VR has a monopoly on the railway market. The starting point in reforming the rail market was the point at which the State Railway was divided into three units: one for freight and passenger traffic, one for the infrastructure and one for administration.

Finnish airports are mainly public owned and organised along local monopoly lines. The Civil Aviation Administration (CAA) is a self-financing State Enterprise. The CAA owns and maintains 25 airports. In addition, there are three small airports with a private (foundations) or municipal ownership base. About 95% of the passenger movements start or end at Helsinki/Vantaa airport. There is one dominant operator, Finnair, which used to be 100% state owned, but now has mixed ownership. Its market share is approximately 95% on domestic flights. Much of Finland's international passenger and goods traffic is maritime traffic, but only a minor volume of goods and passenger traffic use the inland waterways.

5.6.4 Denmark

Denmark consists of a peninsula and several islands. The surrounding water demands an infrastructure containing ferry connections or bridges. Bridges have been built over Store and Lille Bælt, and the construction of a bridge over Öresund to Sweden has started. In Denmark, the main roads are publicly owned, while the smaller roads are private or have mixed ownership. Road operations are in the private sector, apart from some publicly owned long distance passenger operators. The freight market is competitive, but a concession system for passenger transport exists. A separation of railway infrastructure ownership from operations has recently been implemented in Denmark.

Many of the airports are municipally owned, but some airports are owned by the state or have mixed ownership. The largest airport, Copenhagen/Kastrup, is owned by the state together with private interests. The domestic air traffic market is divided between seven operators. SAS and Maersk are the two largest companies on the market. The other five are much smaller.

There are several ferry lines in Denmark. The biggest ferry operator is owned by the state. Other operators are owned by municipalities and/or have other ownership types. Ports are mainly publicly owned.

5.7 Iberia

5.7.1 Portugal

The Portuguese transport sector tends to differ from what exists in the most advanced countries in Europe. This is a reflection of the country's size, its peripheral location, the historic role of transport and the economic development of some of its hinterland areas.

Deregulated Sectors

Road haulage has been deregulated since 1992 with a large number of operators competing in the market place. This intense competition is complemented by a significant own-account sector (65% of total goods transported by road). The majority of operators are small companies, who lack the facilities to offer good intermodal transfer and may have poorer access to information. The industry is dominated by a few large competitive firms who set market rates and provide a high quality service through a series of national/international depots.

Two air carriers provide European services to/from Portugal and competition on some routes exists. Air services are still dominated by TAP (the National airline) which operates about 93% of international European services. TAP's main rival is the private company Portugalia, who operate scheduled flights to European destinations and have about 7% of the market.

Four large companies dominate the shipping sector, controlling almost 95% of the market, these are, Soponata, Sacor, Transinsular and Portline. In synthesis, this transport sector is seen as being located in the private sphere, with almost perfect market conditions.

Regulated Sectors

All three of Portugal's main airports, Lisbon, Oporto and Faro are state owned and operated, as are the main airports in Madeira and the Azores. The country's secondary/regional airports are owned by local authorities, the private sector or a combination of the two. All Portuguese airports are subject to regulation from the Civil Aviation Administration, regardless of ownership, whilst a nationalised company (ANA) manages air traffic control. There are plans for the privatisation of airport management and air traffic control, with the state retaining a supervisory role only.

Inter-urban coach transport is provided mainly by private companies, although some firms operate concessions from local/national authorities, which define the operating zones, routes, schedules and tariffs. Market concentration is important and several large groups control most of the market.

Following the implementation of Directive 91/440/EEC the rail industry has reorganised itself into an infrastructure manager (REFER), a transport company (CP)

and a rail regulator. The REFER (Rede Ferroviaria Nacional, E.P) was created in 1997 and is now responsible for the operation and maintenance of Portugal's rail infrastructure. Rail passenger and freight operations are the sole preserve of CP.

All of Portugal's ports are under government control and administration, with the exception of two container terminals in Lisbon which are operated under private concession. There is an element of competition between the ports.

Road infrastructure is provided by central government and local (municipal) authorities. The national network is planned by JAE with construction subject to public tender. The Tagus crossings in Lisbon and an 800 kms motorway network are operated under concession. Recently, another two tenders for concessions to build and operate new motorway regional networks have been issued.

5.7.2 Spain

Road transport has, by far, the highest market share in both the passenger and freight sectors. Access to the Road Haulage market is restricted by administrative concessions and a quota system. It is operated by a large number of small sized firms, mainly autonomous entrepreneurs, who own the vehicles and cannot set prices freely. The road infrastructure is publicly owned except in the case of some motorways where users are charged a toll.

The national airline (IBERIA) dominates the domestic air passenger market with a total share of 70%. The other five operators have developed niche markets and different market structures can be perceived depending on the route. Airports and air traffic control are the concern of AENA, a public company which owns and manages the air transport infrastructure. Handling services are mainly supplied by IBERIA, although recently, private companies were authorised to compete for these services.

Rail transport is supplied by publicly owned companies, with one national operator (RENFE) and several regional passenger networks, all of which own the infrastructure they operate on. The prices and service levels are regulated for social routes and deregulated for commercial services.

Although the short sea passenger market is deregulated, there is a system of administrative authorisations for regular services only. The public company TRANSMEDITERRÁNEA dominates the market with a share of 65%.

The freight shipping sector is subject to the same regulation as the passenger sector and has an underlying monopolistic competition structure consisting of a large number of private firms. The port infrastructure is state owned and managed by regional authorities. The state regulates direct harbour services but has deregulated indirect services.

5.8 Greece

There are 34 airports in Greece, 25 of which are based on islands. The airports are all publicly owned and so enjoy a monopoly market position. The airport at Athens is subject to capacity limits and also has somewhat poor connections into the city's urban public transport system. Air traffic control is owned by the government as is the national airline (Air Olympic), which is the sole operator of all domestic flights. There is some competition on intra EU operations but Air Olympic is by far the largest operator.

The Greek railway company (CH) is a vertically integrated, state owned enterprise. It faces no competition and has yet to implement EU Directive 91/440. Electrification of the system is limited and the infrastructure is in need of repair.

The provision of roads in Greece is the responsibility of the state. Road freight operations are owned by private companies operating in a competitive but regulated market structure. The low wage rates at which the Greeks operate prevent entry from other EU operators. Road passenger operations are both publicly and privately owned and similar to road freight operate in a competitive but regulated market environment.

All of the 138 ports in Greece are under public ownership, with 96 located on islands. The services operating from them are mainly private with certain routes subject to competition. Cabotage however, will not be introduced until 2004.

5.9 Italy

Italy's airports are publicly owned by the municipalities, with each enjoying a local monopoly. There are capacity barriers at many airports and poor connections with urban transport systems. Air traffic control and the national airline (Air Italia) are both owned and operated by the government with a moderate level of competition on the main routes in both the domestic and the intra-EU markets.

Italy's rail infrastructure is owned by the state railway company FS, which together with 27 regional companies operate rail services within the country. The road infrastructure is publicly owned, with long term concessions for toll motorways, whilst a number of regional companies are owned by local municipalities and regions. Road freight operations are undertaken, predominantly, by small private companies within a highly competitive market, subject to a regulatory system that displays signs of being 'captured'. Road passenger operations are controlled by a number of municipal companies operating regulated urban concessions, whilst regional transport concessions are operated by a mixture of public and privately owned companies.

Within the short sea shipping sector there is a steady progression towards the privatisation of port terminals. Every port has a local monopoly, although competition does exist between them for container traffic. Short sea shipping services are operated by a variety of private and public companies (the majority of the latter being heavily subsidised) with only a moderate level of domestic competition.

In terms of inland waterways there is only one navigable river in Italy, the Po (c 1,400 kms) served by a mixture of public and private terminals. Operations are carried out largely by private barges in an oligopoly market structure.

Table 5-1 Summary Table of National Reviews

	Infrastructure	Operations					
		Air	Inland Waterways	Rail	Road Freight	Road Passenger	Short Sea Shipping
Benelux	Publicly owned & financed Eurovignette	Mixed Ownership Oligopoly	Mixed regulations Competitive	Public Monopoly	Under regulated Competitive	Regulated No Competition	Deregulated Monopolistic
France	Public admin. & Private Concession (roads)	Publicly owned Oligopoly	Regulated Competitive	Public Monopoly	Deregulated Competitive	No competition	Deregulated Oligopoly
Germany, Austria & Switzerland	Publicly owned Eurovignettes & restrictions	Mixed ownership Oligopoly	Deregulated Competitive	Ongoing reform Monopoly	Deregulated Competitive	Regulated No Competition	Deregulated Monopolistic Competition
Great Britain	Publicly owned (roads & inland waterways) Privately owned (other sectors)	Private ownership Liberalised	Not significant	Privatised Fringe Competition	Deregulated Competitive	Deregulated Private Competitive	Deregulated Perfect Competition
Ireland	Publicly owned (except regional airports)	Mixed ownership Liberalised	Not significant	Public Monopoly	Deregulated Competitive		Deregulated Competitive
Nordic Countries	Publicly owned Some admin. Reforms	Mixed ownership Liberalised	Not significant	Ongoing reform Monopoly (except Sweden)	Private Competitive	Private Concessions	Oligopoly Mixed Ownership
Portugal	Publicly owned Private concessions for Tagus Crossing and Motorways	Dominant public firm Liberalised	Not significant	Public Monopoly	Deregulated Oligopoly	Private Some Concessions	Deregulated Competitive
Spain	Publicly owned except for some motorways	Dominant public firm Liberalised	Not significant	Public Monopoly	Private Concessions	Private Regulated	Oligopoly Mixed Ownership
Greece	Public	Dominant public firm Liberalised	Not significant	Public Monopoly	Private Regulated	Mixed Regulated	Mixed Regulated
Italy	Public except for some motorways	Dominant public firm Liberalised	Not significant	Public Monopoly			Mixed Deregulated

5.10 Overview

The results of the country reviews are summarised below. They are based upon the matrix method of analysing organisational change (Hartley et al., 1991), by which one constructs a capital market-product market matrix and notes the location of firms or industries in that matrix at two or more dates (in our case 1980 and 1997) (see Appendix One). With such an analysis we considered the product market (or competition) to consist of five types with the following weights being used to calculate a score:

Weight	Product Market Form
1	Perfect Competition - many firms, substantial competition;
2	Monopolistic Competition - many firms (more than 10) - some competition but some monopoly in terms of time and space;
3	Oligopoly - a few firms (three to, say, 10) - some competition;
4	Duopoly - two firms - some competition; and
5	Monopoly - one firm - no competition.

For each sector, we have distinguished between infrastructure, freight operations and passenger operations, unfortunately, space constraints preclude the analysis of ancillary services. We considered the capital market (or ownership) to be consistent with six types with the following weights:

Weight	Capital Market Form
1	Private - manager owned. Capital assets are 100% owned by private individuals but shares not traded on the Stock Exchange. Examples include family owned firms, Management Buy-Outs (MBOs) and Employee Share Ownership Programmes (ESOPs);
2	Private - Stock Exchange listed. Capital assets are 100% owned by private sector bodies and shares exchanged in the Stock Market (e.g. public limited company (plc) in UK);
3	Mixed Ownership – capital assets owned jointly by public and private sector bodies;
4	Public Sector Company - publicly owned but independently controlled, with little interference by politicians;
5	Government Agency – publicly owned but only indirectly controlled by politicians; and
6	Government Department - publicly owned and under the direct control of the politicians.

For each sub sector we calculated the appropriate scores for the year end 1980 and 1997 and present, in Table 5-2, the change in scores between 1980 and 1997. In this analysis, a totally free market would have a score of one (or possibly two), whilst a

totally regulated market would have a score of thirty. The results show that in both 1980 and 1997 the sectors with the greatest degree of state intervention in terms of both the product and capital markets are rail, air, road and water in that order. Secondly, all sectors have seen some liberalisation with the greatest absolute changes being in the rail and air sectors which have also seen the greatest relative change. Finally, in 1980 the least liberalised transport market was in Finland and the most liberalised in France (the latter result being mainly due to the relatively low involvement of the state in the road sector).

Table 5-2 Summary of National Matrix Analysis - By Sector

	Rail Sector		Change	Road Sector		Change	Air Sector		Change	Water Sector		Change	Average All Sectors		Change
	1980	1997		1980	1997		1980	1997		1980	1997		1980	1997	
Austria	25.0	20.0	-5.0	15.5	15.5	0.0	19.0	16.3	-2.7	15.5	15.5	0.0	18.8	16.8	-2.0
Belgium	23.3	20.0	-3.3	15.5	15.5	0.0	16.3	11.0	-5.3	15.5	15.5	0.0	17.7	15.5	-2.2
Denmark	30.0	21.7	-8.3	9.0	7.7	-1.3	20.0	15.0	-5.0	11.8	11.8	0.0	17.7	14.0	-3.7
Finland	30.0	21.7	-8.3	12.3	10.0	-2.3	22.5	20.0	-2.5	17.5	10.3	-7.3	20.6	15.5	-5.1
France	20.0	20.0	0.0	5.0	6.0	1.0	15.0	13.0	-2.0	11.6	10.0	-1.6	12.9	12.3	-0.6
Germany	25.0	12.0	-13.0	18.7	13.0	-5.7	16.8	13.3	-3.5	11.8	11.8	0.0	18.1	12.5	-5.6
Ireland	20.0	20.0	0.0	23.0	14.3	-8.7	20.0	16.0	-4.0	15.0	6.7	-8.3	19.5	14.3	-5.2
Luxembourg	20.0	25.0	+5.0	15.5	15.5	0.0	16.3	11.0	-4.3	-	-	-	17.3	17.2	-0.1
Netherlands	20.0	20.0	0.0	15.5	15.5	0.0	14.7	10.7	-4.0	9.8	9.8	0.0	14.0	13.1	-0.8
Norway	30.0	21.7	-8.3	11.7	10.0	-1.7	18.5	16.0	-2.5	11.8	10.8	-1.0	18.0	14.6	-0.4
Portugal	20.0	20.0	0.0	15.7	9.3	-6.3	18.0	18.0	0.0	16.0	11.5	-4.5	17.4	14.7	-2.7
Spain	20.0	20.0	0.0	11.0	11.0	0.0	22.5	13.8	-8.8	12.7	12.7	0.0	16.5	14.4	-2.1
Sweden	30.0	21.7	-8.3	12.3	9.3	-3.0	20.0	16.0	-4.0	8.6	7.2	-1.4	17.7	13.6	-4.1
Swiss	25.0	20.0	-5.0	18.7	17.0	-1.7	16.3	14.3	-2.0	15.5	15.5	0.0	18.9	16.7	-2.2
UK	20.0	6.6	-13.3	17.0	11.3	-5.6	21.3	12.3	-9.0	13.8	9.8	-4.0	18.0	10.0	-8.0
Average	23.9	19.5	-4.4	14.4	12.1	-2.4	18.5	14.4	-4.0	11.8	9.9	-1.9	17.5	14.3	-3.2

6 SECTORAL REVIEW

6.1 Air

Overview

European carriers seem to have substantially improved their productive efficiency after the market reform introduced by the Liberalisation Packages. During the period 1990-1995, the European industry has dramatically reduced the levels of real unit costs and increased productivity. Some carriers have already nearly matched the efficiency of North American airlines, traditionally pointed out as more efficient by other studies, e.g. Caves et al (1987) and Doganis (1991). This improvement is particularly marked for airlines from those countries that started the liberalisation of their international services (and subsequently, of their domestic markets) and the privatisation of state-controlled companies during the mid-1980s namely, the UK, Ireland, Germany, Netherlands and Belgium.

Public ownership is found to be a cost-augmenting determinant of airline performance. On average, costs are 7.7% higher for publicly owned airlines than for those which have been privatised. However, the imposition of severe limits on public subsidisation of airlines has improved their results considerably.

In addition to the effect on the airline performance, the new competitive framework is generating gains in terms of consumption efficiency. A rise in the number of operators on a route, and the corresponding reduction of incumbents' market shares has resulted in lower fares and higher demand levels and therefore a higher aggregated consumer surplus. A similar effect has resulted from competition through indirect connecting-flights. In addition, it is found that the number of available fares also rises when competition is present.

