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Research Summary –
Economic Aspects**

EXTR@Web Project

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Abbreviations and Acronyms Used

3PLP	Third party logistics service providers
AG	High level Advisory Group (to the EXTR@Web project)
BG	Benchmark Group (associated with the EXTR@Web project)
CEEC	Central and Eastern European Country
DG TREN	EC Directorate-General for Energy and Transport
EC	European Commission
EFTA	European Free Trade Association (Norway, Iceland, Switzerland, Liechtenstein)
ERA	European Research Area (EU, EFTA and CEECs)
EXTR@Web	Exploitation of Transport Research Results via the Web (DG TREN FP 5 Accompanying Measure project)
EU	European Union
FP 4 (5, etc)	EC Fourth (Fifth, etc) Framework Programme
GDP	Gross domestic product
HGV	Heavy goods vehicles
IRPS	Inter-urban road pricing schemes
PAG	Programme Analysis Group (part of EXTR@Web project)
RTD	Research and Technical Development
TEN	Trans-European transport networks
TRKC	Transport Research Knowledge Centre; TRKC website at ec.europa.eu/transport/extra

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1. Introduction

This paper provides a structured guide to the results of Research and Technical Development (RTD) projects relating to **Economic Aspects**, carried out in transport research programmes throughout the European Research Area (ERA).

It is one of a series of 28 papers. Two further from an original set of 30 transport themes – i.e. Long-distance Transport and Financing Tools – have been discontinued as separate reports, though all related projects will be covered elsewhere in Thematic Research Summaries.

	Paper no.	Transport theme
Dimension 1	1.1	Passenger Transport
	1.2	Freight Transport
	1.3	Urban Transport
	1.4	Rural Transport
	1.5	Regional Transport
	1.6	EU Accession Issues
Dimension 2	2.1	Air Transport
	2.2	Rail Transport
	2.3	Road Transport
	2.4	Waterborne Transport
	2.5	Other Modes
	2.6	Intermodal Transport
Dimension 3	3.1	Economic Aspects
	3.2	Efficiency
	3.3	Equity and Accessibility
	3.4	Environmental Aspects
	3.5	User Aspects (incl. ergonomics, quality, choice and rights)
	3.6	Safety and Security
Dimension 4	4.1	Decision-support Tools
	4.2	Information and Awareness
	4.3	Infrastructure Provision (incl. TENs)
	4.4	Integration
	4.5	Intelligent Transport Systems
	4.6	Regulation / Deregulation
	4.7	Land Use Planning
	4.8	Transport Management
	4.9	Pricing, Taxation and Financing Tools
	4.10	Vehicle Technology

Of the more than 5600 projects from research programmes the Transport Research Knowledge Centre (TRKC) ultimately has considered, a total of **584** projects deal partly or fully with the issues of **Economic Aspects**.

1.1 How to use this paper

It is recommended that you use this paper to locate RTD (Research and Technical Development) results on sub-themes where you have a particular interest, rather than reading the paper from start to finish:

- Start in Section 2 to get an overview of the scope of the particular theme.
- Read Section 4 that summarises the findings for each sub-theme of interest to you.
- Consult Annex I to identify the individual projects, be they of European or national origin, relating to a particular sub-theme.
- If this is the first time you have used one of the series of thematic research summaries, it is strongly recommended that you read Annex II. This explains the background and purpose of the EXTR@Web project, and the basis upon which information in this document was selected and analysed.

The other sections of this paper can help you to gain an overall picture of the **Economic Aspects** theme, associated policy issues and the background of project EXTR@Web.

The analysis in this paper is the responsibility of the EXTR@Web project team, and does not represent the official viewpoint of the European Commission.

1.2 The link to the Transport Research Knowledge Centre website

Further details on individual projects can be obtained from the Transport Research Knowledge Centre (TRKC) website at: ec.europa.eu/transport/extra

The TRKC website includes summaries and full final reports of individual projects, as well as a variety of analyses, and publications prepared by the EXTR@Web project.

How to best use the online resource:

- The 'Projects & Analysis' section allows the user to specify a project-wide search on 'Publication date', 'Origin', 'Document type', 'Mode', 'Sector', 'Geographic area', 'Policy objective' and 'Tool', or any combination of these criteria.
- This may be complemented, or superseded, by the flexible 'Free text search'.
- On the query result screen, free text search criteria may be refined, as appropriate. Further tick boxes here allow limiting query results according to 'Project status' (five levels).
- Query results are presented in a table, which allows for sorting by column (click on relevant column header for alphanumerical sorting).
- Project-specific summaries may include links to project websites, or provide contact details for the project, where available.

It should be noted that the online Transport Research Knowledge Centre will be updated frequently, though dependent on input from project co-ordinators.

Other parts of the TRKC website cover transport research at Programme level, and expand on transport related issues, e.g. in the 'Links', 'Events', 'Glossary' and 'FAQs' sections.

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2. Scope of theme

2.1 Definition of theme

The theme **Economic Aspects** is concerned with the competitiveness and economic development aspects of sustainable mobility. The competitiveness aspects concern the impacts originating from infrastructure and other policies affecting the provision of transport services on the competitiveness of both the transport industry and any other industry. The economic development aspects concern the impacts on the development of the areas that are affected by such policies and on their economies.

Competitiveness and development impacts occur mainly through the mechanisms of cost savings and improved accessibility: these can affect to a different extent industry sectors and areas, the main effects being the revival of economic activity, the increase of employment levels, the attraction of new investments or the expansion of existing industries. The competitiveness of the EU transport industry is a key objective of the EU transport policy. Competition between transport modes is subject to EU regulation aimed at shifting the current unsustainable balance and meeting the future growth in demand for transport services.

2.2 Topics included in theme

Topics which conventionally are included in the economic theme are:

- Direct costs of transport, which are the costs borne by the transport operators, the providers of the transport infrastructure, the travellers and the freight shippers;
- external costs of transport, which are the costs inflicted on the other travellers and the non-travelling public, for example congestion, pollution and road casualties;
- appraisal of transport investments; and
- market structure and the regulation of transport services.

Topics which recently have also been subject of research are:

- Drivers of demand for both passenger and freight transport;
- pricing of transport infrastructures and services so that users pay the full costs and adapt their choices accordingly;
- links between transport and issues of location, urban and regional development, and economic growth; and
- participation of the private sector in the financing and management of public infrastructures.

Also, economic aspects are dealt with in two strongly related areas of research:

- Development of scenarios, which identify the social, economic, political, and technological factors likely to shape mobility and the transport business in the future; and
- evaluation of policies for sustainable mobility, which extends the assessment of the impacts and of the implementation aspects to regulatory and economic policies in addition to infrastructure provision.

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The above summary of topics describes the principal breakdown of technical, organisational and managerial aspects that come under the theme, whereas Chapter 4 of this document reflects sub-themes according to actual priorities in transport research policy.

2.3 Significance of theme

The economic importance of the transport sector stems from the benefits and costs that it produces. Transport is a contributor to the creation of GDP and employs a significant number of persons: in the transport services sector the value created is 7% of the EU GDP and the number of persons employed is 5% of all persons employed in the EU [14]. However, transport at the same time produces disadvantages in terms of external costs (congestion, environmental impacts, and accidents). The mid term review of the EU White Paper [14] reports that the external costs of road traffic congestion alone amount to 1% of Community GDP. Environmental costs of all transport to 1.1% of GDP.

Economic growth is strongly correlated with the development of the transport sector. Data at EU level show that GDP growth and growth in transport demand have always developed in parallel although with slightly different rates. This is not surprising: on the one hand, transport demand is a derived demand because it is linked to production and consumption activities, on the other hand, transport demand needs to be met in order to prevent that an insufficient provision of infrastructures and transport services acts as a constraint to economic growth.

For these reasons the EU transport policy has recognised efficient transport systems as an essential element to the competitiveness of the European business, economic growth, and employment. At the same time, the concerns about the external costs produced by transport have led to the principle that economic growth needs to be “disconnected” from the attendant growth of transport externalities.

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3. Policy context

The priorities of the EU policy have been focused on the:

- Opening up to competition of the markets of the different modes;
- support for the competitiveness of the European transport industry;
- financing of the infrastructures; and
- elimination of the distortions in competition with the encouragement of the diversion of road traffic to more sustainable modes by infrastructure charging and taxation.

In the road sector, the White Paper “European Transport Policy for 2010: Time to Decide” [4] had remarked that price competition is fierce for haulage companies and enlargement is expected to exacerbate this. Maintaining profitability is difficult under the pressure exerted on prices by consignors and industry especially in periods of diesel price increases. Support was therefore advocated to encourage owner-operators to group together to provide logistics-related activities and advanced information and management systems.

In the rail sector, the three directives of the 2001 railway package (Directive 2001/12/EC, 2001/13/EC, 2001/14/EC) have opened the main rail axes to European rail companies for freight international traffic and have defined the organisation of the railway sector with particular regard to the role of the infrastructure manager who has to open the access to the network for a multiplicity of operators in a non-discriminatory way. The package follows the 1991 Directive on the separation of accounts between infrastructure management and transport service provision.

A new railway package has been proposed in 2002 including the total liberalisation of the freight markets (international and national), the liberalisation of the passenger markets (international and national), and the creation of a Community structure for safety and interoperability.

The 2001 White Paper had stressed the need for combating in particular the decline of rail in new Member States, where it retains a higher share of the freight market compared to the EU15, by reforming the rail sector before road transport completely gains the upper hand.

The definitive transition of the air sector to an open and competitive market had been set with the three Regulations 2407, 2408, and 2409 of 1992. The 2001 White Paper had stressed the need for a more efficient use of airport capacity to cope with the traffic growth, also due to the enlargement. In this context the definition of a new regulatory framework on slot allocation at airports was proposed to allow also greater access to the market using market mechanisms. Also, the White Paper had suggested keeping the privatisation of airports under control with specific reference to the implications on transport capacity.

In the waterborne sector, the Commission has recently taken initiatives in favour of a more pronounced opening up of the market of the port services [6], as well as of the reform of the Regulation 4056 of 1986 which grants liner conferences an antitrust exemption [10].

In the sector of public transport services the 2001 White Paper had suggested that transport services of general economic interest should be governed by a series of general principles, notably: (i) use of the tendering procedure within a clear legal framework defined at Community level, (ii) granting of exceptions or exclusive rights where necessary, (iii)

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awarding financial compensation to operators responsible for performing public service tasks.

The orientation stated in the White Paper has been followed up by an amendment to the proposal for a new Regulation (to replace 1191/69 which does not say how the contracts should be awarded) concerning public service requirements and the award of public service contracts [7]. The proposal would require the majority of urban public transport services to be opened to competition with some exemptions including contracts for low-value routes or networks. A ruling of the European Court of Justice of July 2003 on subsidies for public transport services (the Altmark case) could speed up the Commission's proposal to come into force. The Court ruled that subsidies can be paid without breaking competition rules but only if they support clearly-defined public service obligations.

To support the competitiveness of the European transport industry, initiatives have included the:

- Support for the tonnage-based taxation system, which since the publication of the White Paper has been adopted in an increasing number of Member States, to promote the re-flagging of as many ships as possible to Community registers;
- proposal of a revision of the procedures for the aviation negotiations with the United States and other non-EU countries to reinforce the competitive position of European airlines in extra-Community routes;
- proposal for a regulation concerning protection against subsidised or unfairly priced air services supplied by non-Community carriers on certain routes to and from the Community; and
- support for the development of the satellite system Galileo as a key tool for the development of the European transport policy and to open up significant markets of products and services for the European industry.

The difficulty of mobilising capitals was recognised by the 2001 White Paper as a main obstacle to carry out infrastructure projects. This is particularly important for the trans-European transport network which is vital for the economic and social cohesion of the EU. In this respect the White Paper had proposed three lines of action:

- A change of the funding rules for the Trans-European Network, increasing the maximum Community contribution for cross-border projects crossing natural barriers and for projects at the borders of new and candidate Member States;
- the encouragement of public/private partnerships and the introduction of new procedures for public contracts, including public works concessions, in order to achieve greater involvement of private capital in infrastructure funding; and
- the pooling of funds, with the introduction of a new Community framework for infrastructure charging to allow also Member States to use income from infrastructure charging to fund the building of new infrastructure, particularly rail, on competing routes.

In the amended proposal on the rules for the granting of financial aids [11] the Commission proposed the amendment of Regulation 2236/95 to allow Community co-financing of up to 30% of the total cost for cross-border sections of projects declared to be of European interest.

