THEMATIC SYNTHESIS OF TRANSPORT RESEARCH RESULTS

PAPER 1 OF 10

INTEGRATED POLICY ASPECTS OF SUSTAINABLE MOBILITY

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Contents

EXECUTIVE SUMMARY

This paper provides a structured guide to the findings of research carried out in the Transport RTD Programme[1] that relate to the development of an integrated policy perspective on sustainable mobility. (See Section 1 for advice on how to use the paper.)

Many people see the current trends in European transport activity as unsustainable, with traffic growth leading to greater congestion, increasing emissions of carbon dioxide and depletion of fossil fuels. Yet the pursuit of *sustainable* mobility presents a challenge. Actions to limit the environmental and other costs of traffic movements must be reconciled with Europe's aspirations for economic growth and social demands for mobility. The solution is widely perceived to lie in an *integrated* approach, combining pricing instruments, new technologies and other policy actions. Research is providing a vital foundation for this, developing guidelines and tools to support the implementation of policy measures, and demonstrating their likely impacts.

The research has three important strands:

- work on *understanding the future* has provided the foundation for policy analysis;
- analysis of *economic, social and environmental aspects* has enabled policy decisions to be made in a balanced way;
- evaluation of the *transport effects* of policy measures and research on *policy integration* have provided the means of identifying appropriate packages of measures.

Economic, social and environmental aspects are covered in detail in other papers. This paper deals with the two remaining strands, reviewing results for "clusters" of research projects in eight inter-related areas:

Understanding the market
Extensive surveys have identified the institutional and political barriers to the introduction of new types of policy measure and transport service, in both the passenger and freight sectors. Policy actions to overcome these barriers have been specified, particularly aimed at filling various gaps in enabling legislation. Case studies of current policies and the situation in various transport markets have been used to identify the scope for change and to share experiences between Member States.

Visioning the future
A "reference scenario" has been developed for the effects of current trends in the European transport sector to the year 2020, to provide a baseline for future work on policy assessment. In addition, alternative scenarios have been devised to help policy-makers explore the consequences of uncertainty in future socio-economic and political developments. This has indicated actions that would help to deliver policy objectives across all scenarios.

Tools and methods
Data collection techniques have been devised and tested to meet current serious gaps in the availability of transport statistics to support policy formulation. These techniques will also benefit the development of a European Transport policy Information System (ETIS), serving

[1] Part of the Fourth Framework Programme for Community activities in the field of research, technological development and demonstration for the period 1994 to 1998.

both the public and private sectors. A software structure and prototype tools have been prepared for ETIS, based on a modular architecture to allow data sharing across Member States. In addition, a range of tools and guidelines have been developed for the evaluation of transport projects and investment programmes, and for simulating the effects of policies and traffic management measures.

Transport management
Case studies have provided real-life evidence of the effects of using a wide range of measures to reduce travel demand, improve traffic flows and encourage modal shift. Combinations of measures were shown to have the greatest effect, and good practice guides have been provided on their implementation, to help cities learn from each other's experiences. Pricing measures were identified as the most important single component of an integrated strategy, with land-use planning (in the longer term) and restrictions on urban access for cars also playing a significant role.

Pricing and financing
The Transport RTD Programme has been the focal point for European research on the use of pricing measures to promote more sustainable travel choices. The work has identified the potential for optimising taxes, charges and tariff structures to influence transport demand and travel patterns, and has indicated the effects on different modes of transport. Practical guidelines and calculation methods have been devised to support the introduction of such measures, and demonstration projects have shown the likely impacts.

Mobility management
Mobility management entails providing information services and co-ordination mechanisms to make better use of existing transport facilities. This can minimise the number of vehicle trips to major sites such as workplaces, for instance through car sharing. Projects in the Transport RTD Programme have been influential in raising the awareness of mobility management practices across Europe, through demonstration schemes in various cities and the preparation of good practice guides. Guides have also been provided on the use of information and awareness campaigns.

New technologies and transport concepts
The potential contribution to sustainable mobility has been studied for all sorts of new transport technologies and concepts. Telematic technologies were highlighted as likely to be of benefit across all impact categories. In the freight area, significant RTD has focused on the potential for introducing freight transhipment terminals, capturing the lessons from European experiences and disseminating them to a wider audience. Similarly, software and good practice guides have been developed to help vehicle operators and policy-makers introduce cleaner vehicles and fuels.

Evaluating the Common Transport Policy and Trans-European Transport Network
To support decisions on integrated policy strategies in the face of complexity and uncertainty, a series of tools have been developed. These have been used to evaluate the broader and longer-term impacts of investments in the Trans-European Transport Network, and provide a basis for reaching consensus on the policy packages that would meet the objectives of the Common Transport Policy.

1. INTRODUCTION – HOW TO USE THIS PAPER

This paper provides a structured guide to the results of Research and Technical Development (RTD) projects relating to the *integrated policy aspects of sustainable mobility*, carried out in the European Community's Transport RTD Programme. It is one of a series of papers:

Paper no.	Theme
1	Sustainable mobility – integrated perspective
2	Sustainable mobility – economic perspective
3	Sustainable mobility – social perspective
4	Sustainable mobility – environmental perspective
5	Urban transport
6	Efficiency and quality
7	Safety and security
8	Human factors
9	Interoperability
10	Freight intermodality

Of the 275 projects within the Programme, 72 dealt (partly or fully) with the issues of integrated policy for sustainable mobility. Most of these projects were finalised in the year 2000.

How to use this paper:
You are recommended to use this paper to locate RTD results on topics where you have a particular interest, rather than reading the paper from start to finish:

- Start in Section 5 to get an overview of the topics addressed by "clusters" of RTD projects.
- Read the part of Section 6 that summarises the findings for each topic of interest to you.
- Use Annex 1 to identify the individual projects relating to that topic.
- Use Annex 2 to review the key results from each of these projects.

Further details on individual projects can be obtained from their web sites (noted in Annex 2, where available) and from the following Commission web sites:

- http://europa.eu.int/comm/transport/extra/home.html, which includes summaries and the full final reports of individual projects, as well as a variety of analyses and publications prepared by the EXTRA project;
- http://cordis.lu/transport/src/project.htm, which provides the project objectives and summary results as compiled by the RTD project teams.

The other Sections of this paper can help you to gain an overall picture of the urban transport theme, associated policy issues and the objectives for RTD.

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

2. SCOPE OF THE THEME

2.1 Definition of Sustainable Mobility

Concept of Sustainable Development

A new consciousness towards the environment and the use of natural resources has led to the development of the concept of sustainable development. This was first put forward by the World Commission on Environment and Development[1] (the "Brundtland Commission") in 1987 and defined as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development is generally considered to comprise two main elements:

- minimising environmental impacts, and
- making the best and most equitable use of resources.

In promoting sustainable development, the challenge for policy-makers is to reconcile three objectives:

- securing higher standards of living through economic development;
- protecting and enhancing the environment;
- ensuring an equitable distribution of the benefits between present and future generations.

Subsequently, the Treaty on the European Union (Amsterdam Treaty[2]) explicitly included sustainable development as one of the European Union's objectives for the first time (in Article 2). Article 6 of the same Treaty requires environmental protection to be integrated into the definition and implementation of all Community policies and activities. Reflecting this position, the EU committed itself in 1997 to draw up strategies for sustainable development in time for the 2002 World Summit on Sustainable Development.

Concept of Sustainable Mobility

The mobility of people and goods provides benefits (i.e. effective and efficient transportation from one location to another) and a series of unwanted economic, environmental and social side effects. The causes of these problems are relatively well known and solutions have been suggested. One notable example is the set of solutions defined at the UN Conference for Environment and Development in June 1992, and formulated in the document known as 'Agenda 21'.

In the formal Agenda 21 document, six objectives are set for transportation[3]. In order to make transportation more sustainable or to make it less unsustainable, Agenda 21 requires society:

- to reduce transportation demand;
- to develop public transport;
- to promote non-motorised transport (cycling and walking);
- to integrate all aspects in planning and to maintain public infrastructure;
- to develop and communicate processes between the different countries/communities;
- to change the patterns of consumption and production in our societies.

Thus the term sustainable mobility stands for a process and a path to be followed, rather than simply representing a vision of a future situation. The following objectives can be mapped out for this path:

1. *To provide access to goods, resources and services, while reducing the need to travel - such that economic, environmental and social needs can be met efficiently and in an integrated manner.*
2. *To ensure that transport infrastructure and travel use does not exceed the capacity of the environment to withstand their impact.*
3. *To ensure that users pay the social and environmental costs of their transport decisions without making industry uncompetitive or preventing those on low incomes from meeting their transport needs.*
4. *To reduce the growth in car and lorry traffic to sustainable levels.*
5. *To ensure that transport infrastructure investments take proper account of environmental aspects.*
6. *To increase the choice, and encourage the use, of economically, environmentally and socially efficient transport modes.*
7. *To protect critical natural and physical capital.*
8. *To meet environmental quality standards based on critical ecological limits and precautionary public health requirements.*
9. *To ensure that renewable natural resources are used in ways which do not diminish the capacity of ecological systems to continue providing those resources over time.*
10. *To ensure that non-renewable natural resources are used in ways which account for future needs and the availability of alternative resources.*
11. *To enhance public health and safety, reduce accidents and improve security.*
12. *To ensure the economic and social acceptability of new measures.*

Based on these objectives, sustainable mobility can be defined in practical terms as:

A transport system and transport patterns that can provide the means and opportunities to meet economic, environmental and social needs efficiently and equitably, while minimising avoidable or unnecessary adverse impacts and their associated costs, over relevant space and time scales.

As in the pursuit of sustainable development, the challenge is to reconcile economic growth and social demands for mobility with the environmental and other costs of traffic movements. The solution is widely perceived to lie in an integrated approach, combining:

- a change in people's transport behaviour and the way they live (affecting travel demand, land-use patterns etc.);
- technological improvements to raise efficiency while reducing environmental impacts and improving safety;
- a pricing regime which incorporates the true costs of transport into decision-making, thereby influencing the overall consumption of transport services and promoting the least damaging mode of transport;

- a focus on accessibility, intermodality and mobility management, to meet transport needs with the most efficient traffic volumes and patterns, while respecting quality and other social goals such as safety and security.

2.2 Topics included in the theme

The promotion of transport sustainability was identified as one of the three major policy objectives for RTD in the Key Action on "Sustainable Mobility and Intermodality" in FP5. The aim is to develop a long-term balance between the growing demand for mobility on the one hand and the necessity to respect environmental, social and economic constraints on the other hand. The goal will be to decouple the direct link between economic growth and traffic volumes, reduce the negative impact of transport modes and encourage their more sustainable use.

The overall concept of sustainable mobility has therefore been disaggregated into four main themes for the purposes of EXTRA:

- economic goals and impacts - particularly improved European competitiveness;
- environmental objectives and impacts;
- social aims and impacts – particularly accessibility and equity;
- the achievement of an overall balance between impacts and benefits, *integrated* across economic, environmental and social aspects.

The following Sections identify the scope of each of these themes. The rest of this paper will focus on policy research towards an *integrated* perspective on sustainable mobility; the other three themes are dealt with in separate papers.

Sustainable mobility - environmental aspects

This theme covers both the direct environmental impacts of interest to operators and users, such as noise and tail-pipe emissions, and the externality costs of concern to policy-makers, such as air quality and health effects.

The relevant groups of impacts are:

- *environmental sustainability* - energy resource use, non-energy resource use, global warming, stratospheric ozone depletion, and destruction of habitats and bio-diversity;
- *local air quality* - damage to health and materials;
- *regional air quality* - damage to crops, forestry, aquatic and terrestrial ecosystem;
- *nuisance* - noise and vibration, visual intrusion, landscape degradation and community severance;
- *waste* - land contamination and water pollution.

Sustainable mobility - economic aspects

This theme is particularly concerned with the impacts of mobility on economic activity and competitiveness.

The main topic areas are:

- *land-use patterns*, and the interaction with transport patterns;
- *regional linking*, and broadening the external dimension (i.e. links across EU borders);

- *completion of the Single Market*, including standards, interoperability and open markets;
- *EU competitiveness*, in terms of transport costs to consumers (especially industry), and costs to the transport industry (vehicle and fuel suppliers etc.);
- *macro-economic effects* such as employment, triggering of innovation, export potential and security of energy supply.

Sustainable mobility - social aspects
This theme concerns the needs of citizens, transport users and workers. The main topic areas are:
- *equity* - social equity of changes, effect on income distribution and public acceptance;
- *accessibility* to transport services and destinations (for both essential and discretionary trips);
- *care for marginal/disadvantaged/vulnerable groups;*
- *working conditions* for operatives.

Sustainable mobility - integrated perspective
This theme concerns the achievement of the most appropriate future transport system, taking into consideration the trade-offs between individual policy objectives and impact categories. Often this is seen as a balance between economic costs on the one hand, and environmental and social benefits on the other. The use of pricing mechanisms to ensure that transport decisions take into account all their associated costs (i.e. internalisation of external costs) is seen as a key approach to achieving a fairer and more efficient balance.

However, it remains impractical to consider all the aspects of sustainable mobility in terms of an equivalent monetary value. Therefore more integrative frameworks are needed to characterise the synergies, conflicts and trade-offs inherent in strategies for sustainable mobility.

2.3 Significance of the theme

The increasing mobility of persons and goods is a source of much concern. Clearly, mobility is a ‘normal’ - and even positive - phenomenon in a growing economy. It increases economic efficiency through trade and labour mobility, and it also offers more social opportunities through a better access to amenities. But the positive effects of mobility are offset by negative externalities, such as environmental pollution, congestion or lack of accessibility, and high accident rates.

There are many developments that are inducing even more mobility. These include changes in behavioural patterns, demographic changes, and structural developments in the world economy and in modern production systems. Thus any policy in favour of sustainable mobility faces the dilemma of how to limit or reduce the adverse impacts of mobility (if not mobility itself) in the face of driving forces which are hard to change.

Adverse impacts on *the economy* include congestion, inefficiencies in freight and passenger travel, and resource waste. The adverse environmental and social impacts also have indirect economic costs, which are borne in varying degrees by public expenditure, industry and the public.

The main adverse *environmental* impacts include unacceptable rates of:
- loss of important wildlife habitats and concomitant threats to wild species;
- emissions of a wide range of air pollutants, such as carbon monoxide, volatile organic compounds, nitrogen oxides and particulates;
- emissions of the primary greenhouse gas, carbon dioxide;
- use of non-renewable resources, such as primary aggregates, land and fossil fuels;
- waste, such as tyres, oil and other materials.

The main adverse *social* impacts include:
- deaths, illness and chronic threats to public health from air pollution;
- deaths and injuries from road traffic accidents;
- noise, vibration and visual intrusion, from road traffic in particular;
- the difficulty, for many people without a car or acceptable public transport alternative, of making essential journeys;
- other quality of life considerations, such as the loss of green-field sites and open spaces in urban areas as a result of new transport infrastructure and associated development.

In Europe, there has been a rapid increase in distances travelled, with cars and lorries taking an ever-increasing share. If current trends (i.e. 2% per year growth in freight and passenger transport) continue unchecked, the network will become increasingly congested. This will impose a rising cost on the economy of the EU. Already, more than 5000 km of motorways are congested every day. The overall level of damage to the environment will grow, despite some new standards and technological improvements; and many people will remain disadvantaged either because of the indirect impact on them of transport infrastructure and traffic, or simply through lack of mobility, especially for those without access to a car.

European countries and regions are gradually moving towards an integrated network economy, where important nodes of economic, cultural and technological progress are linked together by a well connected infrastructure network. However, the intensified use of European networks also raises many issues. The access to and benefits from the European network are unequally distributed among different socio-economic groups and among different regions in Europe, so that serious equity issues emerge. Also the large-scale mobility of goods resulting from the European free market is a cause of many environmental externalities and hence of serious concern.

In the light of these observations, European transport policy is faced with many challenges. In this respect, the Transport White Book of the European Commission (1993) states: "*The activities of the European Community in the field of research and development regarding transport must supply the new tools for the attainment of sustainable mobility: efficient, safe transport, in the best possible social and environmental circumstances*".

To put these issues in context, consider the following historical data:
- In 1996, 6 million people in the EU were employed in the transport services sector, around 4% of all persons employed. In addition, 2 million people were employed in the transport equipment industry, and over 6 million in transport-related industries. Since 1970, GDP growth of around 80% has been facilitated by similar growth in goods transport. So there are real economic and social benefits from transport.

- Road fatalities have fallen by 40% since 1970, and vehicle emissions are also declining despite the growth in traffic. So moves towards sustainable mobility are being made.
- Nevertheless, the impacts of traffic are substantial. In 1996, 42,000 people were killed on the roads. Road transport accounts for more than 50% of total NO_x and CO emissions in the EU-15, and the transport sector contributes 28% of EU CO_2 emissions.
- Moreover, the trend in traffic volumes remains upward, offsetting the gains from technological advances and other measures. For example, passenger transport demand has grown by more than 110% since 1970, outstripping economic growth.

Congestion is increasingly seen as a key problem. This occurs mainly in urban areas, but is also a growing problem for the Trans-European Transport Network: some 10% of the road network is affected daily by traffic jams, and there are bottlenecks on the railways and at airports. Altogether the delays result in an extra 6% of fuel consumption, and there is a serious risk that Europe will lose economic competitiveness. The most recent study on the subject showed that the societal costs of road traffic congestion alone amount to 0.5% of Community GDP, increasing to 1% over the next ten years if nothing is done.

3. POLICY CONTEXT

3.1 Policy objectives related to the theme

According to the EC Treaty (Treaty on European Union, signed in Maastricht), the Common Transport Policy (CTP) is one of the activities that the Community must pursue in order to establish a common market and progressively harmonise the economic policies of the Member States. In addition, the Treaty underlined the importance of other goals, including sustainable growth respecting the environment.

Key documents outlining the objectives of the CTP are the 1992 White Paper on the future development of the CTP[4], followed in 1995 by the CTP Action Programme 1995-2000[5] and in 1998 by the CTP Action Programme 1998-2004[6]. Some general policy aspects (public transport, transport pricing) were put in more concrete form in the 1995 Green Papers on The Citizens' Network[7] and Towards Fair and Efficient Pricing in Transport[8], and subsequently in the 1998 Communication on Developing The Citizens' Network[9] and the White Paper on Fair Payment for Infrastructure Use[10]. Concerns over global warming were addressed in the Communication on Transport and CO_2[11] and strategies for the development of intermodality in the freight sector have been put forward in 1997[12]. The role of transport in reducing regional and social disparities in the European Union and in the strengthening of its economic and social cohesion were discussed in a Communication issued in 1998[13]. Most recently, the Commission has adopted the policy guidelines for a new White Paper on the Common Transport Policy[14].

The CTP White Paper of 1992 called for a global programme in pursuit of sustainable mobility, including:

a) the continued reinforcement and proper functioning of the internal market, facilitating the free movement of goods and persons throughout the Community;
b) a transition from regulation towards the adoption of balanced policies favouring the development of integrated transport systems for the Community as a whole using the best available technology;
c) the strengthening of economic and social cohesion by the development of transport infrastructure to reduce disparities between the regions and to link peripheral regions with the central regions of the Community;
d) measures to ensure that the development of transport systems contributes to a sustainable pattern of development by respecting the environment and, in particular, by contributing to the solution of major environmental problems such as the limitation of CO_2;
e) actions to promote safety;
f) measures in the social field;
g) the development of appropriate relations with third countries, where necessary giving priority to those for which the transport of goods or persons is important for the Community as a whole.

Following on from this, the CTP Action Programme 1995-2000 consisted of policies and initiatives in three areas:

- *improving quality* by developing integrated and competitive transport systems based on advanced technologies which also contribute to environmental and safety objectives;
- improving the functioning of the *single market* in order to promote efficiency, choice and a user-friendly provision of transport services while safeguarding social standards;

- broadening the *external dimension* by improving transport links with third countries and fostering the access of EU operators to other transport markets.

This was supplemented by targeted initiatives in such areas as:
- liberalisation of market access (particularly for railways and ports);
- development of the Trans-European Networks for Transport (TEN-T);
- identification of transport sector responses to the Kyoto agreement on curbing CO_2 emissions.

The latest policy guidelines[14] concern around 60 proposals that will be detailed in the CTP White Paper due in 2001. The aim is to provide the European Community with a programme of actions to gradually decouple growth in traffic from economic growth. Highlighted actions include:
- revitalising the railways, particularly by opening up the markets and creating routes dedicated to freight transport;
- promoting transport by sea and inland waterway, with the creation of sea motorways;
- striking a balance between growth in air transport and the environment, by making air traffic management more efficient while controlling aircraft noise and pollution;
- turning intermodality into reality, by ensuring technical harmonisation and interoperability and by Community support for innovative initiatives;
- completing the priority work on the Trans-European Transport Network, such as the removal of bottlenecks on the railways and improving links to Central and Eastern Europe;
- improving road safety and urban transport, particularly through exchanges of good practice;
- adopting a policy on effective charging for transport, including the harmonisation of fuel taxation for commercial users and making charges reflect the real costs of transport.