With regards efficiency in consumption, there exists a very limited number of routes where three or more operators compete and this poses a serious barrier to the transfer of gains obtained by airlines to travellers. The US experience shows that after deregulation a relatively large number of new operators enter the market, but that in equilibrium many of these do not survive. Therefore, the objective of regulation for this industry should be that at least some degree of potential competition should continue in the equilibrium situation.

Most of the experts interviewed point out that, at present, the main barriers to interoperability and interconnection in the air sector are capacity shortages at key European hubs. Although most member States are already enlarging or planning new infrastructure to alleviate this problem, future market configuration can be affected by the capacity shortages today. In particular, slot allocation systems should be revised in order to prevent large incumbents exploiting their dominant position at main hubs, in terms of blocking the entry of new competitors. There is also some doubt as to whether the predict and provide approach to airport investment takes into account environmental externalities? The present trend towards the formation of a few large groups of airlines complementing their networks at world level may result in an

undesirable market structure in which competition, though legally promoted, is effectively infeasible.

Summary of literature review

Liberalisation of air markets was first initiated in the US in the late 1970s, for domestic and international services. The European regulatory changes, which have been introduced more than a decade after, have benefited to a great extent from the observed outcomes from the US experience. Most studies in the air sector are based on the US case, though there are also comparative studies between US and Europe, and some recent works aimed at studying the effects of the European deregulatory process.

According to the literature on the US experience, it is generally considered that liberalisation policies have a positive net impact on the air industry. For the US case, Caves et al (1987) estimated a 10% increase of productivity, with a great part of this improvement being translated into lower fares and different types of fares. Morrison and Winston (1995) estimate that deregulation lowered fares by 22% in 1993, compared to the level they would otherwise have reached. Baltagi et al (1995) analysed the impact of deregulation on costs, concluding that deregulation in the US had a positive impact by promoting technical change and allowing airlines to exploit both economies of density and economies of scale .

Other reported effects were a substantial entry of newly created operators, and a trend towards hub-and-spoke type networks. It should be pointed out that after an initial dynamic period of new entries, not many new carriers survived, and the air industry is not now regarded as a paradigm of a contestable market. The actual US market structure currently consists of six large operators at national level and many small airlines which operate reduced networks. Routes rarely have more than three or four operators, except on some dense corridors (Forsyth, 1998).

The liberalisation process in Europe has followed a different pattern, taking a gradual approach rather than the US ‘big bang’ type of deregulation. One of the main forces driving the process of liberalisation was the benchmark comparison between US airlines and European carriers. Many studies compared productivity levels and costs between European and US airlines, consistently showing an advantage in favour of the latter (see Caves et al, 1987; Doganis, 1991; Pryke, 1987; Windle, 1991).

There is a scarcity of empirical studies aimed at evaluating the impact of de-regulation in Europe, since the gradual approach chosen and the short period since the market has been fully deregulated (April 1997) makes it unlikely that any clear statistical evidence can yet be found. Nevertheless, there are already some work that have initiated this type of analysis (see Encaoua, 1991; Marín, 1995a, 1995b; and Betancor and Campos, 1997). Results generally indicate that deregulation seems to produce positive effects in terms of the productive efficiency of European airlines, especially for those carriers from countries that initiated the process earlier (UK, Netherlands, Ireland, Germany).

The process of deregulation, both in the US and in Europe, has eliminated the legal constraints for the operation of airlines but, it has been pointed out that other types of barriers can still be in operation. Barret (1992) describes two general types that can be found in a deregulated air market, structural and strategic barriers. Structural barriers include, hub airport dominance, ground handling monopolies and control over computer reservations systems whilst, strategic barriers include incumbents with large networks offering selectively lower fares in response to entry on contested routes whilst raising fares on uncontested ones (predatory pricing). Additionally, several incumbents can co-operate and respond to new entrants with collusive prices and different capacity levels. The success of a deregulatory process should ensure that these types of structural and strategic barriers do not effectively impede fair competition in the air industry.

Summary of interviews

Sixteen in-depth interviews were undertaken in the air sector. The material obtained from the interviews carried out with experts in the air sector allowed us to present a picture about the present situation of the industry across Member States. In addition, it was possible to study the extent to which privatisation and liberalisation policies have been implemented. The basic tool of analysis has been the use of a two-dimensional index, in which the type of ownership and the type of market structure can be summarised. Furthermore, it is possible to combine both dimensions in a single score. Changes in this basic score provide information about the degree of change introduced in the industry, and allow comparisons across countries. This type of index was applied to three different elements of the air industry: infrastructure (terminals), passenger operations and freight operations. An average value of the score was computed both for 1980 and 1997, and the change of the air industry during this period studied.

Results indicate that the UK is the country that underwent the most profound modification between 1980-87 for both infrastructure and operations. All Member States except Portugal (no information was available to compute indices for Italy and Greece), have applied some type of policies in the direction of liberalisation. It is also interesting to note that those countries that initiated the signing of more liberal bilateral agreements with the US are those which are more advanced in terms of liberalisation of their domestic markets and the rest of their international services, e.g. the UK, Netherlands, Belgium, Germany and Luxembourg.

Privatisation is a policy which has been extensively employed in some countries, especially with regard to operations. Many national carriers have been sold to the private sector, although there are some significant exceptions which are still state-controlled, although severe limitations have been introduced on the use of public subsidies for these airlines. With the exception of Britain, privatisation is not so advanced in other areas such as infrastructure, generally under public ownership. The only area where competition with private operators exists is in baggage handling and catering operations. Air traffic control (ATC) is another area where public agencies dominate in all EU countries.

Regarding barriers to interoperability and interconnection, experts generally agree that similar problems exist across Member States. Among the more severe of these problems is a lack of capacity at some important hub airports, which raises questions about airport domination by incumbents and the allocation of existing and new landing slots. Many states are already building or have plans to enlarge airport capacity (e.g. Heathrow, Roissy, Barajas), or to build new alternatives (e.g. Gardermoen). Other reported limitations to interoperability are environmental limits (noise, pollution), and some technical aspects (compatibility of ATC systems). Some congestion is mentioned by interviewees in terms of ATC in particular zones, for example, the UK-Mediterranean routes, where the holiday market is very large.

Summary of modelling results

The main objective of the modelling work for the air industry performed in this project has been to analyse the impact of the three EU liberalisation packages on the productive efficiency of airlines and the consumption efficiency reached in the market. Regarding production efficiency, the question that needs answering is what cost savings have been obtained as a result of a more competitive framework? With respect to consumption efficiency, the question that needs answering is how has this new framework affected consumers, in terms of fares, supply of services and quality aspects? The bulk of modelling work for the air sector has been empirical. In order to estimate models to answer the questions above, data sets were assembled from information reported by airlines to international organisations (International Civil Aviation Organisation (ICAO) and International Air Transport Association (IATA)). Data on prices were obtained from published fares (ABC guides).

The analysis of the productive efficiency of airlines has involved the use of productivity and unit cost indices on the one hand, and the estimation of a translog cost function on the other. Results are highly informative about the present situation of the European air industry, and about its evolution during the period 1990-1995. First, it is found that in 1995 there still existed a gap in terms of performance between an average European airline and a North American carrier (airlines from US and Canada were included to provide a benchmark of reference). If European countries are divided into those that were quick to initiate the signing of liberal bilateral agreements and the rest, it is found that airlines from the first group are closer in their performances to the North American levels. Another interesting result is the observation of a general improving trend for all European carriers, towards convergence with US and Canadian levels of efficiency.

The estimated cost function reveals the existence of mild returns to density and to scale in the air industry, the latter being slightly higher. This implies that airlines should be extremely concerned not only about the level of service that they provide on given routes, but also on the number of points served and the configuration of their networks, since they might have a significant effect on their costs. These results can therefore explain the trend towards alliances and mergers observed in practice among airlines, which might be justified by a need to complement their networks.

In order to analyse the effect of regulatory changes over consumption efficiency, the effect of competition on fares and volumes of traffic was studied. Equations for prices

and for traffic levels have been estimated (see Table 6-1), using as explanatory variables the number of operators on a given route, their relative market shares, and also the degree of airport control that carriers might have. Data corresponds to a large sample of international intra-Europe routes for the year 1994 (207 routes and 919 route-airline observations) with passenger and freight services considered separately.

Table 6-1 Price Equations, Route-airline Level Sample (OLS estimation, Endogenous. Variables: fares/kms)

	Highest discounted Fare		Economy-class fare		Business-class fare	
	Parameter	t-ratio	Parameter	t-ratio	Parameter	t-ratio
Constant	2.544*	13.766	1.992*	15.958	2.038*	15.357
Distance	-0.552*	-33.448	-0.419*	-37.564	-0.402*	-33.800
GDP	0.194*	9.676	0.309*	22.752	0.254*	17.645
Frequency	-0.014	-0.773	0.017**	1.441	0.030*	2.317
Paxperf	-0.048*	-3.244	-0.056*	-5.648	-0.031*	-2.952
Route share	0.035*	3.863	0.043*	6.936	0.012*	1.820
Indirect flights	-0.0008*	-3.342	-0.0007*	-4.112	-0.0003**	-1.604
Airport concen.	0.091*	4.496	0.089*	6.503	0.001	0.103
R^2	0.71		0.80		0.76	

Number of observations: 919

** Statistically significant at 90%

* Statistically significant at 95%

and Airport concen. - % of landing slots controlled by an airline.

Paxperf – number of passengers carried on a route

(all airlines)

Route share – An airline's share of passengers number of weekly departures on a route.

Source: Hernandez et al. (1998)

The results show that competition among airlines is generating an improvement in the consumption efficiency of the industry. A rise in the number of operators on a route and the corresponding reduction of incumbents' market shares results in lower fares and higher demand levels, therefore in higher aggregated consumer surpluses. Moreover, there is also a similar effect caused by competition through indirect connecting-flights. Combining these two findings from direct and indirect flights, the conclusion is that competition is taking place mainly on fares, which is highly positive for travellers, although quality of service is also found to be valued by users. Flight frequency was identified as a demand augmenting factor when used as a proxy for quality. It was also found that fares rise when frequencies are higher indicating that users are prepared to pay for quality. This conclusion is reinforced by the fact that the effect of frequency on fare is more significant for business-class than for economy-class and it is not found to be significant for the high-discount segment.

The impact of airport saturation over market outcomes is examined by including a Herfindahl index of concentration constructed from airlines' shares over total weekly

departures from airports. It is found that routes linked to more dominated airports have comparatively lower traffic levels and higher fares for economy class and high-discount (the effect is not found for business-class). This is evidence that low margin business has been squeezed out and this seems to indicate that saturated airports may be a barrier to entry: the more protected a carrier is from competitors, the higher the fare it may charge.

The aim of the EU liberalisation packages of promoting competition by eliminating the legal barriers to entry may be ineffective if strategic barriers can still be used by incumbents. The combination of a lack of landing slots and acquired rights is extremely problematic for a competition framework and a revision of the existing concession systems is probably required to guarantee a minimum number of available slots to new entrants to complement the liberalisation process of the air industry.

Other potential strategic barriers that may lead to unfair competition between incumbents and new entrants include, ground handling operations and the possible information advantages that may be generated by computer reservation systems (CRS). Regarding handling operations, there have already been changes with the guarantee of a minimum quality service to all carriers using an airport, either by forcing main flag carriers to offer these services as demanded and/or the introduction of independent handling firms.

Conclusions

As a result of the combination of the interviewing and the modelling work, some policy conclusions and recommendations can be offered:

a) Liberalisation and privatisation policies seem to have had a positive impact on the productive efficiency of airlines. A general trend towards improvement is observed in productivity and unit costs. Further privatisation should be pursued by those Member States that still have state-controlled airlines. The recent reforms of Air France are reassuring in this respect.

b) Competition generates positive effects for travellers, in terms of lower fares and a wider spread of fare types to chose from. Results indicate that the number of operators on a given route, and the frequencies offered on alternative connecting routes imply lower fare levels, especially for the more elastic market segments.

c) Introduction of competition should be encouraged. At present, the number of routes where there are three or more operators is extremely small. Even though the lapse of time since domestic markets have been fully open to competition is still too short to have produced significant entries, it is considered that there exist several potential barriers to competition that may provide incumbents with advantages against new entrants. The expansion of low cost airlines such as Debonair, Easy Jet and Ryan Air and the response from established airlines (e.g. British Airways establishment of the Go subsidiary) is an important development.

d) Lack of capacity at relevant hub airports and the privileged position of large incumbents in the slot allocation systems can consolidate a domination of the market

by a few large carriers. A revision of the existing allocation systems and the introduction of reforms should be a priority, in order to avoid the configuration of an oligopolistic market structure.

e) The existence of some economies of scale indicates that the configuration of large networks with adequate connections can also be a potential weapon for an incumbent to deter or to make difficult the entry of new rivals. The observed trend in the industry towards the consolidation of a few large groups of airlines at world level might be explained by the existence of these economies of scale. In terms of policy recommendations, the only possible regulation without interfering too much with the market is to guarantee that these large groups do not have the possibility of combining acquired rights of members and effectively blocking the entry of competitors.

f) Regarding privatisation and the introduction of infrastructure for the air sector (terminals), there is not sufficient evidence to estimate the potential benefits of these policies. At the moment, only the British experience and a few other European airports provide information on this point, and no sound conclusions can be extracted from the results.

g) With respect to the provision of air infrastructure, there appears to be a 'predict and provide' philosophy in most countries, despite such an approach being increasingly discredited for the road sector. There are strong arguments that liberalisation should be accompanied by environmental and congestion charges, however, this would counterbalance some of the effects of anticipated fare reductions.

6.2 Inland Waterways

Overview

The inland navigation sector is characterised by a large number of individual carriers operating on a network of waterways which have fluctuating gauges and locks to overcome differences in water levels. They often act as a natural barrier for some types of vessels and for full capacity utilisation of the ships. For a number of other reasons the sector has been and still is to some extent, confronted with excess capacity. This puts downward pressure on prices, hence governments have traditionally intervened by imposing minimum prices on some parts of the network and for some types of goods. Navigation on the Rhine system was deregulated at the time of our study but the North-South market between the Netherlands and Belgium and France remained regulated.

Summary of Literature Review

There was very little literature to be found on this sector. Work by Beuthe and Jourquin (1994) describes the organisation of inland navigation and the tour de rôle system in Europe and Belgium in particular. The authors developed a method in order to calculate the additional transport costs in Belgium caused by maintaining the regulated system, which were found to be rather high. As a result, the decrease in price following the abolition of the regulated system would result in a reduction of the profits for independent bargemen. This is due to the combined effects of the decrease in prices and the low price-elasticity of demand.

Meersman and Van de Voorde (1997a) used a logit model to predict the relative shares of freight transport by road, rail and inland navigation given an increase in industrial production and therefore in demand. The estimation results of the models show that for three product groups (metal, chemicals and machinery) the three modes are substitutes. Furthermore, the price-elasticity of road transport is inelastic and also insensitive to changes in rail and inland navigation prices, whereas rail and inland navigation are sensitive to changes in road prices. In a bi-modal model inland navigation is less price sensitive.

Meersman and Van de Voorde (1997b) analysed the relationship between economic growth and demand for freight transport, taking into account the modal split. In this study they extended their analysis to a number of European countries. The results show that economic growth in Europe, especially in industrial production, induces an increase in the demand for freight transport, with the strongest effect being felt by road transport.

Summary of the Interviews

A variety of methods were used to contact independent bargemen, including personal contact and advertising in a magazine. In the end a total of 14 useable questionnaires were received. From these responses, we found that freight transport by waterways was the main and only activity of all the independent bargemen. All the workers were full time. In most cases the owner works on his ship together with his family. There is

no timetable, as bargemen work when and where it is necessary to do so. In most cases the owner and his family do not pay themselves a wage but simply live off their profits.

The fact that 12 of the barges were dry bulk transport and only 2 were liquid bulk is explained by the fact that most individual bargemen work under the tour de rôle system, which is involves dry bulk traffic only.

In addition a number of Belgian shipping companies were contacted, with 5 replying. For 2 of the 5 companies interviewed, freight transport by waterways was their only activity. For the other 3 shipping companies freight transport by waterways was their main activity, the others being chartering, freight forwarding and acting as shipping agents.

Summary of Modelling

In the current situation the price in the regulated market is fixed. Although historically justified to protect the interests of independent bargemen after the war, the regulation of inland navigation maintains a system where the price on the regulated market is independent of supply and demand. The regulation stipulates that an individual bargeman has to queue, irrespective of the characteristics of his vessel. Thus, this regulation acts as a disincentive for the individual bargeman to invest in improving his boat.