The most adequate tools to support the investments in transport infrastructure projects were analysed in a Communication in 2003 [12]. In particular, the Communication addressed the Community financing sources, the pros and cons of private-public partnerships, and the conditions and solutions needed to attract private capitals.

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The reform of the Directive 1999/62 on the charging of heavy goods vehicles for the use of certain infrastructures (the Eurovignette Directive) had been proposed in the 2001 White Paper. The subsequent proposal of the Commission for a new Directive amending the Eurovignette Directive [13] allows the Member States to apply mark-ups to tolls in particularly sensitive areas to cross-finance the investment costs of other transport infrastructures – railways – of a high European interest in the same corridor or area. Following this, the EU has finalised the approval of a new directive in 2006 on freight vehicles. The directive makes provision for Member States to be able to increase tolls with a “mark-up” on roads in particularly sensitive mountainous regions. The income from these mark-ups must be used to fund alternative transport infrastructure.

In the 2001 White Paper, charging for infrastructure is recognised as one instrument, together with fuel tax, for integrating infrastructure costs and external costs, and thus replacing existing transport system taxes. The White Paper stressed that while transport may be too heavily taxed it is above all badly and unequally taxed as users are all treated alike, irrespective of the infrastructure damage, bottlenecks and pollution they cause. The consequence is a considerable distortion of competition both between transport operators and between modes of transport. Infrastructure charging, based on the “user pays” and “polluter pays” principles, is advocated as a particularly effective means of managing congestion and reducing other environmental impacts, and fuel tax as a means of controlling carbon dioxide emissions.

The principles of infrastructure charging had been discussed in the Green Paper “Towards Fair and Efficient Pricing in Transport” [1], in the White Paper “Fair Payment for Infrastructure Use: a Phased Approach to a Common Transport Infrastructure Charging Framework in the EU” [3], and in the series of reports of the High Level Group produced in 1998 and 1999.

As a follow up of the infrastructure charging debate, the Directive of 2001 on rail infrastructure charging has required marginal social costs to be used as the basis of charging, whilst permitting supplementary charges where necessary for cost-recovery purposes. In the road sector, the proposal of the Commission for a new Directive amending the Eurovignette Directive [13] aims to change the framework for tolls and vignettes for goods vehicles over 3.5 tonnes, with the introduction of a higher differentiation including: distance travelled, accident and environmental costs, congestion levels by time period, local population density, vehicle emission classes. In addition, the proposal provides the methodologies for the calculation of the different toll components. The road charging Directive finally approved in 2006 represents the first step towards taking account of external costs: it will allow a greater variation in tolls to reflect congestion, and toll variations to reflect the pollution caused by vehicles will be mandatory from 2010. The new Directive also establishes the principles for calculating tolls and limits frequent user discounts, to ensure that they are fair, proportionate, transparent and non-discriminatory. These improvements will reduce obstacles to the free movement of goods and guarantee fair competition between road haulage operators.

As a follow up of the White Paper proposal of a harmonised taxation of fuel used for commercial purposes, the Commission has proposed [8] to amend Directives 92/81 and 92/82 which had imposed less taxation on diesel for reasons of economic needs of road hauliers. Further to the White Paper support for the use of alternative fuels, fiscal promotion of bio-fuels has been included in a proposed Directive [5]. The proposal then has been incorporated in the Directive 2003/96 on taxation of energy sources providing Member States with the option of applying a reduced rate of excise duty to pure or blended bio-fuels, when used as motor fuels.

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In the air sector, the 2001 White Paper had proposed to re-consider the tax exemption for kerosene on intra-Community flights as this exemption provides no incentive for airlines to use the most efficient aircraft and also creates situations where the competition between air transport and other modes is unfair. However, this proposal up to now has met opposition by the operators within the sector.

The mid term review of the White Paper [14] has recognised that economic growth has been less than expected. On this basis the principle of decoupling transport from economic growth is no longer valid. Mobility is essential to competitiveness of Europe economy. Mobility needs to be disconnected from its negative side effects. The future transport policy will need to optimise each transport mode's own potential to meet the objectives of clean and efficient transport systems. Shifts to more environmentally friendly modes must be achieved where appropriate, in particular on long-distance, in urban areas and on congested corridors. Co-modality, i.e. the efficient use of different modes on their own and in combination will result in an optimal and sustainable utilisation of resources.

The orientations of the transport policy outlined in the review build upon the 2001 White Paper. They include actions to narrow excessive differences in fuel taxes in road transport with a view to impacts on competition in the freight transport market. In the rail sector they include actions to create a competitive European railway network through liberalisation, technological innovation and interoperability of equipment, investment in infrastructure and better market monitoring with a new scoreboard from 2007 onwards. Motorways of the sea and short sea shipping need to be developed with an increased emphasis on landward connections. The European ports policy, which will be launched in 2007, will have as one of its goals increased investment within ports and towards the hinterland. Smart charging will contribute to a more rational use of infrastructure. The review announces a methodology as a basis for smart infrastructure charging by 2008.

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4. Synthesis of findings from completed projects

Research projects contributing to the theme of **Economic Aspects** can be broken down to the following sub-themes:

- Drivers of demand for freight and passenger transport;
- costs in relation to pricing for infrastructure use;
- socio-economic impacts of transport investment and policies;
- policies and conditions for sustainable mobility; and
- market structures.

You may wish to further consult the following Thematic Research Summaries that present research findings which are complementary to those covered in this paper:

- D2.E-4.1 Decision support tools;
- D2.E-4.6 Regulation/deregulation; and
- D2.E-4.9 Pricing, taxation and financing tools.

Results from the following **20** projects have been included in this Thematic Research Summary:

Research sub-theme	Contributing projects
Drivers of demand for freight and passenger transport	PROTRANS; SULOGTRA; Transport Intensities within Industrial Branches in Finland
Costs in relation to pricing for infrastructure use	DESIRE; IMPRINT-EUROPE; MC-ICAM; RECORDIT; UNITE; Fair and efficient pricing
Socio-economic impacts of transport investment and policies	IASON; TRANSECON; Building damages due to road and rail transport in Switzerland: Update of external costs in 2000; Costs imposed by heavy goods vehicles; Passenger rail services and economic performance
Policies and conditions for sustainable mobility	FORESIGHT FOR TRANSPORT; PRO-POLIS; SPECTRUM; SPRITE
Market structures	MARETOPE; Quality bus partnerships and market structure

Detailed findings and policy implications for individual projects can be found in Annex I. Please refer to acronyms and project titles, respectively, listed above.

4.1 Drivers of demand for freight and passenger transport

4.1.1 Research objectives

In this area research objectives include factors affecting growth of passenger demand, impacts of changes in logistics on the markets of transport services and on freight flows.

4.1.2 Main findings

European research looked into the logistics and supply chain trends and examined the decision processes involved. Social, technological, economic, environmental and political drivers shaping the logistics system were identified. The markets of the different modes as well as of intermodality were analysed. The optimisation of the supply chain was investigated with a view to reconciling private goals with public goals. An assessment was carried out of the impacts on value created within the supply chain and broader economic development of increasing transport costs: it was concluded that the attendant decrease of production value, value added and employment is relatively low. Policies were assessed with respect to their potential to achieve a curb of road freight transport growth and medium- and long-term EU policy objectives in transport, environment, infrastructure-related and socio-economic areas.

Finnish research looked in particular into the transport intensity, measured as tonne-km per Euro, of the different national industry sectors. An average increase of transport haulage lower than the growth in GDP was found. It was argued this could be explained by a change in the industrial structure, with technological industry, producing less transport, having grown relatively more than basic industry, producing more transport.

A database of third party logistics service providers (3PLPs) at EU level was developed. The potential of 3PLP to improve the market of intermodal transport was assessed. It was found that 3PLPs have greater influence in increasing the road-rail share for fast moving high-valued goods than for slow-moving low valued goods. The actions which are needed on the side of policy makers to encourage 3PLP implement intermodal transport strategies were identified. It was predicted that in the future 3PLPs should act as Pan-European integrators and liability guarantors.

4.2 Costs in relation to pricing for infrastructure use

4.2.1 Research objectives

In this area research objectives include development of accounts providing economic and financial flows of the individual transport modes, definition of efficient prices to be charged in different local and traffic contexts.

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4.2.2 Main findings

European research provided pilot accounts for all transport modes in EU15 countries plus Switzerland, Estonia and Hungary. Results from accounts show that for road total revenues cover total infrastructure costs in all but one country. In more than half of the countries considered the total revenues exceed the total costs of infrastructure, accidents and the costs of air pollution, global warming and noise. Conversely, for rail the percentage of system costs covered by revenues are in the best case 63%.

Research into pricing reform in the EU showed that disagreements and uncertainties still exist which prevent from having charges estimated in the various countries according to a common basis: a suggested way forward is to seek consensus on a lower limit of costs. Areas needing further research identified by the project include processes and institutions (who should set or regulate prices and re-allocate revenues?), and ways of translating research results into action.

Insights were provided on how the implementation of the pricing reform should progress in the EU taking into account the existing barriers and attendant constraints. Case studies which used mathematical modelling concluded that it is beneficial from the welfare viewpoint to start with simple pricing measures with limited scope, relatively low charges and minimal differentiation if these are the only feasible. In road transport such simple schemes can be cordon tolls and distance-based charges for HGV (heavy goods vehicles). It is possible to move to more comprehensive and differentiated schemes in the longer term as confidence and acceptability builds up.

Research into pricing reform in Switzerland proposed the introduction of a tax based on distance travelled similar to the one used for HGV. In return the fuel tax could be restructured as a CO₂ tax and reduced.

Research into inter-urban road pricing schemes (IRPS) focused on two distance-dependent schemes: DAREA ("Distance-dependent area pricing" based on the amount of kilometres driven within a certain perimeter) and NET ("Distance-dependent network pricing" based on the kilometres driven on a net of interrelated motorways of the same hierarchy-level). To avoid as a consequence of a NET scheme the traffic detour to secondary roads, with attendant externalities, a mixed NET/DAREA scheme was suggested as a good solution although it was underlined this might raise problems of acceptability. An assessment of the impacts of road tolls anticipated as effects the choice of alternative road corridors as well as better logistic organisation. Also, it was forecast that some reduction of trade and slowdown of economic growth should be expected due to the higher transport costs.

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4.3 Socio-economic impacts of transport investments and policies

4.3.1 Research objectives

In this area research objectives include first the assessment of the indirect impacts and of the distribution of direct and indirect impacts among groups, industries and regions that are brought about by transport policies such as investments in transport infrastructures and services, pricing, demand management and regulation; second the assessment of the external costs of transport.

4.3.2 Main findings

European research has made available a set of interconnected tools which can be used to assess the spatial and economic consequences of transport policies. The starting point is a good quality sector cost-benefit analysis. A wider economy model linked to a transport model does offer a way forward in modelling the total effect, including the economic network effects. The outputs of such models include forecast changes in GDP and employment by region. Application of such tools showed that the TENs have relatively strong distributive effects to the economy, affecting in particular the East-West growth balance and stimulating the rate of cohesion. While the economic growth effect can be relatively small for regions in the European core, for regions at the European periphery or in the accession countries a gain in accessibility by a new motorway or railway may bring significant progress in economic development.

Other research investigated the impacts of infrastructure policies in urban transport, including public transport and cycling infrastructure. Multiplier effects of the investment costs on the regional gross domestic products up to 6 were estimated for public transport. It was found that large scale infrastructure investments can stimulate re-urbanisation development. Substantial changes of land use patterns can be brought about by public transport investment. As an example the improvement of public transport accessibility in built-up areas within a conurbation can stimulate follow-up investments in the catchment areas of the station. Investment by local commerce and industry can increase the land prices and encourage the outward migration of the residents. On the other hand bicycle investments indicate support of residential land use in central areas.

Research in Switzerland provided an assessment of building damages due to air pollution brought about by traffic. It was found that overall building damages of traffic amount in Switzerland in 2000 to Euro 170 million per year, 93% being from road traffic. Particle emissions are today the most important cause. Improvements are expected in the future by cleaner fuels. In the UK a model was developed which provides estimates of track and environmental costs, including noise, imposed by goods vehicles. Monetary values applied to these emissions rates identified health and non-health impacts. Other research in the UK provided an assessment of the impacts on individuals and business of poor rail performance. It was estimated that direct harm to business travellers and business amount to £ 1 billion per year, equivalent to £ 7 per journey. It was also found that employees' productivity is decreased by 13-18% after a stressful journey.

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4.4 Policies and conditions for sustainable mobility

4.4.1 Research objectives

In this area research objectives include socio-economic and political scenarios for future mobility, identification and assessment of policies for sustainable mobility.