In another recent development, the European Council of Gothenburg has adopted a strategy for sustainable development, following proposals made by the European Commission[15]. Transport congestion, particularly in urban areas, is identified as one of the main threats to sustainable development. Three headline objectives are put forward for the transport sector – to decouple transport growth significantly from growth in GDP, to bring about a shift in transport use so that the share of road transport in 2010 is no greater than in 1998, and to promote more balanced regional development. Measures at the EU level would focus on: a framework for pricing that reflects societal costs; the introduction of payment systems for road transport; giving priority to infrastructure investment for public transport, railways, inland waterways, short sea shipping and intermodal operations; developing open markets; and promoting the use of alternative transport fuels.

Many of these individual policy objectives and initiatives are discussed in detail in the other EXTRA thematic papers (on economic aspects, environmental aspects etc.). This paper focuses on policy issues concerned primarily with achieving the right *balance* between the growing demand for mobility and its negative impacts. The following Sections therefore look at (a) pricing policy, (b) approaches for system management (passenger and freight), and (c) the integration of policy measures in a comprehensive approach.

3.2 Pricing policy

A key policy action aimed at reconciling the individual objectives of sustainable mobility (economic, social, environmental) is in the area of costs, charges and pricing[8,10,14]. This is expanded in the Green Paper on Fair and Efficient Pricing, as follows:

Transport policies have in the past focused largely on direct regulation. Whilst rules have brought significant improvements in some areas, they have not been able to unlock the full potential of response options that can be triggered through price signals. Decisions made by individuals with respect to their choice of mode, their location and investments are to a large extent based on prices. So prices have to be right in order to get transport right.

The Green Paper explores ways of making transport pricing systems fairer and more efficient - by giving users and manufacturers incentives to adjust their transport behaviour. The aim is to reduce congestion, accidents and environmental problems. The purpose of this policy is not to increase the costs of transport. On the contrary, by reducing the negative side-effects of transport - and the sometimes hidden costs they represent - the real costs of transport (i.e. those currently paid by individual users plus those paid by others or society as a whole) are set to decrease.

In order to achieve a balance between different modes of transport, the significant differences in the way infrastructure and external costs are charged have to be minimised. Also, differences in charging systems in different Member States can distort competition, even within a single mode of transport, giving some national industries advantages over others.

The subsequent White Paper[10] has further developed ideas on a harmonised approach to paying for infrastructure use across all modes of transport. This is to help to create the European-wide, integrated, sustainable transport system that is vital to the free movement of goods and people in the Single European Market. The underlying principle is that charges should be related to marginal social costs, i.e. those variable costs that reflect the cost of an extra vehicle using the infrastructure, including “external” costs such as congestion, pollution and accidents. This is to remove the huge competitive distortions between modes, within modes and between Member States created by the existing different charging systems.

The size of the costs that are not directly borne by those who cause them is very large - even on conservative estimates. Congestion is estimated to cost the Union some 2% of GDP every year, accidents another 1.5%, and air pollution and noise at least 0.6%. This amounts to some 270 BECU per year in the Union (or 700 ECU per person) and over 90% of these costs are related to road transport. Therefore attention has concentrated on road transport, and the benefits of switching to other modes.

In the long run, telematics - e.g. electronic road pricing - has the potential to provide a system which meets the requirements of a fair and efficient pricing system, whilst respecting the privacy of Europe’s citizens. However, the full introduction of these systems will probably take a decade and possibly longer. Given the severity of the problems, action cannot be put off until then - hence the recent White Paper proposed a phased approach to introducing a common transport infrastructure-charging framework.

When implemented, the overall savings to the transport system, passed on to users, would be in the order of at least ECU 50 billion per year. The initial challenge is to establish ways of estimating the marginal costs of transport, to develop transparent accounting methods, and to find ways to mitigate costs following changes in the pricing system. Such developments are essential to increase the acceptability of pricing measures. Existing RTD will form an important input to this work.

3.3 Approaches for system management

In order to achieve socio-economic and environmental sustainability, the efficient and balanced use of existing capacities throughout the European transport system has become a key challenge. One response has been the promotion of intermodality as a tool for integration (within a broader integrated portfolio of policies), enabling a systems approach to transport. This has been adopted particularly in the freight sector[12], but the principles apply equally to passenger transport.

The objective of intermodality is to develop a framework for an optimal integration of different modes so as to enable an efficient and cost-effective use of the transport system through seamless, customer-oriented door-to-door services whilst favouring competition between transport operators.

Implementing a European intermodal transport system requires co-ordinated development of transport policy at European, national and regional levels. Four key strategies will provide the necessary impetus to the development of intermodal transport in the overall context of the Common Transport Policy:
- a European strategy on infrastructure: trans-European transport networks and nodes;
- the Single transport market: harmonisation of regulation and competition rules;
- identification and elimination of obstacles to intermodality and the associated friction costs;
- implementing the Information Society in the transport sector.

A similar systems approach to transport management is embodied in the policy framework for the Citizens' Network[7,9] (for local and regional passenger transport). Here again, intermodality is seen as a key element for integration. The Commission's role is to provide useful tools for authorities, operators and user groups, *and to establish the right policy framework for sustainable mobility*.

Therefore, the Commission is developing measures to:
- address the transport aspects of land use planning;
- encourage mobility management schemes;
- support fairer and more efficient transport pricing;
- promote applications of transport telematics;
- set harmonised standards for vehicle design;
- ensure appropriate competition in public transport; and
- address the transport needs of women and of people with reduced mobility.

Intermodality as a key element for integration in local and regional passenger transport:

- intermodal transport planning and infrastructure development, so that the modes are well connected and interchange between them is easy
- intermodal transport operations, with co-ordinated timetables and the capacity for operators and authorities to respond flexibly to disruptions of the transport system
- intermodal ancillary services and technologies, making services like travel information, ticketing and payment mode-independent and - ideally - covering all transport in an area.

With regard to the role of the European Union in the transport sector, the key principle is subsidiarity. The Union should act only where it can add value to action at national, regional and local levels. The consultation on the Citizen's Network Green Paper showed widespread support for the view that the European Union can add value in four key areas, serving mainly as a supporter or catalyst of action by others:

- *stimulating information exchange* - making it easier to find out what has worked elsewhere and what has not;
- *stimulating the benchmarking of service performance* - so that public authorities and transport operators can benefit from comparing the performance of their local and regional transport systems with systems elsewhere;
- *creating a policy and legal framework* which promotes better use of local and regional passenger transport systems contributing to the European Union's Common Transport Policy objectives of efficiency, quality and sustainable mobility;
- *using the European Union's financial instruments effectively* so that these encourage investment in local and regional passenger transport where this is needed to deliver European Union objectives such as growth, competitiveness, equal opportunities, accessibility for people with reduced mobility, employment, economic and social cohesion, better air quality, energy saving and enlargement of the Union.

All these areas have been the subject of Framework Programme RTD.

3.4 Integrated policy approaches

As indicated previously, pricing policy is only one aspect of the necessary integrated approach to promoting the path towards sustainable mobility. A comprehensive policy framework will include:

- fiscal instruments, such as taxes, charges, fees and subsidies. These are usually regarded as efficient means to achieve a fair balance in terms of social costs, but social acceptance and feasibility may be a problem.
- regulations and standards in support of sustainable mobility, e.g. concerning vehicle emissions, speed limits, vehicle safety, inspection and maintenance, and traffic management. Common agreement may be needed at the European level to maintain equal competitive conditions.
- infrastructure policy, including investment, maintenance and financing on the supply side, and the charging framework on the demand side.
- planning interventions to control land use and its transport implications.

- local traffic controls, for instance on the supply and pricing of parking spaces.
- voluntary measures secured through consensus and co-operation with industry/society, e.g. voluntary agreements on fuel consumption, impact reduction targets, information programmes and best practice promotion, and eco-labelling.

There are also policy opportunities in areas such as:

- telematics to increase the efficiency of existing networks and freight logistics;
- modern technology in vehicle design, road maintenance, noise reduction, safety equipment etc.;
- alternative infrastructure design such as new tunnelling solutions for road and rail.

All of these options can contribute, as part of a balanced policy package, to meeting the challenge of reconciling economic and social goals with environmental costs.

4. RTD OBJECTIVES

The development and implementation of the Common Transport Policy calls for research to achieve efficient and cost-effective transport networks for goods and passengers under the best possible environmental, social and energy consumption conditions, within the general objective of sustainable mobility.

The Transport RTD Programme provides information to support decision making and quantify the foreseeable impact of the various possible options, in support of Community transport initiatives at both national and European levels.

The goals of the Programme are:
- to develop a more efficient, safer and more environmentally friendly transport system for passengers and goods;
- to facilitate the interconnection and interoperability of the separate transport networks;
- to increase the efficiency of each individual mode and improve co-operation between them;
- to promote the design and management of infrastructure with a view to reducing the damage to the environment and improving the quality/price ratio;
- to provide industry, transport operators and users and authorities with the appropriate decision-making instruments based on better knowledge and understanding of mobility, traffic flows, their interactions and interdependencies.

The general objective of the research is to arrive at pre-normative or pre-legislative conclusions, making it possible to incorporate into the transport sphere new policy options and facilitate the implementation of new technologies. In addition, the research will further the development of the European Union by establishing the preconditions for an efficient trans-European transport system.

More specific RTD objectives within FP4 relating to an integrated perspective on sustainable mobility are:
- to develop policy scenarios relating to the achievement of sustainable mobility criteria and the use of fiscal measures;
- to develop models and methodologies for evaluating all direct and indirect costs and benefits of transport, including externalities such as accidents, pollution and congestion;
- to model the impact and sensitivity of pricing and other policy measures on modal split, route choice and transport demand;
- to identify an optimum interaction between different modes including appropriate economic and other instruments;
- to develop transport demand management strategies, and tools for assessing their effects on accessibility, economic conditions and the environment;
- to identify potential transport policy strategies and test them against CTP-related targets.

5. SUMMARY OF RESEARCH CLUSTERS

5.1 Overview

The RTD projects contributing to the development of an integrated perspective on sustainable mobility can be considered within eight topic areas or “clusters”, each relating to one of three categories of research. These clusters are:

RTD categories	**Clusters**
Enabling research	*Understanding the market* *Visioning the future* *Tools and methods*
Applied research	*Transport management* *Pricing and financing* *Mobility management* *New technologies and transport concepts*
Policy research	*CTP and TEN-T*

The enabling research provides the information base and assessment methods to support other RTD. This feeds into applied research, where particular strategies are developed and evaluated. In turn, the policy research compares these strategic options, evaluates their impact on CTP objectives, and identifies policy actions to facilitate the most promising measures.

All of the projects tend to have common elements: dissemination, demonstration or case study, provision of best practice guidelines etc. Moreover, their scope often overlaps - for instance combining policy work with the development of methods, or considering various strategies in combination. Given this complexity, this paper concentrates on identifying key contributions to the theme, rather than surveying the full extent of each project.

5.2 RTD clusters

This Section defines the scope of research in each cluster. More specific objectives are given in Section 6. The titles and objectives of relevant RTD projects are listed in Annex 1, together with a Table identifying the cluster(s) to which each project contributes most strongly.

Understanding the market

Research aimed at *understanding the market* looks at the prevailing economic factors, organisational structures and barriers to change within the existing transport markets. The focus is on establishing improved ways of working and recommending guidelines for their introduction.

Visioning the future

Work on *visioning the future* takes a longer-term view. It identifies trends in transport supply and demand and the underlying driving forces, in order to identify the needs and opportunities for substantive change.

Tools and methods

Policy research is underpinned by the development of *tools and methods*. These provide the data collection techniques, databases, models and assessment methods necessary for robust analysis of policy options and their effects.

Transport management

Research into *transport management* covers a wide range of measures, which would be used in combination in any integrated approach to sustainable mobility. These include land-use and transport planning, physical infrastructure, traffic control and demand management measures. The purpose of RTD is identify the effects of single and combined measures and provide advice on their implementation.

Combined *land-use and transport planning* aims to reduce the need to travel and make best use of public transport services. Similarly, *infrastructure measures* are often targeted on reducing car usage and promoting public transport, for instance through parking management and bus priority measures. *Pricing* is usually a key measure in controlling demand, and *traffic management* contributes to the efficiency of traffic flow.

Pricing and financing

In the area of *pricing and financing*, the research aims to show that pricing measures reflecting the *real* costs of transport use (e.g. including environmental damage) are an efficient and viable way of influencing transport demand and travel patterns. Such measures include road user charges, parking fees, fuel taxes, vehicle taxes, and public transport fares and subsidies.

Mobility management

Another contribution to transport sustainability comes from making more efficient use of the existing transport facilities and minimising the number of vehicle trips. This is *mobility management*. Mobility management includes strategies such as the co-ordination of car sharing and load sharing on trucks. The measures are usually based on information, communication, organisation, co-ordination and promotion/marketing. RTD has been promoting best practice in this area.

New technologies and transport concepts

In the area of *new technologies and transport concepts*, the research is assessing the potential contribution of new ways of delivering and organising transport services. This covers both passenger and freight transport. Three main approaches are considered:

- innovative transport solutions based on new vehicle and infrastructure technologies, such as advanced telematics;
- new modes to alleviate surface congestion, such as airships and underground freight systems;
- city logistic schemes and freight platforms where goods are transferred at terminals to a highly efficient delivery system.

CTP and TEN-T

At the highest level of policy research, a number of strategic projects are assessing the options for achieving *CTP and TEN-T* objectives. This requires methodologies and tools for assessing the impacts of policy strategies, particular measures and infrastructure investments.

6. SYNTHESIS OF FINDINGS FROM COMPLETED PROJECTS

This Section provides a synthesis of the research objectives and main findings from completed projects for each of the RTD clusters defined in Section 5. The key results, policy implications and achievements of individual projects are summarised in Annex 2.

Results from the following projects have been included in the current version of this thematic paper:

Clusters	**Relevant RTD projects**
Understanding the market	AFFORD, CONCERT-P, INTRAMUROS, LEDA, MINIMISE, PRIVILEGE, PROMOTIQ, REDEFINE, SOFTICE, STIMULUS
Visioning the future	EUROMOS, POSSUM, SCENARIOS, STREAMS
Tools and methods	ASSEMBLING, BRIDGES, ECONOMETRIST, EUROSIL, HIPERTRANS, INFOSTAT, INFREDAT, INTERNAT, MAESTRO, MEST, MESUDEMO, MYSTIC, OD-ESTIM, PROTEE, SESAME, SITPRO, SMARTEST, STEMM, TEST
Transport management	CAPTURE, DANTE, INCOME, MOTIF, OPIUM, OPTIMA, PRIVILEGE, START, TASTE, TRANSLAND
Pricing and financing	AFFORD, CAPRI, CONCERT-P, EUROTOLL, FATIMA, FISCUS, PATS, PETS, PRIMA, QUITS, TRANSPRICE, TRENEN
Mobility management	CAMPARIE, ICARO, INPHORMM, MOMENTUM, MOSAIC
New technologies and transport concepts	DIATS, FANTASIE, LEAN, RECONNECT, REFORM, TRANSINPOL, UTOPIA
Evaluating the CTP and TEN-T	ASTRA, CODE-TEN, MINIMISE, SAMI, TENASSESS

6.1 Understanding the market

Research objectives

Specific objectives of research in this area are:

- to identify, through surveys and demonstrations, how to overcome the institutional and political barriers to the implementation and acceptance of pricing measures;
- to provide guidelines on implementing the most effective legal, regulatory, technical and organisational measures to promote sustainable transport;
- to identify the main factors affecting demand and costs in the freight sector, the effects of taxation policies, and the implications for policy harmonisation between Member States;
- to evaluate the potential for improving logistics and introducing door-to-door multi-modal transport services.

Main findings

Getting prices right will require legal and institutional reform

Pricing based on marginal social cost (charging users for the environmental damage, congestion and other costs they create) is widely perceived as one of the most important levers for promoting sustainable mobility. Surveys carried out within the Transport RTD Programme have indicated that the legal and institutional frameworks required to implement such pricing have, so far, not been put in place in many EU Member States. This will require action at a national level, for instance to introduce institutions with the powers to control transport pricing across cities and regions and across transport modes (rather than trying to construct complex relationships across multiple local authorities).

Actions are needed to make new charges acceptable

Surveys also showed that successful pricing would need effective communications to overcome public opposition. Marginal cost pricing, especially prior to implementation, is regarded with a lot of scepticism and even hostility. It may be politically vital to redistribute a significant majority of revenues to the local or regional population that pays, whether or not the funds are used for transport.

Part of the argument to be used in favour of pricing lies in the benefits to consumers. Modelling work has shown that packages of pricing measures can yield substantial welfare and environmental benefits. This needs to be communicated.

On-site demonstrations of road pricing measures have indicated that public acceptance of road pricing measures may be higher if revenue hypothecation is *visible* (e.g. improving local public transport using the taxes raised on roads in the same area). Such hypothecation would require national governments to introduce the necessary enabling legislation. The demonstrations also showed that drivers tend to change their time of travel and choice of route to incur lower road prices before they consider switching to public transport. A greater level of modal transfer would require policies to ensure a good public transport alternative.

Enabling legislation is needed in several areas of policy reform

The absence of enabling legislation has been identified as a barrier to policy development in a number of areas besides pricing. In particular:

- Gaps have been noted in national frameworks that inhibit the introduction of *alternative transport concepts* – such as car sharing, demand-responsive public transport and mobility management services. For instance, it may not be possible to grant preferential parking to vehicles that are used for car sharing, and information and awareness campaigns are often not covered by legislation.
- For a number of potential *network management measures* aimed at reducing congestion (such as restrictions on general road use), the legal framework has not yet been put in place. This situation varies from country to country, as does the political and social acceptability of different measures.
- *Planning systems* are often weak, in that they fail to integrate spatial development with transport and environmental aspects. For example, planning approvals may not require new developments to be sited adjacent to public transport or to have limited parking provision.

Countries can develop more effective policies by sharing experiences

To help cities learn from each other, a web-based database has been developed covering experiences with over 200 legal and regulatory measures used in 41 European cities. It enables stakeholders at a city level to search for examples of experiences with measures that interest them. A brochure is also available, covering 20 less well known but effective measures.

There was found to be no simple correlation between city characteristics and the transferability of measures between cities. Therefore guidelines have been devised to aid cities in assessing the transfer of experiences to their own situation. The most significant barriers to transfer were found to be political and public acceptance (which themselves are often closely related). The keys to gaining acceptance include a thorough consultation process and a targeted public awareness campaign.

New methods of market analysis give a clearer understanding of likely reactions to policies

In view of the importance of public acceptance, a new approach to *structuring the responses of different stakeholders to transport measures* has been developed as a software tool. The method involves the identification of natural groupings of people with a particular psychological outlook on the world, and was shown to lead to better understanding and prediction of the target audience than traditional methods of segmentation.

For example, segments such as car users and public transport users have traditionally been regarded as different target audiences with different preferences and requiring different communication campaigns. However, surveys showed that few differences exist between these groups.

Institutional co-operation is also vital to the implementation of many measures. Therefore a decision support tool has been developed, aimed at helping the various organisations responsible for different aspects of the urban transport system to identify areas where greater co-operation is possible between them. It was concluded from test applications that there is no single organisational, financial and legal structure that will best encourage transport integration for all the different types and sizes of urban areas in Europe – hence the need for analysis at a local level.

Freight market conditions vary substantially between countries

Considerable RTD has been devoted to understanding the freight market and the barriers to increased efficiency and new services. Factors relating changes in the structure of industry and supply chain logistics to changes in road freight demand were shown to be complex. Quantitatively different behaviour is found in different countries and between different types of commodity. *An increase in the average length of haul (typically 20-40%) was identified as the single most important contributor to increased road freight demand in recent years*.

Related research has looked at the factors affecting road freight costs and the consequences of different tax policies on the freight market. Survey results showed that drivers' wages are the largest single cost factor (especially for collection/distribution operations), and fuel is the next largest factor (especially in long distance haulage). These factors, and consequently cost-competitiveness, vary substantially between countries. Total tax costs also vary between countries, ranging from 10% to 25% of the total operating cost of long haulage trucks. For 100km distance, EU prices are between 3 and 8 times higher than in Eastern European countries, but prices are closer for long distance freight. Typically, transport costs account for around 3% of the total costs of industrial production, but with significant variations by industry sector. Case studies suggested that systematic violation of traffic rules could reduce costs per tonne-kilometre by up to 30-40% in some countries.

There is strong resistance from shippers to taking freight off the roads

Feedback from shippers indicated that, when faced with policy changes or traffic problems, they are more willing to consider measures like increasing transport prices or changing shipping times than anything to do with modal transfer. The unwillingness to change mode is largely attributed to bad experience with other (non-road) transport modes, no matter whether that experience has been directly suffered or just reported by other companies.