Liberalisation of inland navigation means the abolition of the regulated market. Both supply and demand in the regulated market are to be trusted to competition in the free market. This means that after deregulation there will be only one market with a single price and it is assumed that this will lead to a better circulation of information. The consequence of better information is a more efficient supply and, even in some cases, a more efficient demand.

The question: “How will this liberalisation affect the free market?” has no clear cut answer based on quantitative results from previous research. Nevertheless, we can give an indication of the effects of liberalisation based on some possible scenarios in a static framework. A starting scenario is that the demand in the regulated market is absorbed by other transport modes following deregulation. Assuming that inland operators enter the free market this scenario will lead to an increase in output and a reduction of the equilibrium price. Another possible scenario is that the operators from the recently deregulated market cannot compete in the new market and retreat from it. If demand from the regulated market remains in the newly deregulated market then the increase in demand forces both the equilibrium output and price upwards. In reality a combination of both scenarios will occur. Our analysis, however, indicates that output is likely to increase, whilst the effect on price is ambiguous. It is reasonable to assume, however, that the price will drop as a consequence of the liberalisation.

On this assumption, deregulation will have consequences for the revenues and profits of carriers operating in the regulated market segment. They both will go down, threatening the survival of these small, single-vessel companies. The additional

problem is that the vessels of the carriers operating in the regulated market, are small and most of the time cover short distances. Both these factors have an additional negative influence on revenues and profits. The possibility of compensating for these negative effects with higher prices will disappear with deregulation. They will be forced to stop their operations, which will reduce the excess capacity, or look for other, more efficient opportunities that help them to survive. They might survive by making investments (e.g. larger barges) or by pooling their resources and risks by co-operation. Others will work for chartering companies as sub-contractors. As for chartering and shipping companies, they will try to survive by increasing their scale through mergers, as can already be seen in the market. Some companies will become integrated operators, others will specialise, in the sense that they no longer wish to own ships, but rather use individual bargemen as subcontractors.

Demand in transport has experienced a trend towards concentration in the past, unrelated to the liberalisation of the inland navigation market. Some shippers transport their own goods. But here as well, shippers tend to specialise by subcontracting their transport. After deregulation this tendency will probably grow stronger since shippers will be able to make long term transport agreements with a carrier. All this means that the market of inland navigation will be characterised by big shippers on the demand side facing small suppliers. The outcome of this unequal competition is still open to research, but there are some dangers of monopsony that will exert further downward pressures on price.

This market should be seen in the total array of transport modes. Therefore we will now turn our attention to how inland navigation relates to the other modes of transport. The lower prices which will result from the deregulation may improve the competitive position of the inland navigation sector in relation to rail and road freight transport. Empirical investigations suggest that the strength of these effects differs considerably over goods categories and are rather small (usually inelastic).

Conclusions

The future of inland navigation can be summarised as follows. It seems that inland navigation is a good substitute for long distance transport of certain product groups by both rail and road, provided the network of waterways allows it, but is a complement to short distance road traffic. Inland navigation suffers less from congestion and exhibits very competitive prices for long distance bulk. As such it will mainly compete with rail.

Economic growth in itself will have a positive impact on inland navigation for those countries with a network that allows large vessels (the Netherlands, Germany and to a lesser extent Belgium), but in order to induce additional shifts from road and rail towards inland navigation policies other than price deregulation will probably be required. The survival of the inland navigation sector will therefore depend largely on its creativity to find new market niches and to become an important partner in the logistics chains which will dominate European transport in the future. This can only be realised if intermodality is stimulated, giving each mode of transportation its optimal position in the logistics chain.

6.3 Rail

Summary of the Literature

Several themes emerged from the summary of the literature, namely: railway reorganisation; production/cost theory; demand models; regulation; infrastructure investment and barriers to interoperability. The main issues raised by railway reorganisation were the pricing of infrastructure, whether off-track competition gave more a more optimal welfare outcome than on-track competition and whether vertical separation made the rail industry truly contestable. It appeared that there were a number of different charging regimes in place throughout Europe, with some based upon fixed costs and others upon variable costs and others a combination of the two. Only in the UK are full cost recovery charges in place, which according to Jahanshahi (1998) act as an incentive to improve productive efficiency. The difficulty of such an approach with regard to open access is acknowledged by Siraut (1997). He points out that with open access, entrants would be charged on an average network cost basis, leading to entry into areas displaying large discrepancies between prices and costs, rather than poor service quality.

The review of production and cost theory literature examined the following types of modelling: parametric cost and production functions; non parametric index numbers and functions. A number of studies had found constant returns to scale with respect to firm size for 'all but the smallest railroads' (Caves et al, 1985). In addition they showed increasing returns to density, suggesting that economies of scale arise from the use of the infrastructure rather than from operational factors (Preston, 1994). It is these arguments that helped sway the argument for vertical separation as a forerunner to introducing competition into the rail industry.

Reviewing the literature on demand modelling proved difficult given that the factors influencing demand vary within Europe from country to country. They include, market structure, type of ownership, regulatory environment, service quality, the generalised cost to the passenger and the general state of the economy. Despite the associated problems several studies have estimated price and service elasticities for both passenger and freight services, with Fitzroy and Smith (1995) and Palomo (1996) estimating price elasticities of around -0.5 for passenger services. These elasticities however, were for the overall passenger network and will thus be influenced by lower-elasticity short-distance commuting traffic.

Regulation of the rail industry was seen as a priority, with the literature appearing to agree that safety regulation was non-negotiable and that the over-riding aim of the regulator should be to protect the interests of passengers, especially commuters. In addition, vertical separation ensured that the prevention of monopolistic pricing by infrastructure authorities was now one of the regulator's main tasks (Nash, 1994 and Gylee, 1993). Another key issue is the structure of incentives to promote punctuality, reliability and other features of service quality.

Summary of the Interviews

A total of 39 interviews with Government officials and industry managers were carried out by SORT-IT. The interviews were semi-structured and covered issues relating to the specific objectives of the SORT-IT project, namely what is/are the type(s) of: 1) ownership; 2) market structure; 3) market failure; 4) regulatory failure and 5) barriers to interoperability and interconnection. Six major themes emerged from the interviews:

1) Vertical Separation

There were major concerns raised about the behaviour of infrastructure operations. In Germany and France there was immense speculation as to whether infrastructure authorities were acting as independent organisations, or were in fact still an integral part of the operating company. Further concerns were raised about the monopolistic behaviour (or potential behaviour) of infrastructure authorities with regard to infrastructure pricing. Some interviewees were more positive and felt that vertical separation had allowed managers to manage and had led to more successful marketing of rail services.

2) Reorganisation As A Limited Company

Several state owned companies expressed a wish to be privatised to obtain greater managerial freedom and easier access to private capital.

3) Open Access

Many operators and Government officials were openly hostile to the notion of open access in the passenger market. The problems of cream skimming and its consequences were frequently mentioned, namely, the disincentive to invest in new rolling stock and the threat to network benefits. A further point raised was that in many cases severe barriers remain in place that discourage open access, in particular access to rolling stock and experienced staff.

4) Track Access Charges

Whilst the concept of track access charging seemed to be universally accepted, there were differences as to what the best pricing structure was. Many people felt that the charges should be equated to marginal costs and others that access should be auctioned, whilst only Railtrack supported fully recoverable charges. One common theme that emerged was that charges should be simple, transparent and equitable.

5) Freight and International Services

There appeared to be no objection to the introduction of open access competition into mainstream freight and international passenger services.

6) Barriers to Interoperability and Interconnection

With the exception of SNCB and NS, all the rail companies still reported the existence of numerous barriers to both interoperability and interconnection. The most frequently mentioned being,

a) Interoperability

- Technical - different track gauges, signalling systems and operating procedures.
- Capacity - existence of bottlenecks.
- Institutional and organisation - different organisational structures.
- Strategic - slot allocation.
- Innocent - economies of experience and brand loyalty.
- Physical - mountains, seas etc.
- Environment - restrictions on air and noise emissions.

b) Interconnection

- separate terminals/interfaces/absence of connection.

Summary of the Modelling

Several models were developed in order to assess different aspects of performance by the 17 rail companies included in the study. The first modelling technique built up a series of non-parametric index numbers that examined operating, commercial and financial performance. It should be pointed that these findings are based upon 1994 data, due to availability and the desire to standardise the results of our models, e.g. since the franchising of rail operations in the UK, our main statistical source (UIC) only gives figures for Railtrack. This data may or may not reflect the changes in rail legislation that have been implemented to differing degrees by European rail operators. For example in the case of France, rail reforms were not implemented until 1997. In the following year a freight freeway (a rail route where barriers to interoperability are minimised) was opened, running from Belgium, through France to the South of Italy. In addition France has improved links with both Spain and Luxembourg and has also ensured greater access on its tracks for international groupings. We should therefore point out that in certain cases our findings may have pre-empted the results of legislative reforms.

From the results several conclusions could be drawn:

1. Commercial operators appear to outperform operators tightly controlled by the state both operationally and financially. For example, the average number of train kms produced per member of staff is 3,318 for commercial operators and 2,522 for companies tightly controlled by the state. A similar picture is reflected if one looks at the cost-recovery ratios which for operators tightly controlled by the state is around 0.42 and for commercial firms around 0.48. To test whether these differences in the mean were statistically different we calculated the standard deviations of the means and carried out a two-sample t-test. We found that whilst

there was a statistically significant difference in the means at an operational level (at the 10% level) there was no such difference at a financial level.

2. Firms tightly controlled by the state appear to outperform commercial firms at a commercial level, with traffic units per vehicle of 185 and 164 respectively (although this difference might also be explained by variations is the traffic mix). A two-sample t-test however, showed that this difference was statistically insignificant.
3. From the times series graphs (Shires, 1998), it is clear that all rail operators have improved their operational performance. The picture is not quite as clear for the other types of performance, namely, commercial and financial.

Railway costs were modelled using a transcendental logarithmic (translog cost function) that was estimated from the following data: total operating costs; three input prices (labour, energy and materials); and three output prices (passenger train kms, freight train kms & length of route). From the results (Table 6-2), four types of railways were identified with regard to returns to density: those with large increasing returns to density, (greater than two or less than 0, namely, NSB, SJ, VR, CP, RENFE, CFL, CH and CIE); railways with modest increasing returns (greater than 1.1 and less than 2, namely, DSB, FS, OBB, SNCB and SNCF); railways with constant returns (0.9 to 1.1, namely, BR, CFF and DB); and railways with decreasing returns (0.0 to 0.9, namely, NS).

The results also identified returns to scale (Table 6-2) that could be split into three groups: those with increasing returns (greater than 1.1 or less than 0, namely, CIE, DSB, CH and CFL); those with constant returns (between 0.9 and 1.1, namely, CFF, CP and NS); and those with decreasing returns (all other railways). Taken together, the two sets of results can answer the question, what is the optimal sized railway network to minimise operating costs? The results suggest that an optimal network should be around 2,914 line kms and run around 60 million train kms per annum. This was based upon regression results (Shires et al., 1999) whereby returns to density and returns to scale were regressed against density and length of line respectively. The optimal rail company is based upon the assumption that returns to density and scale are unity. Sensitivity tests indicate that setting returns to density and scale at 0.75 results in a rail company running 124 million train kms per annum over a 5,000 km network. Setting returns equal to 1.25 results in 44 million train kms per annum being run over a 2,000 km network. It should be noted that the model (based solely upon operating costs) may be underestimating the optimal sized railway, given fixed capital costs (Preston, 1994). At present none of the EU rail operators can be described as being optimal. Only CFF and NS have networks approaching 3,000 line kms but their densities of operation are around 35,000 and 40,000 train kms per line km per annum respectively.

Table 6-2 Average Value of Key Variables by Operator (1971-94)

	Returns to Density	Returns To Scale	Train Km per Annum (000s)	Length of Line	Density (train km Per line km)
BR	0.96	0.50	431,349	17,313	24,920
CFF	0.97	0.92	104,242	2,962	35,161
CIE	-8.83	1.35	12,868	2,003	6,453
DB	1.08	0.45	614,083	28,588	21,511
DSB	1.33	1.12	48,674	2,216	22,019
FS	1.20	0.51	298,721	16,263	18,375
NS	0.84	0.92	112,382	2,845	39,548
NSB	12.92	0.89	33,918	4,185	8,108
OBB	1.67	0.71	103,550	5,776	17,973
SJ	4.77	0.61	100,348	11,195	8,969
SNCB	1.23	0.81	92,242	3,978	23,448
SNCF	1.58	0.43	486,945	34,787	14,014
VR	8.56	0.77	42,619	5,949	7,163
CP	5.39	0.93	34,498	3,466	10,039
RENFE	2.53	0.56	147,349	13,099	11,290
CH	-43.75	1.15	17,338	2,533	6,783
CFL	3.40	-4.24	9,726	823	17,282

Where:
BR – British Rail
CFF – Swiss Federal Railways
CIE – Irish Transport Company
DB – German Federal Railway
DSB – Danish State Railways
FS – Italian State Railways
NSB – Norwegian State Railways
OBB – Austrian Federal Railways
SJ – Swedish State Railways
SNCB – Belgian National Railways
SNCF – French National Railways
NS – Netherlands Railways
VR – Finnish State Railways
CP – Portuguese Railways
RENFE – Spanish National Railway
CH – Hellenic Railways (Greece)
CFL – Luxembourg National Railway Company

Source: Shires (1998)

A series of demand models were estimated for both passenger and freight flows at both a European level and a country specific level. The European level estimated demand elasticities are shown in Table 6-3, together with elasticities estimated from earlier work,

Table 6-3 Comparison of Passenger Rail Demand Studies

	Fitzroy & Smith (1995)		Palomo (1996)		SORT-IT (1998)	
	(1)[1]	(2)[2]	BR	RENFE	Neilson (1997)	Shires (1998a)
Price	-0.10	-0.44	-0.47	-0.49	-0.02	-0.46
GDP	0.83	0.59	0.87	0.39	0.38	0.02
Frequency	0.44	0.52	0.95	0.20	0.11	0.20

1: The elasticities for the unrestricted specifications.
2: The elasticities for the zero restrictions on the coefficients of petrol price and station spacing

Source: Shires (1998)

The policy conclusions to emerge were that,

- The price elasticity would indicate that there is a lot of scope to price up rail services.
- GDP is an important determinant of rail demand .
- The service elasticity indicates that service levels are perhaps a less important determinant of rail demand possibly, indicating that the quality not the quantity of service is of greatest importance to the traveller.

The freight demand models estimated a series of short and long term price elasticities. We identified two types of rail hauliers. Those who have low market share and ship low value, highly price inelastic commodities, at a price that road cannot compete against, e.g. BR, CIE, CFL. Secondly, networks that have substantial market shares and ship a mixture of freight (exhibiting greater price elasticities) in markets contested by road, e.g. OBB, DSB, SNCF.

In the simulation work we examined on-track and off-track competition based on models developed from stated and revealed preference data. Our work suggested that the most likely form of on-track competition was cream skimming. This competition increases benefits to users but it also reduces welfare because of large reductions in producer surpluses. The results of our work on off-track competition suggests that franchising can reduce subsidy levels in most cases, whilst maintaining current services and fare levels, and is thus likely to be welfare positive. Larger franchises, looser regulation and protection from competition will all reduce subsidies, although they may have disadvantages in terms of fare increases and service reductions, with uncertain welfare implications.

Work on competition between rail and coach has found significant cross elasticities between the two, particularly in the leisure market and for travel by the elderly and the young, e.g. a mean rail leisure cross elasticity with respect to coach price of 0.14 and a mean coach leisure cross elasticity with respect to rail price of 0.3. The results suggest that where competition on the rails is not possible, for example, because of rail capacity shortfalls (e.g. in the Netherlands and approaches to large cities elsewhere) substantial deregulation can be introduced at the margins by deregulating coach services (assuming there is spare road capacity).

Modelling work on the effects of interoperability barriers on passenger flows and passenger generalised costs found that substantial barriers still exist, despite the TEN program of ongoing improvements. The effects of interoperability barriers are summarised in Table 6.4. This shows that national boundaries and market concentration substantially reduce demand and increase generalised costs. This suggests that the pattern of European rail services may still be too constrained by state boundaries (which will coincide with company market areas - unlike in the road sector) which may in turn reflect linguistic/cultural, technical and organisational barriers.