4.4.2 Main findings

An expert consultation exercise at EU level provided an assessment of the non-transport domains that are likely to influence most future mobility and transport systems. It was found that in the environmental and energy domains key issues are renewable energy sources, rational use of energy at household or firm level and environmental taxation. In the technology domain the price and efficiency of new technologies and the rate of their diffusion. In the social domain the developments in the labour market and those in the debate on public services. Other important issues are family policy, location patterns as well as migration trends and policies. Other issues were identified in the economic and business domains, including firm strategy towards teleworking and transport plans, strategies of the car industry towards greener and smaller cars, diffusion of car sharing in cities.

Other European research addressed the issue of decoupling and provided an assessment of those measures having a potential to influence transport intensity and unit environmental load whilst not having large detrimental effects on GDP. These include combined measures to change mobility-related attitudes and traffic behaviour, car sharing as part of combined mobility, controlled parking zones, urban road pricing, hydrogen fuel cell vehicles, high-speed rail, road pricing for freight traffic. It was suggested that tradable permits might be promising but there is a lack of research to back this up. Also the trade-off between ease of implementation and effectiveness was underlined: measures such as encouragement of people to change behaviour are easier to implement because of less acceptability barriers but are presumably less effective than pricing measures.

Economic instruments were addressed within European research. It was found that there remains considerable potential for the greater use of economic instruments at both urban and interurban levels, particularly when implementation is in package with other measures. In the case of airports economic instruments were assessed as a valid capacity allocation mechanism and were suggested to internalise externalities, noise in particular. In the case of roads it was found that motorway tolls would have relatively small welfare effects compared to fuel taxes. In the urban case it was found that some of the best performing packages involve distance charging and fuel taxes. As all-winners measures are possibly non-existent, it was concluded that a successful move towards a greater use of economic instruments would lie in a package of measures where the costs are spread in such a way that the barriers on feasibility are low across the board and there is not a strong adverse impact on any single indicator.

European research provided assessment of policy measures for urban transport from the point of view of the environmental, economic and social sustainability. Assessment of no-policy scenarios was indicative of a deteriorating trend related to the growth of the urban population, sprawling land use and attendant growth of car traffic. The assessment of policy scenarios concluded that a good urban policy should consist of co-ordinated elements which work together to produce cumulative long-term effects. These elements include car pricing policies in combination with appropriate public transport fares, investment pro-

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grammes in public transport, and land use plans increasing public transport use by encouraging people to live close to central areas or along well served public transport corridors.

4.5 Market structures

4.5.1 Research objectives

In this area research objectives include investigation of the impacts of change and of the barriers to change in the regulation of urban public transport, and assessment of the acceptance and of the effects on competitive behaviour of quality bus partnerships.

4.5.2 Main findings

European research carried out an assessment of the change process in the regulation of urban public transport. A set of case studies were investigated in the EU and Norway. Changes in the organisational framework of local public transport have been aimed at improving the transparency, economic efficiency, and quality of service. It was found that the relationship between authorities and operators is a key success factor, and that productive efficiency pressure was more effectively applied by tendering procedures, with authority taking the role of entrepreneur. The impacts of change were identified along with barriers to change. Main performance indicators were identified and grouped into the categories of productive efficiency, network design and commercial effectiveness. Recommendations were provided to help different actors face barriers to change and choose the tools that fit better the legal and organisational setting.

Research in the UK addressed quality bus partnerships. It was found that the development of successful quality initiatives require some form of co-operation between the commercial operators and local authorities. Theoretical analysis, using a simulation model of bus market at corridor level, provided an assessment of the effects on competitive behaviour. It was found that quality measures are unlikely to stimulate competition and that the natural outcome is some form of weak monopoly where the gains from publicly funded quality measures are partially captured in enhanced monopoly rents to bus operators. Options suggested for pro-public interest regulation of the market include some form of price or margin regulation and quality contracts under which operators accepts regulation in return for exclusivity on the basis of “best value”.

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Annex I: Contributing projects

Preface This Annex lists all the projects (European and national) which belong to the **Economic Aspects** theme, in alphabetical order of project acronym (for projects with acronyms), followed by projects without acronyms in alphabetical order of the project's name in English. Where results have been made available to the EXTR@Web project, a summary of key findings and policy implications relevant to this theme are given.

In 'Origin' column, use ISO 3166-1 country designators as follows:

Austria – AT; Belgium – BE; Bulgaria – BG; Cyprus – CY; Czech Republic – CZ; Denmark – DK; Estonia – EE; European – EU; Finland – FI; France – FR; Germany – DE; Greece – GR; Hungary – HU; Iceland – IS; International – INT; Ireland – IE; Italy – IT; Latvia – LV; Lithuania – LT; Luxembourg – LU; Malta – MT; Netherlands – NL; Norway – NO; Poland – PL; Portugal – PT; Romania – RO; Slovakia – SK; Slovenia – SI; Spain – ES; Sweden – SE; Switzerland – CH; United Kingdom – UK; Other countries – Oth

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Key findings / Policy implications / Project website or contact			
DESIRE	Designs for Inter-urban Road pricing schemes in Europe	EU	Costs in relation to pricing for infrastructure use
<u>Key findings</u>			
<ul style="list-style-type: none"> • IPRS state of the art. The added value of this result is also linked with its potential role in future projects and discussions concerning IRPS issues at national and/or international level. • Model Designs of Possible IRPS. This result provides a detailed definition of different basic forms of IRPS and a discussion of the technical systems and institutional dimensions that support the implementation of these IRPS. It includes: <ul style="list-style-type: none"> • A common basis of the analysis - this concerns the objectives and basic forms of IRPS, the pricing principles and, most important, the functionality of an IRPS. • The discussion of possible technical and procedural solutions - this discussion is focused on solutions for the two mileage-dependent schemes DAREA and NET. • The definition and assessment of possible institutional solutions - shows that there is not the one institutional model, but depending on the weight given to different objectives, an All Public, a Mixed or an All Private Model are conceivable. • This output also includes an Excel toolkit for self-assessment of country situation and feasibility assessment regarding introduction/ implementation of IRPS. • Framework for Assessment of Country Situation as Regards IRPS. This result is mainly concerned with the feasibility of different types of IRPS under different transport environment characteristics (national contexts). This analytical framework was also designed in order to provide better knowledge on the conditions under which a common or an interoperable European concept(s) can be introduced. This detailed specification and methodologies for the analysis of country situation is of strong relevance road authorities since it can provide information on strategies and conditions for successful implementation of IRPS. • Impact Analysis of IRPS Methodology. This result consists in the design and test of a methodology for impact analysis supported by a (calibrated) network model that allows a sound understanding of the actual circumstances affecting the feasibility of possible IRPS designs as well as possible patterns in their evolution. The basic assumption is that the effect of IRPS should be in compliance with the set of policy goals and political agreements made in the past. Through the running of the referred network-based transport model the bulk of impacts has been identified, which has allowed to analyse in a systematic way how such indirect impacts are dynamically passed through regional economies and may 			

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Key findings / Policy implications / Project website or contact			
<p>eventually impact on both macroeconomics performance and long-term environmental sustainability.</p> <ul style="list-style-type: none"> • Best Functional IRPS. This result consists in the identification of the most appropriate IRPS for the European situation, which has major importance in the context of the goals of the Common Transport Policy, particularly in what concerns the necessity to guarantee interoperability of electronic road pricing schemes. Of particular relevance is the exploration of implementation (transition) paths that can serve the purpose of identifying IRPS options that support the aim of future European interoperability and implementation of increasingly 'sophisticate' pricing policies. <p><u>Policy implications</u></p> <ul style="list-style-type: none"> • There is a considerable diversity of objectives and framework conditions surrounding the introduction of road tolls. Part of those objectives and conditions are dynamic, but others are rather stable, so there is and there will be for a long time legitimate reason for diversity of tolling strategies by national governments. • Prices are just one of the types of instruments in support of transport policy (the main others being supply [infrastructure and technology] and regulation [technical and economical]). In search for an optimal intervention on the transport system, governments should remember the availability of these three types of instruments. • Just like companies in a market try to recur to different combinations of production factors to find their spaces of competitiveness, so do national governments recur to different combinations of those instruments to find situations where their transport systems may promote the competitiveness of their economies. This search has to be done in respect of some basic rules of the European Union, like the principle of territoriality and the promotion of the Internal Single Market and reduction of barriers to trade, of which free access to markets and a strong harmonisation of technical regulations are necessary supporting elements. • Identity of transport prices would make sense if countries were facing identical situations of density and sophistication of supply of transport infrastructure and services, and of density of demand, i.e. ultimately of identical situations of population density and purchasing power, which clearly is not the case in Europe. • It is recommended that ownership of transport infrastructure stays in public hands, as well as the decision to build it and to what standards; the State should ensure independent audit of the processes of revenue collection and application, as well as of the processes of handling customer complaints. • There are technological solutions available to allow comfortable and transparent application of EFC in the various tolling schemes studied. The choice of the most adequate technology depends not only on the basic form of tolling (NET vs. DAREA) but also: <ul style="list-style-type: none"> • for a NET scheme on whether tolling has been considered in the design of the motorways or not (retrofitting), • for a DAREA scheme, on the main objectives underlying the introduction of the tolls, and with them the need for variability of tariffs (i.e. time modulation of the tariff or higher tariff levels in more sensitive areas), • for any scheme, on the desired other functions to be developed on top of the tolling technology, • for any scheme, on the transaction costs and enforcement difficulties associated with the various technologies; • The project has included an analysis, not only about the circumstances in which tolls should be introduced, but also in which an existing tolling regime should be changed. In both cases, the analysis includes recommendations on how to manage those changes. • There are possible important contributions from the EU in the short and medium term: <ul style="list-style-type: none"> • to impose open specifications for on-board units (OBU) in all countries, • to encourage convergence of standards in the GPS/GSM platform (as done for the DSRC platform), • to encourage convergence of vehicle classification. 			

Theme: Economic Aspects			Last update: 10 August 2006	
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Key findings / Policy implications / Project website or contact				
<u>Project website (or contact)</u>				
None				
FORESIGHT for TRANSPORT	A Foresight exercise to help forward thinking in transport and sectoral policy integration	EU	Policies and conditions for sustainable mobility	
<u>Key findings</u>				
<p>The EU enlargement will impact on the volumes of traffic, the transport market and the organisation of the transport sector as well as infrastructure development. The impacts will however differ considerably depending on the institutional and socio-economic basis of the enlargement and alignment process. The strongest positive effects in terms of liberalisation, the harmonisation of prices and taxation as well as logistics, railway reform and TEN-T infrastructures can be expected under a scenario of rapid institutional and policy integration supported by high economic growth. Economic sluggishness and/or setbacks with regard to institutional reform following the variable geometry or core/periphery rationale would diminish these positive impacts or slow down their trajectory. The environmental impacts of transport will be reduced only if sustainable environmental policies are adopted, also within the transport sector, and if people change their behavioural / lifestyle patterns. The FORESIGHT for TRANSPORT study has provided the method and elements for a continuation of the strategic dialogue on transport and mobility and this should be counted as among one of its achievements.</p>				
<u>Policy implications</u>				
<p>Important non-transport intermediate variables influencing mobility and the transport system are household arrangements and, in this connection, family policy, settlement / location patterns and, related to this, housing construction patterns as well as migration trends and policies. The transport impact pathways examined by the FORESIGHT for TRANSPORT study have furthermore shown that besides policy several positive changes will depend on the economic and business sector - in conjunction but also independently from developments at the policy level. Significant areas of intervention in this respect are:</p> <ul style="list-style-type: none"> • Firm organisation / management strategies with regard to teleworking and transport plans. • The strategies of railway companies concerning passengers. This is clearly relevant for urban public transport and commuting travel but also for medium- and long-distance leisure and tourism trips • The strategic development of the car industry, especially concerning greener and/or smaller cars. • The organisation and diffusion of car-sharing schemes in cities. 				
<u>Project website</u>				
www.iccr-international.org/foresight/				
IASON	Integrated assessment of spatial economic and network effects of transport investments and policies	EU	Socio-economic impacts of transport investment and policies	
<u>Key findings</u>				
<p>With regard to overall economic impact of transport projects and policies, it can be said that socio-economic macro trends have a much stronger impact on regional development than transport policies. If one considers that under normal economic circumstances the long-term growth of regional economies is in the range between two and three percent per year, and additional regional economic growth or less than one or two percent as is observed in Western Europe over twenty years can be considered small. With respect to indirect effects per se, there is no evidence that transport infrastructure investment is</p>				