Survey responses indicated that internalisation of the external costs of road transport (environmental damage, infrastructure costs) is increasingly considered by freight operators as a fair principle and an effective means of fighting congestion. However, *the magnitude of price increases that operators would expect in inter-urban transport is not enough to cause major modal transfers* – and there is a lack of non-road alternatives for urban freight. A strong improvement in efficiency and quality from other modes is necessary in parallel for shippers to consider the scale of modal transfers thought desirable to meet policy goals.

Thus two of the key challenges for the development of more sustainable European freight transport are:

- *intermodality*, i.e. encouraging the use of non-road modes in a door-to-door trip, and
- *interoperability*, i.e. enabling ease of movement across the European network in an open and competitive market.

The development of intermodal freight requires policy action, especially deregulation

The potential for a new generation of door-to-door multi-modal transport services has been studied for six market segments:

- rail traction;
- short distance (<300km) intermodal transport;

- small shipments in intermodal transport;
- segments where quality (speed, reliability etc.) is at a premium;
- integration of air transport into multi-modal chains;
- short sea shipping.

It was concluded that *deregulation and competition* are the key to new intermodal services, with the shippers and transport providers developing joint operations. Priorities for policy changes were proposed to be:

- early moves towards the *efficient pricing regimes* already proposed by the EC (e.g. for track access and terminal use);
- establishing a *pan-European regulator for intermodal transport* (with the task of harmonising market liberalisation and access to infrastructure in the EU Member States);
- encouraging *public-private partnerships* along the transport chain, particularly involving door-to-door shippers;
- providing limited *subsidies* for new and improved intermodal infrastructure;
- establishing and promoting *standards* (e.g. for loading units, electronic data interchange and harmonised procedures/documentation at transhipment points and border crossings);
- allocating further funding to *research and development*, particularly concerning information systems and technologies for faster transhipment;
- continuing EC support for *pilot projects* in combined transport;
- organising roundtable *meetings between stakeholders* in each Member State, tasked to identify and remove barriers to intermodality.

Impediments to interoperability in trans-European transport were identified for seven sectors: parcel services, road freight, rail transport, waterborne transport, intermodal transport, air transport, and urban/inter-urban public transport. Benefit/cost ratios were evaluated for a range of measures to improve interoperability, such as improved border control facilities, harmonisation of regulations and investment in Electronic Data Interchange. Twenty-six measures were shown to have a positive benefit/cost ratio.

6.2 Visioning the future

Research objectives

The goals of work on *visioning the future* are:
- the development of a common "reference scenario" for future European research on policy options in pursuit of sustainable mobility;
- the preparation of 20-30 year forecasts and scenarios for transport demand and technology development, and the identification of socio-economic and environmental impacts and policy implications.

Main findings

A baseline scenario has been defined for European transport policy development

A "reference scenario" has been developed for the European transport sector for the year 2020. This is based on the projection of current trends up to the horizon year, and covers socio-economic variables, regional effects, transport supply and demand, and the effects of European liberalisation and harmonisation policies.

For *passenger* transport, anticipated trends are:
- increasing journey lengths, due to improved transport links and urban sprawl;
- increasing car dependency, due to ageing of the population, lifestyle changes and income effects;
- increasing long distance trips, due to globalisation of business and growing demand for international holiday travel.

For *freight* transport, key influences are:
- globalisation of production and markets;
- networking to rationalise business processes;
- new information and communication technologies;
- "greening" of the business context.

Most of these influences point to an increase in freight transport, especially long-distance trips. Electronic commerce and "green" pressures may slightly reduce the growth rate.

The reference scenario supports the development of quantitative forecasts

The reference scenario for liberalisation and harmonisation policies has been used in the European Commission's pilot Strategic Environmental Assessment of the Trans-European Transport Network. For the road sector, the scenario shows a decrease or no change in costs under liberalisation policy, and an increase in costs due to harmonisation measures. For rail, costs will increase under liberalisation but remain stable under harmonisation.

To support the use of the reference scenario in policy development, the scenario assumptions have been incorporated in a software model of transport supply and demand in Europe, suitable for forecasting *aggregate* statistics. This shows a 50% increase in passenger-kilometres from 1994 levels in the year 2020, and a doubling of freight tonne-kilometres. The number of kilometres of "overloaded" transport links is predicted to double to 9% of the network.

Alternative scenarios identify policies that are robust and merit early introduction
In contrast to a *reference* scenario, *alternative* or *contrasting* scenarios help policy-makers to explore the consequences of uncertainty in future socio-economic and political developments. For this purpose, a set of such scenarios has been developed for the European transport system through to the year 2020, showing how it is possible to meet CTP objectives for economic efficiency, regional development and environmental protection. The scenarios explore alternative social and political developments outside the transport sector, and show what transport policies would then deliver the targeted outcomes. A number of early policy actions would be appropriate across all scenarios:

- *Tax reform* – a shift of the tax base from labour to the use of natural resources in order to strengthen incentives for dematerialization and energy conservation.
- *Experiments with low emission zones* – providing an incentive for the market to select clean vehicle technologies.
- *Tele-commuting* – experimenting with tele-working options in conjunction with land-use planning.
- *Road pricing* – taxation on the use of congested urban roads, coupled with measures that provide alternatives (such as quality public transport).
- Actions to provide *integrated information systems*.

Scenario analysis advises on how to implement policy
Since the CTP faces large uncertainty but has high potential impact, scenario analysis implies that the appropriate strategy is to proceed in small steps with frequent re-evaluations. It is also preferable to try several solutions in order to learn. The role of public policy is then to promote innovation, support experiments, and set the conditions for selection of options through market forces.

Some key conclusions for the development of policy towards sustainable mobility were as follows:

- Both new technologies *and* the decoupling of transport growth from economic growth are needed to achieve sustainability targets.
- For technological innovation, action is needed at the European level to build consensus and provide incentives for rapid movement along clear technology trajectories. Support for innovation may need to precede open market developments.
- The CTP must be complemented by measures outside the transport sector (such as tax reform, regulation of information technology, and land-use planning).
- Those measures that have a long lead time (e.g. aimed at changes in behaviour) must start early.
- Measures should be adapted to local conditions where uniform national or European policies would be inefficient.
- The Trans European Networks must form part of an integrated transport strategy, such that they do not simply encourage more travel overall.
- The growth in air travel and the increased demand for leisure activities (e.g. from an ageing population) will act as other major constraints on the achievement of sustainable mobility targets.

Scenario analysis identifies the conditions for new mobility services
Scenarios have also been developed for travel patterns in European cities for the year 2010, with the introduction of 16 types of new mobility service. These include:

- private services, such as transporting children to and from school;
- demand management, such as the sale of capacity on private road infrastructure;
- car leasing and sharing arrangements.

Strong traffic demand management, restriction of individual motorised transport in the central business district and support for other modes would favour the development of these new services. However, regional planning may be needed to inhibit the dispersion of homes and businesses to areas outside the traffic management zone. Otherwise the collective transport services may not remain financially economic. Policy-makers will also need to look at the conditions for competition between traditional public transport, the new intermediate services, and private taxis.

Scenario analysis helps to identify significant new technologies

As a spin-off from the work on the reference scenario, projections were made for the evolution of technologies, not based on trends, but rather on the conditions for their entry to the market. The main conclusions are as follows:

- *Intelligent transport systems* will have the most significant impact on transport in the year 2020. Their use for traffic and safety regulation will depend on European-wide agreement on standards and financing schemes.
- The contribution of *intermodality* will be a matter of improved organisation rather than technology, and will depend primarily on the extent of policy support.
- *Information technologies* (teleservices) are expected to play a key role in society as a whole, but not so much in the transport system. Teleworking and videoconferencing may become a substitute for some business traffic, but they may also foster traffic generation by making more time available.
- *Magnetic levitation* technologies are difficult to finance and environmental concerns are leading to the development of underground solutions. They will not have a significant influence on transport supply in Europe by 2020.
- *Autonomous urban transport systems* are expected to spread from 2010 onwards. This will follow the standardisation of telematic systems, especially automatic debiting systems, on which they rely heavily for operation.

6.3 Tools and methods

Research objectives

Particular targets of RTD in this cluster include the development of:
- methods for collecting and organising data on transport flows, transport infrastructure networks, land-use and travel patterns;
- the building blocks of a European Transport policy Information System (ETIS);
- tools and techniques for evaluating technology and infrastructure projects, including the Trans-European Transport Network (TEN-T);
- simulation models for more effective control in a congested road network.

Main findings

Methods for providing statistical information on transport must be radically improved
European integration has seen dramatic changes in mobility patterns to meet developments in economic activities. However, the statistical tools to monitor these patterns and support policy-making have changed little, and some sources of data (particularly border controls) have disappeared with the development of the Single Market. In particular, there is a lack of data on international flows, the TEN-T, new logistic services, transport chains and intermodality. Moreover, a software structure is needed to make these data widely available in a decision-useful form. Therefore RTD has been directed towards both the collection of data and defining the ETIS system for data handling.

New methods have been developed for collecting travel data
A common European survey methodology has been developed to acquire data for long distance trips, based on the recording of travel diaries. This provides a benchmark for the current survey work of Member States and commercial data providers. A combination of telephone and postal contacts is used to improve travellers' response rates, and new analytical methods offer greater cost efficiency and accuracy than previous methods.

Linked to this, the use of new technologies for collecting, analysing and disseminating travel survey data has been piloted. These tests have demonstrated the potential to improve data quality and reduce costs by automating data transfer. Applications include:
- the use of hand-held computers during trips for data collection;
- web-based data entry for the completion of long distance travel surveys;
- the use of geographical information systems to improve the accuracy of recording place names visited during trips;
- web-based access to stored data.

New methods have been devised for estimating travel data from secondary sources
Other research on transport data has addressed the need for information on origin-destination flows. Methodologies have been developed for building origin-destination matrices for passenger and freight transport at a pan-European level from currently available data, and for characterising intermodal freight flows. In addition, for countries with few data, methods have been devised for estimating inter-regional flows based on a quantification of the relationship between socio-economic variables and the associated demand for transport. (The latter approach is based on the premise that adequate economic data are often accessible when transport flow data are missing.) These methodologies have been tested successfully in pilot-scale applications.

For the freight sector, the research demonstrated that paper and telephone-based interview methods could be used to trace shipments from origin to destination through each link of the transport chain, and thereby estimate pan-European trip matrices. This supplements the collation of published statistics.

More work is needed to allow automated data collection from information systems
A survey of electronic data interchange (EDI) systems showed that the information required to build freight trip matrices often exists in the computer system of the originator of the consignment. However, automation of data collection from these systems would be difficult without standardisation. The research concluded that it is not practical to use data from EDI and tracking and tracing systems at present. However, there is an immediate opportunity to introduce an EU-wide *standard for freight data collection formats*, to feed into the new EDI products currently being developed at a time of rapid change in freight logistics systems.

It will also be important to establish an organisational structure for data management that safeguards sensitive data and ensures quality. For example, in the freight sector, it appears that surveys among shippers need to be sponsored by official agencies, since companies are reluctant to respond to non-governmental initiatives.

More work is needed on data collection to support land-use planning
Land-use planning measures are perceived as an important means of influencing transport demand and trip patterns in the longer-term. However, relatively few data are available that would indicate the effects of such measures. Therefore a common set of indicators and methods has been provided for city planners to facilitate more effective policy decisions. A sample database of values for those indicators has been created, covering 40 European cities. Recommendations have been made concerning the extension and harmonisation of future data collection, such as travel demand surveys and parking surveys.

A European Transport policy Information System (ETIS) has been defined
All these various developments in data gathering will support the development of the European Transport policy Information System (ETIS). ETIS is planned to support decision-makers in both public and private sectors in understanding changes in mobility, logistic patterns and the effects of policy measures. It will handle new statistical concepts such as transport chains, intermodality, families of commodities with the same logistical requirements, performance indicators for transport quality, congestion and environmental hotspots, corridors and networks, and the accessibility of regions and cities.

Through the work of the Transport RTD Programme, the principles and concepts for ETIS have now been defined and data requirements assessed. A general architecture and structure have been proposed, and a process defined for its development. A critical conclusion underlying the methods put forward is that data can best be supplied at the national level, but processed at different levels, rather than being assembled into a single centralised and fully harmonised data system. The data architecture should be based on the (top-down) policy questions to be addressed, while working within the (bottom-up) constraints of data availability.

The architecture for ETIS has been devised and software components tested
The suggested architecture is a network of interconnected co-operating systems, allowing access to external databases, processing that data to create a structured core database, and supporting the analysis and viewing of subsets of data that relate to specific policy issues at regional, national and European levels.

In a further step, RTD has provided tools to support the connection of ETIS to external software modules, including a directory of information sources relevant to ETIS, a proposed standard format for data exchange between transport databases and models, and applications to simplify the interface with end users. Several non-ETIS decision support systems have already been developed using these tools, and are being used by planners and decision-makers in the European Investment Bank and local planning authorities.

This modular architecture is seen as one of the key achievements of the work on ETIS. Information and communication technologies are expected to evolve rapidly, and new databases and more advanced transport models are expected to emerge in the next few years. Only a highly decentralised, interconnected and open architecture will have the flexibility to adapt and exploit the power of the Internet.

Data gaps have been identified and data management techniques evaluated
Pilot studies found that existing national data are too heterogeneous to be harmonised and too scarce to provide European coverage at a satisfactory level of geographic detail for ETIS. Therefore some effort will be needed to encourage countries to enrich and adapt their present systems of data collection. There are also problems with the confidentiality of operators' data to be overcome. Nevertheless, trade and transport databases were successfully harmonised in a demonstration tool focused on trans-Alpine traffic. In another demonstration of feasibility, a pilot database was developed for freight movements along transport chains.

The most significant data gaps and harmonisation needs for ETIS were identified as:
- the social determinants of transport;
- origin-destination flows, especially for transit flows and transport chains;
- intermodal transport demand;
- infrastructure for transport networks;
- data on transport prices and reliability;
- data on the economic and land-use impacts of transport.

As described above, the Transport RTD Programme has already been addressing the methodological requirements to fill some of these gaps. In another development, a prototype has been established for an information service on the use of transport infrastructure and corridors. Here, a network of web sites demonstrated user-friendly access to harmonised information coming from a pilot group of monitoring centres (defined as local, regional, national or trans-national bodies that manage information relevant to transport or its impacts).

Methods of project evaluation have been made available
ETIS itself will provide an essential input to the evaluation of major transport investments. To support the evaluation process, the Transport RTD Programme has developed a number of tools and methods. These cover the management and evaluation of pilot-scale projects as well as complete transport corridors.

Generic guidelines have been developed for the selection, design and evaluation of individual pilot and demonstration projects. These guidelines cover the various decisions and evaluation phases through the entire life cycle of the project, from the definition of the transport problem, through project design and initial evaluation, to implementation, final evaluation and exploitation of the results. In a similar way, a more focused guide to good practice has been developed specifically for city-based projects with clean vehicles and fuels.

The expected users include decision-makers (such as funding agencies), project managers, experts in the project team, and other stakeholders. A vital feature of both sets of guidelines is the provision of a "quality assurance" framework, ensuring that the project results give clear-cut answers to the *policy-related* questions/issues that called for the piloting of the new transport solution. In addition, the guidelines advise on making findings transferable between different city and national contexts, and on taking the decision whether or not to proceed to full-scale implementation.

Evaluation methods have been put forward for radical innovations and long-term impacts
In complementary research, a new methodology has been developed and tested for the evaluation of projects involving *radical or break-through innovations*. The core idea is to consider a project as an exploration of alternative possible outcomes. Whereas most other evaluation methods try to gain as much information as possible on these outcomes, this new approach focuses on the structuring and evaluation of the learning process itself. It uses indicators of key factors that influence the probability of failure of an innovation. These allow the project champion and an external evaluator to assess the "quality" of the learning curve of the innovation, and thereby decide whether or not to continue the exploration.

Another problem in project evaluation lies in assessing policy impacts that may not necessarily materialise for several years. Therefore, similar to the case of radical innovations, progress along the *pathway* towards these impacts has to be evaluated as a proxy indicator. A methodology has been recommended for this purpose. Evidence suggests that the strength of the relationship between the promoters and the users of the research is a key determinant of the rate of progress. In the area of strategic policy research, where there are many potential stakeholders (the majority of whom are not aware of relevant projects), it was recommended to minimise the barriers to dissemination and exploitation by:

- providing the infrastructure for web-based access to project Deliverables at a Programme level, and providing a structured information system to help potential users determine what research may be useful to them;
- making Deliverables available during the course of each project;
- encouraging wide-reaching dissemination to the research community (presentations, journal articles, newsletters etc.), as well as workshops and networking for more in-depth investigation by lead users.

(Such dissemination is precisely the purpose of the EXTRA project that has been responsible for this thematic paper and the web-based Transport RTD Programme Knowledge Centre.)

Evaluation methods have been provided for strategic transport investments such as TEN-T
Other evaluation guidelines and software have been developed to support decision-making on long-distance transport investments, specifically to take into account the impacts of multi-modal links on regional development. This covers the selection of criteria for the evaluation,

the choice of traffic modelling methods, the estimation of impacts, and the definition of weighting factors for combining different impacts according to the selected criteria.

These guidelines have been complemented by the development of computer models for passenger and freight transport that simulate mode and route choice for European networks and specific major corridors, and by the identification of new techniques for Strategic Environmental Assessment to support future evaluation of the TEN-T.

The computer models have been calibrated for selected countries and routes. For example, case study results indicated that:

- Charging road and air passenger transport with emissions-dependent costs would provoke stronger changes in modal split than infrastructure investment.
- For cross-Channel freight traffic, any move towards greater use of combined transport and rail must take positive measures towards rail – purely restrictive policies towards road transport would have little effect.
- Rail deregulation and the introduction of freight-ways could be crucial in increasing the share of intermodal transport for trans-Alpine goods traffic (e.g. from less than 15% to more than 50% in 2010). Important complementary measures would be the extension of the rail network and a mileage tax to internalise the external costs of road freight. Any strategy would need to be co-ordinated between the Alpine countries to avoid undesirable detour traffic.

New simulation tools support traffic management and planning

In the final area of RTD on tools and methods, modelling tools have been developed for traffic simulation, aimed at traffic planners and network managers. This work is particularly aimed at tackling the threat to sustainable mobility posed by increasing traffic congestion. The tools focus on two applications:

- the design and operation of urban traffic control systems;
- the simulation and prediction of traffic management problems caused by incidents, heavy traffic, accidents and roadworks.

Work has focused on microscopic simulation of the dynamics of vehicle movements, which can provide a more effective tool than traditional traffic network models for assessing behavioural responses. A good practice manual has been produced identifying how to make best use of existing simulation models. In addition, new software has been developed to fill the most important gaps in these models. The new tools include:

- real-time simulation of traffic movements in the road network and the effects of different urban traffic control systems;
- faster than real-time prediction of the consequences of traffic hold-ups;
- powerful visualisation capabilities.

6.4 Transport management

Research objectives

Transport management uses a wide range of measures in combination, including land-use and transport planning, physical infrastructure, traffic control, information systems, network management and demand management. Research aims to identify:

- the most effective strategies for trip reduction, travel avoidance and mode switching;
- good practice in the use of such measures, especially in combination;
- advice on the impacts of alternative strategies, such as the effects on infrastructure financing and cost recovery.

Main findings

Pricing is the most effective single way of reducing travel demand

The problems of traffic congestion (particularly in cities) have increased interest in strategies to *reduce the demand for travel*, as a complement to policies aimed primarily at the efficient management of traffic (discussed later in this Section). Research has indicated that the most cost-effective measures for reducing demand are based on pricing (see also Section 6.5). *In a city*, road pricing per kilometre or at a city cordon performs well, while parking charges have a less direct impact and may not work where there is extensive private off-street parking within the congested area. Subsidies to urban public transport are considerably less effective.

On inter-urban roads, the use of tolls to reduce traffic is more problematic. The dominant response from users is likely to be a diversion to alternative routes rather than a switch to alternative modes or a reduction in the total amount of travel. This is likely to be counter-productive in terms of environmental and congestion costs.

The most effective strategy for travel reduction involves a package of measures

A good practice guide has been developed for the selection and implementation of traffic demand reduction strategies, particularly aimed at city authorities. This covers some 30 measures, illustrated by case studies. "Push" measures to deter the use of vehicles (e.g. road pricing, fuel taxes) are seen as more effective than "pull" measures (e.g. improving alternative modes), and even essential. But travel reduction is found to be most likely where both "push" and "pull" measures work together in a *package*, with the revenue from the former being used to fund the latter.

As examples of the "package approach", land use planning measures are needed to constrain the decentralisation of population and economic activity to locations beyond an area in which traffic restrictions apply. Fuel taxes, vehicle taxes and road pricing need to be co-ordinated so that the right signals are sent to vehicle users in congested areas, while avoiding inefficiently high taxation in rural areas. Public awareness messages are needed to encourage a change in travel behaviour, as well as providing information on the available alternatives.