Table 6-4 Effects of Barriers on Passenger Flows and Generalised Costs (%)

Demand Model	% change in average passenger flows (2,380,000)			
	Market Concentration	Belgium Dummy	Amsterdam Dummy	German Dummy
Model 1	*-55*	-67	-68	-60
Model 2	**-14**	-32	-31	-29
Generalised Cost Model	% Change in Generalised Cost (£138)			
	Market Concentration	Belgium Dummy	Amsterdam Dummy	German Dummy
Model 3	*-48*	+25	+47	+54
Model 4	**-5**	+63	+85	+86
Model 5	Na	+63	+86	+87

Italics – denotes market concentration measure within mode, e.g. other rail companies.
Bold – denotes market concentration measure for all modes, e.g. rail, coach and air companies.

Source: Shires (1998)

Conclusions

In our conclusions we recommend a number of policies, several of which are in agreement with issues raised by Neil Kinnock in his latest communication (1998). The first set of policies are recommendations for the current situation. They include the following:

1. *The commercialisation of rail companies.*
2. *Establishment of an independent Infrastructure Authority (subject to regulation)*
3. *Off-track competition rather than on-track competition, except for freight and international passenger services.*
4. *Establishment of Rolling Stock Leasing Companies (subject to regulation)*
5. *The introduction of Coach Deregulation*
6. *The introduction of infrastructure/track access pricing that is simple, transparent and equitable.*

Our policy recommendations also suggest a New Direction that might include:

1. *Horizontal separation with vertical integration*
2. *Network re-configuration.*

Our overall conclusion is that although there is some evidence to support the current proposals to liberalise European railways, there are also some serious doubts. Vertical separation has had some advantages in promoting specialisation and a better understanding of infrastructure costs. There are also a number of problems stemming from the natural monopoly characteristics of rail infrastructure. If the current plans fail to revitalise the railways' futures, consideration should be made of alternative regimes. We would recommend some form of off-the-track competition for vertically

integrated concessions which may be based on lines (as originally envisaged for the Channel Tunnel Rail link) or networks. Open access could still be permitted for, for example, international passenger traffic and freight traffic using some variant of the minimum efficient component pricing rule. Paradoxically, this regime might be more successful following vertical separation, which might assist in establishing starting infrastructure charges. Moreover, it may be possible to devise market tests for vertical integration by permitting vertically integrated and vertically separated bids. In such bidding, we would recommend that alternative proposals with respect to track configurations should also be permitted. We would also recommend that such a regime should be preceded by privatisation and deregulation, where applicable, of rival transport modes, particularly express coach and air services. We also believe that the type of regime we are proposing may be assisted by the horizontal separation of passenger and freight operations and the existence of a competitive on-the-track, or between the track (competition between franchises along shared franchise routes), fringe in order to prevent collusion.

6.4 Road Freight

Overview

The road freight analysis of the SORT-IT project delivered two main sets of findings, the first based on the literature and interviews and the second based on a review of available data and databases. In relation to the second area, considerable difficulty was experienced in finding relevant and complete datasets, largely due to commercial confidentiality and the difficulties of obtaining accurate data from a large number of small sized companies.

Summary of the Literature

A number of reviews of road freight and logistics at the European level have been identified. An early review is provided by Mackie et al. (1986) but more up-to-date reviews include the following. MarketLine International (1997a, b) have undertaken surveys of the European Union logistics and courier and express services. They estimate that the EU logistics market was worth around 140 BECUs in 1996. Around one-quarter of this expenditure went on third party services and the remainder on in-house systems. The share of logistics expenditure that is contracted out varies from 34% in the UK to 11% in Greece. They estimate that the EU courier and express market was worth around 33 BECUs in 1996. Cooper et al. (1997) estimate that the road freight market in the European Union was worth around 150 BECUs in 1990, with the top 30 firms controlling around one third of the market. Gerondeau (1997) estimates that the value of the road freight industry in western Europe in 1993 was 350 BECUs, including heavy and light vehicles. Moreover, he estimates that, excluding pipelines, the total value of the western European freight industry is 362 BECUs giving road an almost 97% share in terms of value. Whilst these figures are controversial, it is clear that road has a higher share in terms of value than it does in terms of tonnes (82%) or tonne kms (58%) (DGVII, 1997).
Deloitte and Touche (1998) have undertaken a survey of 600 companies in nine EU countries (the member states not covered are Austria, Finland, Greece, Ireland, Luxembourg and Portugal). The UK compares favourably with other EU countries with below average logistics costs and above average service standards. There have been significant performance improvements in some sectors. For example between 1995 and 1998 food and drink retailers have reduced inventory costs by 55% - although some of this inventory has been pushed back along the supply chain. Kearney (1998) reports on a survey of 163 companies across Europe in which around 10% were considered to show ‘extremely advanced and integrated logistics’. Cooper et al. (1997, 1998) examine supply chain dynamics at the European level. Ten components are identified including lean supply chains, focused production, postponement, reverse logistics and pan European sourcing.

McKinnon (1998) reviews the deregulation of road haulage operations, particularly at the European Union level. He concludes that ‘the long and varied experience of commercial liberalisation in the road haulage sector shows that countries can safely abolish all quantitative restrictions on road freight operations without risking the destabilisation of markets or the concentration of market power in the hands of a small number of large carriers’. He questions the need for restrictions on the activities of

own-account operators and for the financial standing requirements that new operators must meet. The environmental case for re-introducing quantitative controls is examined and dismissed. It is argued that the main priority for policy makers should be the 'the refinement, enforcement and harmonisation of operational regulations'. A similar review is provided by Bayliss (1998). The impact of deregulation on market stability and sector efficiency is examined. It is noted that in Europe's two most mature deregulated markets (the UK and Sweden) the number of operators has shown a high level of stability. In terms of sector efficiency, various logistical and supply chain trends are noted, such as just-in-time and globalisation. It is concluded that deregulation has allowed the sector to change its structure and operating practices to increase efficiency and respond to fast changing demands.

Nijkamp et al. (1997) have studied freight flows across the Alpine routes by using data on the use of different modes between 108 European regions in 1986. Using a form of competition simulation model they examine the impact of eco-taxes and increased congestion. Competition simulation work for the freight sector in Sweden has been carried out by Kagesson (1998) in a similar manner to the work that has been undertaken by SORT-IT for the passenger sector. Kagesson finds that for product goods moving more than 500 km, if social and environmental costs are to be fully internalised, by the year 2010 the cost of 40 tonne trucks should be increased by 66-76%, 60 tonne trucks by 38-43%, wagonload rail services by 52-105%, large cargo ships by 6-9% and large ro/ro ships by 13-26%.

Hague Consulting Group (1998) has undertaken an assessment of the economic costs of barriers to road transport by examining five European countries (UK, France, Italy, the Czech Republic and Poland). Five types of impediments were examined: traffic congestion, border delays, traffic bans, strikes/blockages and speed restrictions. It was estimated that impediment costs represented 7% of total transport costs in the UK, 5% in France, 3% in Italy, 8% in the Czech Republic and 29% in Poland.

The literature makes it clear that road freight is characterised by a fragmented structure. There is a lack of integration and, although, some multi-national companies are increasingly dominant, there is also a lack of consolidation in terms of co-operation and lack of consistency in, and enforcement of, regulations across the EU.

Empirical evidence on the impact of deregulation from the US suggests that it leads to reductions of freight transport rates by 12-25% (Moore, 1986), increases in productivity of 4-13% and increase in concentration for less than truck load traffic (Boyer, 1993) and reductions in empty mileage (Brown, 1994). Similar trends have been observed in Europe (Bayliss and Millington, 1995).

Summary of the Interviews

45 interviews were conducted in the road freight sector, including interviews carried out by MINIMISE. The interviews highlighted some of the commonalties in the experience of those involved in the European road freight industry. The findings are found in full in deliverables D1 (Beaumont et al, 1996) and D3 (Arbault et al., 1998). The road freight industry is typified by entrepreneurial individuals who are running small businesses with under 5 employees. There were a few Trans-European firms that

had a significant share of the market, but in most countries, small business operations predominate.

The road haulage industry is privately owned and, in some areas, characterised by cut-throat competition and low entry costs. The interviews showed that in some countries (such as Germany and Portugal), own-account operations are important. German studies suggest that switching from own-account to hire and reward can reduce vehicle km by 5%.

There is a great deal of overcapacity as many owner operators are prepared to offer very keen prices to remain in or to enter the market. This has been referred to as fierce rather than free competition (Arbault et al, op cit.). The markets are competitive, but some market dominance was reported in Spain, Great Britain, Norway and Sweden, but the much talked about mega-carriers have yet to emerge(Cooper et al, 1997).

In general, the freight industry seems to exhibit minimal economies of scale, although work by Beuthe and Sayez (1994) using French data suggests that small firms may have diseconomies of scale and scope. They suggest that the optimal sized firm for long distance trucking is around 40 trucks operating 4.4 million kms per annum (110,000 kms per vehicle per annum), although this assumes the same prices for labour and capital inputs for all sizes of firms. Browne and Allen (1997) speculate that there may be greater economies for specialist freight and for logistics companies with some signs of concentration and monopoly rents in these sectors.

The impact of cabotage seems to be modest so far, with the country most affected (Germany) only having an estimated 1.5% of the domestic market affected at the time of the interviews. It does not seem that the introduction of full cabotage in July 1998 has had a ‘big bang’ effect.

Technical barriers such as speeds, and weights were the other main barriers referred to by respondents. In particular the 28 tonne lorry weight restriction in Switzerland was mentioned as a problem.

In terms of interoperability, fiscal barriers were identified by our respondents as probably the most important (see also Krausz, 1998). The European Community hopes to harmonise the levy system (vehicle taxes, excise duties on fuel, users’ charges etc) but there are obvious issues about whether charges should be harmonised at the lowest level, the highest level or some value in between. The level of motor fuel duties in relation to European competitors is one of the main concerns of the Road Haulage Association in the UK (RHA, 1998). The introduction by some countries of Eurovignettes (essentially road tax for non national goods vehicles) has led to some divergence in this area.

Social barriers (e.g. wage levels and conditions) gave rise to some concerns, particularly with respect to the low rates of pay and poor working conditions of some Eastern and Southern European drivers which has encouraged flagging-out in some countries such as the Netherlands. In addition, data we have collected suggests that, compared to German operators, the cost advantage of southern and eastern European operators are relatively modest (20% at most).

Interconnection barriers include border crossings and poor infrastructure: the EU regulations increasing the weight of lorries is causing concern in some countries such as Great Britain that bridge strengthening programmes may not be able to keep up with the demands made upon them.

The key market failures identified by our respondents include environmental externalities (see also Kageson, 1998.), information imperfections (with Electronic Data Interchange offering some prospects for improvement) and economies of scale and integration.

In terms of interconnection the main problem highlighted by respondents was related to border crossings with central and eastern Europe and particularly with states of the former Soviet Union. Poor roads and terminal facilities were cited as problems by some interviewees.

Summary of Modelling

In relation to the second area of findings - modelling - obtaining suitable data for modelling proved to be very difficult. This is despite the research team writing to a Ministry of Transport or similar official body in each country requesting the required information. Only four responses were received (from Germany, Portugal, Belgium and Denmark). For those countries for which data was not received from the Ministry, a Road Haulage or National Association of Freight Operators was also contacted. Unfortunately, this did not resolve the problem of gathering adequate data.

From the literature review, it is clear that the difficulties we have had with obtaining adequate data are not unique. The usefulness of some of the tables contained in the ECMT Report (1998) are impaired by gaps in the data and commentators, such as Cooper et al (1997) are often forced to resort to company records and other commercial data in order to find the information they require on road freight. This can be complicated when commercial confidentiality is an issue. The ECMT Report contains some tables with new data that is of use to us (see below) but does not contain any information on costs or revenues. Browne and Allen (1997) have some very interesting freight data, but it is either for the UK alone or it is for the UK, USA and EU as totals and therefore, although relevant, not detailed enough for our purposes.

Some useful general data for the EU15 has been collated by DGVII (1997). In 1970 road transport carried 431 billion tonne kms but by 1995 this had increased to 1,103 billion tonne kms, an increase of 156% or 3.7% compound growth per annum. In 1970 road accounted for 49% of the EU15 goods transport market but by 1995 that had increased to 72%. Road's share was highest in Greece (98%) and lowest in Austria (41%) based on 1995 data. The average length of haul by road was 100 km in 1995. The 60% of freight in terms of tonnes shifted less than 50 km accounts for only 10% of tonne kms. Only 3% of freight, in terms of tonnes, is moved more than 500 km but represents 25% of tonne kms. Road freight in the EU12 in 1992 was concentrated in three product groups. 29% of freight (measured by tonne kms) was in agricultural

products, 29% in machinery and manufactured articles and 19% was in cement and building materials.

The data gathered from ECMT and the non-parametric index number models that we have been able to construct are given in Table 6-5. It should be noted that this data includes urban as well as inter urban road transport. Although the data is highly problematic we consider it to be more reliable than the data from Eurostat which we used previously (in D4).

Based on million tonne kms it can be seen that on average 72% of freight is carried by hire and reward operators, of which there are some 280,000 in the 14 countries for which we have data. Hire and reward firms have the highest market share in Luxembourg (89%) and the lowest in the Netherlands (49%). Other countries in which own account operations are important include Portugal, Austria and Germany, confirming the evidence collected in the interviews.

In terms of tonnes lifted we estimate that on average 7% of road goods traffic may be classified as international (the corresponding figure given by DGVII is 4%). This percentage varies from 36% in Austria to 0.4% in Finland, although this may reflect data problems. For example, the Finnish data excludes ro/ro and transport by ferries. The Netherlands (20%) and Belgium (17%) are the other countries with high proportions of international traffic. It should be noted that, in the way international traffic is defined (on the basis of goods lifted), countries with high proportions of international traffic in transit (e.g. Luxembourg, Switzerland) are not identified.

In terms of the percentage of heavy goods vehicles (defined as lorries over 1.5 tonnes capacity, except in Norway (2 tonnes) and Italy (2.5 tonnes)) in the total road goods transport fleet, the average percentage is 24%. The highest percentages are in Luxembourg (67%) and Germany (42%). The lowest percentages are in the Netherlands (10%) and France (12%).

In terms of staff per vehicle, employment in the road freight industry was estimated using data on total employment in the road sector and on the relative size of the road passenger and road freight fleets. This is likely to be only a very crude approximation. On average it was estimated that there were 0.65 staff per heavy goods vehicle with the highest figures recorded by the Netherlands (1.61) and the lowest by Switzerland (0.15). The fact that the average of this ratio is less than one reflects that many road transport staff (particularly for own account operations) are not classified as working in the road transport sector.

In terms of tonne kms carried per heavy goods vehicle, the average is estimated at over 250,000 tonne km per annum, with the highest rate being achieved by Luxembourg (660,000) and the lowest by Greece (72,000).

In terms of vehicle kms per heavy goods vehicle, we estimate the average to be 72,865 km per vehicle per annum, slightly below Beuthe and Sayez's (op cit.) suggested optimum of 110,000 km per vehicle per annum. The highest utilisation is achieved in the Netherlands (273,000 vehicle kms per heavy goods vehicle) and the lowest in Portugal (less than 11,000 vehicle kms per heavy goods vehicle per annum). The

average load implied by this data is around 3.5 tonnes. The figures for the Netherlands seem to be implausibly high, suggesting over 1,000 kms per vehicle per working day and again reflects data problems.

Overall, our conclusion from Table 6-5 is that although the ECMT data is in some ways more plausible than the Eurostat data reported in deliverable D4, it nonetheless is also plagued with definitional inconsistencies. Although both data sets suggest some important variations in the performance of the road freight industry in Europe, we must conclude that this is mainly due to data inconsistencies.