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uniquely or exceptionally highly productive. The additional benefit to the economy which is supplementary to the benefits in the transport system is an order of magnitude lower than the travel cost improvements. For specific regions, however, benefits to the economy can be of the same order of magnitude as the monetized accessibility improvements. Performing a high quality but conventional transport CBA, therefore, in some instances will only give a limited account of the full benefits for these regions. Concerning the effects of specific policies, Social Marginal Cost (SMC) based pricing, relative to the base, has an effect which can be considered large. It replaces an inefficient tax by an efficient charge, and thus creates new efficiencies within the economy. Speeding up the TEN-T programme has an effect on GDP which is relatively small. The test with the different models indicate that the TENs have relatively strong distributive effects to the economy, affecting in particular the East-West growth balance and stimulating the rate of cohesion. High-speed rail projects seem to be more effective in terms of promoting regional economic activity than conventional rail projects, and rail projects seem to be more effective than road projects. All transport pricing scenarios have negative economic effects but these can be mitigated by their combination with network scenarios with positive economic effects, although the net effect depends on the magnitude of the two components. The network scenarios in general reduce disparities in accessibility, but reduce disparities in GDP per capita only if also the TINA projects are implemented. Pricing policies are not favourable for the poorer regions. CGEurope shows a characteristic spatial pattern of pricing scenarios, i.e. disfavouring the peripheral regions. Also, network effects of transport initiatives tend to be additive, i.e. little evidence was found with respect to sub- or superadditivity of transport projects. Concerning the linkage between accessibility and economic growth, it was found that the increases in regional accessibility from TENs policy translate into relatively small increases in regional economic activity. For regions in the European core with all the benefits of a central geographical location plus and already highly developed transport and telecommunications infrastructure, additional gains in accessibility through even larger airports or even more motorways or high-speed rail lines may bring only little additional incentives for economic growth. For regions at the European periphery or in the accession countries, however, which suffer from the remote geographical location plus an underdeveloped transport infrastructure, a gain in accessibility through a new motorway or rail line may bring significant progress in economic development. But, to make things even more complex, also the opposite may happen if the new connection opens a formerly isolated region to the competition of more efficient or cheaper suppliers in other regions. The linkage of a transport model with a regional economic or macro economic model combines the benefits of a transport model, which has a detailed underlying network, with the benefits of a model, which measures the economic effect of changes in transport patterns to economic sectors and captures the effects of various investment strategies.

Key findings

The state of the art of appraisal of transport projects and policies is developing rapidly. However, the TEN-T projects and in particular the opening of Europe to the East poses formidable challenges for transport appraisal. Better transport infrastructure will link together places with quite different labour markets, standards of living and access to goods and services. In such conditions the general conclusions are:

- For major projects and policies, a good quality transport sector cost-benefit analysis is vital. This requires adequate data and modelling of the transport networks to generate the inputs to the analysis. A wider economy model linked to a transportation model does offer a way forward in modelling the total effect, including the economic network effects. The outputs of such models include forecast changes in GDP, employment by region and consumer surplus. Conceptually such models generate the total economy-wide benefit of a project or policy.
- An appraisal that is consistent in its treatment of effects from both national and supranational perspective is capable of dealing with cross-border effects. The choice of scale and models is important to highlight these effects.
- The relationship between the total benefit and the benefit measured in a transport-only cost-benefit

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<p>analysis is understood in principle, but the size of the difference between them in practical cases is as yet poorly understood. Markets which are notoriously imperfect, such as land and labour have not yet been fully incorporated into the wider economy models used within IASON.</p> <ul style="list-style-type: none"> From the perspective of the policy makers, the spatial pattern of gains and losses is important, and spatial economic models can help to identify these. Therefore a consistent approach of transport cost-benefit analysis plus spatial economic modelling may be an attractive combination providing insight into the absolute value, or social rate of return on investment and the spatial and social distribution of winners and losers. <p>The project has made available a new set of interconnected instruments that now can be used to assess the spatial and economic consequences of transport policies. Besides producing broad pictures of the overall economic impact for the EU, the function of the models is in particular to point the attention of policy makers to those regions, sectors or policy packages where the indirect impacts of infrastructure and pricing policies are above average. While the wider economic impacts can be substantial as transport impacts propagate over time through the economy, these are not necessarily always welfare effects that are additional to the transport impacts. When they are, they can be of significant magnitude, and these cases cannot be uncovered by models like CGEurope and E3ME, when linked to the appropriate transport modelling tools.</p> <p><u>Project website</u> www.wt.tno.nl/iason</p>			
IMPRINT EUROPE	Implementing pricing reform in transport effective use of research on pricing in Europe	EU	Costs in relation to pricing for infrastructure use
<p><u>Key findings</u></p> <p>The key areas in which the Imprint-Europe thematic network reached conclusions are:</p> <ul style="list-style-type: none"> Measurement of marginal social cost: <ul style="list-style-type: none"> most countries have some information suitable for setting more efficient charges, though the disagreements and uncertainties identified above serve as a barrier to estimation of charges according to a common basis, a likely way forward is to seek consensus on a lower limit of costs that should be reflected in price, raising this as evidence becomes stronger and more accepted. Acceptability and phasing of pricing reform: <ul style="list-style-type: none"> acceptability tends to be higher where problems are particularly acute and demonstrable, where there is an identified package of complementary measures and where revenue use is transparent and/or earmarked, making simple and modest reforms first, progressing towards more sophisticated charging systems, can address concerns about reform, each new phase of reform should generally move prices in the right direction in terms of the ultimate goal, even if short term considerations might dictate otherwise, Drawing on experience and research, ten steps to implementation have been identified to serve as a guideline for policy-makers. Key Issues for Newly Associated States <ul style="list-style-type: none"> there is a strong link with financing: financing needs are more acute, and other sources of finance more limited, so pricing is seen very much as a way of financing investment, issues concern transit traffic and peripherality; there is a risk that NAS countries incur substantial costs to improve infrastructure for transit traffic but cannot recover this in price because of low congestion. 			

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<p><u>Policy implications</u></p> <p>A start has been made in some sectors: for instance the Rail Directive contained a sensible pragmatic approach to marginal social cost based pricing, and the proposed revised Eurovignette Directive was a step in the right direction, although still containing many constraints which would prevent fair and efficient pricing of road freight vehicles.</p> <p>However much disappointment was expressed that the proposed framework directive and common methodology paper for all modes seems to have been abandoned. It is felt that such a directive would be an important step forward as it would provide a clear objective towards which pricing reform should be concentrated on all modes, and encourage transparency in the setting of prices. In its absence areas where reform is most needed were identified as:</p> <ul style="list-style-type: none"> • Congested urban areas; • trans-European road and rail corridors; • aviation; and • ports. <p>Processes and institutions need research – what bodies should set or regulate prices and be responsible for allocating the revenue? How do prices feed through to and impact upon end-users? Institutional issues are particularly complex in the aviation and maritime sectors.</p> <p><u>Project website</u></p> <p>www.imprint-eu.org</p>			
MARETOPE	Managing and Assessing Regulatory Evolution in local public Transport Operations in Europe	EU	Market structures
<p><u>Key findings</u></p> <p>MARETOPE aimed to investigate in an integrated way, the impacts of change on the roles and activities of the different stakeholders: public transport operators, public authorities, users and producers of transport means and systems. The project has produced: - Reference framework and harmonisation of concepts - Updates of views on the current legal, organisational and financial frameworks of local public transport systems - Analytical framework for the assessment of barriers, impacts and tool changes - Synthesis of empirical experiences - Assessment of barriers and impacts to change - Tools to assist key players in the process of change - Recommendations for the management and assessment of regulatory evolution in local public transport operations in Europe - 'Real world' feedback</p> <p><u>Policy implications</u></p> <p>A major downfall of the research was that there were a limited number of cases in which a sufficient time lag had passed after the implementation of reform that could allow measurement of the full extent of impacts. The research highlights that the main driving forces of change for most European countries and cities were of financial nature (cost coverage and subsidies) and were also concerned with more transparent, effective and better quality urban public transport services. Recommendations from the research refer to a set of improvements that authorities and operators should undertake in order to create the basic data that will enable the assessment of their performance.</p> <p><u>Project contact</u></p> <p>global@tis.pt</p>			

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MC-ICAM	Implementation of marginal cost pricing in transport – Integrated conceptual and applied model analysis	EU	Costs in relation to pricing for infrastructure use
<p><u>Key findings</u></p> <p>The MC-ICAM studies on barriers and constraints and the modelling case studies produced a great number of results and insights relevant for designing how the implementation should progress in the key dimensions of the pricing system.</p> <ul style="list-style-type: none"> • Sensible phasing and packaging of simple pricing measures with limited scope, relatively low charges and minimal differentiation can lead to substantial benefits already in early phases. Waiting for the ideal solution to be possible is no good excuse for not acting: the best strategy from the welfare viewpoint would be to start implementing with what is feasible now. • A careful choice for the initial steps of implementation is extremely important for building up acceptability for more comprehensive and sophisticated developments later on. This works both through demonstrating the benefits and increasing confidence. • Scope of the pricing system. It is best to start with pricing measures or schemes that have a limited scope but which focus on areas and aspects/issues where problems are most acute. In road transport such simple schemes can be e.g. cordon tolls or km charge for HGVs with limited scope and minimal degree of differentiation. One can move to the more comprehensive schemes only in the medium and long run as confidence and acceptability builds up. • Level of charges. Increases in charges need to be gradual; It is often stressed that it is important that each new step improves overall social welfare and is not perceived as moving backwards. A particular problem here from the viewpoint of implementation is to protect implementation paths from erosion that may occur when new elections take place during the execution of the path. • Composition of charges. Appropriate packages of measures within and across modes are important for both efficiency (welfare) and acceptability. In an intermodal context this may mean e.g. environmental charges on all modes at once. • Degree of differentiation. The urban case studies showed considerable social benefits from differentiation of prices over time (peak and off-peak). The interurban case studies showed that geographic differentiation is likely to have remarkable social benefits and significant impacts on modal shares. But the studies also showed that differentiation is likely to benefit those (here road freight) who are the object of pricing. • Use of revenue is crucial. The best use of revenue from the welfare perspective would be to reduce other distorting taxes, such as taxes on labour. However, the problem is that these tax reductions would be widely spread and would not be perceived as a benefit of the pricing reform. It may be necessary – in the beginning at least – to accept a less than optimal use of revenue in order to provide clear benefits to the losers and to buy off their opposition. <p><u>Policy implications</u></p> <p>Urban In urban transport, where problems are acute and benefits of implementation clear, it is likely to be possible to move straight to higher prices and more complicated schemes than when this is not the case. Thus we would expect to see the biggest most congested cities moving straight to fairly high charges and quickly to reasonably sophisticated schemes. Smaller cities with less acute problems may never progress beyond simple low cordon tolls.</p> <p>Interurban roads Many countries are reluctant to impose motorway tolls themselves because of possible diversion to other roads, and thus need a more sophisticated system of charging heavy goods vehicles. If they do move to a</p>			

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<p>GPS based system, the technology is then in place both for added sophistication of HGV charging (by time and place) and the extension of charging to all vehicles. Where the geography of the country involves large cities at relatively large distances (Spain, France) a continued reliance on motorway tolls may be more adequate.</p> <p>Rail, air, water</p> <p>In the rail, air and water sectors, the stronger competition and the more acute capacity problems the more sophisticated a system is likely to be both justified and acceptable.</p> <p><u>Project website</u> www.mcicam.net</p>			
PROPOLIS	Planning and research of policies for land use and transport for increasing urban sustainability	EU	Policies and conditions for sustainable mobility
<p><u>Key findings</u></p> <p>The PROPOLIS project has shown that it is possible to use urban land use and transport models as a platform for producing urban environmental, social and economic sustainability indicators that can be used in assessing policy options. The social index deteriorates, except in Helsinki, Naples and Brussels, where the current old polluting car fleet is expected to improve, thus improving the health indicators. However, equity and accessibility indicators deteriorate in all cities. Regulating car speed policies had positive effects on traffic accidents, as intended, but they were not enough to compensate the effects of the worsening opportunity, accessibility and air pollution related indicators. Also the tested public transport policies, increasing speed and service and reducing fares, worked well. In most cases they were environmentally, socially and economically feasible. The combination of public transport policies with car pricing policies produced cumulative positive results and the negative land use effects of the individual policies could be avoided or mitigated. Adopting the above line of actions leads, in the case cities, to a 15-20% reduction in CO₂ emissions, 8-17% reduction in traffic accidents and often to at least small reductions in exposure to noise and pollutants and the total time spent in traffic. Also accessibility to the city centre and services is improved. The socio-economic benefits vary but are typically 1000-3000 euro/inhabitant (net present value). It is important to note that the optimum level of the pricing actions is "city specific" and that the optimum levels should be locally defined taking into account the cumulative effects of the individual actions. Bigger, more congested cities seem to need more radical actions than smaller cities.</p> <p><u>Policy implications</u></p> <p>Urban sustainability could be improved only with the coordinated intervention of both local and national decision-making levels. The good results obtained by the combination policies emphasises the need of a close cooperation between the different levels of authorities, as local authorities cannot implement all the policy measures. A good urban policy consists of co-ordinated elements that work together to produce cumulative long-term effects that attain a balanced set of environmental, social and economic goals. These elements may include: -combination of pricing policies directed at car users, with differentiation between peak and other hours as well as congested and non-congested areas, with an appropriate level of pricing of public transport fares; -investment programmes supporting the demand changes caused by the above policies and especially responding to the increased requirements for better public transport speed and service.</p> <p><u>Project website</u> www.mcicam.net</p>			