Modelling confirms the choice of measures for urban transport

To complement guidance based on good practice, new modelling methods have been developed to assess urban transport strategies. These methods allow theoretically optimum strategies to be defined for specific cities, according to criteria such as sustainability and economic efficiency. Again, it was found that optimal strategies involve a *combination* of measures. Also, there is no single best measure or strategy for general application. Nevertheless, some general recommendations could be drawn:

- *economically efficient* strategies can be expected to include low cost improvements to road capacity, improvements in public transport (increased service levels or reductions in fares), and increases in the cost of car use (either road pricing or increased parking charges);
- public transport infrastructure investment is not likely, in most cases, to be a key element in these strategies;
- reductions in capacity to discourage car use are not likely to be economically efficient;
- the optimal changes in service levels and fares for public transport will depend on the current level of subsidy - in some cities a reduction in service levels or an increase in fares may be justified on economic grounds;
- the optimal increase in costs of car use will depend in part on current levels of congestion;
- in most cases, economically efficient strategies can be designed which can be funded from user charges.

The modelling showed that the pursuit of *sustainability* (rather than pure economic efficiency) is likely to justify investment in public transport infrastructure, further improvements to public transport services and/or fares, and further increases in the cost of car use. However, the availability of finance will be a major barrier to implementation of many strategies that are optimal for sustainability.

Of course, other tools also exist for the assessment of transport demand management strategies. Therefore guidelines have been developed, providing a general procedure for using the available tools in an integrated way. Case studies showed that investment in appropriate tools achieved an economic payback within one year or less.

Land-use planning is vital for a sustainable effect on transport over the longer term

Travel reduction policies are not the complete answer to sustainable mobility. Scenario analysis has shown that, in the short and medium term, the likely travel reductions from demand management strategies are only of the order of one or two years' growth in (unconstrained) demand. Policy actions may still be desirable, but the lesson is that there is no *simple* strategy that will *dramatically* affect levels of congestion in the short to medium term. Therefore there has been strong interest in the use of policy to change patterns of land-use *in the longer term*, aimed at reducing the extent of vehicle movements.

Overall, transport policies have been found to be more direct and efficient than land-use planning controls in moving towards a sustainable urban transport system. Nevertheless, land-use policies are seen as an essential *accompanying* strategy for creating less car-dependent cities *in the long run*. Information policies are also necessary, both to influence behaviour and to increase social acceptance of other tougher measures.

Member States have much to learn about good practice in land-use/transport planning

A review of existing practice in the combined planning of land-use and transport has led to the following conclusions:

- Combined land-use and transport policies are only successful in reducing travel distances and the share of car travel if they make car travel *less attractive* (more expensive or slower).

- Land-use policies to increase urban density or mixed land-use (e.g. locating homes near factories and services) without accompanying measures to *discourage car use* have only little effect.
- Transport policies to make car travel less attractive depend on trip start and end points not being excessively dispersed already. Co-location of specialist businesses in certain areas and the increase in multiple worker households also set limits on the co-ordination of work places and residences.
- Large dispersed retail and leisure facilities increase the distances travelled by cars and the share of car travel. Land-use policies to prevent the development of such facilities are more effective than land-use policies aimed at promoting high-density mixed-use development.
- *Fears that policies to constrain the use of cars in city centres are detrimental to the economic viability of those centres have in no case been confirmed by reality, except where massive out-of-town retail developments have been approved at the same time.*
- Transport policies to improve the attractiveness of public transport have in general not led to a major reduction of car travel, but have contributed to further suburbanisation of the population.

Despite the interest in land-use controls, research has shown that planning systems are often weak, in that they fail to integrate spatial development with transport and environmental aspects. For example, planning approvals may not require new developments to be sited adjacent to public transport or to have limited parking provision. The Netherlands and the UK were identified as examples of promising practice in this respect.

Travel reduction measures create a problem for private financing of infrastructure
RTD has also identified that travel reduction measures create a problem for policy towards the *financing* of transport infrastructure. In order to develop private sector interest in the financing and management of road infrastructure projects, the public sector will need to develop new ways to pay for roads. Otherwise, would-be investors will be deterred by the sensitivity of income projections to new traffic reduction initiatives.

Findings on the effectiveness of traffic management measures have been made available
Traffic *reduction* strategies are complemented by traffic *management* strategies, aimed at increasing the efficiency of vehicle flows and encouraging the use of different modes. Both types of strategy can be achieved through *physical* infrastructure measures, and through the use of traffic management *systems* such as urban traffic control.

The Transport RTD Programme has provided detailed findings on the effectiveness of physical transport measures. These measures include bus lanes, public transport prioritisation, improvements to junctions and interchanges, area access restrictions and controls on central area parking.

- *Schemes to restrict road space and parking space* for private cars have proved very successful in terms of their impact on travel behaviour and consequent environmental benefits. The main difficulty lies in opposition from shopkeepers, although residents and visitors are generally supportive.
- *Traffic calming* reduces overall traffic speeds and noise at a local level. This is perceived to benefit vulnerable users and could reinforce measures to promote modal shift.

- *Parking management and guidance* appear successful in reducing circulating traffic at a local level, and could influence modal split if implemented widely across a city. Parking measures are generally self-financing.
- *Public transport priority* does not have a strong influence on modal split, but improves the speed and reliability of bus services. Greater modal shift might be achieved if priority measures are implemented more extensively or integrated with traffic restrictions and improvements to bus services.
- *Measures to favour cyclists and pedestrians* have only limited effect on modal shift when used in isolation, but are perceived by users to improve safety.

The greatest environmental benefits are achieved where road space is closed to private cars or where traffic volumes are reduced. Park-and-ride and parking schemes are successful in this respect. However, measures that lead to slower speeds and increased journey times, such as traffic calming and bus priority, result in an increase in pollutant emissions.

Physical infrastructure measures support other policies

Overall, it was concluded that physical measures do not *in themselves* generally have a major short-term impact on modal split, unless they are large in scale. Nevertheless, physical measures are important because they can improve the performance and perceived advantages of public transport. This is an essential precursor for a change in travel behaviour, whatever the levers (pricing, green commuter plans etc.) used to induce that change. Similarly, they may encourage a change in behaviour when people periodically re-assess their travel decisions due to changing circumstances such as a job or house move.

City experiences show that physical measures are not easy to introduce. The most common barriers include conflicts of interest between the institutions involved, a lack of funds, and opposition from affected stakeholders. Experience suggests that only two or three institutions need to be involved in the implementation process for serious conflict to arise – highlighting the importance of building consensus throughout the process. Small-scale, low-visibility cheap solutions are the most readily implemented. However, these run the risk of failing to achieve large-scale change, unless introduced as part of an overall vision and strategy.

Traffic management needs a package of measures

The research on traffic management concluded that modal change requires a package of measures in a well thought-out strategy. Individual measures can yield benefits in their own right, even if used only locally, but their deployment as part of an integrated strategy has the potential to yield significantly greater benefits. In particular, public transport priority and bicycle measures are increasingly effective at larger scale.

It is apparent that there are no “off-the-shelf” solutions for cities to apply. For example, bus lanes have had good success in some cities and little in others. Changes must be planned individually, taking into account local conditions, the ease of implementation and user reactions. City size is not a major factor in determining the most appropriate measures, but city type (historic versus modern) may be significant.

At the national and European policy levels, good practice examples need widespread dissemination, particularly to counter popular perceptions about the effects of access restrictions and pedestrianisation on city centre trade.

Guidance is available on the implementation of traffic management

As noted above, *restrictive* policy measures are seen as effective in managing traffic. To use them, city authorities need to assign different levels of priority to different user groups (such as public transport). A good practice guide has been provided for this purpose, setting out 31 individual measures for urban road traffic priority management. The catalogue includes implications for enforcement and skeleton plans for the introduction phase.

Other support for the implementation of traffic management strategies has aimed at improving urban public transport through a better matching of service characteristics with the requirements of different groups of users. For this purpose, new market research methods have been devised. The trial application of these methods showed that:

- Passenger priorities differ substantially between countries, with only punctuality/reliability commonly achieving a high ranking. The postulated importance of travel speed in modal choice may be over-rated. Therefore user needs must always be confirmed locally.
- Previous market research has often focused on frequent travellers, and thereby failed to spot the different needs of other user groups. For example, only low importance is attributed *on average* to pre-trip information, but this aspect is significant for infrequent and potential users.
- The correlation between delivered and perceived quality is weak. Direct measurement of satisfaction will remain the most reliable indicator of product quality as seen by the customer, rather than a more objective measurement of quality indicators.

Guidance is available on advanced traffic control systems

To complement the work on physical and regulatory measures, RTD has also looked at the potential benefits of *integrating* innovative traffic control and information/communication technologies within an overall traffic management system. Simulation modelling and field trials were used to evaluate combinations of such technologies. A guidebook has been compiled for transport managers and local authorities, summarising the results, infrastructure requirements, factors affecting the benefits, and other implementation issues.

Examples of the potential benefits include:

- *Bus priority in urban traffic control*. Public transport achieved journey-time savings of around 5-15% with a payback period of less than two years.
- *Integration of UTC priority and automatic vehicle location for buses*. This allows selective priority to be given to buses that are running late, thereby improving reliability. Predicted improvements in bus regularity and in passenger waiting times are around 10%.
- *Bus gating at traffic signals*. This involves holding back queues of private vehicles at traffic signals on strategic routes, allowing buses to overtake along segregated bus lanes. The bus lanes doubled the savings in bus delay compared to bus priority alone at traffic signals.
- *Fully integrated traffic management systems.* Sharing of data and control signals between sub-systems in Turin has reduced travel times for both general traffic and public transport by 20%, with an accompanying modal shift of 3% to public transport. Local pollutant emissions were estimated to fall by 21%.

6.5 Pricing and financing

Research objectives

The projects on *pricing and financing* cover a spectrum of inter-related objectives:

- to show that pricing at marginal social cost can, in practice, help to internalise transport externalities (such as congestion and environmental impacts) and regulate demand in a socio-economically efficient and equitable way;
- to evaluate the effects of pricing schemes and tolls on modal split, traffic volumes and travel patterns;
- to demonstrate technical solutions, such as the use of integrated pricing and payment systems covering multiple transport modes;
- to identify the barriers to the implementation and acceptance of pricing measures, and show how they can be overcome;
- to provide modelling tools to help assess external costs, appropriate pricing and financing strategies and the transport consequences.

Main findings

Transport prices should be reformed

The research concluded that, in principle, pricing policy should be based on “marginal social costs”, charging users for the *additional* costs they cause through infrastructure use, including externalities such as accidents, air pollution, global warming and noise. This is a central strategy for the development of sustainable mobility.

Charges can take account of congestion, pollution and accidents in practice

RTD results show that *all* of the main externalities can be taken into account in pricing structures, even though some uncertainty exists in their estimation. Specific evaluation methods have been recommended for particular impacts, and a handbook has been prepared giving practical guidelines on evaluation, aimed particularly at urban policy-makers, planners and transport operators. This handbook also advises on how to finance urban transport systems, covering new mechanisms (such as private finance and taxing land values) as well as the application of user charges and public budgets. Other work has similarly demonstrated practical methods for calculating marginal social cost for *all* modes, illustrated through case studies on transport corridors.

Near-optimal charges can be implemented in practice

The projects commonly found that existing pricing mechanisms and levels are failing to provide appropriate signals to influence behaviour. For example, greater differentiation in road charges by time period and area is necessary to cope with congestion resulting from heavy peaks in travel demand. Electronic road pricing may form one part of the solution, but other pricing measures such as parking and cordon charges were shown to be *more cost-effective and practical* in many situations.

Surveys have indicated that the legal and institutional frameworks required to implement marginal cost-based pricing (such as congestion charging) for transport have, so far, not been put in place. Therefore action is needed at a national level, for instance to introduce institutions with the powers to control transport pricing across urban regions and across transport modes.

Charges may go up or down

The current price of *inter-urban* car travel is estimated to be too high relative to the marginal social cost in 2010, partly as a result of tighter vehicle emissions regulations. On the other hand, the research confirmed the case for *urban* road pricing in congested cities. A substantial switching of trips onto public transport is justified in the urban case, with a reduction of car traffic of up to 40%.

In the case of road freight, long-distance freight is generally under-charged (with the exception of the Transalpine corridors through Switzerland), because taxes do not increase sufficiently with vehicle weight and distance travelled.

For the railways and other public transport, efficient pricing is again likely to require greater peak/ off-peak differentials in tariffs, and also an element of public funding (particularly for short-distance urban services). Nevertheless, in some places existing subsidies are already excessive. Improving the service quality and investment in infrastructure may be the most important measures for improving modal shares, as opposed to internalisation of externalities for all modes via the pricing mechanism – this is particularly the case for freight transport.

However, the existing range of pricing policies in EU Member States is so varied that the impacts of introducing marginal cost pricing have to be assessed on a case-by-case basis. *The extent and direction of any price changes will depend strongly on current levels of taxation and charging*, and will not necessarily imply lower travel demand. Thus it is not universally true that the more environmentally friendly modes would uniformly benefit at the expense of other modes.

Nevertheless, *as a broad conclusion*, pricing reform to reflect social marginal cost is likely to involve:

- a decrease in prices for inter-urban road and rail passenger transport and an increase in the price of urban road travel (particularly for the private car and at peak periods of congestion);
- an increase in prices for both road and rail freight.

New patterns of charging will change travel behaviour

The effects of road pricing measures in urban areas have been demonstrated. In one city, charging for road use during peak periods according to the level of congestion reduced traffic levels by more than 10%. This was mainly due to drivers changing their time of travel, with a smaller decrease in the total number of trips due to trip suppression or modal shift. In another city, 15-20% reductions in daily car travel could be largely attributed to drivers switching to public transport. Nevertheless, the overall conclusion is that *drivers tend to travel at different times or by different routes before considering switching to public transport*.

Demonstrations and modelling work in other cities confirmed that road pricing *can* change modal split from private car to public transport and Park & Ride, giving city centre traffic reductions of 5-30%. Cordon pricing is particularly effective when applied to congested central areas and over peak periods (reducing car trips by up to 25%). Pricing of parking also restrains car trips, provided enforcement is effective. Integrated payment systems (such as smartcards) have a small impact on modal split on their own (especially for Park & Ride), but more importantly support pricing measures that are co-ordinated across different transport modes.

Pricing reform will benefit society as a whole
Modelling work has shown that packages of pricing measures based on marginal cost pricing can give rise to substantial welfare benefits for the urban population. Annual gains may be up to 400 Euro per capita, depending on the city context and measures applied, and may be dominated by the environmental benefits. A major part of this gain may depend on the effective use of the revenues, for instance allowing a reduction in labour taxes.

The equity effects of pricing are estimated to be moderate (either negative or positive). Overall, accessibility is reduced, particularly for car users, due to the reduction in trips. However, if revenues are used to subsidise public transport services, then accessibility may even be increased for most of the population.

Pricing reform can be made acceptable
Extensive user surveys in various cities have shown that public acceptance of new pricing measures is low, particularly among motorists, even though pricing is perceived to be an effective tool. *To increase acceptability, the introduction of pricing should be staged*, starting with simple systems with low charge levels. In addition:

- The revenue should be earmarked (or "*hypothecated*") for specific spending programmes such as public transport, or returned to the local population in some other way.
- *Compensating measures* should be considered for social groups that are disadvantaged by the pricing scheme.
- *Guarantees* should be given over the protection of privacy.
- *Evidence* should be provided that pricing measures have been effective in solving transport-related problems.

Methods have been provided to implement and evaluate pricing reform
To support the evaluation of pricing measures, the Transport RTD Programme has developed and tested a methodology for assessing the various costs specific to *individual* journeys/routes, for different modes of transport, trip purposes, desired times of arrival and expected lengths of stay at destination. These costs include direct costs (e.g. fuel), the value of travel time, and external costs such as accidents, air pollution, noise and global warming. The methodology focuses on modal comparison, and is useful for benchmarking purposes. For instance, substantially lower externalities have been illustrated for rail compared to road transport on some routes.

Models have also been developed to illustrate the performance of different policy instruments in reflecting external costs in transport prices. Case studies gave the following results:

- *Parking policies*: making all road users pay for the resource cost of their parking place plus an extra charge can be very effective, achieving 1/3 to 2/3 of potential societal benefits and reducing congestion.
- *Emissions taxes and standards*: stimulating the use of cleaner cars is important for urban areas, but may not be cost-effective in non-urban areas.
- *Fuel tax policies*: higher fuel taxes could reduce car traffic in urban areas and on peak period inter-urban trips. However, other traffic (such as off-peak road freight) may also be unjustifiably inhibited. Fuel taxes are therefore not a good instrument for pricing reform, due to the lack of differentiation between different transport markets.

- *Reduced subsidies to public transport*: once the pricing of car transport has been corrected, public transport fares should not be set below the marginal social cost and should differ between peak and off-peak periods.
- *Simple congestion pricing*: cordon pricing in urban areas and congestion pricing on inter-urban highways can realise a substantial fraction of the benefits of optimum pricing.

Modelling shows the relation between charging and financing mechanisms

Other modelling work has provided a methodology that, in many cases, cities can use to identify optimal strategies that can be *fully funded from user charges*. For other cities where private finance is needed for capital investment, the optimisation procedures can identify the appropriate modifications to the strategy to achieve the best performance within the financial constraint.

This methodology shows that *private sector* operation of public transport reduces the net social benefits of the optimal transport strategy, particularly under full deregulation. If a city authority decides that private operation of public transport *is* beneficial, it should ideally use a form of *controlled competition* in which it specifies the objectives and the optimal service levels and fares.

6.6 Mobility management

Research objectives

Mobility management aims to make more efficient use of existing means of transport and minimise the number of vehicle trips to traffic-generating sites (such as schools, companies, hospitals and shopping centres) through the use of organisational, information and awareness tools. It includes strategies such as better information on sustainable transport solutions, improving collective transport for specific user groups, the co-ordination of car-pooling and public awareness campaigns. *Projects in the Transport RTD Programme have been influential in raising the awareness of mobility management practices and promoting their acceptance across Europe*.

Research into mobility management and associated information measures has aimed at:
- demonstrating and evaluating new mobility management concepts, strategies and tools;
- providing guidelines on measures and instruments at local and national levels that can support mobility management;
- disseminating best practice.

Main findings

Concepts for mobility management have been defined and demonstrated

Based on a survey of mobility management approaches in use across Europe and beyond, integrated concepts have been defined for mobility management strategies and "mobility centres", and for the transfer of strategies between locations. These concepts address all types of traffic and trip purposes.

Certain strategies were demonstrated in a number of cities across Europe. These focused in particular on the use of mobility centres and the targeting of commuter trips. From these experiences, a number of good practice guides have been prepared. These include a user manual aimed at the initiators and managers of new schemes, a brochure for policy-makers and the owners of major traffic-generating sites (hospitals, companies etc.), and a CD-ROM defining the different elements of mobility management.

Critical success factors have been identified

The following general lessons were drawn on the implementation of mobility management strategies at a site level:
- *The creation of partnerships between stakeholders* (including transport operators, community groups, local councils and local businesses) is crucial.
- *Target efforts onto selected users* (such as companies or young people) rather than spreading efforts across a wide range of user groups.
- *Use networking opportunities* such as the European Platform on Mobility Management (EPOMM) to learn from other people's experiences.
- *Select the strategy according to the national context*, such as the attitudes of users and their reaction to "push" measures such as car parking restrictions.
- *Use promotion and awareness-raising campaigns* as a key element in the delivery of new schemes.

The demonstrations showed that mobility consultants and mobility centres can achieve some modal shift and are effective in encouraging the adoption of Mobility Plans and Green

Commuter Plans. The greatest success was obtained with the largest organisations and sites (500+ employees), and such organisations should be targeted first. An additional benefit of mobility management was seen to be the raising of awareness of transport alternatives – which may then be stimulated more strongly by other policy measures such as pricing.

Car-pooling is most effective at a workplace

A more focused study on car-pooling found that this is most successful for employees from the same workplace. Therefore initiatives to promote this behaviour are best targeted on the workplace, particularly by working with companies. In contrast, *general* promotion campaigns for car-pooling were found not to be effective.

The willingness to car-pool increases with the distance between home and work. However, flexible working hours can pose a serious obstacle. (Nevertheless, other research has shown that staggered working times across companies and flexibility of working hours within companies can decrease pollution by cutting congestion at peak periods.)

The provision of high-occupancy vehicle lanes was shown to be an effective way of increasing car occupancy. "Matching centres" to put drivers and passengers in touch are also effective, provided sufficient people join the database. Preferential parking for car-pool vehicles at the workplace has limited impact though, especially where parking is readily available and free of charge. No convincing evidence was found for guaranteed ride home schemes influencing the decision of people to car-pool.