Table 6-5 European Road Freight Industry - Key Indicators

	Proportion of hire and reward	Estimate of proportion of international traffic (tonnes lifted)	Proportion of heavy goods vehicles in the total fleet	Staff per vehicle	Tonne kms per vehicle	Vehicle Kms per Vehicle
Austria	0.61	0.36	0.28	n/a	75,641	188,410
Belgium	0.78	0.17	0.32	0.49	338,211	28,321
Denmark	0.74	0.05	0.19	n/a	158,333	101,733
Finland	0.80	0.00	0.20	0.44	506,122	45,102
France	0.76	0.06	0.12	0.50	272,545	37,033
Germany	0.63	0.03	0.42	0.97	225,872	67,942
Greece	0.66	0.01	0.19	n/a	71,795	n/a
Ireland	0.65	0.02	0.37	n/a	104,000	16,520
Italy	0.87	0.04	n/a	n/a	n/a	n/a
Luxembourg	0.89	0.05	0.67	0.32	660,000	31,400
Netherlands	0.49	0.20	0.10	1.61	210,345	273,448
Norway	n/a	0.01	0.24	0.44	n/a	41,287
Portugal	0.53	0.02	n/a	0.42	119,333	10,513
Spain	0.83	0.03	0.15	0.77	181,862	69,695
Sweden	0.87	0.03	0.25	1.13	348,684	40,750
Switzerland	n/a	0.02	0.33	0.15	n/a	67,963
UK	0.73	0.01	n/a	n/a	n/a	n/a
Average	0.72	0.07	0.24	0.65	251,749	72,865

Derived from ECMT, 1998.

Conclusions

A key issue is production efficiency. Our interviewees believed that road freight was reasonably efficient in terms of production, as witnessed by low prices (and hence low costs) and increasing productivity. Our non parametric indices suggest some problems with excessively large vehicle fleets (particularly of small vehicles), low vehicle utilisation and low load factors. These are symptoms of an industry with some excess capacity. What is not clear is whether this excess capacity is needed to drive production costs down to their economic level or whether it is causing costs to be higher than they otherwise could be. The presumption amongst our interviewees was that the former was the case. There was a concern amongst some interviewees that the industry was ultra competitive and as a result prices were too low.

Another important question is whether road freight is efficient in terms of consumption. Our interviewees generally believed that road freight's mix of price,

service levels and service quality was efficient, although some interviewees believed that load consolidation and exchange of back-hauls could improve the price/service mix. The fact that road freight demand has been increasing in terms of volume and market share would suggest that the industry is reasonably efficient in terms of consumption although there is some suggestion of variation in quality between firms and, to a lesser extent, between countries.

The main barriers to interoperability identified by interviewees related to issues of fair competition. There was some suggestion that barriers to interoperability are limiting efficiency. Particular concern was focused on the lack of fiscal and social harmonisation. The main technical barrier was believed to be the lorry weight limit in Switzerland which results in trans-Alpine road freight being less efficient than might otherwise be the case. The main legal barrier is the limitation on the role of own-account operations in some countries.

Our findings also suggest that efficiency may be reduced by barriers to interconnectivity. The main barrier that has been identified here is the delays at some border crossings to central and eastern Europe and particularly those to the former Soviet Union. There may also be some barriers due to lack of transhipment and distribution centres.

This study has highlighted the clear need for better data about road freight operations to be made publicly available. Overall, the study showed that road freight is characterised by a fragmented structure. There is a lack of integration and, although, some multi-national companies are increasingly dominant, there is also a lack of consolidation in terms of co-operation and lack of consistency in, and enforcement of, regulations across the EU.

6.5 Road Passenger

Overview

Road passenger transport (bus and coach services of all types, for inter urban travel) plays a greater role than is often recognised, especially when non-scheduled services are included. While car clearly predominates in the inter urban passenger sector, the share held by bus and coach may in some cases be not far below that of rail. A substantial coach tourist industry is widespread, and international flows have grown rapidly, although regular scheduled domestic services (especially on routes competing with rail) may be restricted in some countries, notably France and Germany.

There are no comprehensive coach operations from which statistics equivalent to those for national air and rail systems can be derived for modelling of the type shown elsewhere in this report. It is however, possible to draw on the British experience of coach deregulation since 1980 to indicate that the scheduled market is not necessarily as contestable as might be assumed - in this case a single operator, National Express, is clearly dominant.

The road passenger transport mode is defined for the purposes of this study as inter-urban bus and coach travel, including all types of service and journey purpose (i.e. as well as scheduled public express services: extended tours, day trips and private hire). In some cases, an explicit definition based on distance may be available in published reports (e.g. passenger trips over 80 km identified separately in the British National Travel Survey), while in others legal differences based on route length may be followed (for example, that of 50 km, above which EU drivers' hours rules apply).

In the British case, for example, the latest published results from the National Travel Survey (NTS), indicate that coach has a similar market share to rail for journeys over 161 km, when all types of coach service are included (i.e. tours, private hire, etc. as well as scheduled express). Since 1992 the NTS has included better coverage of long-distance travel (over 80 km), and a sample of 50,000 journeys by all modes has now been built up (DETR 1998, pp 18/19).

Overall, car dominates (84% of all trips), while rail has 8% and coach 6%. Rail predominance is most marked for journeys under 161 km (7% or 8% compared with 5% by coach) where rail commuting is substantial. It also dominates over 564 km (rail 20%, coach 10%, and air 24%). In the range 161 - 564 km the proportions are very similar (7% for both coach and rail between 161 and 242 km, and 12% for both between 403 and 564 km).

Aggregate statistics are available for bus and coach travel in each of the EU15 countries, indicating a general growth in passenger-km per head since 1970 (albeit falling as a percentage of all travel), with a current EU-wide average of about 950 km per head per year. No split between inter-urban and local movement is generally available, and the latter is almost certainly dominant within the bus and coach sector.

It is reasonable to infer that, in all countries, the private car is the dominant mode of inter urban travel, probably representing 70 to 80% of all such movement. For

example, for the EU15 states (taking all journey lengths and travel between as well as within states) the respective shares of passenger-km in 1995 were (DGVII, 1997):

Cars	80%
Buses and coaches	8%
Rail	6%
Air	6%

Competition thus occurs between public transport as a whole (including rail) and the private car, and between the public transport modes. In some countries, the absence of a legalised scheduled network competing extensively with rail (notably in France and Germany) results in coach travel being confined mainly to the tourist sector, but even so, a holiday journeys market share of about 10% can be identified in Germany, for example.

Summary of Literature Review

Greater information is available on the British case, resulting from research conducted following the deregulation of coach services in 1980. Evidence clearly indicates a marked dominance within the scheduled coach network of a single operator, National Express, despite the expectations of contestable market theory that many smaller operators might compete successfully. It is clear that competition mainly comes into play between the coach and rail modes, especially in terms of price.

Due to the structure of the bus and coach sector, and limited statistical data available, modelling of the type produced in this report for rail and air industries has not been feasible. Even where a single major national carrier exists (National Express in Britain) the data series is of variable quality and data such as vehicle-km operated are not generally available. It is however, possible to examine trends in total passenger trips carried by National Express and fluctuations associated with real price variation. An overall coach own mode price elasticity in the order of -1.0 is supported. Studies by MVA (Terzis et al 1997) and the Institute for Transport Studies, University of Leeds (MMC 1996) indicate significant cross-elasticities between coach and rail (the elasticities being greater with respect to the coach passenger volume than rail, due to the smaller market share generally held by coach where competition occurs).

Even during a period in which National Express fares rose rapidly in real terms between 1989 and 1993, little new independent competition emerged. While an incumbent price advantage of about 8% was identified by Thompson and Whitfield (1995), a substantially greater price increase appeared to stimulate very little new independent operation, and its overall extent has continued to decline.

No comprehensive cost or revenue data for the coach operating industry as a whole (including the tourist sector) is available. Given this, use can be made of British cost and revenue data for the whole non-local bus and coach market, and known input costs for coach operation. These indicate average costs per vehicle-kilometre (including capital costs and an operator profit margin) in the order of 70 - 80 pence (around 1.2 Euros). Due to the much higher capital cost of coaches (vis a vis urban buses), this element (expressed, for example, as an annual leasing charge, or straight-

line depreciation) represents a much higher share of total operating cost than in the case of local bus services (in which driver wages are the dominant element). The high proportion of capital cost also results in a marked inverse relationship between annual vehicle utilisation and average cost per kilometre.

There is no direct evidence of any economies of scale (in terms of costs) by fleet size, but the close relationship with utilisation suggests that an operator able to gain high utilisation (for example, through running long-distance services, or gaining tourist traffic over a longer season than normally found) will experience lower unit costs. In addition, cost per passenger km will be affected by load factor and hence marketing, pricing policy, and network effects such as the creation of interconnecting hubs and through ticketing.

This appears consistent with the evidence for the dominance of the scheduled express market by National Express, and also the major role played by some large operators in the extended tour market in Britain (e.g. Shearings and Wallace Arnold).

Although scheduled express coach services are in most cases at a speed disadvantage when competing with rail, there are some market sectors in which they may offer a more attractive product. A notable example is the direct links to major airports from regions other than the city region the airports primarily serve. For example, London Heathrow attracts a large number of land-mode feeder trips from other regions of Britain, as well as London and the South East. In this sector, air passenger surveys indicate a higher coach market share than rail, and an ability to attract higher-income use.

Data has been drawn from the national interviews conducted by members of the SORT-IT and MINIMISE consortia (see Arbault et al, 1998) to identify the role of the coach sector. Apart from classifying the regulatory and ownership frameworks, this produced relatively little detailed statistical data. It was evident, however, that while Britain was the only example to date of complete coach sector deregulation, a relatively liberal approach was found in some other countries, resulting in significant provision of scheduled public express services (e.g. Irish Republic, Sweden, Norway, Spain), while in other cases very little provision of such services competing with rail is found (e.g. France, Germany, Netherlands).

In addition to the data derived from the initial round of interviews, short case studies have been assembled for selected countries, generally through direct correspondence with relevant researchers or operators, and through work conducted by postgraduate student research, rather than direct interview. These include Germany, Norway and the Irish Republic (See D4, appendix A). Where scheduled public services are provided, a picture similar to that found in Britain appears evident, i.e. when competing with parallel rail services, coach tends to occupy a lower speed/lower price niche of the market. Assuming users are neutral in respect of other factors, a value of time at which they would be indifferent as between coach and rail of about £3 - £5 (4.5 - 6.5 Euros) per hour may be inferred.

Conclusions

The first conclusion that may be drawn is that the role of the coach mode is often not fully appreciated. Little attention has been given to it by politicians or policy makers, yet it can be shown to represent a share close to that for rail for inter-urban travel in Britain, when all types of coach service are taken into account. Even in other cases where direct scheduled competition is very limited, coach may have a significant share of the tourist market (for example, in Germany).

It is also clear that the available statistics are of poor quality, and more systematic collection and classification is required. This would be assisted by more comprehensive household surveys of long-distance travel, and consistent definitions where data is already collected, for example at border crossings (estimates of international coach passenger movements between Britain and France differ by a factor of four due to different definitions used by each country).

The overall role of coach services may be constrained by the general application of a 100 kph speed limit, together with effects of traffic congestion, especially within and around larger urban areas. The ability of coaches to compete with rail may thus be limited, especially where higher-speed rail services are being introduced. For example, the British government's consultation paper on trunk roads, published in summer 1997 (DETR,1997) identifies the likely growth in congestion by 2016 on substantial sections of the motorway network as traffic volumes increase without commensurate growth in capacity. Substantial time losses are also experienced by road freight and passenger operators, due to border delays and other factors (IRU 1998). There may be some scope for bus and coach lanes on certain sections of motorway.

Because the average speed of coaches is lower than rail on most routes where parallel services exist (except for some rural, single-track railways), the higher-income users will tend to travel by rail or car. For users with low incomes and low values of time, coach may provide opportunities for additional mobility that are not at present offered by rail. Greater freedom for coaches to compete with rail thus provides direct benefits to such groups, which may be extended by rail responding with similar fare policies, i.e. user benefits would be given not only to those using coaches per se, but also some rail user groups who could benefit from the lower fares offered through the competitive process. In addition, coach services could offer new direct links to points not well served by rail, such as international airports.

Under current EU policy, several types of service are defined. Since January 1996 cabotage has been permitted on all non-regular or occasional services. It is currently proposed to extend this to regular services also under a new cabotage regulation (12/98), due to come into force in June 1999, replacing regulation 2454/92, although the cabotage will still be subject to the host country's laws on rates, contracts, technical standards, etc. (OJEC 1998). This would appear to create scope for cabotage on international scheduled services, which in turn might stimulate a more liberalised approach to domestic regulation within the countries concerned. The experience of British operators however, indicates that the volumes of traffic handled under such arrangements (of which a record is required under regulation 2454/92) are very small.

Clearly, such volumes would have very little impact on the coach market within the countries in which cabotage was taking place.

In terms of inter-operability, constraints appear less severe than for other modes (notably rail). Extensive international through running already occurs, and even differences such as the rule of the road (left or right hand running) seem to create few difficulties in practice. The main issue may be the inconsistency in maximum permitted dimensions. While a 2.55m width is now generally accepted, and Britain has now moved into line with an 18 tonne gross weight for a two-axle vehicle, substantial differences are found in the permitted maximum length of rigid vehicles, from 12m in Britain to 15m in Sweden and some other countries. A recent study for the EU (EC 1998) suggests that relatively few problems arise from the use of such vehicles. A common EU-wide policy has yet to be determined, but one possible outcome is that a 15 metre limit may be set for coaches making international journeys, while limits ranging between 12m and 15m may be set for national traffic, varying between member states. Substantial variations also exist in taxation levels on diesel fuel. Few technical barriers exist to competition, and initial investment may be low. Experience of the National Express case in Britain suggests that a dominant operator may have major network advantages, such that new entry may be limited in practice.

6.6 Short Sea Shipping

The price cartels typical of deep sea liner shipping including containers are rare in the short sea shipping sector. Every separate deep-sea trade route for general cargo is organised as a price cartel, that is a liner conference. There are two sorts of liner conferences. There are so called closed conferences which act more or less like clubs with a strictly limited membership, and there are open conferences. The open conferences are an effect of American anti-trust laws that stipulate that the conferences should be open so far as liner trades originating or terminating in the USA are concerned.

The liner conferences in deep-sea shipping try to co-ordinate itineraries and timetables in a rational way from an overall point of view. They also fix freight rates that all members in the conference must adhere to. The principle for the liner conference tariff is to charge what each traffic can bear, i.e. price discrimination by commodity type applying the inverse-elasticity rule. Not even containerisation has put an end to the specialised cargo tariffs. Shippers have to tell the operators of deep-sea liner services what is in the containers. Because of this the discriminatory rates can still be charged.

As far as short sea shipping in the Baltic and North Sea is concerned, there is no such thing as international liner conferences. The freight rates are often determined by each individual shipping line, and negotiated individually for each shipper which means that public tariffs of freight rates common to a number of shipping lines are rare.

The traditional European shipping nations have seen part of their national fleets being flagged out to international registers during the three last decades. Some of these international registers are classified by the International Transport Worker's Federation as registers of convenience. Registering ships under a flag of convenience has been necessary for the survival of many ship owners. The reason for flagging out is that the labour costs required by the national register are much higher than for a flagged out register. By moving to the flags of convenience the ship owners are not bound to apply their own national laws on labour costs but those that apply to the country that operates the register (SOU, 1995). In short that means that they can hire cheaper crew than previously. In the short run this does no harm, but in the long run the availability of qualified seamen will diminish and maybe even disappear because of problems in attracting newcomers, leading to strategic concerns, particularly with respect to defence.

The distortion of competition from the use of flags of convenience is a major problem for all shipping nations. The Member States have therefore tried to solve this problem by different means. The first attempt to tackle the situation has been to subsidise national crew labour costs (through tax reductions) to ensure that the national labour cost is competitive with the international crews. Other methods have been to start different forms of international registers and capital subsidies for ship procurement. By introducing a new tax reduction for the shipowners (tonnage tax) the Norwegian government has established good conditions for Norwegian ship owners to compete in the international shipping arena. Norway and other States have also created their own international shipping registers with more liberal rules that ensures mixed crews on the national ships.

Subsidies have increased over the years in most EU countries but it is a trend that cannot continue in the long term. Distorted competition has to be solved through ways other than providing heavy state subsidies. However, it is not easy to abandon a system that seems to work fairly well. As the Swedish Shipowners' Association puts it: "Basically, shipping subsidies mean the State doing without income which it would not otherwise have had"(SOU, 1995).