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PROTRANS	Role of third party logistics service providers and their impact on transport	EU	Drivers of demand for freight and passenger transport
<p><u>Key findings</u></p> <ul style="list-style-type: none"> • Operating costs of 172 European logistics providers; • importance of integral strategic logistics vision with both public and private partners involved; • importance of 3PLPs in developing economy and competitiveness; • economies of scale of 3PLPs are the most important factor for transport efficiency/ effectiveness and are required to reduce prices; • analysis of the shippers' and 3PLPs' opinions and estimation of value (in monetary units) of the improvements 3PLPs could bring to intermodal transport (IMT); • insight on the market share of IMT that may be reached when the characteristics of the services offered are modified through variations of door-to-door transport price/transit time; • 3PL improve the efficiency of IMT by reducing transport cost and kilometres, and increasing load factor; • identification of opportunities and barriers that occur for 3PLPs, i.e. services presenting the highest equivalent monetary value, which could be offered by 3PLPs. Opportunities arise as shippers are turning to outsourcing strategies and regulations are applied on taxation, environment, and labour issues fostering the use of IMT. IMT growth depends on the improvement of action variables of IMT (transit time, transfer price or reliability); • evaluation of concrete scenarios by which 3PLPs could influence IMT efficiency; • estimation of the impact of 3PLPs' pro-active behaviours on the market share of IMT; • 3PLPs have greater influence in increasing the road-rail share for fast moving high valued goods than for slow moving low valued goods. <p><u>Policy implications</u></p> <p>The benchmark is an assessment tool that can be used by regional, national or EU policy makers to develop logistics, but also by shippers and 3PLPs to gain insight in the regional variances, strengths and weaknesses, which is of great value for decisions on location choice and network development.</p> <ul style="list-style-type: none"> • For more efficient logistics, further outsourcing and improvement of IMT is required; • regulatory measures on transport, taxation and environment increase the use of IMT; • tariff integration of IMT services to a single ticket provided by a single point of contact is required. • policymakers should align infrastructure plans at all levels, in order to provide efficient transport connections and stimulate integrated logistics strategies in regions, in which public and private partners participate for the development of an integral strategic logistics vision of a region. • policymakers should develop an integrated railway infrastructure pricing policy across EU Member States, which might rise the contributions of other modes towards sustainable development and help 3PLPs choose the most suitable transport mode on a more representative economic basis; • future roles for 3PLPs are to act as Pan-European integrators and liability guarantors ('Freight Integrator' initiative as outlined in the White Paper); and • 3PLPs can implement IMT related strategies fostering the use of road-rail. <p>Based on PROTRANS European policymakers need to act towards:</p> <ul style="list-style-type: none"> • Logistic centres for (de)consolidation nearby or in conjunction with a rail terminal; • access to rail capacity; • development of IMT units; • marketing IMT; and • revenue sharing between operators according to reliability. 			

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<u>Project website</u> www.logistik.tu-berlin.de/sulogtra+protrans/protrans/			
RECORDIT	Real Cost Reduction of Door-to-door Intermodal Transport	EU	Costs in relation to pricing for infrastructure use
<u>Key findings</u> <p>With information about the private (internal) and social (external plus internal) costs of intermodal transport and its competitor - road freight transport, it was possible to identify how and why this gap varies in different parts of the European transport network. The final results of the project inform the debate on "fair and efficient pricing", and show the necessary charges (taxation) that are required for road and rail transport in different countries in order to meet those twin objectives of efficiency and fairness.</p>			
<u>Project website</u> www.recordit.org			
SPECTRUM	Study of policies regarding economic instruments complementing transport regulation and the undertaking of physical measures	EU	Policies and conditions for sustainable mobility
<u>Key findings</u> <p>The results from the multimodal case studies indicated that instruments linked to internalisation of externalities had significant effects on welfare. This was confirmed in the context of the European Scale Assessment, where the scenario involving introduction of SMCP pricing had the highest positive welfare changes.</p> <p>The uni-modal case studies highlighted the importance of the social costs associated with externalities and the appropriateness to internalise them through economic instruments was pointed out in all case studies. For the mode specific case studies the following key conclusions can be put forward.</p> <ul style="list-style-type: none"> • In the airport case study, the instruments under scrutiny demonstrated the close inter-relationship and very frequently they were found to be implemented as packages. In addition, economic instruments appeared to be very relevant, representing a valid (sometimes optimal) capacity allocation mechanism and a market based way to internalise problematic externalities at airports. Specifically, the air case study demonstrated the relevance of introducing specific noise charges to address noise problems. • The rail case study determined that operators should be charged for the capacity they use in accordance with the social opportunity cost of that capacity. Simulation exercises (PRAISE) established that if auctioning could be arranged with appropriate subsidies in place, it would give the best outcome in terms of social welfare. <p>Looking across the urban case studies, some of the best performing packages involved distance charging and fuel tax, however in terms of implementation there are questions on the public acceptability of such measures, especially with short term implementation. Cordon charging was also a high performing measure in some cases (but not in other case studies) and the interpretation on this finding needs some care. Other key conclusions are:</p> <ul style="list-style-type: none"> • In some cases, an instrument combination generated disbenefits when assessed in a short term time horizon in a road sector case study, but generated positive benefits when assessed over a long term time horizon (such as 30 years) in a multimodal case study. • Synergy was found with respect to two combinations: cordon pricing and traffic signal optimization (in York); and distance-based road pricing and bus lanes (in Leeds). • In the urban context, economic instruments performed best overall when implemented in packages 			

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with other instruments – particularly those that involved improvements to public transport. Urban instruments performing less well overall included economic instruments implemented in isolation. In the interurban case, marginal cost pricing measures performing strongly.

- The key to a successful move towards a greater use of economic instruments would seem to lie in a package of measures where the costs are spread in such a way that the barriers on feasibility are low across the board and there is not a strong adverse impact on any single indicator.
- A final issue may be the maturity of the transport system. A system that is already mature (in the sense of levels of saturation, current instruments in use, levels of future demand and other factors) may have much to gain from a step change in management approach and be less resistant in terms of barriers.
- Overall it should be considered that policy instruments that provide efficiency gains without costs to a particular stakeholder or group are rare and possibly non-existent. For example changes in public transport fares would be at the cost of the operator, which may be unacceptable for privately operated public transport systems.

Policy implications

- Political acceptability of some measures is a concern which may outweigh the benefits in terms of efficiency; moreover the perception of what is acceptable seemed to vary according to the nationality of the respondent.
- In the urban context, there was strong support for including various public transport measures regardless of efficiency or other performance.
- The administrative issues in implementing packages that included measures implemented at local level e.g. public transport and those generally implemented at national level (e.g. fuel taxes) were raised. Further administrative issues were raised in the interurban context with respect to the setting of rail fares and frequency.
- Fuel taxes were seen by some stakeholders to have particular negative equity implications.

Project website

www.its.leeds.ac.uk/projects/spectrum/

SPRITE	Separating the intensity of transport from economic growth	EU	Policies and conditions for sustainable mobility
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Key findings

Seven illustrative measures stand out from the results as having proven potential (albeit not necessarily at a European scale) to influence transport intensity and/or unit environmental load whilst not having large detrimental effects on GDP. These are (in no particular order):

- Combined measures to change mobility-related attitudes and traffic behaviour;
- car sharing as part of combined mobility;
- controlled parking zones;
- urban road pricing;
- hydrogen fuel cell vehicles;
- high speed rail; and
- road pricing for freight traffic.

These are the areas where we believe the EU could currently most usefully focus its efforts in terms of decoupling. We have provided an estimate (albeit based on case study information which is not always as complete as we would like) of the scale of possible changes which might be realised given the implementation of a particular measure. The EU needs to consider whether the measures suggested here are ones which could successfully be implemented as part of a policy to influence decoupling and whether there are issues of acceptability. Clearly it will be easier to implement measures such as green transport plans

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<p>which are based around encouragement of people to change their behaviour, compared to measures which will force a change in behaviour through pricing or other means of control. Of course, ease of implementation does not imply effectiveness. It is noticeable that many of the most promising measures in terms of their decoupling potential are likely to be the most difficult to implement as a result of high public discontent and resultant political wavering. It is worth noting that some of the measures considered which are not in the most promising list, for example tradable permits, appear to have potential to influence transport use, but there is a distinct lack of research to back this up. Such measures certainly have the potential to change the costs of driving and to influence vehicle kilometres. The individual measures identified by the SPRITE consortium are illustrative measures, that is they are examples of different kinds of measures, but in most cases are by no means the only example of each type. Each individual measure has some potential for reducing transport intensity, even in isolation. However, for their full impact to be recognised, they have to be incorporated into strategies of measures, which are both mutually supporting in the field for which they were designed and have beneficial, rather than adverse knock-on effects in the wider world. There is a clear message which comes out of all of the aspects of the SPRITE project (review, questionnaires and panel sessions) that no one measure alone will make a significant difference, rather there is a need for an integrated approach. It is naturally more difficult to predict what the gross effects of different packages of measures may be and it is essential to consider the behavioural response to measures and packages of measures when planning their implementation. It is important to recognise that some measures may need to be formed into packages to be fully effective, for example pricing may need to be supported by enhanced provision of alternatives in order to have the desired effect on mode choice, emissions and sustainability. Clearly there is potentially some additive benefit to be gained from packages of complementary measures or measures which affect different aspects of the transport system. Thus, a combination of pricing measures and measures to improve high speed rail systems is likely to have a greater impact than either one measure alone. Also the addition of Green Transport Plans (although of limited benefit alone) or other measures designed to influence attitudes, may be expected to further enhance the decoupling impact.</p> <p><u>Policy implications</u></p> <p>The seven areas listed above are the areas where we believe the EU could currently most usefully focus its efforts in terms of decoupling. We have provided an estimate (albeit based on case study information which is not always as complete as we would like) of the scale of possible changes which might be realised given the implementation of a particular measure. The EU needs to consider whether the measures suggested here are ones which could successfully be implemented as part of a policy to influence decoupling and whether there are issues of acceptability. Clearly it will be easier to implement measures such as green transport plans which are based around encouragement of people to change their behaviour, compared to measures which will force a change in behaviour through pricing or other means of control. Of course, ease of implementation does not imply effectiveness. It is noticeable that many of the most promising measures in terms of their decoupling potential are likely to be the most difficult to implement as a result of high public discontent and resultant political wavering.</p> <p><u>Project website</u></p> <p>www.its.leeds.ac.uk/projects/sprite/</p>			