In many countries, success in car-pooling requires national action to remove obstacles and enact supporting legislation. For example, the tax treatment for reimbursement of costs between car-poolers may need to be defined and the insurance situation for car-pooling clarified. Regulations for high occupancy vehicle lanes still need to be included in national traffic regulations in various Member States. Linked to this, a harmonised European car-pooling sign for high occupancy vehicle infrastructure should be agreed.

Good practice has been compiled for information and awareness campaigns

The change in behaviour required by mobility management is strongly dependent on communication tools. A review of over 120 transport information and publicity campaigns has been compiled, and good practice guidelines developed which target a range of organisations. These include recommendations for local authorities, public transport operators, major institutions and their site managers, and environmental, cycling and walking groups. Three types of campaign are described in detail – public awareness campaigns; campaigns for targeted groups and settings (such as schools and workplaces); and campaigns aimed at individual travellers and households.

In addition, a software tool has been developed that provides information on more than 100 previous campaigns (mainly concerning public transport). It is designed to help practitioners identify experiences relevant to their own situation. The software is complemented by guidelines on the *process* of designing a campaign.

The analysis of previous experiences shows that:

- Communications as part of an integrated transport plan *can* enable changes in travel behaviour. However, many organisations have failed to achieve good practice in the past.
- Practical advice and ongoing support are essential to maintain such changes.

- *The success of a campaign is maximised when combined with one or more specific policy measures (such as traffic restrictions or a new public transport service).*
- Mixes of measures and mixes of campaigns seem to have an increased effect relative to isolated efforts.
- Among the most effective campaigns are those co-ordinated by partnerships (such as between operators, site owners and local authorities). Co-ordination of national and local campaigns is also important, leading to greater media coverage.
- General awareness campaigns need to be repeated at regular intervals – otherwise they lose their "power" to influence behaviour. Campaigns targeted on specific groups (such as schools, workplaces and neighbourhoods) have stronger and longer-lasting effects.
- Times of change for individuals, organisations and communities are worth targeting. Examples include people moving house or changing jobs, businesses moving site and new housing developments.
- Most of the campaigns studied can be transferred to other locations, with appropriate adaptation.

6.7 New technologies and transport concepts

Research objectives

The aims of the research into *new technologies and transport concepts* are:

- to assess the technical, economic and environmental potential of such innovations;
- to develop policy guidelines on how to promote these concepts and remove policy/market barriers;
- to provide local actors with good practice guidance on their design, introduction and operation.

Main findings

Key technologies for policy purposes are telematics and advanced vehicles/propulsion

The Transport RTD Programme has studied the potential contribution to sustainable mobility of all sorts of new transport technologies and concepts. In addition, it has conducted more specialised investigations of promising areas.

The most wide-ranging review identified and assessed new technologies that could have a *major* impact on transport systems in Europe and the attainment of the objectives of the Common Transport Policy over the next 30 years. This provided a wealth of information covering specific technologies, vehicle and system concepts, their market shares, and the aggregate impacts on safety, efficiency and the environment across the EU.

Particularly promising technologies were seen as:

- *telematic technologies* – likely to be of benefit across all impact categories – such as on-board emissions management, multi-modal traveller information and trip planning, dynamic route planning and navigation, electronic tolling, anti-collision systems, smart cards, intelligent cruise control and traffic management systems;
- *fuel cell and hybrid propulsion systems*, offering significant energy and environmental benefits;
- *improvements in the conventional car*, such as advanced turbo-diesel engines, direct injection gasoline engines and reduced weight;
- *tilt rotor technologies* for air transport, giving significant fuel savings and noise reduction;
- *airships* for moving heavy and bulky loads;
- new systems for *personal rapid transit*;
- *road trains*.

Transport technologies require generic and specific policy suppport

The research also identified implications for policy. Policy options to promote new technologies can be generic (trying to improve the conditions for innovation) or specific to certain selected technologies. Some experts on technology policy prefer generic options because these allow the market actors to come up with new ideas and the most cost-effective solution. However, the realisation of specific technologies often requires changes in legislation and regulations to remove barriers – generic policy action may be insufficient. Therefore a combination of the two approaches is recommended:

- *Generic* measures are needed across the transport sector, such as standardisation, R&D funding, pilots and demonstrations.
- Packages of policy measures should be directed towards *specific clusters* of technologies, such as propulsion systems, urban transport technologies, intermodal systems, air traffic

management systems, travel information, and road traffic management and payment systems.

Road traffic management systems will improve both safety and congestion
Telematic technologies seem to hold great potential, not only because of their positive benefits, but also because they may face lower barriers to market deployment than innovations (such as alternative fuels) that have to compete with a strongly entrenched conventional technology. A focused assessment of the options for deploying advanced transport telematics for road traffic management in Europe over the next 10 years has shown that:

- *The option of greatest current interest is automatic incident detection coupled with variable speed limits*. This has been found to reduce unsafe situations and the duration of congestion for drivers approaching an incident. Variable speed limits also provide some safety benefits on motorway sections that are prone to prolonged heavy congestion.
- Roadside warning lights can improve safety, particularly in areas with poor visibility and prone to bad weather.
- Ramp metering is effective at reducing main carriageway congestion at peak levels of traffic flow. However, national guidelines are needed for the implementation of metering, for example to minimise disruption on approach roads.
- Adaptive cruise control is unlikely to have significant impacts on traffic efficiency in the near future. Technology penetration rates above 20% are required for this.

Certain technologies create policy issues
There is a policy dilemma over the choice of vehicle headway for adaptive cruise control. Nationally recommended headways are somewhat greater than those observed on busy motorways. If drivers stick to national recommendations, motorway capacity will be reduced and congestion increased. If drivers select a smaller headway, the establishment of liability in the event of an accident will be affected. In addition, there are a number of other legal issues for the introduction of this technology.

Policy issues have also been identified in the areas of information and communication services, comprehensive payment systems, and satellite communication and navigation systems. These include:

- privacy issues in relation to the European Directive on data protection;
- implications for competition law and regulations on access to infrastructure, resulting from the potential for anti-competitive conduct;
- the lack of a liability framework in case of damage caused by errors or failures, which may be best addressed by a European Directive in the context of the Galileo satellite system.

Innovative concepts for urban freight look promising
Of course, significant innovations in the transport sector do not depend solely on technology. One important example, combining both a new service concept and advanced logistics systems, is the development of *freight platforms*. These are transhipment areas where many transport companies (such as forwarders and logistic service providers) are located, and ideally where at least two transport modes are connected. They allow the efficient consolidation of loads, reducing the number of vehicle movements to distribute goods within the city centre. However there is only limited experience and knowledge of how such platforms perform. Therefore a database of 96 European freight platforms and their key characteristics has been created, and a handbook developed for local authorities and transport sector companies.

The handbook provides guidance and evaluation methods for establishing new freight platforms. Topics include:

- financial and organisational issues, and their impact on the efficiency of platform operations;
- the impact of technology, equipment and design on platform efficiency;
- evaluation of potential impacts on urban traffic and the environment.

These impacts have been tested by computer simulation at sites in Berlin, Brussels, Rome and Madrid. Depending on the local situation, the introduction of freight platforms would have different levels of benefit, for example reducing truck kilometres by 15% in Rome. Other studies have illustrated the potential to offer cost savings to freight service providers (e.g. around 10% for a proposed scheme in Vienna).

To support the operation of such “city logistic” schemes, information technologies will be increasingly important. For example, a system has been devised for “load zone management”, which is the automatic reservation of space in a city centre zone for loading and unloading lorries (supported by stricter enforcement of regulations to prevent illegal parking by private cars in that zone). It aims to reduce traffic jams due to parked cars and lorries blocking the street. The design is based on Internet access, making it available to a wide range of users without them needing special software.

Guidance has been developed to support the introduction of cleaner vehicles and fuels

Freight platforms focus on improving the *efficiency* of transport. A complementary means of improving the urban environment is the use of *cleaner vehicles and alternative fuels*. There are many barriers to the introduction of these new technologies, such as high capital and lifetime costs and a lack of refuelling infrastructure. However, certain niche applications such as public sector fleets can provide a way of lowering some of the barriers, supported by policy actions. In addition, demonstration projects are important in developing market acceptance.

Software tools and guidelines have been developed to help project managers and policy-makers develop appropriate strategies towards cleaner vehicles, based on test site experiences across Europe. These include:

- an assessment of the *most promising applications* for cleaner vehicles and supporting measures, from a city perspective;
- recommendations on *policy actions* at the European and national levels to promote or facilitate market introduction and demonstration;
- a good practice guide to setting up and running *pilot and demonstration projects*, aimed at potential project champions;
- a software tool which provides information and *assessment methodologies* covering clean transport solutions, to support city planners and vehicle operators.

Key conclusions on the role of supporting policies were as follows:

- The most important policy measures are *fiscal incentives*. A distinction is needed between incentives to kick-start the market for individual fuels, and efficient incentives in the longer term that are not technology-specific (e.g. differential rates of fuel taxation based on relative environmental damage).
- *Demonstration projects* have an important role in testing technologies, stimulating the market and raising consumer awareness.

- Information measures such as *eco-labelling* and *green fleet certification schemes* are important, especially where the label remains on the vehicle in everyday use.
- *Green procurement* by Governments, whether voluntary or mandatory, can be significant in creating an initial market for new fuels and providing a signal to private consumers that these fuels are serious.
- *Technical standards* for vehicles and fuels are important in creating a unified market and ensuring consumer confidence.
- *Low Emission Zones* that allow city centre access only for clean vehicles, and *Quality Contracts and Partnerships* between local authorities and fleet operators, are new powerful tools for encouraging cleaner vehicles at a local level. Governments may need to provide the regulatory framework for their implementation and enforcement.

Airships are a promising and inexpensive means of reducing congestion
New transport concepts could also help to tackle *urban congestion*. For example, comparative assessment showed that high capacity elevated passenger transport systems (such as the H-Bahn Dortmund and the Wuppertaler Schwebebahn) offer good potential for reducing congestion as the backbone of a public transport system. Nevertheless, the infrastructure needs and total costs are high. For freight, underground concepts (such as the Underground Logistics System proposed in Amsterdam) provide an efficient means of distribution. Again, infrastructure costs are fairly high, but can be reduced using new small-bore tunnelling technologies.

In contrast, airships are promising for point-to-point operations in both passenger and freight transport, and their costs are *not* particularly high. For example, they may allow bulky and heavy items to be taken to the final destination, replacing a whole shipment chain.

Financial and commercial hurdles pose the biggest obstacle to these new concepts, particularly for public transport. However, tailor-made transport services such as airships are proving more attractive to private investors. Regulatory barriers are also significant, particularly for automated and driver-less vehicle concepts.

6.8 Evaluating the CTP and TEN-T

Research objectives

Specific aims of research concerning the *CTP and TEN-T* are:

- to develop methodologies and tools for assessing the impacts of policies and strategies relative to CTP targets;
- to provide support for decision-making on transport infrastructure investments, especially TEN-T;
- to identify measures to promote the interoperability and economic efficiency of the European transport system.

Main findings

The development of transport policy is complex. It has to take account of uncontrolled influences from outside the sector, and also its own impacts outside the sector. Changes have to be anticipated in both the short and the long term, over wide spatial areas. The combined effects of a range of interacting measures need to be estimated. Different policy-makers may attach different weights to the various decision criteria, and must take decisions in the face of uncertainty. Therefore, to assist policy-making in the face of such complexity, the Transport RTD Programme has developed and tested a number of decision support tools. These are summarised below.

Evaluating the strategic impacts of investments in transport corridors

The first of these tools concerns the TEN-T and similar network investments. Multi-modal corridors across Europe represent costly infrastructure programmes that require phasing. Classically, economic evaluations are critical in decisions on prioritising projects. However, in the context of *network* development, a more strategic assessment method is needed, taking account of the socio-economic and political context. This is essential to support the policy of expanding the European Union to Baltic and Central European countries.

Therefore a tool has been developed for assessing the strategic impacts of the development of pan-European corridors. The tool applies a scenario approach to elaborate consistent images of the future through to the year 2015, featuring high or low rates of economic growth and fast or slow integration of neighbouring countries into the EU. Using these images, the alternatives for corridor development are subjected to impact assessment to help in decision-making.

The tool is supported by a comprehensive information system covering 30 European countries. This provides information on politics, regional socio-economic data, regional road information, foreign trade, transport costs, resource costs, networks and maps. This has been used to support in-depth corridor studies for the Trans-European Transport Network. Combinations of road and rail projects were generally found to offer the greatest benefits. The method could also be applied more generally to other infrastructure programmes.

Evaluating the interactions between the transport sector and the wider economy

A second tool has explored how to model the *long-term interactions* between the transport sector and other sectors of the economy. It uses a “system dynamics” methodology to assess the wider socio-economic and environmental impacts of transport policy packages over a 25-year time horizon. This is achieved by linking sub-models covering macro-economic activity, regional economics and land-use, transport demand and environmental impacts, and using feedback loops to capture the inter-relations between variables.

The tool was used to simulate the effects of policy packages of varying complexity. Overall, a fully integrated set of measures produced the best results. Other significant points from the policy analysis were as follows:

- None of the tested packages was able to meet the Kyoto requirements for abatement of greenhouse gas emissions.
- No further significant improvement could be identified for road accidents.
- Air transport growth would be significant in all scenarios, and in some cases would counterbalance most of the environmental benefits of policies giving a reduction in road transport.

Evaluating policy in the face of uncertainty

A third tool has aimed at assisting the development of complex transport policies in *uncertain* situations. For this purpose it includes:

- scenarios that describe alternative possible political and socio-economic contexts within which the impacts of policy options can be evaluated;
- a model of the European transport sector with a short run time that allows the rough screening of the effects of a large number of policy variables;
- an evaluation methodology and software for comparing different transport strategies. This includes a number of approaches, such as multi-criteria analysis, the evaluation of uncertain or fuzzy data, and the determination of the acceptability of policy options against threshold criteria.

Evaluating policy from multiple perspectives

Related research has found that many of the problems in developing coherent policies on pan-European transport relate to the variation in policy *processes* between Member States. The following aspects have specific importance:

- the distribution of responsibility between national and lower levels;
- the extent of master planning and evaluation frameworks for transport;
- the degree of stakeholder (including public) involvement in decision processes.

This leads particularly to conflicts over the relative role of European, national, regional and local levels, the trade-off between economic and environmental objectives, and the rate of deregulation and restructuring of the transport market. This has adverse effects on the strengthening of regional links through efficient cross-border transport.

To help to overcome some of these conflicts, a tool has been developed for assessing the effectiveness of different measures and investments against policy objectives. The model helps different stakeholders to make explicit how they rate specific policy objectives and project impacts. Another software tool has been developed to help users anticipate barriers in the *implementation* of transport infrastructure projects and policy initiatives.

It was concluded that a clearer distinction is needed between policy plans and infrastructure plans. Policy plans should be enhanced to include measurable objectives and performance indicators. Infrastructure plans should show a closer consideration of strategic policy goals (such as regional linkage), e.g. through the process of Strategic Environmental Assessment.

The links between national and European policy plans should be made explicit, so that variations in national strategies can be understood and co-ordinated where appropriate.

Evaluating the barriers to interoperability in trans-European transport

The lack of coherence in policy-making is evident in the various impediments to interoperability in trans-European transport. These have been highlighted through detailed case studies. Cost-benefit evaluation indicated a range of positive measures to improve interoperability. Based on this, the following recommendations were made for policy actions:

- for *parcel services*, further liberalisation of the letter market, simplification of border crossing procedures, and abolition of regulatory requirements for documentation of parcels in some Member States;
- for *road freight*, funding the faster introduction of information technology, investing in border crossing facilities with Eastern Europe, and reform of regulatory controls on vehicle operations;
- for *rail transport*, applying a competition regime (e.g. concerning State Aid and market organisation) that creates an efficient single market;
- for *waterborne transport*, promoting the use of information technology, reducing and harmonising customs paperwork, and harmonising port and customs operating practices while minimising restrictive labour regulations and practices;
- for *intermodal transport*, setting up a competitive and non-discriminatory process for the management of infrastructure (such as rail freight freeways) and for the allocation of scarce capacity;
- for *air transport*, improving the systems for pricing the use of infrastructure and for slot allocation, improving air traffic control, and collecting more extensive statistical data to support policy development;
- for *public transport*, encouraging deregulation through franchising of routes, and promoting the appointment of transport authorities to manage through-ticketing structures and the use of smartcard ticketing.

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ANNEX 1 RTD PROJECTS CONTRIBUTING TO THE THEME

This Annex lists (in alphabetic order) the titles and objectives of RTD projects relevant to the urban transport theme. The following Table identifies the RTD cluster(s) to which each project contributes most strongly.

Clusters	**Relevant RTD projects**
Understanding the market	AFFORD, CONCERT-P, INTRAMUROS, LEDA, LOGICAT, MINIMISE, PRIVILEGE, PROMOTIQ, REDEFINE, SOFTICE, STIMULUS
Visioning the future	EUROMOS, POSSUM, SCENARIOS, SCENES, STREAMS
Tools and methods	ASSEMBLING, BRIDGES, CONCERTO, ECONOMETRIST, EUROSIL, HIPERTRANS, INFOSTAT, INFREDAT, INTERNAT, MAESTRO, MEST, MESUDEMO, MYSTIC, OD-ESTIM, PASTEUR, PROTEE, SESAME, SITPRO, SMARTEST, STEMM, TEST
Transport management	CAPTURE, DANTE, INCOME, MOTIF, OPIUM, OPTIMA, PRIVILEGE, START, TASTe, TRANSLAND
Pricing and financing	AFFORD, CAPRI, CONCERT-P, EUROTOLL, FATIMA, FISCUS, PATS, PETS, PRIMA, QUITS, TRANSPRICE, TRENEN
Mobility management	CAMPARIE, ICARO, INPHORMM, MOMENTUM, MOSAIC
New technologies and transport concepts	DIATS, FANTASIE, LEAN, RECONNECT, REFORM, TRANSINPOL, UTOPIA
Evaluating the CTP and TEN-T	ASTRA, CODE-TEN, MINIMISE, SAMI, TENASSESS

Project acronym	Title	Objective(s)
AFFORD	Acceptability of fiscal and financial measures and organisational requirements for demand management	The project aims to show that marginal cost based pricing measures are both efficient and feasible. The pricing methods to be considered include road user charges, parking fees, fuel taxes, vehicle taxes, and public transport fares and subsidies. In particular, it is intended to show that marginal cost pricing in combination with other fiscal and financial measures can effectively internalise transport externalities such as congestion and environmental impacts, and can regulate demand in a way that is socially efficient and equitable. An equally important aim is to identify the institutional and political barriers to the implementation and acceptance of such pricing measures in Europe, and to show how they can be overcome.
ASSEMBLING	Assembling a European network of monitoring centres for transport infrastructures	The aim of the project is the establishment of a network of transport infrastructure monitoring centres devoted to transport infrastructure decision-making processes.
ASTRA	Assessment of transport strategies	The aim of the project is to develop a common methodology and tools for strategic policy impact assessment related to CTP targets and the TEN-T.
BRIDGES	Building bridges between digital transport databases, GIS applications and transport models to develop ETIS software	The aim of the project is to develop and implement the software structure supporting the European Transport Information System. This will provide a standard format for data exchange and interfaces to external software applications.
CAMPARIE	Campaigns for awareness using media and publicity to assess the responses of individuals	The aim is to recommend strategies for information management and awareness campaigns aimed at influencing travel behaviour in favour of sustainable transport modes. This will include the provision of guidelines on campaign design and implementation, and the production of a computer-based tool for strategy optimisation and impact evaluation.
CAPRI	Concerted action for transport pricing research integration	The aim is to facilitate dissemination to Member States of the results of projects dealing with the pricing of transport and to attempt to build up a consensus on the policy implications.
CAPTURE	Cars to public transport in the urban environment	The aim of the project is to assess and recommend policy instruments and strategies using physical measures designed to encourage travellers to use public transport, cycling and walking as opposed to public motoring in EU urban areas. Information on the most appropriate strategies and decision support will be provided to decision-makers; policy strategies will be tested in demonstration sites, singly or in combination; and tools and databases will be developed to ascertain the transferability of results to other urban areas.