A survey by the EU Commission in 1997 measured state subsidies for the shipping industry in the EU countries (Austria excluded and Norway included). It found that 15 countries have tax reductions for ships crews; twelve countries have international registers or special registers besides the national register; ten countries have special funds
for shipowners; reduced company tax or tonnage tax is used by ten countries; seven countries are using investment subsidies, and; six countries have special rules for depreciation (Sveriges Redareforening, 1997a, p14).

The EU Commission has drawn up some guidelines for state subsidies in the shipping industry (Sveriges Redareforening, 1997a, p14). The main rule is that state subsidies can only be given to ships registered in a Member States' own shipping register. There is an upper level for state subsidies; the subsidies are not allowed to exceed a given maximum reduction for labour taxes and company taxes. Major restrictions are placed on investment subsidies for ship procurement (SOU, 1995).

State subsidies to shipping within the EU must not create unfair competition with other transport modes within the EU such as road and rail. This is essential to bear in mind when talking about state subsidies for providing fair and equal terms of competition between the Member States and International shippers in short sea shipping.

There must be regulations concerning safety and environmental issues for ships and the shipowners within the EU as these matters are often neglected by ships that are registered under a flag of convenience. Regulations must also ensure minimal social conditions for the crews on such ships. By developing Port State control, there can be some supervision by the local port authorities (SOU, 1995).

The liner shipping on the Baltic Sea and the North Sea includes ferry lines. This area is one of the most developed regions for ferry traffic in the world. In 1996 the total passenger traffic to Sweden by ferries was 37 million one-way tickets. 53 percent was due to passenger traffic on the ferries between Sweden and Denmark, for instance on the ferry lines Helsingborg-Helsingör and Göteborg-Frederikshavn. The ferry traffic between Sweden and Finland (Stockholm-Helsingfors and Stockholm-Mariehamn) is another big contributor with 24 percent of the total ferry passengers and the passenger traffic between Sweden and Germany (for instance Trelleborg-Travemünde and Gothenburg-Kiel) generates 8 percent of the total (Sveriges Redareforening, 1997b, p66).

Ferry traffic on the Baltic Sea and on the North Sea is under severe pressure. The abolition of tax-free sales within the EU from July 1st 1999 will effect the traffic

patterns in the Baltic Sea and the North Sea. It is estimated that leisure travel on existing ferries in the Baltic Sea will fall by up to 50 percent as an effect of the abolition of tax-free sales. The passengers will probably shift to ferries that still have tax-free sales, that is ferries that sail to ports outside the EU. Calculations suggest that the freight rates may have to be increased by an average of 30 percent because of the abolition of tax-free sales (Shippax Information, 1996).

The bridge connection over the Öresund is soon to be completed. Once finished it will effect the choice of transport mode for goods and passengers. There is reason to believe that lorries will shift from using ferries to land transport and there is also reason to believe that many car passengers will choose to cross the Öresund via the bridge rather than by ferries. The magnitude of the shift from ferries to the bridge is hard to calculate. The final price for using the bridge connection has still to be decided. It is uncertain to what degree and extent there will be a price reduction for local passengers that intend to use the bridge for daily car transport to Malmö and Copenhagen.

The bridge will not only effect the choice of transport mode in the local area of the bridge (that is Malmö and Copenhagen). It is likely to have an impact on transport between Helsingborg-Helsingör through changes in the relative generalised (GC) cost of modes. How big this impact is going to be will depend on the GC of using the bridge - compared with the GC for using ferries. A large modal shift away from the ferry may reduce the viability of ferry operations across the strait.

Developments over the past ten years indicate an increasing volume of goods being transported by sea but decreasing market share. Nowadays much goods transport, for instance in Sweden, is carried by land transport (lorries) in combination with ferry traffic. The reasons for this shift away from conventional coastal shipping are related to companies' demand for just-in-time (JIT) transport. The decline in coastal shipping means an increase in long land transport by lorry, to ferry terminals located on the west and south coast of Sweden. Short sea shipping is in this sense the core link in a transportation chain that connects Scandinavia with the rest of Europe (SOU, 1997). The decline in coastal shipping has not occurred in some countries, such as the UK, due to the emergence of North Sea oil and gas traffic.

The increasing use of road transport from Scandinavia, through Germany, to the rest of Europe is becoming a real problem. The road congestion in the northern parts of Germany is likely to cause a traffic impasse in the EU (SOU, 1997; Wijnolst, Van der Hooven, Kleijwegt et al; 1993). This problem can be solved if short sea shipping finds an effective way to compete with road and rail transport within the EU.

Ships spend, on average, 60 percent of their total time in ports (Sveriges Hamn - Och Stuveriforbund, 1995). The turnaround time of ships and the stevedoring and port costs have to be reduced dramatically to make short sea shipping competitive with long haul land transport. One way to try to solve this problem is by making the ship independent of the availability of labour. It is also necessary to speed up the loading and unloading process (Wijnolst et al, 1993). Key factors for increasing demand are the price of transport, frequency of departures, transit time and quality of service. Short sea shipping will have to improve in these areas to fully complete with road and rail.

Wijnolst, Sjobris, Peeters et al (1994) suggest that a new transport system should be considered. They propose a multimodal short sea transport system concentrated on maritime containers or stackable swapbodies. This port hopper service is to be based on three market segments: the feeder market, the coastal market and the door-to-door market. The policy would be for port hopper services to act more as a door-to-door operator rather than as a traditional shipping company. The idea is that the port hopper calls very frequently in ports and that ships will be loaded and unloaded semi-automatically by the ship's crew. The frequent calls in ports are thought to be the strength of the port hopper system but the present port cost structure does not favour the frequent use of ports instead it penalises it. For the port hopper system to be successful, the rate structure must be changed. The labour laws will also have to be changed in some Member States before the ship's crew can load and unload the ships, since this is currently prohibited by law in some countries.

6.7 Intermodal Passenger

Overview

Whether or not intermodality is a transport sector in itself is an open question since by definition it involves transport performed by more than one mode of transport in the door to door transport solution, and many different views can be taken on the topic? For instance, technical, legal, informational perspectives etc. can be seen. All these factors influence a traveller's choice of mode and therefore the demand for intermodal transport solutions. Ortúzar and Willumsen (1994) have classified these factors into three groups:

1. Characteristics of the trip maker. The following features are generally believed to be important:
- car availability and/or ownership;
- possession of a driving license;
- household structure (young couple, couple with children, retired, singles, etc.);
- income;
- decisions made elsewhere, for example the need to use a car at work, take children to school, etc.;
- residential density.

2. Characteristics of the journey. Mode choice is strongly influenced by:
- the trip purpose; for example, the journey to work is normally easier to undertake by public transport than other journeys because of its regularity and the possibility of long run adjustment;
- time of day when the journey is undertaken. Late trips are more difficult to accommodate by public transport.

3. Characteristics of the transport facility. These can be divided into two categories. Firstly, quantitative factors such as:
- relative travel time: in-vehicle, waiting and walking times by each mode;
- relative monetary costs (fares, fuel and direct costs);
- availability and cost of parking.

   Secondly, qualitative factors which are less easy to measure, such as:
- comfort and convenience;
- reliability and regularity;
- protection and security.

A good mode choice analysis and also a good mode choice model should include as many as possible of these factors, which are relevant for the analysis. In the SORT-IT intermodal modelling approach several of the quantitative factors included under (3) were covered by using the concept of generalised costs. Characteristics of trip makers were considered by dividing passengers into different income groups. Because it is always easier to interpret results from less complex models and because different characteristics of the journey were found to be less important for the kind of travel modelled, such factors were not taken into account.

The gaps in modelling work listed above were to a large extent covered by the SORT-IT interviews and literature reviews. This coverage was mainly focused on how to improve intermodality and thereby increase consumer benefits. As travel opportunities increase with improved intermodality, consumer benefits usually increase with such improvements. Whether that also implies more socially beneficial solutions, is the key question when developing policy measures regarding intermodality. That question was the main focus in the modelling work. Whether many of the improvements suggested in interviews and in the literature and not covered by the SORT-IT modelling work are socially beneficial remains a question for future research.

A brief summary of all the national reports (see also Arbault et al., 1998) on passenger transport intermodality is now presented, followed by summaries of the interview material and the modelling work respectively and the conclusions and policy implications.

Summary of literature review

The following key issues emerged from the literature review:

- The use of informatics as a means of **information provision** raises some questions on efficiency. Who should run these systems i.e. can private firms perform these functions and if so would costs be lower than an equivalent public sector service? Another question is at what geographical level services should be provided, i.e. what degree of centralisation is desired?

- **Arrangements at terminals** can be a problem, for example, the separation of bus and rail stations. However, rail services can be supplemented with bus feeder services.

- **Capacity constraints**, mainly on railways, but also to some degree at some airports in peak periods and airport feeder transport make intermodal transport solutions less attractive and decrease consumer surplus compared to a situation with fewer capacity problems.

- **How should infrastructure, necessary for improving intermodality, be financed?** One solution exists in France where pre-determined subsidies are financed by specific taxes (road tolls, fuel taxes) and not by general taxes (income tax).

Summary of interviews

Four key issues, for improving intermodality, emerged from the interviews:

- **Consumers lack of information**. There are several areas where consumers' lack of information affects their travel decisions. Some possible means to overcome these informational problems include: better co-ordinated price and price-information systems, the use of smart cards (for wider improvements in intermodality this calls for standardisation), better co-ordination between timetables for local and long-distance public transport and co-ordinated luggage

check-in between different modes of transportation (it should be possible to check-in luggage at the first terminal on an inter-modal journey) etc.

- **Co-ordination of services**. Better co-ordination can be a substitute for improved information. Tendering can produce a complementary and improved co-ordination in an operator-authority relation, enabling the authorities to decide/set time tables and ticket prices.

- **Capacity or bottleneck problems** affect the attractiveness of an intermodal transport solution, especially for airports. Common capacity problems at larger airports take the forms of number of gates at the airport, check-in systems, luggage handling systems and the capacity of connecting public transit to city centres.

- **Ownership** can possibly affect intermodality since co-ordination, which affects intermodal travel solutions, can be a problem with private sector operators. This problem can be reduced by an appropriate tendering system.

Summary of Modelling

Economic Analysis of Competition Between Long Distance Passenger Services in Sweden

Much of what was found in the literature was in favour of the development of intermodal solutions and further implementation of them. The reason is that improved intermodality increases the set of possible transport solutions for the consumer. Therefore, if at least one passenger chooses the new travel opportunity, with everything else held constant, utility must increase. Improved intermodality can raise costs and it is important to contrast these costs with the gains that can be obtained.

Basic Analytical Method

Passenger transport is regarded as a system, where passengers can choose among lines and operators and where a single journey may involve several lines and operators. To analyse the outcomes a simulation package (VIPS) was used that employs a computerised route-network-analysis. The package can be used to constructs a network of nodes for various modes at a number of levels for example, urban, inter-urban, regional or national. The package can then be used to set different service frequencies, journey lengths, fares and service patterns etc, for each of the modes and also within mode (e.g. two bus companies). Once set the package then simulates the effects of offering different levels of services and fares across competing (and complementary) modes, for example, bus, rail, car etc. The outputs from the VIPS package include patronage splits between modes, revenue splits and cost splits etc, which allow the effect on consumer and producer surpluses to be estimated (for further details on the modelling method and results see Shires, 1998). Alternatively, the outputs from the package can be used to calculate financial indices (e.g. cost recovery ratios) or service elasticities.

Policy changes 1992-1996 - national level

Air services were completely deregulated in Sweden on the 1st of January 1992. As a result supply, in terms of number of departures, has slightly decreased and prices have risen for leisure trips but reduced for business trips.

According to the model analysis, the choice of mode seems to have changed very little and thereby intermodality is not affected much, ceteris paribus, following the domestic deregulation of the coach industry.

Internalisation of external effects

Internalisation of external effects through taxation on a vehicle kilometre basis was analysed. It was assumed that tax revenues are used for reducing other taxes. The analysis found that the loss in terms of consumer surplus was smaller than the gain in state surplus through the tax increases. There are therefore large potential additional benefits from internalisation of external effects from car traffic. If such state surpluses were hypothecated for the development and implementation of improved intermodality, such measures could be used to decrease losses in consumer surplus, as illustrated in the example from France.

Hypothetical full Coach Service Deregulation

The Swedish government recently deregulated coach services (1st January, 1999), the hypothetical outcome of which has been analysed. It was assumed that coach deregulation would result in a substantial increase in the number of departures per week. The results of the analysis indicate that the benefits from deregulation are substantial, especially for passengers with low values of time, whilst the loss of profit for the railway, the airline and regional bus operators is relatively small.

In a second study we have not assumed any response from other operators, to explore the first-round effects of coach deregulation. In this study we have explicitly used a car assignment model. The results indicate that the social net benefit is much smaller when no reactions are assumed. In fact it seems as if the net social benefit might be very slightly negative.

These results imply that coach deregulation, at least in the long run, can be an effective policy measure, particularly in making other modes (especially rail) more efficient. This analysis also highlights the need for infrastructure investment in intermodal transfer points to meet the expected increase in intermodal demand.

Co-ordination of Services

Co-ordination of services was possibly the most direct policy measure affecting intermodality analysed in our modelling work. One issue is whether independent, non co-operating suppliers, will provide the best service from the passengers' point of view. Co-ordination may be of various kinds. A small study of matched transfers between coach and train at four stations for three passenger groups demonstrated the

passenger gains. The increases in operating costs however, need to be offset against this.

Conclusions and Policy Implications

The market seems to fail in providing the necessary information for consumers to make rational travelling decisions. Ways of overcoming this market failure have been discussed in the literature. Competition between operators must not be distorted by concentrated information provision, instead common technology and infrastructure must be available. This is necessary both in the interface with consumers as well as in the interface with operators.

A second factor emphasised in the literature and flagged up in several interviews is capacity/bottleneck problems that make intermodal passenger transport solutions less attractive, e.g. railways and airports. Railways, airports and also connections to them often suffer from capacity restraints. A general conclusion is that along with other policy measures affecting intermodal passenger transport, there should be investment plans for necessary infrastructure expansion.

A third factor is the separation of transfer points, for instance, separated bus and rail terminals. Relocation of terminals, or supplementary bus services, are methods for overcoming such problems.

Finally, we conclude that co-ordination of the long-distance services in order to enhance intermodality is beneficial from the passengers' points of view, however, the costs of such co-ordination is difficult to assess.

6.8 Intermodal Freight

The working hypothesis of SORT-IT assumed that the development of the combined transport market in Europe is strongly influenced by the current harmonisation endeavours and efforts to improve interoperability and interconnection. The aim being to influence mode choice behaviour and protect the environment against intense road freight transport. Therefore the description of intermodal freight must consider political influences as formative factors on the organisational structure of this part of the transport market.

Given that combined transport requires a high level of technical and organisational standards, the market may not be contestable. This implies that the relevant strategic and operating decisions should therefore be co-ordinated between the actors who make up the whole transport chain and the national political players. It is clear that a number of existing barriers have to be removed if combined transport within Europe is to become viable.

Within such a context, the development of the freight rail freeway concept should be considered an important step towards co-operation and therefore improvement of combined transport capabilities by making more attractive train paths available. The freeway concept would help overcome one of the main barriers to interoperability, namely insufficient co-ordination of journeys. Border crossings, changes of modes and the accompanying documentation reduce the average speeds of international combined transport dramatically, e.g. for flows travelling across Germany, the average speed is between 26 kph and 37 kph, in part due to the difficulties of obtaining track slots. Therefore on short to medium hauls combined transport cannot really compete with road only haulage.

A number of measures have been suggested to make combined transport more viable. These include not changing rail crews at borders and agreeing to more flexible working practises. Selective investment would help eliminate localised bottlenecks at stations, marshalling yards and lengths of track. Other suggested measures include the total deregulation of the international freight market or the auctioning of timetable slots to provide capacity and infrastructure services for efficient freight hauliers.

6.9 Informatics

New technologies have been viewed as an important driving force for economic advance. The incentives for the development and diffusion of technology must be considered as key elements in the market relations between consumers and firms. It is known that the incentives for technology development depend on variables such as the market structure, the nature of competition and regulations like the patent system, licensing laws and competition laws. The technological process involves several stages: research and development, adoption and diffusion. To assess the impact of a new technology we consider the supply and the demand for transport services and their inter-relation.