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SULOGTRA	Effects on transport of trends in logistics and supply chain management	EU	Drivers of demand for freight and passenger transport	
<p><u>Key findings</u></p> <p>The project investigated the process of value creation in supply chains and the relationship between logistical activities and economic development by establishing categories of social, technological, economic, environmental and political drivers reshaping the logistics system. The economical drivers were mainly: changes in GDP, interest rates, intra and extra European trade levels, globalisation of industry/ services, shift from industrial to service sector, proliferation of product types, and outsourcing of non-core activities. The SCM tend to support the increase in the road share; however there is a decrease in road share in primary, international/ long haul movements, where the rail and water transport share is increased, providing faster and more economical transport. Air share is influenced in a positive way, since the sectors to which it is applicable can afford the high transport cost implied by the use of air transport. There is a tendency to develop hub and spoke intermodal systems. For international movements of products like petrol, more economical modes of transport are used, i.e. rail or ship.</p> <p>The project defined the supply chain optimisation from a public and a private perspective, to examine the conflicts that arise and find a way to reconcile them. The objectives of the private entities mainly relate to short-term or long-term financial success, while the interests of the public bodies include environmental, economic and social factors. Therefore public and private goals of supply chain optimisation vary widely; best-practices are often oriented toward large multinational companies and may be economically inefficient for medium or small firms.</p> <p>The analysis of Value Creation in Supply Chains focused on the process of internal value creation in supply chains and its external effects on local and regional economies. It investigated the process of value creation in supply chains and the relationship between logistical activities and economic development. The assessment of macro-economic impacts was performed based on the Strategic Model for Integrated Logistics and Evaluation (SMILE) model. For each of the 4 sectors, the economic state of the art has been assessed and 3 scenarios have been run: transport costs remain at the same level up to 2005; increase by 12%; and increase by 24%. It can be concluded that the impact of the increasing transport costs, on production value, value added and employment is relatively low. The largest slowdown of the growth of a sector (compared to the base case) is visible in the chemicals sector and the smallest effect of transport cost increases is visible in the building materials sector. A 24% increase in transport costs results in a 1.2% - 2.4% decrease of the growth of production value and value added.</p> <p>The data analysis and the benchmarking in the case studies achieved an overview of the state-of-the-art in SCM in the selected sectors with a macroeconomic perspective and allowed companies to compare or benchmark their performance and degree of development in their activities with partners in their supply chains against sectoral values. The database gives users the opportunity to compare their supply chain performance to others within their industrial sector or even across the whole of the industry.</p> <p><u>Policy implications</u></p> <p>SULOGTRA focused on the effectiveness of political measures and identified factors that influence logistics. It has identified key drivers of the most recent logistics trends, has characterised them and evaluated their impact in freight transport. Furthermore, it presented concrete measures aiming at curbing the growth of road freight transport and achieving medium and long-term EU policy objectives in transport, environment, infrastructure-related and social and economical areas. The analysis and assessment of EU policies has been conducted along 5 policy issues with direct bearing on SCM development: transport, environment, infrastructure, social/economic policy and enterprise policy. In terms of the social/economical orientations, the promotion of competition and the support of regional development policies can have both positive and negative effects, depending on the existence of competitive advantages in a region (industrial,</p>				

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<p>geographical, accessibilities, etc). A set of issues which have captured the attention of policy makers and are likely to offer new developments impinging on SCM trends are harmonisation of fuel taxation, internalisation of external costs, pricing and charging, improvement of quality and safety in road sector. One of the main concerns of the Commission is related to the acceptability and effectiveness of political and economic measures to be implemented. 3 groups of policy measures can be distinguished:</p> <ul style="list-style-type: none"> • External measures (measures that impact the management of the supply chain and, indirectly, freight transport), • taxes and charges, • measures aimed at the transport sector, i.e. transport systems (vehicles, fuels), transport technologies and transport infrastructure. • Macroeconomic policy (liberalisation/ deregulation) can be classified among others as an external one. <p><u>Project website</u> www.logistik.tu-berlin.de/sulogtra/</p>			
TRANSECON	Urban Transport and Socio-Economic Development	EU	Socio-economic impacts of transport investment and policies
<p><u>Key findings</u></p> <p>In general, the project hypothesis of expected third party effects of large scale infrastructure investments is confirmed as much as there is a clear:</p> <ul style="list-style-type: none"> • Stimulation of socio-economic development in areas of improved accessibility, • stimulation of re-urbanisation dependent on the potential development, • potential of decentralisation of housing (spatial diffusion) and centralisation of shopping. <p>It can be said that the methodological approach was successful, but there are some limitations of the interpretation as the data availability and data quality was limited.</p> <p><u>Efficiency of Transport Infrastructure Projects</u></p> <p>The efficiency of the investigated transport infrastructure projects shows great variance, revealing major differences in efficiency depending on the relevant public transport category (underground, suburban railway and tram). The following conclusions can be made in general:</p> <ul style="list-style-type: none"> • When decision of traffic policy are taken, greater priority should be given to the efficiency of investments. It is overriding importance that cost/benefit ratio is carefully weighted and that indirect effects are also considered. • As a general rule, investments in surface public transport with priority route are more efficient than investments in underground public transport. • Investment in light rail systems are more cost efficient than investments in conventional railways. • Improvements of existing rail routes, respectively the reuse of existing routes (for instance suburban railways) are more efficient than newly built routes. • Investments in bicycle traffic with inter-modal interfaces (e. g. bike and ride) are highly efficient. <p><u>Regional economic effect</u></p> <ul style="list-style-type: none"> • The direct multiplier effect of transport infrastructure investment costs (public transport and bicycle) for the regional gross domestic product is 2,2 on average (range 1,9 – 2,5), and for the regional income 1,4 on average (range 1,2 – 1,6). • The multiplier effect of total investment costs (including follow up investments) for the regional gross domestic product is up to 6 for public transport investments. • The additional employment effect of infrastructure investment per Mio. € is between 25-32 persons additionally employed per year. • The size of additional employment is not influenced by the different project types. <p>Changes within the Transport System</p>			

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<p>Factors of success in increasing the demand towards the new project as much as possible are firstly to introduce accompanying measures for public transport infrastructure investments, e.g.:</p> <ul style="list-style-type: none"> • Park-and-ride; • bike-and-ride; • information & marketing; and • integrated fare-, ticket-, service-, timetable-, network system etc. <p>Secondly to support the public transport infrastructure investment by restrictive car-policy measures, e.g.:</p> <ul style="list-style-type: none"> • Parking fees; • reduction of lane capacity and parking facilities; • access restrictions; and • road or congestion pricing. <p>Urban Regeneration Large scale transport infrastructure investments can stimulate re-urbanisation developments. Preconditions for use of potential re-urbanisation development are local economic situation: demand for new space in offices, housing, etc.</p> <p>Economic and Spatial development Public transport investment can cause substantial changes of land use patterns (spatial sprawl, re-urbanisation, commercial concentration, etc.) in the catchment area of the station whereas bicycle investments indicate support of residential land use in central areas. The improvement of public transport and car accessibility in outer regions of conurbation stimulates migration from the city centre in the outer city regions (if land is available). The improvement of public transport accessibility in built up areas within a conurbation can stimulate follow up investments in the catchment area of stations. Investment by local commerce and industry are increasing the land prices and support the outward migration of residents. The strength of the socio-economic development caused by public transport infrastructure investment is dependent on the local economic framework and competition of other potential development sites.</p> <p><u>Policy implications</u></p> <p>In order to maximise the social-economic benefit of a large scale infrastructure investment, factors of success are:</p> <ul style="list-style-type: none"> • Existence of a competent regional authority, which has the vision and power for carrying forward the project (often a person with a strong personality – so-called “project champion”) is the driving force behind a successful project; • existence of a comprehensive transport policy, some times stimulated by a huge transport problem or clear and convincing transport objectives to follow; • existence of a consistent program of measures: promotion of environmental friendly modes, supporting intermodality (bike-and-ride, park-and-ride), car restrictions, parking management, capacity reduction, traffic calming, marketing, etc.; • intensive co-operation between transport authorities, city authorities, land-use authorities, developers, private businesses and developers; an appropriate organisational framework is supporting such co-operation; • co-operation with other transport operators (from the users' point of view public transport must be an integrated mobility service system), again an organisational framework can support such co-operation; • early and well organized consultation and participation with stakeholders: transport-users, motorists, local businesses, residents, institutional representatives, etc.; and • national and European funding may give long-term benefit in certain cases but should not be limited to a specific type of public transport mode. Funding should be dependent on the efficiency of an investment project. 			

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<u>Project website</u> www.transecon.org				
TRANS-TALK	Thematic network on policy and project evaluation methodologies	EU	Socio-economic impacts of transport investment and policies	
<u>Project contact</u> l.giorgi@iccr-international.org				
UNITE	Unification of accounts and marginal costs for transport efficiency	EU	Costs in relation to pricing for infrastructure use	
<u>Key findings</u> <p>The main conclusions about cost estimation methodologies have been:</p> <ul style="list-style-type: none"> • Congestion cost estimates have been produced for road, rail and air transport, but the latter two modes are little researched and more evidence is needed; • scarcity costs – the value of creating or taking up a path or slot in a capacity-constrained network – are even less well understood and remain a priority for future research; • a new methodology developed for accident costs which distinguishes between external and internal costs leads typically to lower estimates than previous studies; • the impact pathway approach for the measurement of environmental costs appears as the only reliable but transferability (except for the costs of global warming) appears limited. <p>A major result of the UNITE project is the development of the so-called pilot accounts for all transport modes in all EU countries, Switzerland, Estonia and Hungary:</p> <ul style="list-style-type: none"> • They show the social costs (the cost of infrastructure, accidents, environmental damages, delays and the costs of supplying transport services) and the revenues from taxes, charges and subsidies of transport for two analysis (1996, 1998) and 1 forecast year (2005); • for road, total revenues cover total infrastructure costs in all countries except for Hungary; • in more than half of the countries studied, the total revenues exceed the total costs of infrastructure, accidents and the costs of air pollution, global warming and noise; • the degree to which rail system costs are covered by revenue from passengers and freight differs substantially between the countries studied, from a maximum of 63% (Finland) to a minimum of 8% (Hungary); • it should not necessarily be concluded that rail transport is under priced relative to road as in terms of efficiency it is necessary to look at the marginal costs: the marginal cost case studies imply that marginal cost of rail transport is very much below the average cost, while the reverse holds for congested roads. <p>Results from the TRENEN partial equilibrium model have shown that:</p> <ul style="list-style-type: none"> • Maximum benefit would be obtained by marginal social cost pricing; the second best pricing policy is Ramsey pricing and average cost pricing is worst; • compared to the current situation, average cost pricing typically reduces taxes on road traffic and raises public transport fares. <p>Results from general equilibrium models for Belgium and Switzerland have shown that:</p> <ul style="list-style-type: none"> • The most efficient use of revenue is to reduce labour taxes, benefiting the better off; • average cost pricing makes all groups worse off; • marginal social cost pricing produces a small but negative indirect economic effect. 				

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<p><u>Policy implications</u></p> <p>The project concluded that:</p> <ul style="list-style-type: none"> • It is the use of case study and accounts data together which is likely to be the most practical means of generating marginal cost estimates which feed into pricing policy; • the creation and maintenance of a set of consistent social accounts for the transport sector is particularly valuable for monitoring the impacts of policy, including pricing policy; • consideration of how much revenue to raise within the transport sector needs examination of sources and uses of revenue elsewhere in the economy; • where budget constraints are needed, they should be implemented flexibly, with provision for cross subsidisation between modes, if they are to do least damage to economic efficiency. <p><u>Project website</u></p> <p>www.its.leeds.ac.uk/projects/unite/</p>			
–	Building damages due to road and rail transport in Switzerland: Update of external costs in 2000	CH	Socio-economic impacts of transport investment and policies
<p><u>Key findings</u></p> <ul style="list-style-type: none"> • Overall building damages due to air pollution amounts to 546 mill. CHF in the year 2000. Almost 50% of these total costs can be attributed to traffic (265 mill CHF per year) whereas the rest (281 mill CHF) can be attributed to other sources. • From the 265 mill CHF per year building damages that are related to transport, the biggest part of cost originates in the metropolitan areas and agglomerations. Overall, 125 mill CHF per year originate in urban areas, 110 mill CHF per year in the agglomerations and only 30 mill CHF per year in rural areas. • Differentiated according to transport means, 93% of the costs can be attributed to road transport (i.e. 246 mill CHF per year): 129 mill CHF per year to road passenger transport and 117 mill CHF per year to road freight transport. <p><u>Policy implications</u></p> <ul style="list-style-type: none"> • Particle emissions are today's most important cause, and they serve also as basis of the allocation to the different transport means. • The biggest part on damages caused by exposure to heavy traffic is allocated to road transport. Here also the future prospective improvements (through cleaner diesel fuel and diesel engines) will lower the resulting costs. But it will be more difficult to reduce the likewise relevant particles which are caused by mechanical processes such as abrasion and re-suspension. • Rail transport also is a contributor to these processes. <p><u>Project contact</u></p> <p>christoph.schreyer@infras.ch</p>			