Project acronym	Title	Objective(s)
CODE-TEN	Strategic assessment of corridor developments, TEN improvements and extensions to the CEEC/CIS	The project will provide a comprehensive strategic assessment methodology that can be applied to transport corridors, and will identify major policy-related issues as an aid to decision-makers. A tool for assessing interactions between policy instruments and corridor/network developments will be produced.
CONCERTO	Concerted action for European transport information systems	The project aims to facilitate the networking of research activities in information systems and information gathering. In particular, it seeks to feed strategic research results into policy-making, and promote the development of a European Transport Policy Information System.
CONCERT-P	Co-operation for novel city electronic regulating tools	The general aim of the project is the assessment of demand management policy instruments such as pricing/ restraint measures. The potential of the different measures will be assessed, the impact of integrated pricing/restraint measures on urban travel behaviour evaluated, the public acceptability of different forms of pricing/restraint tested, and the obstacles to their implementation examined.
DANTE	Designs to avoid the need to travel in Europe	The aim of the project is to determine the most effective strategies for trip reduction, travel avoidance, switching and substitution - for both urban and inter-urban travel. The main outcome will be a “Good Practice Guide” for cities and national governments that will summarise the opportunities for strategies to avoid the need to travel, and the conditions for their implementation.
DIATS	Deployment of interurban ATT test scenarios	The aim of the project is: to identify options for implementing “co-operative driving”, based upon ATT systems for motorways; to develop scenarios of “highest potential impact” for the identified systems; and to identify the elements needed in field tests.
ECONOMETRIST	Economic evaluation of transport activities’ impacts on Member States	The aim of the project is to assess the effects of transport sector activity on the domestic economic activity of Member States, including the impacts of new economic measures such as transport investment, pricing policies and internalisation of external costs.
EUROMOS	European road mobility scenarios	The aim of the project is to develop scenarios as a tool for evaluating future mobility trends and the impacts on policies and services, for conurbations and national transport.
EUROSIL	European strategic intermodal links	This project will provide a set of guidelines, criteria, modelling and evaluation tools for analysing modal split, intermodality and interoperability in European transport networks.

Project acronym	Title	Objective(s)
EUROTOLL	European project for toll effects and pricing strategies	The objective is to assess the potential of tolls in achieving sustainable mobility, increasing the efficiency of the transport system, and managing demand and modal split. Case studies, tools and policy analyses will be provided for decision-makers.
FANTASIE	Assessment of new technologies and environmental issues	This project aims to identify new technologies that are expected to have a major impact on EU transport systems and the attainment of CTP objectives. It will also provide a forecast and impact assessment for possible future transport systems, identify policy implications, and recommend a methodology for transport Technology Assessment at a European level.
FATIMA	Financial assistance for transport integration in metropolitan areas	The project aims to provide recommendations on financing approaches, with particular regard to the private sector role, for optimal urban transport strategies. The benefits to the private sector of optimal urban transport strategies, and the potential for obtaining private sector funding to reflect those benefits will be identified. The differences between strategies optimised using public funds and those optimised within the constraints imposed by private funding initiatives will be determined. Mechanisms by which private sector funding can be provided will be proposed.
FISCUS	Cost evaluation and financing schemes for urban transport systems	The project aims to analyse existing cost allocation methodologies and financing schemes for urban transport, and conceive new ones in response to identified gaps and weaknesses. The expected output is a European handbook for evaluating real urban transport costs and designing financing schemes.
HIPERTRANS	High performance transport network modelling and simulation	The aim of the project is to develop a visually interactive simulator for a road transportation network within a high-performance computing environment. The simulator will have real time interfacing with urban traffic control systems, and will enable traffic forecasting for the network in order to make better use of the existing infrastructure and reduce congestion levels.
ICARO	Increase of car occupancy through innovative measures and technical instruments	The project aims to provide guidelines on measures and instruments at local and national levels that can increase car occupancy. Best practices concerning technical instruments and organisational measures will be identified; the institutional, legal and cultural framework necessary for increasing car occupancy will be identified; and a methodology for selecting the right measures and instruments will be set up and disseminated.

Project acronym	Title	Objective(s)
INCOME	Integration of traffic control with other measures	The aim of the project is to develop and integrate strategies for the optimisation of Urban Traffic Control, Driver Information Systems and Public Transport Systems within Urban Traffic Management Systems (UTMS). EU, national and local policy/user requirements for integrated UTMS will be established, existing UTMS reviewed, field trials evaluated, and guidelines on the effectiveness of different strategies provided.
INFOSTAT	Information systems	The aim of the project is to develop a methodology for establishing transport databases and information systems required for strategic transport planning at a European level.
INFREDAT	Methodology for collecting intermodal freight transport data	The aim of the INFREDAT project is to develop a consistent methodology for collecting intermodal freight transport data at a European level.
INPHORMM	Information and publicity helping the objective of reducing motorised mobility	The project aims to produce guidelines showing how to use various kinds of information and publicity campaigns in order to reduce dependence on the car and levels of motorised mobility. A comprehensive review of different kinds of information and publicity campaigns will be provided, with illustrations of good and bad practice. A general model setting out relationships between objectives, information and publicity strategies, use of specific tools and likely behavioural outcomes will be developed; and a number of “concept campaigns” will be produced.
INTERNAT	Integrated Trans-European Network assessment techniques	The aim is to assess the potential of innovative techniques for impact analysis of transport infrastructure corridors and plans, such as GIS and remote sensing.
INTRAMUROS	Integrated urban transport concepts and market orientated urban transport systems/on-demand urban transport systems.	The project aims to develop tools for co-ordinating the various actors involved in urban transport management systems (local authorities, public transport operators, regional authorities etc.), covering strategic, organisational, institutional, legal and financial issues. Special attention will be paid to urban traffic control, interurban traffic control and public transport.

Project acronym	Title	Objective(s)
LEAN	Integration of lean logistics in urban multi-modal transport management to reduce space demand and optimise use of transport mode	The project aims to develop and demonstrate new concepts to distribute and collect goods in urban areas. Current European city-logistic schemes will be reviewed and the feasibility of new concepts analysed, including testing of new systems. The following topics will be studied: • logistics to improve productivity in the transport organisation; • city terminal operation to improve forwarding processes, even with additional goods transfer points and handling costs; • telematics to improve control of the goods distribution process; • policy measures to influence transport without radical disruption of economic activities; • measures to support significant modal shift to rail.
LEDA	Legal/regulatory measures to influence the use of the transport system	The project aims to study legal and regulatory measures to promote sustainable city transport, with a focus on passenger transport. Current legal/regulatory measures will be reviewed, and guidelines developed for urban authorities on how to implement the most effective measures. Recommendations will be provided to regional, national and European authorities on possible changes in the legal frameworks.
LOGICAT	Concerted action on logistic, supply and demand chain management in Europe	The aim is to determine fundamentals for formulating an overall European RTD strategy to develop logistics for purposes of competitiveness and external trade, while reducing environmental and social impacts.
MAESTRO	Monitoring assessment and evaluation scheme for transport policy options in Europe.	The aim of the project is to provide practical guidelines and procedures for the selection, design and evaluation of transport-related pilot projects, based on their contribution to identifiable policy aspects.
MEST	Methods for European surveys of travel behaviour	The aim of the project is to develop a new European long-distance travel diary.
MESUDEMO	Methodology for establishing a database on transport supply, demand and modelling in Europe	The aim of the project is to develop a methodology for setting up general European databases on passenger, goods and traffic flows, and on transport infrastructure.
MINIMISE	Managing interoperability by improvements in transport system organisation in Europe	The aim of the project is to analyse the European transport market as a whole and to design specific measures in order to promote interoperability and economic efficiency of the trans-European transport system.

Project acronym	Title	Objective(s)
MOMENTUM	Mobility management for the urban environment	The project aims to develop mobility management concepts, strategies and tools for the efficient use of current transport facilities and the avoidance of trips. Such strategies include information on available public transport, arranging of new collective transport, co-ordination of goods transport, co-ordination of car pooling and communication strategies. Strategies and tools will be demonstrated and evaluated in a number of mobility centres; and concepts for the transfer of mobility management strategies will be identified and disseminated.
MOSAIC	Mobility strategy applications in the community	The project aims to improve understanding and promote best practice in mobility management concepts. Such concepts will be demonstrated and evaluated, and the potentials for wider implementation assessed and disseminated.
MOTIF	Market orientated transport in focus	The project aims to provide guidelines on how to design better market oriented urban transport systems as part of a set of pull measures aimed at balancing modal split more in favour of collective transport systems. The guidelines will be aimed at authorities, transport operators and the transport supply industry, and will cover improvements in the market orientation of, respectively, the overall urban transport system, individual transport systems and transport components.
MYSTIC	Methodology for statistical analyses, modelling and data collection	The aim is to produce key modelling elements for forecasting passengers and freight, within a framework that can be extended subsequently into a European model/ methodology for forecasting traffic and congestion on the Trans European Networks. In particular, the work will define data collection and analysis methods.
OD-ESTIM	Cost-efficient origin/destination estimator	The aim of OD-ESTIM is to provide methods for constructing flow data for inter-regional passenger and goods transport, in a cost-efficient way, based on economic data for each region. This is based on the premise that adequate economic data are often accessible when transport flow data are missing.
OPIUM	Operational project for integrated urban management	The project aims to develop physical traffic management measures in the areas of parking management and guidance, traffic calming and bus priority measures. The impact of the measures on transport efficiency, safety and modal split in urban areas will be evaluated, with particular reference to the impact on vulnerable road users. Recommendations will be made for the future development of urban transport policies.

Project acronym	Title	Objective(s)
OPTIMA	Optimisation of policies for transport integration in metropolitan areas	The project aims to identify optimal urban transport and land use strategies for a range of urban areas within the EU. The acceptability and feasibility for implementing these strategies, both in case study cities and more widely in the EU, will be assessed and guidelines for urban transport policy within the EU will be provided.
PASTEUR	Policy assessment, scenarios, transport economics research in Europe	This project will provide recommendations on research needs and efficient policies in the areas of scenario analysis, technology integration, transport economics and policy assessment.
PATS	Pricing acceptability in the transport sector	The aims of this project are: to identify the reasons behind the acceptance/non-acceptance of transport pricing; to find measures to increase its acceptability: to find ways to harmonise pricing and fairness principles; to identify the legal and political barriers to the implementation of pricing schemes; and to design acceptable pricing schemes and policy packages.
PETS	Pricing European transport systems	The aim of the project is to evaluate the current pricing of transport modes in Member States, and to forecast the consequences of moving to a pricing structure and level which is more appropriate to the real internal and external costs.
POSSUM	Policy scenarios for sustainable mobility	The aim of the project is to develop a set of alternative policies to assist in decision making on the CTP and the TEN. Policy objectives and targets will be based on criteria for sustainable mobility.
PRIMA	Pricing measures acceptance	The objectives for PRIMA are to identify the reasons behind the acceptance or non-acceptance of road pricing and to produce recommendations for the implementation of urban road pricing in Europe.
PRIVILEGE	Priority for vehicles of essential user groups in urban environments	The aim of the project is to put various categories of private and public transport in order of priority, in terms of guaranteeing their mobility in overcrowded road networks.
PROMOTIQ	Conditions for the promotion of a new generation of intermodal transport services and operators	PROMOTIQ aims to identify the opportunities and barriers for companies seeking to develop a new generation of door-to-door multi-modal transport services, and propose guidelines for their introduction to the market.
PROTEE	Procédure dans les transports d'evaluation et de suivi des innovations technologiques considérées comme des expérimentations collectives	The objective of this project is to take advantage of collective experience acquired by national and European administrations involved in transport-related research and development activities in order to define the "collective learning process". This will be used to determine the procedures for successfully introducing new technologies and evaluating their implementation.

Project acronym	**Title**	**Objective(s)**
QUITS	Design and testing of an integrated methodology for the valuation of the quality of transport systems and services in Europe	The aim of the project is to develop and validate a methodological framework for evaluating the direct and external costs of alternative transport modes on individual inter-urban routes.
RECONNECT	Reducing congestion by introducing new concepts of transport	The aim is to identify the potential of new concepts such as underground logistics and airships in alleviating surface congestion, and to assess the requirements for their introduction.
REDEFINE	Relationship between demand for freight transport and industrial effects	The aim of the project is to model the factors affecting the increased demand for road freight transport and the way these factors relate to changes in industrial processes and logistics. Strategies and policies to simultaneously improve freight transport and logistics, improve economic competitiveness and reduce congestion will be developed and evaluated.
REFORM	Research on freight platforms and freight organisation	The project aims to provide guidelines and criteria for designing, locating and organising freight platforms in urban areas. The project focuses on co-ordination of long-distance traffic with city terminals, organisational and operational requirements for successful freight platforms, multi-modality, and the operational improvements to be expected from co-operation schemes.
SAMI	Strategic assessment methodology for the interaction of CTP instruments	The aim of the project is to define a comprehensive methodology and guide for strategic policy assessment on CTP issues, to develop policy recommendations, and to develop decision models that relate the input of policy packages to CTP targets.
SCENARIOS	Scenarios for Trans-European Network	The aim is to develop a common "reference" scenario for future European research on policy options in pursuit of sustainable mobility.
SCENES 10 - 11 - 12	Modelling and methodology for analysing the interrelationship between external developments and European transport	There are three main objectives: to produce transport demand scenarios for the EU for 2020 and beyond; to develop detailed forecasts of factors which will affect transport demand into the future; and to extend (to Eastern Europe) and enhance (with new data) a strategic transport model of the EU and carry out model runs based on the scenarios.
SESAME	Derivation of the relationship between land use, behaviour patterns and travel demand for political and investment decisions; construction of a European database	The project aims to provide an operational framework to support decision-making on local policies for land use and transport planning. The relationships between traffic, land use and externalities will be defined, and recommendations provided to planners on how to elaborate specific strategies using the SESAME tools and database.

Project acronym	Title	Objective(s)
SITPRO	Study of the impacts of the Transport RTD Programme	SITPRO aims to develop and apply a method to assess the policy impacts of transport RTD projects, and identify ways in which these impacts can be enhanced.
SMARTEST	Simulation modelling applied to road transport European scheme tests	The aim of the project is to develop a best practice manual and enhanced simulation tools for the dynamic modelling of road capacity and specific traffic management problems, such as congestion and shock-waves caused by traffic disruption.
SOFTICE	Survey on freight transport including a cost comparison for Europe	The aim of the project is to identify the main parameters affecting freight cost structure in EU Member States plus Switzerland and some CEE countries, and to identify the factors affecting freight transport demand. The effects of different policies for taxation and internalisation of costs on the spatial organisation of production will be identified, and an optimal country-related time path for the implementation of harmonisation policies defined.
START	Development of strategies designed to avoid the need for travel	The aims of the project are: to quantify the impact of road travel reduction strategies and analyse their wider impacts in order to highlight barriers to implementation and find ways of making the strategies more acceptable; to assess the extent to which pricing and other travel reduction strategies may affect infrastructure financing and cost recovery plans, with particular emphasis on the road TEN; to produce an Action Plan of policy packages to reduce road-based travel, covering all levels of decision making.
STEMM	Strategic European multi-modal modelling	The aim is to develop a methodology and models to quantify modal split and route choice for passenger and freight transport, as a tool for policy-making in pursuit of intermodality.
STIMULUS	Segmentation for transport in markets using latent user psychological structures	The aim is to characterise transport users according to their behaviour towards traffic and transport management measures, in order to provide decision-makers with a framework for assessing the likely level of acceptance or rejection of information systems, policies and strategies.
STREAMS	Strategic transport research for European Member States	The main goal is to develop a prototype model to predict the demand for transport across the EU and its broad distribution across the transport network. In addition, the project aims to produce a “reference scenario” for the year 2020.
TASTe	Analysis and development of tools for assessing traffic demand management strategies	The aim of the project is to develop guidelines and a toolbox of enhanced and integrated tools for assessing traffic demand management strategies with respect to European policy objectives.

Project acronym	Title	Objective(s)
TENASSESS	Policy assessment of Trans-European Networks and Common Transport Policy	The aim of the project is to develop a methodology that could be used in the assessment of policies and options related to decisions on transport infrastructure investments (especially TEN-T), and to provide a comprehensive assessment of the CTP.
TEST	Technologies for European surveys of travel behaviour	The aim of the project is to improve on current practice of long distance travel behaviour surveys, which are a central data source for the formulation and evaluation of European transport policies for transport infrastructure, transport regulation and financing. This includes the development and testing of electronic tools.
TRANSINPOL	Transport information systems policies	The aim of the project is to assess the effectiveness and efficiency of policy actions related to the integration of information, communication and navigation services, including payment systems.
TRANSLAND	Integration of transport and land-use planning	This project aims to identify and recommend good practice in the integration of transport and land-use planning. It will cover both the choice of policies and measures, and the effectiveness of procedures and institutional arrangements.
TRANSPRICE	Trans modal integrated urban transport pricing for optimum modal split	The project aims to evaluate the technical/financial options for integrated pricing/payment measures across modes of transport. Political acceptability will be evaluated; an analytical framework establishing the effects on modal split will be set up; a comprehensive impact assessment of integrated pricing/payment scenarios will be provided; and integrated pricing/payment demonstrations in selected European cities will be evaluated.
TRENEN II STRAN	Models for transport, environment and energy - version 2. Strategic transport policy analysis	The aim of this project is to develop and apply a set of strategic models for transport policy assessment in the field of taxation, pricing, regulation and financing.
UTOPIA	Urban transport options for propulsion systems and instruments for analysis	The main objective of the UTOPIA project is to provide decision-makers with the necessary tools and guidelines for hastening the market introduction of the most appropriate urban transport solutions based on new propulsion systems. The lessons from existing demonstration projects will be identified. Key outputs will include policy guidelines, a best practice guide to introduction methods for local transport operators, and an assessment of the most promising solutions.

ANNEX 2 MAIN FINDINGS FROM COMPLETED RTD PROJECTS

This Annex summarises the findings from completed projects for which the Final Report has been approved or made available. Project web page references are provided where known. Summaries of all projects are available from the two web sites given in Section 1 of this paper.

Index of available RTD project results:

Project acronym and title	Key results and policy implications

AFFORD:

Acceptability of fiscal and financial measures and organisational requirements for demand management

KEY RESULTS

The aims of AFFORD were to define practical measures to implement marginal cost pricing for transport in cities, to assess the potential problems and to provide policy guidelines for introducing such measures.

The project evaluated "first-best" and "second-best" policy packages based on marginal cost pricing, rather than assessing individual pricing measures. Results from modelling in four European cities (Athens, Edinburgh, Helsinki and Oslo) suggested that such packages give rise to substantial welfare benefits for the urban population. Annual gains typically vary between 100 and 400 Euros per capita, depending on the city context and measures applied. A major part of this gain may result from the effective use of the revenues, for instance allowing a reduction in labour taxes. (The benefits are therefore quite sensitive to the value or "shadow price" attributed to helping a government meet budget constraints without the need for distortionary taxation elsewhere in the economy.)

The equity effects of pricing were estimated to be moderate (negative or positive). Environmental benefits constitute a significant part of the welfare gain, ranging between 15 and 95% depending on the city. Reductions in trips by private car range between 5 and 30%. Overall, accessibility is reduced, particularly for car users. However, if revenues are used to subsidise public transport services, then accessibility may even be increased for most of the population.

Case studies and surveys in five cities indicated that the legal and institutional frameworks required to implement marginal cost-based pricing for urban transport have, so far, not been put in place. For example, these are different to the frameworks needed for road pricing on inter-urban motorways.

Surveys of public, political and business acceptability of pricing were carried out in several cities. These showed a high awareness of the underlying pollution, congestion and parking problems, but relatively little knowledge of pricing instruments. In general, pricing was perceived to be effective, but likely to lead to disadvantages to stakeholders. A majority of motorists did not accept the proposed packages of pricing measures.

POLICY IMPLICATIONS

The dependence of the welfare benefits of pricing on how the revenue is used implies that urban transport pricing is a general policy issue that goes beyond the local policy level and also beyond the transport sector. AFFORD concluded that the introduction of marginal cost-based pricing will require the creation of supporting institutions and laws, and the removal of inconsistencies in national-level policies. For example, strong institutions are needed with the powers to control multi-modal transport pricing across urban regions, rather than trying to construct complex relationships across multiple local authorities.

Successful pricing will also need effective communication to overcome public opposition. Marginal cost pricing, especially prior to implementation, will be regarded with a lot of scepticism and even hostility. It may be politically vital to redistribute a significant majority of revenues to the local or regional population that pays, whether or not the funds are used for transport.

PROJECT WEB PAGE: http://www.vatt.fi/afford/

Project acronym and title	**Key results and policy implications**

ASSEMBLING:

Assembling a European network of monitoring centres for transport infrastructure

KEY RESULTS

ASSEMBLING developed the prototype for an information service on the use of transport infrastructure, for policy-makers across Europe. A network of web sites was developed to provide user-friendly access to harmonised information coming from a pilot group of monitoring centres (Nordic triangle, Pyrenees, Rhine gateway, East Mediterranean, West Mediterranean). The information particularly concerned infrastructure projects and transport corridors. In addition, "knowledge tools" for forecasting and policy assessment were provided (building on the system dynamics approach developed in the ASTRA and SCENES projects).

A monitoring centre can be defined as a local, regional, national or trans-national body that manages information relevant to transport or its impacts. ASSEMBLING surveyed existing monitoring centres, and made recommendations for the specification of centres to feed information to ETIS – such as a well-defined remit, compatible data systems and political neutrality.

To harmonise the information systems at the five centres, ASSEMBLING experimented with two internet server solutions, both able to provide interactive communication between remote users and the databases, models and graphics tools running on the server. In addition, a central web site was designed to act as the main gateway to the ASSEMBLING information service.