The analysis from a qualitative level is a first approach to the very complex multi-factorial problem of evaluating the effect on transport of introducing a new technology. The main contribution of new technologies is in facilitating *interoperability* in transport. In a second stage, our study has described the main socio-economic impacts derived from the application of some of the most significant Advanced Transport Telematics (ATT) applications. In general, the telematics applications in transport can be classified into three main areas: information systems to the user, fleet management and traffic management.

Information Systems To The User

Advanced information systems (Advanced Transport Information Systems (ATIS)) are based on the principle that if transport users have a great deal of information about route and traffic conditions, they will be able to use it and improve overall trip conditions, and consequently, improve the efficiency level of the system. The simplest examples of ATIS are the traffic reports provided by commercial radios, or broadcasts dedicated to traffic information (Highway Advisory Radio), or by some other mechanisms (including the internet). The most advanced examples of ATIS are in-vehicle navigation systems .

Public Transport Management

The applications related to the management of public transport are known as Advanced Public Transport Systems (APTS). These applications address the efficiency and quality of transport services. There are five groups of technologies (some of them may be considered as ATIS as well): systems for the automatic monitoring and location of vehicles (AVM and AVL); passenger or user interactive information terminals; systems of dynamic information to the user; automatic payment systems; and finally, systems to favour public transport, such as gating systems, exclusively for public transport or vehicles with high occupancy levels.

Fleet management.

These systems (Freight and Fleet Management, FFM, or Commercial Vehicle Operation, CVO) attempt to improve the efficiency of transport companies through the electronic interchange of data and information in real time. It allows an improvement in the management, planning and monitoring of freight transport. There are four main technologies developed in this area: electronic data interchange (EDI); automatic identification of loads (AIL); vehicles (AIV) and drivers (AID) automatic location and bi-directional communications; and navigation systems.

Traffic management.

Advanced Transport Management Systems (ATMS) include a wide group of applications. These are used to monitor traffic in real time and check infrastructure conditions, in order to obtain relevant data. After processing this data, the traffic control centres decide on the most suitable actions for each traffic situation. In addition, some applications also provide information to users.

Specific technologies are currently being aimed at developing Dynamic Traffic Management (DTM). The dynamic management of traffic is the functional integration of different telematics applications for achieving a common objective: the maximisation of effectiveness and security levels across the whole road infrastructure together with the minimisation of the environmental impact caused by them. The functions that such a system integrates are incident detection, prediction -not only of incidents but of stable traffic profiles too-, the decision making process and, finally, the system of road signs. The main groups of telematics applications are: Monitoring Systems, Variable Message Signs (VMS), Ramp Metering, Emergency Telephones and Priority Lanes.

All the new technologies which are mentioned here contribute to improving the interoperability conditions in the transport sector. What follows is a list of the main ATT that can improve the interoperability conditions for each transport sector.

The introduction of ATIS may contribute to relieving some of the bottlenecks and inefficiencies affecting the road freight sector. In particular, wireless data transmission together with global position system technologies may solve the imbalance between origin-destination loads by facilitating the finding of return loads. They may also help in reducing time lost in traffic congestion through the transmission of relevant information on routes in real time. The applications should also be very useful in the emerging less-than-truck load sector by allowing a more efficient use of truck capacity. The adoption of these technologies may result in an efficiency improvements that may lead to cuts in prices and also help facilitate intermodal transport.

Electronic data interchange (EDI) may facilitate the interchange of data or documents between transport firms and customers in a standard format. The reduction in transaction costs and the benefits derived from better handling of the information passing between the different participants are the main advantages of this technique.

The techniques based on the automatic identification of loads, vehicles and drivers may help improve interoperability in the elements of a road freight transport system. The main techniques are identification by radio frequencies, smart cards, magnetic bands, etc.

The ATIS systems may considerably affect the ticketing and reservation systems of inter urban bus coaches reducing transaction costs. In principle, these techniques may contribute to increasing the competitiveness of the transport market by reducing possible strategic barriers. Passenger information systems provided by ATIS may modify the problems that result from the absence of information but, information transmission does not necessarily mean a more competitive framework. It is not clear, from a theoretical point of view, whether or not the communication of relevant data may facilitate collusion among competitors.

For rail transport, ATIS may modify ticketing, reservation and passenger information systems. Other systems such as GPS, GSM, AVM or AVL, may contribute to reducing the problems of congested rail systems. They may also help to clarify timetables and slot allocations among the different rail services. These problems are particularly important in deregulated contexts (as in the United Kingdom). The introduction of new services and companies requires that the position of each vehicle must be continuously controlled. Other technologies such as EDI and automatic identification of loads and vehicles, may favour intermodality and reduce the technical barriers that limit the extent to which railways can interconnect with road and sea transport.

Air transport suffers from serious congestion problems which can be seen as another capacity barrier in the air transport sector. The introduction of GPS or other location systems may be one mechanism to reduce them. The success of the new deregulated context, allowing the entry of new firms and services, will depend to some extent on the contribution these techniques can make.

In inter urban bus and rail transport, ATIS may be used to improve information flows, and so increase competition in the market. It is known however, that some of the larger rail companies have used new technologies (such as computer reservation systems) as a strategic barrier in order to deter entry by potential competitors.

Congestion and space problems are widespread in European ports. Identification of loads and containers and EDI may be mechanisms helpful in reducing delays and favouring intermodality with other means of transport, such as rail or road. Other techniques, such as GPS and other location technologies, have shown their effectiveness in monitoring traffic involved in transport operations.

A number of ATT applications is oriented to the improvement of road traffic management. These include monitoring systems, VMS, ramp metering, priority lanes, etc. We can include other technologies in this group, such as road pricing systems or RDS (radio data systems). One of the main objectives of these techniques is to reduce congestion problems on urban and inter urban road networks. The majority of these ATT applications have been applied in urban contexts. Automatic Payment Systems (APS) present many potential benefits (harmonisation with the payment systems of

other modes of transport, increased revenue, reduction of transaction costs and congestion problems, etc.). We must differentiate between APS applied to urban or inter urban networks. Their introduction in urban contexts is based on the reduction of congestion problems. There are other reasons to justify their introduction in inter urban contexts, for example, harmonisation with the rail payment system, provision of private finance, etc. In urban contexts, APS may often be a good instrument for rationing scarce capacity in an efficient way. In any case, we think that APS cannot simply be understood as a mechanism for collecting revenue. Other assessments must be carried out, for example, what are the effects on final prices, the social implications, the consideration of road service as a public good, the impacts on peripheral regions, etc. In addition, APS may reduce congestion and influence the intermodal decisions of users. Table 6-6 presents briefly the aforementioned findings.

Table 6-6 Barrier and ATT

	Reduction of barriers to interoperability and interconnectivity	**ATT which contribute to the reduction of barriers**
Freight Road Sector	Capacity Barrier Institutional Barrier Technical Barrier	ATIS (GPS, GSM, RDS), FFM, ADI EDI EDI, AIL, AIV
Interurban bus	Capacity Barrier Strategic Barrier	ATIS, ADI
Rail	Capacity Barrier Technical Barrier (intermodality)	ATIS EDI, AIL, AIV
Air	Capacity Barrier Strategic Barrier	ATIS ATIS
Water	Capacity Barrier Technical Barrier (intermodality)	ATIS (GPS) EDI, AIL, AIV
Private Traffic	Capacity Barrier Technical Barrier (intermodality)	ATIS, ATMS, APTS, ADI APTS

An assessment framework that permits us to integrate and to evaluate the set of social and economic impacts should be established. This framework would allow a comparison of the efficiency of each of the various available ATT applications, as well as establish an overview of the methodology. The possible socio-economic impacts of ATT applications can be grouped under the following broad categories:

1.-Changes on the demand side.

Changes in demand for each transport mode.
Price discrimination between vehicles (electronic road pricing system)
Changes in modal distribution.

2.- Changes on the supply side.

Reduction in traffic congestion and the duration of travel times
Increase in the number of services offered
Changes in the quality of services.
Improvements in fleet management

Both 1. and 2. affect prices

3.- Increase in efficiency

Reduction in the costs of transport operators (improvements in interoperability conditions may be important here).

4.- Safety conditions

Increase or reduction in the level of safety conditions.

5.-Externalities

Related to accidents, environmental impact and external costs of congestion.

In summary there are many technologies able to improve operating conditions and efficiency levels in the various transport sectors. The anticipated effects of deregulation may be altered by the introduction of new technologies. Distinguishing the suggested effects separately for consumers and firms helps improve an assessment of them. From a consumers' viewpoint the existence of a generalised open access information system is an advantage in the provision of information about prices, timetables, availability, number of stops in the route, quality etc. This results in a considerable reduction in transaction and information costs and a better adjustment between demand and supply. There are also time saving effects attached to a more accessible reservation system.

Many other ATT applications may improve the efficiency of transport operators. All the new technologies related with ATIS and ATMS might considerably reduce freight and passenger transport costs. In addition, the contributions to intermodal transport must be taken into account because some technical barriers can be reduced by the implementation of ATT. It is important to remember that the services derived from the use of ITS (intelligent transport system) technologies must be based on an appropriate architecture. This architecture must integrate all the applications and contain three basic elements: computer applications, information systems, and communication technologies.

The most important contributions of ATT are probably related to the reduction of impediments to interoperability. We have pointed out that the majority of ATT applications may reduce capacity barriers by the relieving congestion problems and bottlenecks. Also, technical barriers may be reduced, and in particular, new technologies may be an important instrument for the development of intermodal transport. Finally, strategic barriers may be reduced, and it is possible that ATT applications will lead to a more competitive market.

We believe that it is necessary for all these impacts to be integrated in a Cost Benefit or Multi-Criteria Analysis framework. In spite of the evident difficulties, this would permit a complete evaluation of the costs and benefits of the new technologies, as well as establishing criteria for the economic and social acceptability of projects.

7 RECOMMENDATIONS FOR FUTURE EUROPEAN TRANSPORT POLICY

Our overall objectives with respect to policy recommendations were twofold.

1. To develop policy measures addressing the organisation of the European transport system in order to improve the efficiency of the transport sector as a way of enhancing the implementation of the Common Transport Policy.

2. To design measures to promote interoperability and inter-connection, economic efficiency and spatial co-ordination of pan European transport policy.

In the second objective, interoperability was defined as the ability of national and geographically defined transport networks to provide operations and services across national borders and across physical and technical barriers respectively. Inter-connection was defined as a connection for passengers between international, national, regional and local networks, both within and between modes. These two objectives are now discussed in turn. The key recommendations are highlighted in italics and they are also presented in Table 7.1

7.1 *Organisation*

In terms of air, our work suggests that *there may be substantial cost savings of up to 30% if the remaining flag carriers are privatised*. Our work also suggests that *there is little scope for reductions in average cost from producing more output (economies of scale) in the industry and hence mergers should be viewed with suspicion*. Further privatisation of airports may also be beneficial, but we have not been able to evaluate this policy measure. Because *competition leads to higher frequencies, more indirect route competition and lower fares, it should be encouraged*.

In terms of rail, our work suggests that this is a particularly problematic sector in terms of organisation. We believe that *further commercialisation and liberalisation would increase efficiency in production. For large railway companies, it would appear sensible to break them up into a number of operating companies* (horizontal separation). This might include a separate freight company and a number of regional or route based passenger companies. If this unbundling involved the creation of a large number of new companies, a permissive stance should be taken on mergers so that the sector can re-configure to the optimal size. *For small state railway companies, mergers with neighbouring companies might be sensible but would be politically sensitive*.

Separating rail infrastructure from rail operations to the extent that they are owned and managed by separate companies (vertical separation) may also have some merit, although these are still to be proven. We would *support the creation of independent track authorities (the entity in charge of rail infrastructure), as a necessary step to making infrastructure costs more transparent*. If possible, these track authorities should be designed so that vertical re-integration is feasible, should the market require it. *We believe that franchising has substantial merit, particularly if rolling stock leasing companies are set up so as to eradicate one of the most significant barriers to entry namely, access to railway engines, carriages and, to a lesser extent, trucks*. Our analysis suggests that *competition for the right to operate rail services (off-track competition, e.g. franchising) rather than competition between train companies offering competing rail services (on-track competition) may be more effective for domestic passenger services. In addition, on-track competition may be effective for international passenger traffic and all freight traffic*. A pragmatic approach would be to permit open access, by which any rail operator is permitted to operate a rail service in competition with the incumbent operator, on a case by case basis, as this would ensure the existence of a competitive fringe. This would however, require detailed modelling of the benefits of offering different types of services at different prices (and in particular, the impact of product differentiation), niche marketing and competitive pressures on cost, which could be beyond most regulatory bodies.

It is clear that every country has a proportion of lines that serve only a tiny proportion of their populations and at a considerable cost. At the same time, in many countries there are stretches of rail track that cannot handle the throughput of rail traffic (rail bottlenecks), particularly on the approaches to main stations. These bottlenecks constrain the development of new services. *We would therefore advise that the issue of network re-configuration be examined.*

In terms of road freight, the industry appears to be competitive, perhaps too much so. There seems to be excess capacity at the European level, reflected by large numbers of relatively small vehicles operating at low load factors. *Analysis is required to determine whether vehicle scrappage is at an optimal rate. The scope for harmonisation of entry standards and the lifting of restrictions in force in some countries on vehicle fleets owned by manufacturers (own account operations) needs to be investigated. The scope for more stringent vehicle standards might be investigated.*

In terms of the road passenger sector, *the unbundling and privatisation of bus and coach services from state railway and public transport companies should be encouraged*. Our work supports *the introduction of the right for international services to carry domestic traffic within countries they travel through (cabotage) and the deregulation of domestic coach services*. The *establishment of a competitive inter-urban express coach market may be an important way of injecting competition into the rail passenger sector*. Work has suggested significant cross elasticities between the two sectors, for example a rail leisure cross elasticity with respect to coach price of 0.14 (a 10% rise in the price of coach will increase rail demand by 1.4%) and a coach leisure cross elasticity with respect to rail price of 0.3 (a 10% rise in the price of rail will increase coach demand by 3%).

In terms of the inland waterways sector, some excess capacity has been identified. It is believed that much of this excess capacity will be eliminated by the ending of the tour de rôle system (a distribution and queuing system for allocating traffic), which will also probably result in lower prices. Clearly, *directive 96/75/EC needs implementing throughout the sector and its effects monitored*. A significant shake out in the industry might be expected, which may be ameliorated by pooling resources and risks through co-operation, work for chartering companies as sub-contractors or mergers with chartering and shipping companies. The EC should consider financial incentives to help independent bargemen leave the industry.

In terms of short sea shipping, an important organisational issue is the continuing growth in the importance of flags of convenience. These accounted for 60% of the tonnage of the EU merchant fleet in 1996. Countervailing measures such as subsidies, tax exemptions and cheap loans have not proved to be effective, *lending support to an EC investigation into what measures will be effective*. Another important issue is the likely impact of the abolition of duty free sales in 1999. It is claimed that there may be a loss of up to 50% of leisure travel on Baltic ferries between EU countries and that freight rates will increase by 30%, but it is possible that these are overestimates that assume that duty free retail activity will not be replaced by other forms of retailing. *A full investigation into the actual impact on both passenger and freight services is required*. A further organisational issue is the emergence of shipping line alliances to replace the liner conferences (shipping cartels) in the deep-sea market. *A direct parallel exists here with the emergence of global alliances in the air industry and as such competition authorities need to be strengthened*. With respect to ports, there is some evidence that port regulatory duties and responsibilities should be the responsibility of self funding, user orientated public sector port authorities (Baird, 1997).

With regard to intermodal passenger transport the main organisational problem would appear to be lack of co-ordination between different transport modes or companies following privatisation. *A co-ordinating regulatory body and/or an appropriate incentive scheme needs to be devised to deal with this issue. For intermodal freight transport, measures are required to increase the degree of contestability of international markets for intermodal transport, for example a one-stop-shop. In addition, competition rules should be strengthened in order to monitor international alliances and mergers.*

7.2 *Interoperability and Interconnection*

For air, the main technical barrier to interoperability is Air Traffic Control, but it is believed that new research and development will lead to at least a partial solution of this problem. *The key organisational barrier occurs when one airline dominates an airport (hub dominance) and an ongoing approach for the review of slot allocation systems is required*. The continued development of a high speed rail system linking key hubs (airports such as Heathrow, Charles de Gaulle-Roissy, Schiphol and Frankfurt) may be important in releasing some capacity at these hubs. *It is suggested that a mediator agency be established at the European level to deal with issues concerning hub dominance, computer reservation systems, ground handling facilities and predatory pricing* (setting very low, unsustainable prices in order to weaken competition or to keep potential entrants out of the market).