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–	Costs imposed by heavy goods vehicles	UK	Socio-economic impacts of transport investment and policies
<p><u>Key findings</u></p> <p>This project looks into the track and environmental costs imposed by goods vehicles. The project objective was to inform the fundamental review of Vehicle Excise Duty for goods vehicles that was announced by the Chancellor in the 1998 budget and which was overseen by an Advisory Board. This project covers the following economic aspects sub themes:</p> <ul style="list-style-type: none"> • Transport planning and management tools, especially mathematical models for transport demand forecasting • European transport information systems. <p>The research was carried out in two parts producing:</p> <ul style="list-style-type: none"> • An Excel model of the HGV fleet was developed distinguishing between 33 different classes according to gross vehicle weight and axle configuration, and 16 different vintages (33 X 16 HGV combinations). • Track costs were allocated to four road types, whilst emissions covered NOx, PM10 and CO₂. • The model for each HGV combination can then calculate average annual track and environmental costs. • Phase 2 expanded the coverage of environmental costs to incorporate non-methane VOCs, CO, benzene, butadiene and sulphur dioxide. Monetary values applied to these emission rates identify health and non-health impacts. <p><u>Policy implications</u></p> <p>The model also takes into account estimates of noise associated with HGVs This project potentially contributes to reducing environmental impacts through operational and strategic measure including fiscal measures, pricing and incentives. The model examines pricing methodologies for the freight industry, which has implications for freight operators.</p> <p><u>Project contact</u></p> <p>neil.schofield@dft.gsi.gov.uk</p>			
–	Fair and efficient pricing	CH	Costs in relation to pricing for infrastructure use
<p><u>Key findings</u></p> <p>The external costs resulting from road traffic accidents and pollution, not covered by road taxes and other transport-related taxes, amount to a charge on our society of about CHF 10 billion per year, and this burden is likely to increase over time.</p> <p>‘Fair and Efficient Pricing’ is the title under which the authors suggest ways to establish the true costs, and to develop a new pricing system that is related to the originators of damaging effects. Action is most urgently required in respect of private road traffic: here, the authors suggest a restructure of the road tax system.</p> <p>In the long term (from about the year 2005), a tax based on distance travelled could be introduced which would be similar to the tax charged for heavy goods vehicles. A charge of CHF 0.05 per kilometre would cover today’s known external costs, and a supplementary charge could be made in urban areas. In return, the fuel tax could be restructured as a CO₂ tax, and reduced.</p> <p>Rail transport would also have to improve the level of its external cost coverage. Environmental damage could be reduced, through implementation of this pricing reform. For example, CO₂ emissions could be reduced by 5 to 10 per cent, and other hazardous substances reduced by about 15 per cent.</p> <p>However, in some areas (e.g. emission technology, noise pollution, etc.) regulations, as well as technical</p>			

Theme: Economic Aspects		Last update: 10 August 2006	
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Acronym	Project title (in English)	Origin	Research sub-theme
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Key findings / Policy implications / Project website or contact

and voluntary action, would still be required in order to comply with the legal requirements for the protection of the environment, and international agreements concerning the global climate.

Policy implications

The main aspect here is the implementation of a new pricing strategy for road passenger transport (private and public). Transition from the current rather undifferentiated taxation system to a medium to long-term strategy of differentiated road pricing is much more difficult than for road freight transport or rail transport. Implementation involves various problems such as fixing price levels, technical and legal questions, federal and institutional aspects, and last but not least: public acceptance above all of the data protection aspect.

The following eight steps form a basis for implementing these proposals in Switzerland. Most important here are the transitional aspects in road passenger transport, based on existing pricing principles, until an appropriate and cost-effective road pricing technique has been developed:

- Rail reform and rail infrastructure mandate;
- introduction of capacity-related trucking fees (HGV km-tax)
- private road traffic measures: CO₂ tax; parking charges or zonal road pricing in urban areas;
- charges levied on insurance companies;
- introduction of km-related fee, new financing funds, earmarked fuel charges abolished;
- introduction of km-tax for light duty vehicles and busses;
- km-charges converted to road pricing; and
- fee differentiation monitoring instruments: comprehensive cost charging Switzerland has a comparatively good basis for cost estimation in the transportation sector.

For effective implementation of the proposed pricing strategy, however, additional elements are required taking account in particular of a comprehensive traffic system approach.

Priority here is given to comparable infrastructure accounting between road and rail, and a wider basis for environmental cost charging. In the end, marginal costs have to be determined for all areas. This particularly applies to infrastructure cost charging, which soon will be subject to considerable changes in the road transportation sector if the truck weight limit is increased (higher maintenance costs due to increased road deterioration).

Here again, the next step will be to include for air traffic as well.

Project contact

Markus.maibach@infrass.ch

–	Passenger rail services and economic performance	UK	Socio-economic impacts of transport investment and policies
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Key findings

This study has identified four broad areas of harm resulting from poor rail performance:

- Direct harm to business travellers and business - estimates from the desktop study suggest that business travellers incur approximately £1 billion of disutility per annum due to poor rail performance, which is equivalent to nearly £6.80 per single journey. Significant numbers of non-travellers (secondary impact) may also be adversely affected by delayed business travel, potentially raising the damage estimate.
- Indirect harm to business - evidence from the literature review suggests that employees' productivity is reduced by around 13-18% after undertaking an unreliable and congested journey. However, it is unclear how long this reduction in productivity lasts. The literature review also suggested that difficulty travelling to work reduced job satisfaction, potentially raising staff turnover, and increased absences due to illness.

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<ul style="list-style-type: none"> Harm to commuters - evidence from the literature review indicates that unreliable and congested travelling conditions can double the observed stress levels among travellers. The desktop study estimates that commuters incur approximately £500m of disutility per annum due to lateness and unreliability. Harm to leisure travel and tourism - the desktop study estimates that leisure travellers incur around £650m of disutility per annum due to poor rail performance. The disutility caused by poor rail performance may be as high as 10% of average tourist expenditure on trips within the UK. <p><u>Policy implications</u></p> <p>Overall, the evidence from this study shows that poor rail performance has a significant impact on individuals, the economy, and society in general. The estimate for total disutility (relative to an ideal world of zero delays) is equal to around £2.2-£2.5 billion per annum, which is approximately equal to two-thirds of the total annual ticket sales of the railway. Arguably, this is a conservative estimate, as it does not include some external effects, such as the effect on business meetings. Consequently, improvements in rail performance have a significant value attached to them. For example, if each train operator were to reproduce its best year of performance, total disutility, as calculated by the OXERA model, is likely to fall by around £900m per annum.</p> <p><u>Project contact</u> rail@dft.gsi.gov.uk</p>			
–		Quality Bus Partnerships and Market Structure	UK Market structures
<p><u>Key findings</u></p> <p>From the case study strand three main conclusions were drawn:</p> <ul style="list-style-type: none"> Quality is an important dimension of bus service. The development of successful quality initiatives requires some form of co-operation between the commercial operators and local authorities. There is clearly resistance to 'hard' forms of contract backed by statute as opposed to 'soft' forms of agreement. This may be largely because softer forms of agreement are more flexible and adaptable to changes in market and local political circumstances. <p>The model development work has concluded that:</p> <ul style="list-style-type: none"> Quality enhancement and fare reduction were both found to be effective ways of increasing economic welfare relative to frequency enhancement for the relatively high frequency corridors tested. Quality packages were beneficial to both the operators and to society as a whole given the elasticities, costs and traffic densities tested. However, without some form of revenue or capital contribution from operators, there is no direct benefit to the local authority. This is a structural weakness in the incentives to create quality partnership arrangements. Quality measures are unlikely to impact significantly on the competitive environment. Competition is not usually a sustainable outcome. Quality measures are unlikely to stimulate competition and it would be a mistake for the competition authorities to dictate a more competitive outcome as a requirement for approval of a quality partnership. Where quality enhancements do stimulate competition, such competition is likely to be in the service rather than the price dimension. Moreover, such service competition may not be beneficial in welfare terms. However, the implication is that the natural outcome is some form of weak monopoly under which the gains from publicly funded quality measures are partially captured in enhanced monopoly rents to bus operators. Operators who are effectively maximising patronage subject to a minimum profit or margin constraint will be incentivised to pass at least some of the benefits on to consumers. This type of objective is consistent with public statements by bus operators about their objectives and with the less than 			

Theme: Economic Aspects		Last update: 10 August 2006	
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Key findings / Policy implications / Project website or contact			
<p>unit fare elasticities observed in the market-place.</p> <ul style="list-style-type: none"> The conclusions about the unsustainability and undesirability of competition raised the question of public interest regulation of the bus industry. Two options for dealing with any problem of excess profits were suggested. The first was through some form of price or margin regulation. The second would be the introduction of well-specified quality contracts under which a degree of regulation was accepted by operators in return for exclusivity on the basis of 'best value'. This could be a favourable environment for the creation of the next generation of quality measures. <p><u>Policy implications</u></p> <p>None</p> <p><u>Project contact</u></p> <p>p.j.mackie@its.leeds.ac.uk</p>			
–	Transport Intensities within Industrial Branches in Finland	FI	Drivers of demand for freight and passenger transport
<p><u>Key findings</u></p> <p>Industry creates over 80% of domestic transport haulage. Transport created by industry consists of transporting industrial products, basic materials and half processed products. Other branches of industry generating significant transport are earth construction and energy production using coal and peat. Transport intensity of fuel production is highest, about 9 tonne-kilometres per EURO, and technological industry has the lowest transport intensity (0.1 tonne-kilometres per euro). In the long run, transport intensities of industries have changed quite little. The biggest change has been in technological industry, where intensity has diminished because of internal structural change. Transport intensities between different industries can vary considerably. Average transport intensity for industrial production was about 1.1 tonne-km per euro in 2002.</p> <p><u>Project contact</u></p> <p>pekka.iikkanen@ramboll.fi</p>			

Annex II: General information on the Transport Research Knowledge Centre and analysis process used

The Knowledge Centre's background

The EXTR@Web project – Exploitation of Transport Research Results via the Web – attempts to collect, structure, analyse and disseminate transport research results, covering not only EU supported but also nationally financed research in the European Research Area (ERA), as well as selected global transport RTD programmes and projects.

The EXTR@Web consortium has brought together eight main contractors to combine strong and in-depth technical knowledge of transport technology and of EU and national transport RTD programmes with solid communication and dissemination experience.

The current project's direct predecessor, EXTRA (a Fourth Framework Programme Transport RTD project), co-ordinated dissemination activities on the European level for the first time. While FP4 addressed transport research on a mode-by-mode basis, the current Fifth Framework Programme (FP5) focuses on generic themes that consequently reflect transport policy objectives.

The EXTR@Web project will provide support to research at European and national levels by building up and promoting an electronic hub. The key objectives are:

- To establish a comprehensive web-based Knowledge Centre, providing structured and timely access to both detailed and user-oriented summary information on transport research programmes and their results across Europe;
- to provide an electronic hub for inter-connecting European and national programmes and individual networks concerned with transport research into an easily navigable European network;
- to establish a common best practice scheme for the structure and content of the reporting of transport research results;
- to provide high-quality analytical outputs that are structured and tailored according to the type of stakeholder and medium; and
- to raise awareness of the new service, the implications of emerging results, and the wider opportunities under national research programmes across Europe as a whole.

EXTR@Web will provide a comprehensive pool of programme, project and results related information to users, principally in electronic format via the Internet. The approach is based on three main strokes of work covering:

- Monitoring, analysis and information preparation;
- website and electronic news service, the principal dissemination channels; and
- management of knowledge transfer, including dissemination by non-electronic means, and also the maintenance of a contact database and e-mail enquiry service and evaluation of the performance of EXTR@Web.

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Definition of transport research

For inclusion into the Transport Research Knowledge Centre, Transport research programmes and projects have to be within the definition of research and transport simultaneously. This will define the eligibility of projects.

Definition of research

General OECD definition:

"Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications."

Additional transport research criteria:

- Targeted – in line with transport policy aims, strategies and processes to solve the inherent problems for society.
- Accessible – a public activity, open to scrutiny by peers.
- Transferable – useful beyond the specific research project, applicable in principle to other researchers and research contexts as well as decision-makers in policy, industry and science.

Definition of transport

In order to clarify expectations from the Transport Research Knowledge Centre, and to ensure a common understanding of important terms, the Programme Analysis Group of EXTR@Web has come up with the following definition of transport.

- Transport is the means by which a person or material of any kind is passed from its origin to its destination.
- Transport comprises:
 - the transport users: passenger, business, freight;
 - the transport vehicles (full life cycle issues);
 - the transport infrastructure (full life cycle issues);
 - the transport system: the interaction of users, vehicles and infrastructure;
 - the impacts of transport: contribution to objectives, and hence to overall sustainability; and
 - the transport tools: methods and instruments to help ensure an effective contribution to the objectives.