POLICY IMPLICATIONS

ASSEMBLING demonstrated the feasibility of developing a network of observatories to monitor the application of European transport policies, particularly large infrastructure projects. This provides information that is complementary to the statistical data available e.g. through EUROSTAT, allowing problems and solutions to be better understood.

ASSEMBLING made a number of recommendations:

- Selected projects in the Trans-European Transport Network could each have an observatory, providing a good basis for learning across projects.
- The problem of intellectual property rights in relation to data has to be discussed and solved.
- Observatories should provide Internet-based services as much as possible.
- The best short-term option to include monitoring information in ETIS would be through a network of focused observatories, managed by independent experts selected on open bids and supervised by the Commission.

PROJECT WEB PAGE: http://www.mcrit.com/assembling

ASTRA:

Assessment of transport strategies

KEY RESULTS

The aim of the ASTRA project was to develop a system dynamics tool capable of analysing the long-term effects of the EU's Common Transport Policy, not only for the transport system but also for the most important connected systems. The tool was also intended to support the comparison of developments *over time,* not just the static comparison of outcomes in some horizon year (which has been common practice in transport assessments).

ASTRA developed a system dynamics modelling platform integrating four sub-models (covering macro-economic activity, regional economics and land-use, transport

Project acronym and title	**Key results and policy implications**
	demand and environmental impacts). The interfaces between the sub-models allow feedback loops to be established, thereby capturing the inter-relations between variables. Output indicators include traffic volumes, vehicle numbers, environmental impacts, and economic, social and employment indicators. Forecasts are produced from a base year of 1996 to a time horizon of 2026. Important attributes include short run-times for some types of policy test, and the ability to simulate the gradual introduction of a policy measure. The ASTRA model was demonstrated by simulating the effects of five policy packages (each consisting of sets of policy measures) and also a more comprehensive set of measures. The scenarios addressed policy decisions in the fields of taxation, construction of the Trans-European Transport Network, mitigation of air pollution and safety improvement. As an example of the system dynamics approach, the simulations considered different ways of spending the revenue from increased taxation – either for a reduction in labour costs or for construction of new transport infrastructure. Overall, the fully integrated set of measures produced the best results across the range of economic, environmental and employment indicators. Other significant points from the policy analysis were as follows: • None of the tested packages was able to meet the Kyoto requirements for abatement of greenhouse gas emissions. • No further significant improvement could be identified for road accidents. • Air transport growth would be significant in all scenarios, and in some cases would counterbalance most of the environmental benefits of policies giving a reduction in road transport. • The effects of the policy packages on the economy change the average annual GDP growth rate by 0.2% at most between the "best" and "worst" policy options. ***POLICY IMPLICATIONS*** ASTRA has shown that the system dynamics methodology allows for a long-term assessment of the wider socio-economic and environmental impacts of transport policy packages, and provides inherently consistent indicators to enable a direct assessment by the policy-maker. Moreover, the methodology is available in an operational software model for policy assessment on a European scale. This can be used to forecast the "what-if" consequences of planned policies, or be run in a "backcasting" mode to identify measures that will achieve a desired end-state. ***PROJECT WEB PAGE:*** http://www.iww.uni-karlsruhe.de/ASTRA
BRIDGES: **Building bridges between digital transport databases, GIS applications and transport models to develop ETIS software structure**	***KEY RESULTS*** BRIDGES has developed a software architecture to support the development of a European Transport policy Information System (ETIS). In particular, it has provided tools that supports the integration of external software modules, driven from personalised and user-friendly interfaces. The main tools (or "bridges") are: • Digital Data Guide – a directory of information sources relevant to ETIS; • Generalised Transport Format (GTF) – a proposed standard format for data exchange between transport databases and models; • GTF/GIS Translator – an application for transferring data between GTF and GIS formats; • Decision Support System – an application to simplify the interface between end users and the output from complex transport models; • Network Utilities – a set of routines for database management and graphic analysis;

Project acronym and title	Key results and policy implications

- Communication System – a technology to manage the transmission of commands between independent software applications integrated into an open system in an Intranet environment.

POLICY IMPLICATIONS

The BRIDGES software tools are 100% owned by the European Commission, and therefore available for wide exploitation with no licensing fees. There are no commercial software “bridging” tools that serve the same specialist application of transport modelling and policy development.

Although BRIDGES was aimed at meeting the needs of ETIS, it can be used in a variety of other transport applications. Several support systems have already been developed using these tools, and are being used by planners and decision-makers in the European Investment Bank and local planning authorities.

The modular architecture supported by BRIDGES is seen as essential. Information and communication technologies are expected to evolve rapidly, and new databases and more advanced transport models are expected to emerge in the next few years. Only a highly decentralised, interconnected and open architecture will have the flexibility to adapt. BRIDGES allows such connections to be made, and its Communication System is being developed further to support communications over the Internet.

BRIDGES should cut the cost of future software developments, as well as enhancing the value of other models (e.g. by improving data presentation and facilitating data transfer between incompatible systems).

PROJECT WEB PAGE: http://www.mcrit.com/

CAMPARIE:

Campaigns for awareness using media and publicity to assess responses of individuals in Europe

KEY RESULTS

CAMPARIE aimed to collate and disseminate strategies for information and awareness campaigns in the transport sector, based on real-life experiences, in order to provide decision support for future initiatives.

The project developed a software-based tool that provides information on more than 100 previous campaigns (mainly concerning public transport). It is designed to help practitioners identify experiences relevant to their own situation. The software is complemented by guidelines on the process of designing a campaign.

A survey confirmed that local authorities usually use transport planners and engineers rather than communications experts for designing and running campaigns. Conversely, the professional agencies that are sometimes employed to support such campaigns often have little or no experience of transport-related issues. The CAMPARIE outputs aim to bridge this gap by broadening the knowledge base on both sides.

General public awareness campaigns tend to be undertaken by regional and national authorities. Impacts cannot readily be assessed, and a long time period is necessary to obtain reliable results. In contrast, local authorities and operators seem to prefer targeted campaigns and more individualised marketing. This requires some knowledge of user needs, and much could be learnt from the latest developments in market segmentation techniques, computer applications and the targeted use of incentives.

Project acronym and title	Key results and policy implications

Detailed evaluation of six campaigns generated the following insights:

- The success of a campaign is maximised when combined with one or more specific policy measures (such as traffic restrictions or a new public transport service).
- Mixes of measures and mixes of campaigns seem to have an increased effect relative to isolated efforts.
- General awareness campaigns need to be repeated at regular intervals, otherwise they lose their "power" to influence behaviour. Campaigns targeted on specific groups have stronger and longer-lasting effects.
- Most of the campaigns studied by CAMPARIE can be transferred to other locations, with appropriate adaptation.

POLICY IMPLICATIONS

CAMPARIE concluded that marketing is not being used to its full potential in the transport sector to support policy-induced changes in behaviour. This may be due to decision-makers not being comfortable with how to design and evaluate campaigns. The consequence is that they are missing a low-cost approach to increasing the impact of high-cost measures.

CAMPARIE found that there is a need to distinguish a campaign coming from a local authority to that of a private enterprise aimed at promoting a particular product or service. Target audiences often discard material that they consider pure advertising, and therefore need to be warned about "public service" information.

Children need to be addressed by campaigns. It is likely that someone will develop less car-centred travel behaviour and attitudes if their awareness of the issues has been raised from an early age.

For the future, the issue remains as to how to make tools such as the CAMPARIE software available to users and up-to-date. This suggests that future applications of this sort need to be Web-based.

CAPRI:

Concerted Action on transport pricing research integration

KEY RESULTS

The purpose of CAPRI was to facilitate the transfer of information from research projects dealing with the pricing of transport. Key objectives were:

- to aid dissemination of results to Member States and other stakeholders;
- to develop a synthesis of research findings;
- to help to build a consensus on the implications for policy.

CAPRI drew conclusions in six areas (pricing principles, valuation of externalities, road pricing, rail and other public transport, air transport, and the likely impacts of pricing policy). These were based on EC-funded research as well as other evidence from inside and outside the EU.

Pricing principles: Pricing policy should be based on an understanding of marginal social costs, where the user pays the costs that they cause through additional infrastructure use. This will not deter trips that offer a net benefit to society, but it will discourage trips where the benefit to the individual user is less than the cost to society as a whole. Marginal social costs should be used as the starting point for price determination, with other important considerations such as financial needs incorporated in a way that does least damage to society's welfare. One of the main implications of pricing based on social costs is that prices should vary to a greater

Project acronym and title | **Key results and policy implications**

extent according to location and travel time.

Valuation of externalities: All of the main externalities (air pollution, global warming, congestion, accidents etc.) can be taken into account in pricing structures, even though some uncertainty exists in their estimation. CAPRI recommended specific evaluation methods for particular impacts.

Road pricing: Greater differentiation in road charges by time period and area is necessary to cope with congestion resulting from heavy peaks in travel demand. The main impact is likely to be travel at different times or by different routes, rather than a change in mode. To increase acceptability, the introduction of pricing should be staged, starting with simple systems with low charge levels, and the revenue should be earmarked for specific spending programmes such as public transport.

Rail and other public transport: Efficient pricing is likely to require greater peak/ off-peak differentials, and also an element of government funding (particularly for short-distance urban services). Improving the service quality and investment in infrastructure may be the most important measures for improving modal shares, as opposed to internalisation of externalities for all modes via the pricing mechanism – this is particularly the case for freight transport.

Air transport: Environmental pricing can be based on kerosene consumption and/or landing and take-off operations, but policy development in this area requires further research.

Likely impacts of implementing efficient pricing: Pricing based on marginal costs may result in price reductions for some modes as well as price rises for some others. For example, inter-urban passenger travel in uncongested conditions, by road or rail, is typically *over-priced* at present. For inter-urban freight transport, evidence suggests that there is often significant *under-charging* for both road and rail. Finally, urban transport by means of road-based modes is typically *dramatically under-charged*, particularly in congested conditions.

POLICY IMPLICATIONS

The existing range of pricing policies in EU Member States is so varied that the impacts of marginal cost pricing have to be assessed on a case-by-case basis. The extent and direction of any price changes will depend strongly on current levels of taxation and charging, and will not necessarily imply lower travel demand. Nevertheless, as a broad conclusion, pricing reform to reflect social marginal cost would involve:

- a decrease in prices for inter-urban road and rail passenger transport and an increase in the price of urban road travel (particularly for the private car);
- an increase in prices for both road and rail freight.

Regulatory policy may often be more powerful than pricing policy in the control or reduction of some categories of environmental emission, such as noise. For emissions of greenhouse gases, CAPRI recommended that pricing should be based on political decisions about target emission levels, given the lack of consensus about the values to be placed on each tonne of pollutant.

PROJECT WEB PAGE: http://www.its.leeds.ac.uk/projects/capri

Project acronym and title	Key results and policy implications
CAPTURE:	***KEY RESULTS***

Cars to public transport in the urban environment

The aim of CAPTURE was to collate and evaluate data on the effectiveness of *physical* transport measures designed to restrict or encourage the use of different modes (such as parking management, bus priority schemes and restriction of road space for private cars).

Based on the evidence of demonstrations of packages of measures in 11 cities, the project has published detailed findings on the performance and impacts of different measures. Major elements of these packages included bus lanes, public transport prioritisation, improvements to junctions and interchanges, area access restrictions and controls on central area parking.

The project found that physical measures do not *in themselves* generally have a major short-term impact on modal split, unless they are large in scale. Nevertheless, CAPTURE identified positive effects on the performance of public transport (such as lower journey times and better timekeeping). This means that the smaller schemes may encourage a change in behaviour when people periodically re-assess their travel decisions – either due to changing circumstances (such as a job or house move) or due to other policy changes (such as pricing measures).

Physical measures are not easy to introduce. In the CAPTURE cities, the most common barriers were conflicts of interest between the institutions involved, a lack of funds, diversion of attention to alternative schemes, and opposition from affected stakeholders. Small-scale, low-visibility cheap solutions were found to be the most readily implemented. However, these run the risk of failing to achieve large-scale change, unless introduced as part of an overall vision and strategy.

Measures that reduce traffic levels in *areas* of cities are difficult to implement, but are effective when carried through. However, there are no "off-the-shelf" solutions for cities to apply. For example, bus lanes have had good success in some cities and little in others. Changes must be planned individually, taking into account local conditions, the ease of implementation and user reactions. City size is not a major factor in determining the most appropriate measures, but city type (historic versus modern) may be significant.

POLICY IMPLICATIONS

CAPTURE concluded that modal change requires a package of measures in a well thought-out strategy. Physical measures are important because they affect the capacity and efficiency of public transport. This is an essential precursor for a change in travel behaviour, whatever the levers (pricing, green commuter plans etc.) used to induce that change.

Experience suggests that only two or three institutions need to be involved in the implementation process for serious conflict to arise. This worrying conclusion highlights the importance of building consensus and commitment throughout the process.

If area-wide changes are targeted, the following recommendations can be made:

- Carry out public consultation and, preferably, public participation in the scheme design.
- Note that physical restrictive measures are probably more acceptable than road pricing measures.
- In cities where such changes have not previously been attempted, start small or experimentally in order to build up public support.

Project acronym and title	Key results and policy implications

For the national and European levels, CAPTURE concluded that:

- A national or regional body needs to assess local plans with respect to their overall impact on longer-term policy goals (including broader issues such as reducing social exclusion).
- Good practice examples need widespread dissemination, particularly to counter popular perceptions about the effects of access restrictions and pedestrianisation on city centre trade.
- Telematics measures can generally be implemented without delay, but the benefits are often greater to private motorists than to public transport passengers.

CODE-TEN:

Strategic assessment of corridor developments, TEN improvements and extensions to the CEEC/CIS

KEY RESULTS

Multi-modal corridors across Europe represent costly infrastructure investments that require phasing. Classically, economic evaluations are critical in decisions on prioritising projects. However, in the context of *network* development, a more strategic assessment method is needed.

Therefore CODE-TEN has developed a strategic policy assessment tool for assessing the impacts of the development of pan-European corridors. The tool applies a scenario approach to elaborate consistent images of the future that combine information on three aspects: socio-economic development, policy development and infrastructure planning. Using these images, the alternatives for corridor development are subjected to impact assessment to help in decision-making.

The images build on 4 scenarios of socio-economic and political developments through to the year 2015, named:

- Renaissance – high economic growth and fast integration of neighbouring countries into the EU;
- Dilution – high growth and slow integration;
- Solidarity – low growth and fast integration;
- Fragmentation – low growth and slow or no integration.

A comprehensive information system was produced on a CD-ROM covering 30 European countries. This provides information on politics, regional socio-economic data, regional road information, foreign trade, transport costs, resource costs, networks and maps. It has supported in-depth corridor studies on: Via Baltica, Berlin-Warsaw-Moscow, Dresden - Budapest - Istanbul, Venice – Kiev, The Danube Waterway, Copenhagen - Stockholm - Helsinki - Moscow, Salzburg - Belgrade - Thessaloniki, the Mediterranean short sea shipping and the Lisbon-Madrid-Paris Trans-European link.

Descriptions of infrastructure strategies and traffic flow estimations (based on the development of the various scenarios and corridors until the year 2015) have led to the impact assessment of the various alternatives for corridor development, focusing on accessibility, environment and socio-economic factors. Combinations of road and rail projects were generally found to offer the greatest benefits.

POLICY IMPLICATIONS

CODE-TEN gives guidelines for assessing transport investments to support the policy of expanding the European Union to Baltic and Central European countries. The method could also be applied more generally to other infrastructure programmes.

CODE-TEN recommended that, in addition to project-specific assessment, the whole set of related projects should be subject to strategic assessment. The DECODE

Project acronym and title	**Key results and policy implications**
	method elaborated in CODE-TEN is one method for carrying out this analysis. ***PROJECT WEB PAGE:*** http://www.iccr-international.org/code-ten/
CONCERTO: **Concerted action for European transport information systems**	*The final results of this project were not available when this Thematic Paper was prepared.* ***PROJECT WEB-PAGE:*** http://concerto.ece.ntua.gr/Newsletter/nl1/about.htm
CONCERT-P: **Co-operation for novel city electronic regulating tools**	***KEY RESULTS*** Demonstrations of road pricing measures to change modal split in urban areas were conducted at three sites: • In Trondheim, car drivers incurred peak period charges that varied over short time intervals to reflect different levels of congestion. • In Bristol, charges applied throughout the day, with additional incentives for using public transport and higher charges during days of poor air quality. • In Barcelona, zone access control was implemented. Key findings were: • Trondheim: reductions in peak period traffic exceeded 10% (mainly due to drivers changing their time of travel), with a smaller decrease in the total number of trips – indicating some trip suppression or modal shift. • Bristol: 15-20% reductions in daily car travel could be largely attributed to drivers switching to public transport. • Barcelona: the viability of technical implementation was shown to be acceptable to enforcement authorities. It was clear that drivers tended to re-schedule trips before considering switching to public transport, and that individual drivers responded very differently to the charges. This has to be borne in mind when tariff structures are being designed. Public acceptance of road pricing was found to be higher if revenue hypothecation (e.g. to improve public transport) is introduced. ***POLICY IMPLICATIONS*** The project made a series of recommendations: **Pan-European level** Urban demonstrations of multi-modal charging regimes with integrated payment systems should be intensified. Projects should: • combine road pricing with public transport alternatives; • use technology to collect evaluation data and provide a feedback loop to drivers on the financial implications of their daily decisions; • demonstrate the benefits of revenue hypothecation. **National level** Governments and relevant authorities should: • introduce enabling legislation so that revenues from road user charging can be re-invested locally to improve the travel alternatives where road charges are introduced;

Project acronym and title	**Key results and policy implications**
	• encourage local authorities to integrate public transport services in their pricing schemes; • co-ordinate initiatives to develop multi-modal payment systems.
DANTE:	***KEY RESULTS***
Designs to avoid the need to travel in Europe	The project has produced a good practice guide for the selection and implementation of strategies to reduce the need for travel, particularly aimed at cities. This covers some 30 measures, illustrated by case studies. These include mode switching (from cars), time switching (from peak periods), destination switching (to closer places), and trip substitution and avoidance. The main finding is that travel reduction is most likely where several policy measures work together in a package. For example, restraint on car use has been combined successfully with promotion of alternative modes, while "pure" reduction measures seem to have been relatively unsuccessful. The scale of reduction is often difficult to quantify, which will make policies difficult to justify ex-post. Also, it has been seen that restraint in one area of a city can lead to increased use of cars elsewhere (e.g. outside the city centre), unless policies are well co-ordinated. Resource barriers (whether financial, human or physical) have been the most common problems, particularly for alternative modes. These have hindered implementation in almost 20% of the cases studied. Restrictions on car travel more commonly meet social barriers. Land-use planning measures aimed at traffic reduction generally seem to encounter serious barriers. ***POLICY IMPLICATIONS*** The project concluded that "push" measures are essential – the perceived advantages of car use are so great that there will only be a minimal transfer from car driving while car use remains unrestricted. The most effective strategies for traffic reduction seem to involve the promotion of alternative modes. It remains to be seen whether trip substitution/avoidance and time/destination switching hold greater potential in the future, starting from a baseline of limited experience and success, or whether further investment in mode switching is the most cost-effective approach. Public awareness messages are needed to encourage a change in travel behaviour, as well as providing information on the available alternatives. Authorities themselves, as employers, are in a good position to lead by example. This can be done through parking policies, provision of bicycle facilities and the use of teleworking methods. It is important to co-ordinate policies (e.g. within a local transport plan) to reinforce the objective of traffic reduction. For example, measures to promote the efficiency of the traffic system need to consider the travel-encouraging consequences, and the creation of out-of-town centres (which encourage longer, car-based trips) requires careful control.
DIATS:	***KEY RESULTS***
Deployment of interurban ATT test scenarios	DIATS had three main objectives: • to identify the most promising options for Advanced Transport Telematics (ATT) likely to be deployed in Europe over the next 10 years;

Project acronym and title	**Key results and policy implications**

- to evaluate the potential impact of these options;
- to identify the key elements for their successful deployment.

The project focused on automated detection of incidents, ramp metering (i.e. controlled access to motorways), the use of variable message signs and roadside warning lights, adaptive vehicle cruise control and automated driving systems. Assessments were made of simulated traffic effects, road network operator interest, user responses, safety impacts, and legal and administrative issues. Significant findings include the following:

- The telematics applications most frequently deployed in Europe are automatic incident detection coupled with variable speed limits. Most operators wish to link this with variable message signs to encourage the re-routing of traffic.
- Roadside warning lights can improve safety, particularly in areas with poor visibility and prone to bad weather.
- Ramp metering has clear potential to reduce congestion on main carriageways, but more work is needed to optimise designs to reflect local traffic and road conditions.
- Adaptive cruise control is unlikely to have significant impacts on traffic efficiency in the near future. Technology penetration rates above 20% are required for this.
- The effects of adaptive cruise control on driver behaviour and their ability to respond in emergency situations need investigation.
- Cruise control may need to be set at a vehicle headway below 1.2 seconds to avoid reducing road capacity. But this headway is below the level recommended by national administrations for safe driving.
- The legal considerations in developing automated driving systems are considerably more complex than with driver assistance systems.