For rail, research and development has focused on the technical barriers to interoperability such as track gauge, load gauge, signalling systems and power supply systems. *Our research indicates that organisational barriers may be more important, with the lack of a one-stop shop proving an important barrier to the development of the European rail freight industry. The rail freight freeway concept needs to be developed and entrepreneurial cross entry from the private sector road freight and short sea shipping industries encouraged*. There is an urgent need to *develop infrastructure access and pricing systems that are simple, transparent and equitable*. The extent to which this can be achieved without the vertical separation of the ownership of operations and infrastructure needs to be investigated, although the separation of accounts and balance sheets is clearly a prerequisite.

For road freight, *interoperability might be improved by further harmonisation on technical matters, such as lorry weights, fiscal matters, such as standardising the Euro vignette system and on social matters, such as working time legislation. Interconnection might be improved by reducing customs formalities at border crossings*. Some of these problems will be eradicated by the extension of the European Union but preferential trading agreements with other Central and Eastern European countries should be considered.

For road passengers, *experience from the United Kingdom suggests that access to terminals might be an important barrier but one which is potentially covered by the essential facilities doctrine*, which has also been a particular problem for seaports (Soames, 1998). *The 100 kilometre per hour speed limit on coaches has been identified as a possible barrier to the industry competing effectively with other modes*.

For inland waterways, there are some interoperability barriers due to variations in depth gauge and handling equipment, which in particular limits the development of the French network. *The main barrier is an organisational one and it is believed that Government policy should concentrate on promoting inland waterways as part of an intermodal transport chain* (which is also relevant for railways).

For short sea shipping, *an important drawback to development is an environmental one*. The sector is responsible for significant emissions of SO_2 and NO_x, which may be addressed by catalytic converters and also oil spills and grey water discharges. There

are similar concerns for all other modes. These problems might be alleviated by charging systems that reflect environmental externalities based on the polluter pays principle. *Ports are an important bottleneck, with ships spending up to 60% of their time in port. This might be solved by the development of new multimodal short sea shipping systems such as port hoppers* that interact with deep sea container ships.

We have undertaken some intermodal analysis that indicates *that consumers gain when coach and train services are co-ordinated but these may be offset by some disbenefits to producers. It is likely that the net benefits to society will be considerably less than with the internalisation of external effects (charging the costs associated with noise and air pollution etc.), particularly for car traffic, which should be the first best policy* priority. Nonetheless, we believe that further cost-benefit analysis of integrated policies would be useful, whilst it would be *worth examining the impact that agreements between government authorities, who invest in transport infrastructure in return for transport operators investing in more modern vehicles* (quality partnerships), in both the passenger and freight industries, could have on obtaining integration benefits.

Finally, we have assessed the impact of telematics on the interoperability and interconnection of transport systems. *Some generic issues are identified that need to be addressed to ensure that telematics systems are themselves interoperable.* These relate to research and development, harmonisation and standardisation and evaluation. Four areas are identified where telematics may make particular contributions. *First, information systems are required that combine static and dynamic data on public and private modes* (advanced transport information systems and trip planning systems). Secondly, *Public Transport management systems are required to assist in co-ordinating services and promoting interchanges.* Thirdly, *fleet management systems are required to facilitate load consolidation and back hauls in the road freight industry and to identify the nodal centres that are best positioned to achieve this*. Lastly, *traffic management systems are required for all modes for maximising the use of existing infrastructure whilst maintaining acceptable safety margins.*

The list of recommendations is extensive but from our analysis we would be inclined to view the organisational recommendations as being the most important. The benefits from restructuring and commercialising each transport sector are likely to outweigh the benefits from reducing barriers to interconnection and interoperability, given the greater significance of national as opposed to international traffic. It is also possible that the restructuring and commercialisation of each transport sector will, contrary to the expectations of some observers, facilitate greater intermodality between sectors, interconnection across national borders and interoperability between firms.

Table 7-1 Summary of Recommendations

Sector	Organisational Recommendations	Interoperability/Interconnection Recommendations
Air	1) There may be substantial cost savings of up to 30% if the remaining flag carriers are privatised. 2) There are only minor reductions in average cost from expanding production and mergers should be viewed with suspicion. 3) Competition leads to higher frequencies and lower fares and should be encouraged	4) The main technical barrier is Air Traffic Control, but new R&D will lead to a partial solution. 5) A review of existing slot allocation systems is required. 6) A mediator agency should be established at the European level to deal with issues concerning hub dominance, computer reservation systems, ground handling facilities and predatory pricing.
Rail	7) Further commercialisation and liberalisation would increase efficiency in production. 8) For large railway companies, it would appear sensible to break them up into at least two separate operating companies. 9) For small railways, mergers with neighbouring companies might be sensible. 10) Separating rail infrastructure from rail operations may also have some merit but is still to be proven. 11) An independent track authority should be created if infrastructure costs are to be made more transparent. 12) Franchising has substantial merit provided that rolling stock leasing companies are set up to provide fair access to rolling stock. 13) Competition for the right to operate rail services (off-track competition) rather than competition between train companies offering competing rail services (on-track competition) may be more effective for domestic passenger services. 14) On-track competition may be effective for international passenger traffic and all freight traffic. 15) The issue of network re-configuration needs to be examined.	16) The lack of a one-stop-shop is proving to be a barrier to the development of the European rail freight industry. 17) A. The rail freight freeway concept needs to be developed and B. entrepreneurial cross entry from the private road freight sector and short sea shipping industries encouraged. 18) There is an urgent need to develop infrastructure access and pricing systems that are simple, transparent and equitable.
Road Freight	19) Analysis is required to determine whether vehicle scrappage is at an optimal rate. 20) There is scope for harmonising entry standards and lifting restrictions on own account vehicle fleets. 21) The scope for more stringent vehicle standards needs investigation.	22) Further harmonisation is required on technical matters (such as lorry weights), fiscal matters (standardising Euro Vignette system) and on social matters (working hours). 23) Interconnection might be improved by reducing customs formalities at border crossings.
Road Passenger	24) The unbundling and privatisation of bus and coach services should be encouraged. 25) Cabotage rights should be introduced for international companies. 26) The establishment of a competitive inter-urban express coach market may be important for injecting competition into the rail passenger sector.	27) Experience from the UK suggests that access to terminals might be an important barrier. 28) The 100 kph speed limit on coaches has been identified as a barrier to the industry's ability to compete effectively with other modes.
Inland Waterways	29) Directive 96/75/EC needs implementing and its effects monitored. 30) The EC should consider financial assistance for independent bargemen wishing to leave the industry.	31) The EC should promote inland waterways as part of an intermodal transport chain.
Short Sea Shipping	32) The EC should further investigate what measures will reduce the use of flags of convenience. 33) The impacts from the abolition of duty free sales should be monitored. 34) A competition authority is required to monitor the emergence of shipping line alliances.	35) Port access, loading and unloading are important bottlenecks. A pilot scheme for the port hoppers system is recommended.

Summary of Recommendations (continued)

Sector	Organisational Recommendations	Interoperability/Interconnection Recommendations
Intermodal	36) A co-ordinating regulatory body and/or an appropriate incentive scheme needs to be devised to overcome the lack of co-ordination between privatised transport companies.	37) Cost-benefit analysis of integrated policies would be useful. 38) The impacts of quality partnerships between government authorities, which invest in transport infrastructure and transport operators who invest in more modern vehicles, should be assessed.
Telematics		39) The EC should ensure that telematic systems are themselves interoperable in relation to research and development, harmonisation and standardisation and evaluation. 40) Telematic systems are required in four areas: a) systems that combine static and dynamic data on public and private modes; b) public transport management systems that can assist in co-ordinating services and promoting interchanges; c) fleet management systems that can facilitate load consolidation and back hauls in the freight industry; and d) traffic management systems to maximise the use of existing infrastructure without compromising safety standards.

8 CONCLUSIONS AND IMPLICATIONS FOR FURTHER RESEARCH

Following the resolution of the legal action between the European Parliament and the Council and of the Nouvelles Frontieres case in 1985 and 1986 respectively, there have been major strides towards a Single European transport market and the liberalisation of the industry. We believe that the intervention at a European level required to achieve this was justified and should be continued. Research has shown that liberalisation and commercialisation can lead to substantial cost reductions and hence gains in production efficiency. Although such gains have probably been exhausted in the road freight industry, they may still be substantial in the air and short sea shipping industries and barely exploited at all in the rail, road passenger and some parts of the inland waterways industries. Our work has primarily focused on traffic operations, but there are some indications to suggest that there may be gains to be made in all areas of infrastructure. The completion of the liberalisation process, adjusted to the needs of each transport sector, should be the main policy priority. The issues of interoperability and interconnection should be continuously assessed but probably should not be the main priority until organisational reforms are completed. The sequencing of policy is a key issue – outcomes may be crucially dependent on the policy path adopted, for example rail reform and coach deregulation – and should be scrutinised closely. Our work has also highlighted the importance of reforms in related sectors, particularly the labour market.

Future research should continue to examine the implications and constraints of the evolving organisational structures and hierarchies of transport policy implementation. The research should identify the optimal decision-making level for the implementation of different transport policies. Decisions in other sectors of the economy should also be examined with respect to their effect on the efficient implementation of transport policies. Another feature touched upon by our research is the increasing role of the private sector in the operating and financing of transport. Any new research should make use of the additional data that is now available and examine the impact of new management techniques, new labour practises, service innovations and the changes in the roles and activities of the operating industry in relation to authorities and manufacturers. We would therefore suggest that the following six issues need careful consideration:

1. Monitoring of the following deregulation measures;
- the implementation of the 3rd package (air),
- the implementation of cabotage for road freight and long-distance road passenger services,
- the abolition of tour de rôle (inland waterways),
- the abolition of duty free (short sea shipping), and
- the on-going railway reforms.

2. Collection of comprehensive and consistent data especially for road freight, road passengers and inland waterways where our modelling work highlighted particularly acute problems.

3. The sequencing of policy and the consideration of;
- approaches based on a big bang or on gradual implementation, and
- the role of domestic, European and international reforms.

4. Determination of future policy particularly with respect to;
- vertical separation (especially for rail),
- the internalisation of externalities (especially for road and air), and
- the costs and benefits of integration (especially for road and rail).

5. Integrate the results of inter urban and urban studies of transport regulation and organisation, e.g. of the SORT-IT, MINIMISE and ISOTOPE projects. To some extent this is done in the MINIMISE and SORT-IT joint final deliverable (SORT-IT deliverable D8).

6. Supply chain management and its impact on freight transport.

Finally, the transport sectors of the EU are constantly changing and as such require constant monitoring. Transport is not a steady state system. The dynamic processes that underlie the transport sector need to be continuously assessed. As such it is recommended that the effects of organisational and regulatory reform on transport efficiency, performance and interoperability continue to be monitored.

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A research monograph is also due to be published later this year, as part of the Transport Studies Unit, University of Oxford series.

10 GLOSSARY

Barrier	A barrier is an obstacle to perfect competition which raises the costs of firms wanting to enter the market. They can result from the structure of the market (innocent) or from a firm's behaviour (strategic). They can result from technological conditions and/or legislation. Many kinds of barriers exist.
Cabotage	The carriage of goods or passengers within a state, traditionally considered to be reserved for transport operators registered in that state.
Capacity barrier	When observed transport volume demands exceed the capacity limits of the available infrastructure, e.g. roads, track and terminals and inhibits the entry of new operators.
Contestable markets	When new entrants can enter the market and make a normal return, the market approaches that of perfect competition or where the threat of competition is sufficient to prevent monopoly exploitation.
Competition simulation model	A model used to simulate the welfare effects of competition in the society.
Consumer surplus	The "extra" value consumers receive beyond what they pay for the commodity. When the demand curve has a negative slope, all but the marginal consumers would pay more for the good if the price was higher. Only consumers experiencing their willingness to pay equal to the going price have zero consumer surplus.
(Dis-)economies of scale	When long-run average cost (in-)decreases as output increases.
Economies of density	Relates to the unit cost of transport in a market, both in terms of space and time (flow per area unit; flow per time unit). A higher (lower) flow per unit leads to reduced (increased) unit transportation cost.
Economies of scope	Production (or cost) advantages from producing more than one product.
Elasticity	Measures how sensitive a variable is to a change in another variable, typically changes in quantity with respect to price changes.
Environmental barriers	Areas/critical spots which are highly congested and subject to high noise and emission levels or threats to nature reserves and therefore restrict the ability to expand capacity.
EU	European Union
Externality	When parties not involved in a market are affected by the actions of that market.
Generalised cost	Weighted sum of various components associated with costs for travelling. The generalised cost measures the cost perceived by the person.

Gini index	A coefficient based on frequency distributions which shows the degree of inequality. For example, the cumulative percentage of departures for an airline company will give an indication of the extent to which that company's network is concentrated (eg hub and spoke).
Herfindahl index	A way to measure the concentration on a market. The index takes into account the number of firms in the market as well as their different market shares.
Input factor price	The price paid for production factors (resources), for instance price of labour and capital.
Innocent barriers	Where a firm benefits from barriers that have not been deliberately created by the firm for the purpose of blocking entry. Examples could include brand loyalty to historic incumbents and access to cheap finance.
Institutional barriers	Barriers caused by the political and legal system and social structures.
Interconnection	Connections between international, national, regional and local networks (for users), both within and between modes.
Intermodal transport	When the route of an individual passenger or goods unit consists of a **combined chain** from origin to destination **involving at least two different modes** (excluding walk for passengers). For freight transport in particular, intermodal transport means transport between two points in which several modes of transport are used in succession without handing the goods during mode changing operations. The unit that contains the goods may consist of a container, swap body or semi-trailer and is called "intermodal transport unit" or "loading unit".
Interoperable	The ability of national and geographically defined transport networks to provide efficient operations and services across national borders and across physical and technical barriers respectively. Interoperability occurs when rolling stock of a national railway company is able to operate on the whole part of the trans-European railway network, or when two previously separated national networks become interconnected and able to serve common fleet operations.
Interoperability models	These models relate transport system performance to the (non) existence of barriers to entry and exit for new actors on the market.
Link	A link represents a connection between two nodes, one starting node and one ending node. A number of attributes are associated with it such as length, capacity, width, speed limit etc., all affecting the travelling time for the actual distance.
Market failure	When the free market fails to provide the right goods and services at the right price.
Monopoly	When the market is controlled by a single operator or supplier.
Multimodality	The existence of more than one mode offering the particular travel service and the existence of competition between them.

Oligopoly	When the market is controlled by a few operators or suppliers, whose actions affect the other operators.
Organisational barriers	Where an organisation controls aspects of the market so that new entrants face difficulty in entering the market. See also strategic and structural barriers.
Producer surplus	The difference between the price a producer sells a good for and the cost for the producer to supply the good. The producer would sell the commodity more cheaply if it had to.
Public goods	Goods which once provided, are available to all, it is difficult to exclude users and therefore to extract a charge for use. Also one person's consumption of the good does not effect others.
Regulatory failure	When regulation interferes with the production and distribution of goods and services to the extent that significant inefficiency occurs, leading to higher prices and a lack of (managerial) innovation and response to the market and consumers.
Strategic barriers	Where a firm aims to change market structure, eg deterring entry in order to reduce the number of firms in the market and increase its market share, as part of its competitive strategy. For example large airlines can offer lower fares on selective, contested routes to deter new entrants, and collusion between incumbent airlines on price and capacity for the same purpose.
Structural barriers	Economies of Scale and Scope which favour large scale incumbent operators. Also when ownership of complementary services or infrastructure provide an advantage to an incumbent operator, e.g. ownership of terminals or terminal facilities' providers (see also organisational barriers).
Technical barrier	A different technical standard or specific technical requirement that must be met in order to introduce or operate a transport service.
Tour-de-rôle	A distribution and queuing system for the inland navigation business.
Turn penalty	A time penalty (or generalised cost penalty) associated with making a left or right turn in a traffic intersection.