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Three levels of analysis

Project level analysis

For European, national and international projects the following harmonized process was agreed:

- For each eligible project, the project co-ordinator will be requested to draft a Project Profile;
- the EXTR@Web consortium identifies, for each project all relevant themes (typically up to five), and provides the project linkage;
- for each eligible project, the project co-ordinator will be requested to draft the other elements of the reporting scheme – Progress Summary and Result Summary – due to the project progress and provides the final report;
- projects with highest relevance and best available final results will be selected for analysis;
- for every such relevant theme within each project a short and concise paragraph – structured with bullet points as appropriate – will be written to present the key findings of the project in relation to the objectives of the theme; and
- this information will be searchable on the Knowledge Centre website.

Thematic analysis

The thematic analysis has been exploiting existing project level analysis. The consolidated project wise findings have been structured and analysed along 30 themes, which are fixed for the project life time and fed into annual Thematic Research Summaries and Annual Compendia. However, for reporting purposes Thematic Research Summaries have been limited to 28 volumes (cf. Chapter 1).

The sequence of outputs has been comprising an explanation of the overall structure, and regular reports treating national, European and international research in a comprehensive way.

Deliverable number	Title	Release date (final version)
D2.A	"Thematic structure and definitions – all themes"	August 2006
D2.B	"European, national and international project database"	July 2006
D2.C	"First annual thematic research summary"; 30 vol.	December 2004
D2.D	"Second annual thematic research summary"; 10 vol.	March 2006
D2.E	"Third annual thematic research summary"; 28 vol.	August 2006

Table: The sequence of deliverables

Policy level analysis

Whilst the 30 themes are fixed, this type of analysis should give the flexibility to provide information on ad hoc policy priorities. Hence, policy level analysis will synthesize key findings of projects across combinations of themes. As an output, policy brochures shall be prepared depending on ad hoc requirements by DG TREN or by the high-level Advisory Group (AG).

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Annex III: Editorial team for Thematic Research Summaries

Please note that – in principle – all EXTR@Web partners and sub-contractors will be contributing to a particular Thematic Research Summary because all project level findings that are of some relevance to one of the 28 (30) individual themes are presented in the comprehensive format of these papers.

The following summary of authors and peer reviewers is presented in alphabetical order while the main author of this paper is given on page i of the document.

Fabien Drevetton, ISIS; France

Mr Drevetton has an electrical engineering post-MSc degree, an MBA and over 8 years experience in Intelligent Transport Systems for road transport. He has been a senior engineer with ISIS since 2001, specialising in traffic control, motorway management, ITS standards development process and system architecture.

Co-author: Road Transport

Prof J Augusto Felício, Neptune – CEGE/ISEG; Portugal

Professor Felício, holding a PhD in management, is teaching graduate and post-graduate courses such as 'Maritime transport and port management' and 'Land transport and logistic management' at ISEG, School of Economics and Management (Technical University of Lisbon). His activities include participation in transport research where he has published several related articles and books.

Main author: Waterborne Transport, Intelligent Transport Systems

Peer review: Efficiency, Vehicle Technology

Dr Paul E Firmin, Institute for Transport Studies, University of Leeds (ITS); UK

Dr Firmin has 30 years of experience in transport planning and engineering, including local authority, consultancy and academia. His research specialities are: traffic management, transport survey design & analysis, traveller information systems; driver route choice behaviour and transport telematics. He is currently the MSc(Eng) degree programme leader and international student adviser at ITS, University of Leeds. He teaches computing skills and traffic management, and supervises student dissertation projects.

Main author: Information and Awareness

Peer review: Safety and Security

Dr Nils Gendner, Neptune – University of Bremen, ISL; Germany

Dr Gendner has been working for more than four years at the University of Bremen, Institute of Shipping Economics and Logistics. His main topics include the analysis of processes, functions and data flows in shipping and within the rail sector. He contributes to ongoing efforts in intermodality by participating in several projects dealing with intermodal concepts and developments.

Main author: Intermodal Transport, Integration

Peer review: Financing Tools, Pricing and Taxation

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Wolfgang Helmreich, Industriebetriebe-Betriebsgesellschaft mbH (IABG); Germany
Mr Helmreich is a civil engineer from the Technical University of Munich. He has more than 15 years experience with transport planning and infrastructure design in the rail, road and air sector, and sound knowledge of vehicle technologies. His expertise also includes project management, web publishing and dissemination skills. He joined IABG in 1999 as a senior transport consultant after working as project manager at several German engineering companies. He is principal editor of all Thematic Research Summaries.

Main author: Air Transport, User Aspects, Safety and Security

Peer review: Regional Transport, Rail Transport, Waterborne Transport, Environmental Aspects, Land Use Planning

Cristina Ivan, Group of Independent Experts Ltd (GIE); Romania

Ms Ivan has a law degree and has graduated a Master course in project management. Ever since 1998 she has participated in various projects financed by international donors in Romania. The main areas of her expertise cover: project management, legal approximation of the EU acquis & drafting of environmental legislation, as well as the carrying out of awareness raising and dissemination activities, including those for the transport sector.

Main author: EU Accession Issues

Peer review: Economic Aspects, User Aspects, Transport Management

Dr Ann Jopson, Institute for Transport Studies, University of Leeds (ITS); UK

Dr Jopson is a Research Fellow whose main interests and expertise lie in the areas of travel behaviour psychology, transport marketing and urban transport planning and policy, with particular emphasis on travel demand management through attitudinal and behavioural measures. Her PhD thesis was based on the role of psychology in reducing car use.

Main author: Environmental Aspects

Peer review: Rural Transport

Dimitris Koryzis, Systema; Greece

Mr Koryzis is a production & management engineer from the Technical University of Crete and holds an MSc in Decision Sciences from Athens University of Economics & Business. He has more than 8 years experience as technical and managerial consultant for 30 European programmes in the transport sector (road, maritime and intermodal) as well as in research and innovation technology EC projects.

Co-author: Pricing, Taxation and Financing Tools

Peer review: Integration

Ulrich Leiss, Industriebetriebe-Betriebsgesellschaft mbH (IABG); Germany

Mr Leiss is an aerospace engineer from the Technical University of Munich. His professional career includes 24 years experience with research, technical analyses, monitoring and managing national and European projects and programmes. These activities cover the areas aerospace, transport, energy and new technologies.

Main author: Other Modes, Vehicle Technology

Bryan Matthews, Institute for Transport Studies, University of Leeds (ITS); UK

Mr Matthews has 9 years experience of transport research and project management in both consultancy and university settings. His research expertise is in transport policy analysis and transport economics. He has worked on a number of EU, UK DfT and Research Council projects. He also contributes to teaching activities, lecturing on Air Transport Systems and supervising student projects.

Main author: Rail Transport

Peer review: Air Transport

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Prof Anthony D May, Institute for Transport Studies, University of Leeds (ITS); UK
 Professor May has over 35 years' experience in transport planning and traffic engineering. He has been a professor at Leeds since 1977, and has served as Head of the Department of Civil Engineering, Dean of the Faculty of Engineering, Pro-Vice Chancellor for Research and Director of the Institute for Transport Studies. He also has practical experience with the MVA consultancy and the GLC in London. His research specialities include: land use planning, traffic management, road pricing, sustainable urban transport, integrated transport and environmental impacts of transport.

Supervision of entire process of thematic reviews

Batool Menaz, Institute for Transport Studies, University of Leeds (ITS); UK
 Ms Menaz is a transport economist from the University of Leeds. She has been involved in a number of various projects including research into transport pricing reform issues in air, road and rail for the IMPRINT-Europe thematic network project, and research for the UK Rail Research Centre looking at the alternative visions for the future of the British rail system.

Main author: Regulation/Deregulation

Co-author: Passenger Transport, Equity and Accessibility, Land Use Planning

Peer review: Road Transport

Christina Paschalidou, Systema; Greece

Ms Paschalidou is a transportation engineer from Aristotle University (Thessaloniki), with a MSc in Urban and Regional Transport from Laboratory of Transport Economics in Lyon. Her field of interest is transport planning and engineering, EU and national transport policies, sustainability issues and research. She joined Systema in 2005, while her previous experience includes an internship in ISIS, traffic studies elaborated individually and research activities in the Aristotle University.

Main author: Transport Management

Peer review: Information and Awareness

Ignacio Rada Cotera, Neptune – IkerConsulting; Spain

Mr Rada Cotera is a lawyer from Deusto University in Bilbao, holding a diploma and certificate of European studies from Deusto and Saarland Universities, respectively. He has been working on EU projects since 2000. His main expertise is European commercial and regional policy, maritime transport and port affairs, legal aspects of international economic relations, urban planning, regional benchmarking and development.

Main author: Regional Transport

Marco Valerio Salucci, Università di Roma "La Sapienza", DITS; Italy

Mr Salucci holds a degree in mechanical engineering from the University of Rome "La Sapienza". His past research experience has focused on computer modelling of the operations of freight terminals and automatic passenger transport systems, the latter being carried out within EC funded research projects. His current research for a doctorate is in the area of transshipment and information and communication technologies for intermodal freight transport.

Co-author: Freight Transport, Urban Transport, Rural Transport, Efficiency, Decision-support Tools

Peer review: Intermodal Transport

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Dr Karsten Seidel, Neptune – European Networks and Cooperation; Belgium/Germany
 Dr Seidel has graduated as economist and holds a PhD from the University of Bremen. He has been working on EU projects since 1988. His main expertise is in European industrial and regional policy, telecommunication research projects, maritime transport and port affairs, evaluation of technical aid, urban planning, regional benchmarking development.

Co-author: Regional Transport

Dr Paolo Delle Site, Università di Roma "La Sapienza", DITS; Italy
 Dr Delle Site holds an PhD, and is a senior research fellow at DITS, Transport Area, University of Rome "La Sapienza". He combines professional experience with research activities, the latter mainly being carried out within EC funded research projects. Related activities comprise urban transport planning, urban public transport design, transport project assessment, and policy analysis. His teaching activities include courses in transport planning. Furthermore, he is author of papers in Transportation Research Part A – Policy and Practice and in the European Journal of Transport and Infrastructure Research.

Co-author: Freight Transport, Urban Transport, Rural Transport, Economic Aspects, Infrastructure Provision, Pricing, Taxation and Financing Tools

Peer review: EU Accession Issues, Intelligent Transport Systems, Regulation/Deregulation

Damian Stantchev, Institute for Transport Studies, University of Leeds (ITS); UK
 Mr Stantchev holds a degree in Economics and Trade from Varna University of Economics in Bulgaria and an MA in Political Science from the Central European University in Hungary. His early research experience was in the area of small business development in transitional economies of Central and Eastern Europe. Damian has also contributed to an extensive report on the role of the logistics and transportation sector in society for the Logistics & Transportation Corporate Citizenship Initiative of the World Economic Forum. His research for a doctorate examines the role of logistics in enhancing the competitiveness of the regional economy and encompasses all aspects of original research and data collection including the design, conduct and analyses of large scale surveys as well as the collection of commercial data and development of case studies.

Main author: Passenger Transport, Land Use Planning, Equity and Accessibility

Peer review: Freight Transport

Andrew Winder, ISIS; France

Mr Winder is a transport planner with a BSc in transport management (Aston University, England) and over 15 years experience in consultancies and public transport authorities covering transport planning and policy, particularly at UK, French and Europe-wide levels. Since 1998 he has been a senior engineer at ISIS, responsible for a wide range of European projects focusing primarily on Trans-European Networks, ITS for road traffic management, urban and regional public transport and EU enlargement aspects.

Main author: Road Transport

Peer review: Passenger Transport, Urban Transport, Other Modes, Equity and Accessibility, Infrastructure Provision

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Ard Wolthuis, Università di Roma "La Sapienza", DITS; Italy

Ard Wolthuis graduated in Science & Innovation Management, in the field of Transport and Mobility, from the University of Utrecht. He has been involved in transport projects and analysed socio-economic, environmental, political and legal aspects, such as the Phileas project, the Fokker bankruptcy, and innovation policy of companies in the Netherlands. Has participated in a European project on innovation in urban public transport systems. Since spring 2005 has joined DITS as a research fellow. His main areas of activities are policy analysis and dissemination of research results.

Co-author: Efficiency, Decision-support Tools

Dr Zhaomin Zhang, ANAST – University of Liege, Neptune; Belgium

Dr Zhang has got the university degrees of Civil Engineering, Mechanical and Marine Engineering; Master of Transportation Sciences and Doctor of Philosophy. He is a senior engineer and led the important projects related to the "Establishment of a mathematical traffic model on the Belgian waterway network" (Belgian national research program "Transport and mobility"), the project called "On computerisation and management in real-time of operations relating to the exploitation of fluvial traffic to organise the waterway transport", Belgian Regional Ministry of Public Works) and the Project related to the development of a transport cost model in the inland navigation sector. He has also been involved in numerous simulation and operation research activities.

Peer review: Decision-support Tools

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