POLICY IMPLICATIONS

DIATS has highlighted significant benefits of transport telematics applications:

- Automatic incident detection reduces unsafe situations and the duration of congestion for drivers approaching an incident.
- Ramp metering is extremely effective at reducing main carriageway congestion at peak levels of traffic flow. However, national guidelines are needed for the implementation of metering, for example to minimise disruption on approach roads.
- Variable speed limits provide some safety benefits on motorway sections that are prone to prolonged heavy congestion.

There is a policy dilemma over the choice of vehicle headway for adaptive cruise control. Nationally recommended headways are somewhat greater than those observed on busy motorways. If drivers stick to national recommendations, motorway capacity will be reduced and congestion increased. If drivers select a smaller headway, the establishment of liability in the event of an accident will be affected. Other policy issues include:

- whether the legal system should discourage the inappropriate use of cruise control on roads other than motorways (where the current technology may be inadequate to cope with demanding traffic conditions);
- the need for official standards for design and maintenance of cruise control systems;
- the liability of network operators that may provide advisory information or speed regulation signals to a cruise control system from a roadside infrastructure.

Project acronym and title	Key results and policy implications
ECONOMETRIST:	***KEY RESULTS***
Economic evaluation of the impacts of transport activities on Member States	The activity in ECONOMETRIST was split into two discrete elements: • The development and demonstration of a short-term and *static* methodology for evaluating the impacts of transport activities throughout a national economy. • The definition of a methodology for a more comprehensive economic assessment in a *dynamic* world. This approach is more representative of real-world behaviour. The *static* methodology was demonstrated for Spain, the United Kingdom, Italy and the Netherlands. Internally consistent input-output tables were produced, extending the 25 branches of economic activity proposed by EUROSTAT to 31 branches by introducing a greater disaggregation of the transport sector. Public transport services were estimated to account for 4–6.5% of economic activity as a whole. A 5% increase in energy costs would increase rail costs by around 1% and road, sea and air costs by around 0.5%. ***POLICY IMPLICATIONS*** The project indicated that input-output tables *could* be extended to allow more detailed simulation of the broad economic impacts of policy-related changes in transport activity. However, to make this a realistic tool, further work would be needed to develop the *dynamic* modelling methodology (rather than using a static approach).
EUROMOS:	***KEY RESULTS***
European road mobility scenarios	EUROMOS aimed to produce scenarios of mobility conditions in European cities for the year 2010, identify promising new mobility services and evaluate their impacts on policy. Three scenarios were developed. These may be characterised as continuation of current trends, a widening of the spread of household incomes, and the application of strong traffic demand management policies. Their impacts on the cities of Barcelona, Bordeaux, Gothenburg, Munich, Southampton and Turin and the success of new mobility services were shown to correlate strongly with local factors. Such factors include political tradition, social attitudes, city morphology and size, and the regional economic activities. Potential was identified for 16 mobility services concerning: • private needs, such as transporting children to and from school; • demand management, such as the sale of capacity on private road infrastructure; • car leasing and sharing arrangements. Across all scenarios and cities, the restriction of individual motorised transport in the central business district emerged as a general strategy, combined with measures to support other modes. Strong traffic demand management boosted the development of all mobility services relative to the other two scenarios. New technologies were seen as critical to the adequacy of new services, to provide user information, control vehicle operations, and make payment easy. Unwillingness to share data between organisations was identified as a potential barrier. ***POLICY IMPLICATIONS*** The new mobility services provide new forms of public transport. These services will

Project acronym and title	Key results and policy implications

need regulation and may merit public funding. Policy-makers will need to look at the conditions for competition between traditional public transport, these new intermediate services, and private taxis.

Innovative freight services are seen as a contribution to economic competitiveness while improving the attractiveness of central areas in a city. In general, this is thought to require public/private partnerships. Public authorities have an important role in setting up institutional arrangements, monitoring the schemes and providing financial support to overcome initial market barriers.

Regional planning may be needed to inhibit the dispersion of homes and businesses to areas outside the zone of traffic management controls. Otherwise the conditions for financially economic use of collective transport by people and goods going into and out of the city may not be met.

EUROSIL:

European strategic intermodal links

KEY RESULTS

EUROSIL aimed to develop robust guidelines to support decision-making on TEN-T and other transport investments, which would take into account the impacts of multi-modal links on regional development.

Through a series of 12 case studies, EUROSIL identified examples of good practice in appraising the benefits of multi-modal transport investments. However, it was clear that few of the current modelling approaches deal explicitly with regional development effects, and there are further deficiencies in the evaluation of those impacts.

Therefore EUROSIL developed an evaluation framework and software tool to support a structured approach to the assessment of regional development effects. This covers the selection of criteria for the evaluation, the estimation of impacts, and the definition of weighting factors for combining different impacts according to the selected criteria. Guidance is provided on the choice of traffic modelling methods.

For those cases where the decision-maker requires a quick low-cost evaluation of alternatives rather than a sophisticated evaluation, EUROSIL has constructed a simplified set of guidelines.

POLICY IMPLICATIONS

The case studies highlighted a number of barriers to intermodality:
- inadequate information flows between the variety of actors;
- problems with slow procedures at border crossings;
- differences in technical standards and regulations between Member States, e.g. for vehicle size and weight;
- a lack of co-ordination at interchanges (such as different companies working different hours);
- a lack of interoperability between modes, for instance concerning ticketing and information systems.

The EUROSIL evaluation framework is now available for use in real-life decisions on the TEN-T and other major long-distance transport projects. Its incorporation into new developments of user-friendly investment appraisal tools is recommended.

Project acronym and title	Key results and policy implications
EUROTOLL: **European research project for toll effects and pricing strategies**	***KEY RESULTS*** EUROTOLL aimed at providing transport policy-makers with information on the potential effects of different types of road pricing and tolling strategies. The main findings relating to road user behaviour were: • if tariffs vary throughout the day according to demand, car drivers will re-schedule departure times, which leads to less traffic congestion; • if tariff systems reward re-routing, a significant number of car drivers will do so, which again reduces congestion; • road pricing has not been observed to lead to significant modal shift; • it takes time for users to change their behaviour in response to price signals - car drivers are more sensitive than occasional drivers and truck drivers. In addition, EUROTOLL has demonstrated that strategies to integrate pricing measures and transport information applications are able to reinforce the positive effects of both. ***POLICY IMPLICATIONS*** For future pricing strategies, the following recommendations should be considered: • the reason why a pricing measure is introduced has to be clearly explained to users and the general public; • during a trip, more frequent road users of an area or route need less information to react to changed conditions than occasional users; • users who make the same trip frequently will change their behaviour more quickly; • information strategies have to be designed as a combination of pre- and on-trip information; • travellers have to be given sufficient information about the pricing scheme and alternative travel possibilities if behaviour is to change; • alternatives (e.g. routes) and the advantages of alternatives have to be demonstrated and promoted. EUROTOLL concluded that the principles recommended by the EC White Paper on transport pricing could be implemented through a combination of practical pricing methods.
FANTASIE: **Forecasting and assessment of new technologies and transport systems and their impacts on the environment**	***KEY RESULTS*** FANTASIE identified and assessed new technologies that could have a major impact on transport systems in Europe and the attainment of CTP objectives. The project produced a wealth of information covering specific technologies (such as propulsion and information systems), vehicle concepts and transport system concepts, for a range of time horizons (2005, 2020 and 2030), journey types (urban, inter-urban etc.) and socio-economic scenarios. Particularly promising technologies were seen as: • telematic technologies – likely to be of benefit across all impact categories – such as on-board emissions management, multi-modal traveller information and trip planning, dynamic route planning and navigation, electronic tolling, anti-collision systems, smart cards, intelligent cruise control and traffic management systems; • fuel cell and hybrid propulsion systems, offering significant energy and environmental benefits; • improvements in the conventional all-purpose car, such as advanced turbo-diesel engines, direct injection gasoline engines and reduced weight;

Project acronym and title	**Key results and policy implications**
	• tilt rotor technologies for air transport, giving significant fuel savings and noise reduction; • airships for moving heavy and bulky loads; • new systems for personal rapid transit; • road trains. Quantitative estimates of market shares and impacts at a European level were prepared. ***POLICY IMPLICATIONS*** Policy options to promote new technologies can be generic (trying to improve the conditions for innovation) or specific to certain selected technologies. Some experts on technology policy prefer generic options because these allow the market actors to come up with new ideas and the most cost-effective solution. However, the realisation of specific technologies often requires changes in legislation and regulations to remove barriers – generic policy action may be insufficient. Therefore FANTASIE recommended a combination of the two approaches: • Generic measures are needed across the transport sector, such as standardisation, R&D funding, pilots and demonstrations. • Packages of policy measures should be directed towards specific clusters of technologies, such as propulsion systems, urban transport technologies, intermodal systems, air traffic management systems, travel information, and road traffic management and payment systems. Specific policy proposals are included in the project Deliverables. ***PROJECT WEB PAGE:*** http://www.etsu.com/fantasie/fantasie.htm
FATIMA: **Financial assistance for transport integration in metropolitan areas**	***KEY RESULTS*** The aim of FATIMA was to identify the differences between urban transport strategies optimised using public funds and those requiring private funding, and to provide guidance on how best to use private sector funding. Conclusions were drawn from modelling studies in nine cities: Edinburgh, Eisenstadt, Helsinki, Merseyside, Oslo, Salerno, Torino, Tromso and Vienna. In six of these cities, optimal policies could be funded by road pricing or increased parking charges with no net additional financial support (over a 30-year time horizon), allowing public transport services to be increased or fares decreased. In the other three cities, the optimal strategy would require greater funding than the do-minimum case. Where cities face constraints on capital investment, private sector finance could be used, with part of the cost being met from public funds and part from user revenues. However, if the private sector requires a higher rate of return than the public sector, the optimal strategy may well be constrained, resulting in lower social benefits. In this case, an alternative is to raise additional finance through value capture (such as taxing land values that benefit from transport infrastructure investment). However, the modelling suggested that value capture is beneficial in only a limited range of city situations. FATIMA also studied the merits of private sector operation of public transport, whether implemented through deregulation, in which operators are free to determine service levels and fares, or through franchising, where the city authority specifies them. Results indicated that private sector operation reduces the net social benefits of

Project acronym and title	Key results and policy implications

the optimal transport strategy, particularly under deregulation. No convincing evidence was found for a reduction in operating costs, for a given level of service, due to private operation. Moreover, sensitivity tests indicated that such cost savings would have relatively little impact on social benefit.

POLICY IMPLICATIONS

FATIMA made a series of recommendations for the design of optimal transport strategies, the involvement of the private sector, methodology for strategy optimisation and priorities for further research. These included the following:

- Strategies should be based on combinations of measures, with public transport measures and car user charges as key elements.
- There should be a greater distinction between peak and off-peak charges and fares.
- In many cities it will be possible to identify optimal strategies that can be fully funded from user charges, using the FATIMA methodology.
- If private finance is needed for capital investment, optimisation procedures can identify the appropriate modifications to the strategy to achieve the best performance within the financial constraint. However, such a strategy will usually have smaller social benefits than in the absence of the constraint.
- Value capture may help to raise additional finance in cases where strategies are not self-funding and require private financing.
- If a city authority decides that private operation of public transport is beneficial, it should ideally use a franchising model in which it specifies the objectives and the optimal service levels and fares.
- However, if national law requires deregulation, the city authority should identify which of the possible combinations of fares and frequency (at a given level of profitability) best support public policy objectives.
- Future development of the optimisation procedure should incorporate issues of equity. This means that transport models need to output values for appropriate indicators.
- A comprehensive assessment of the consequences of private sector operation of public transport is required.

PROJECT WEB PAGE: http://www.its.leeds.ac.uk/projects/pastpres.html

FISCUS:

Cost evaluation and financing schemes for urban transport systems

KEY RESULTS

FISCUS has produced a handbook giving practical guidelines on evaluating the costs of urban mobility and selecting ways to finance it. This is intended particularly for policy-makers, planners and the managers of operating companies. The handbook covers two main issues: who pays for what, and who puts up the money (e.g. for new investments).

Seven types of cost are addressed, i.e. those associated with infrastructure, vehicle-related operations, congestion, accidents, emissions, noise and other external effects. The reader is given a step-by-step method of estimating these costs for their own city, with worked examples. Given that the availability of data may vary from city to city, the handbook offers two levels of assessment with different data input requirements (light and full). The results show the extent to which users bear the costs they cause – whether full costs, external costs (such as environmental damage) or variable costs.

FISCUS reported evidence that existing pricing mechanisms and levels are failing to provide appropriate signals to influence behaviour. For example, prices need to show greater differentiation according to the time of day and current traffic levels. Also,

Project acronym and title	Key results and policy implications
	existing financing mechanisms (which typically rely on user charges and public budgets) are often not providing sufficient funding for the infrastructure and services that would support an optimal mix of traffic. Therefore the relative merits of new mechanisms such as private finance, value capture (such as taxing land values that benefit from transport infrastructure investment) and cross funding (e.g. from private to public transport) are explained. FISCUS identified three financing *packages* for consideration, each combining various pricing mechanisms and sources of finance. The circumstances in which each package might work well are described. • One is based on electronic road pricing, parking/cordon charges and public transport tariffs all being differentiated by time of day, with public budgets providing subsidies and capital as necessary. • Another is again based on differentiated charges, but with private finance and value capture. • The third is based on making each mode commercially viable, with no subsidies or cross financing. The first two packages are given preference (against criteria of economic efficiency, acceptability and practical feasibility), with the choice depending primarily on the adequacy of funds for investing in the transport system. ***POLICY IMPLICATIONS*** The FISCUS handbook aims to provide practical support for both long-term mobility planning and short-term operational decisions. By promoting the harmonisation of the knowledge base for policy decisions across Europe, it should increase efficiency and fair competition between operators and modes. Electronic road pricing is often seen as the most powerful way of implementing efficient pricing. However, this will not necessarily be the most cost-effective or practical solution in many situations. Therefore FISCUS gives advice on simpler pricing solutions (such as parking and cordon charges), depending on city characteristics such as size, severity of environmental problems and the financial position of public transport. FISCUS concluded that there will be many cases where marginal cost pricing leaves a need for additional funding. In most cases a mix of financing measures will be required, and FISCUS gives advice on when each mechanism is most likely to be appropriate. Public funding is seen as having many attractions, but may not provide adequate resources for investment, in which case a mix of private sector funding and simple approaches to value capture are recommended.
HIPERTRANS: **High performance transport network modelling and simulation**	***KEY RESULTS*** The HIPERTRANS project aimed at developing traffic simulation software to support the design and operation of Urban Traffic Control (UTC) systems. The project has provided the following software products: • a real-time simulator able to provide the operator with the current state of traffic in the road network and interact with UTC systems at real-time speeds; • a real time predictor using high-performance computing able to warn the network manager of the potential development of traffic conditions. The HIPERTRANS products are innovative in several respects:

Project acronym and title	Key results and policy implications
	• the powerful Graphical User Interface (GUI) for entering the model, configuring the simulation and visualising the result; • the real-time traffic simulator has been interconnected with two types of UTC: SCOOT and STU; • the predictor can execute prediction runs faster than real-time; the use of scalable parallel computing has shown that faster than real-time criterion can be met irrespective of the size and complexity of the modelled network, e.g. in dealing with traffic incidents and events and evaluating the consequences of emergencies or operator intervention. ***POLICY IMPLICATIONS*** The HIPERTRANS project has shown that microscopic simulation can be one of the most effective tools in the specification, design, commissioning and operation of UTC systems. The results of the real-time simulator and predictor will be useful for traffic consultants and policy makers to rapidly assess and visualise the effects of new strategies and novel policies in the planning and management of networks. The tool enables transportation network and UTC operators to assess the performance of their network under a variety of operational conditions and behavioural patterns. It also allows them to examine the future effect of their selected actions fast enough to be able to revise and re-test the performance before selecting the best action to take. The market analysis and evaluation of the product and service opportunities emerging from the project have shown promising results in terms of potential market for both the SCOOT- and STU-based UTC systems. The availability of powerful but cheap personal computers is expected to make easy the use of the predictor tool. Further research should be carried out into the effective exploitation of distributed computing to speed up the simulation further in realistic road networks. Future projects should aim at integrating the distributed executions with more user-friendly graphical and animation interfaces, and the simulation technology with the technology of real-time UTC systems.
ICARO: **Increase of car occupancy through innovative measures and technical instruments**	***KEY RESULTS*** The aims of ICARO were to evaluate measures for increasing car occupancy rates in European countries and to provide guidelines for policy development and implementation strategies. Through surveys, demonstrations and modelling in eight countries, the project identified the success factors for car-pooling (also known as car-sharing in the UK), including the effectiveness of supporting measures such as parking restrictions/incentives and high occupancy vehicle (HOV) lanes. Car-pooling was found to be the most successful for employees from the same work place. Therefore initiatives to promote this behaviour are best targeted on the workplace, particularly by working with companies. The willingness to car-pool increases with the distance between home and work. The majority of people looking to car-pool were found to be drivers, particularly those with regular working hours. Experience with matching centres, set up to put drivers and passengers in touch, showed that they need at least 500-800 clients to provide an effective service – or at least 100 clients in a single company scheme. One of the most effective ways of increasing car occupancy is through the provision of infrastructure measures such as HOV lanes. Test site experience showed that car-poolers cut their travel time by 3.5 minutes using a 1.5km HOV lane in Leeds. Preferential parking for HOV’s at the workplace has limited impact, especially where

Project acronym and title	Key results and policy implications
	parking is readily available and free of charge. ICARO found no convincing evidence that guaranteed ride home schemes are influential on the decision of people to car-pool. Public acceptance is greater for incentive measures than for restrictions like HOV lanes or banning single occupancy vehicles from the city centre ICARO estimated that perhaps 30% of car users have the freedom to choose car-pooling as an option. However, this potential is reduced particularly where there is a tendency towards flexible working hours, which is a serious obstacle to car-pooling. ***POLICY IMPLICATIONS*** Test site experiences showed that general promotion campaigns for car-pooling are not effective. ICARO recommended focusing on companies and commuters at the workplace, by embedding car-pooling in "Green Commuter Plans" or "Travelwise" campaigns. There are various legal barriers to car-pooling and the development of HOV lanes that need to be overcome. ICARO recommended that: • The terms car-pooling and HOV should be defined in national legislation for policy and insurance use. • In many countries, the tax treatment for reimbursement of costs between car-poolers needs to be defined. • The insurance situation for car-pooling should be clarified. • For most countries, HOV lane regulations still need to be included in the national traffic regulations. Linked to this, a harmonised European car-pooling sign for HOV infrastructure should be agreed. Project results indicated that measures to make car-pooling more attractive run the risk of attracting people from public transport. However, restrictive measures tend to promote both car-pooling *and* public transport, and are more effective in increasing the car occupancy rate than incentives alone. ***PROJECT WEB PAGE:*** http://www.boku.ac.at/verkehr/icaro.htm
INCOME: **Integration of traffic control and other measures**	***KEY RESULTS*** The goal of INCOME was to provide decision-useful information on the performance of integrated urban traffic management systems (UTMS) combining urban traffic control (UTC), public transport management systems (PTS) and driver information systems (DIS). Various combinations of UTMS components were tested and evaluated through simulation studies and field trials in London, Piraeus, Turin and Gothenburg. A guidebook has been compiled for transport managers and local authorities, summarising the results, infrastructure requirements, factors affecting the benefits, and other implementation issues. Highlights among the wealth of quantitative results were: • *Public transport priority in UTC*. Public transport achieved journey-time savings of around 5-15% across three cities and similar improvements in journey-time reliability. In all cases the payback period was less than two years. • *Integration of UTC priority and automatic vehicle location for buses*. This allows selective priority to be given to buses that are running late, thereby improving reliability. Predicted improvements in bus regularity and in passenger waiting times are around 10%.

Project acronym and title	Key results and policy implications

- *Bus gating at traffic signals*. This involves holding back queues of private vehicles at traffic signals on strategic routes, allowing buses to overtake along segregated bus lanes. The bus lanes doubled the savings in bus delay compared to bus priority alone at traffic signals.
- *Integration of UTC with variable message signs (VMS)*. These applications transferred data from UTC to VMS. The clearest benefits came from the earlier re-routing of traffic in response to incidents, activated by the automatic incident detection function of a UTC, increasing drivers' journey-time savings due to the VMS from 23% to 28%.
- *Intelligent speed adaptation*. This is a new in-vehicle technology aimed at reducing or preventing speeding, which can be integrated with UTC systems. Simulation results indicated a 50% reduction in accidents at speeds above 45 km/h, and speed reductions of up to 20%.
- *Integration of PTS and DIS*. Variable message signs can be used to suggest alternative routes to encourage drivers not to use important bus routes in congested areas. Simulations showed that reductions in bus delays could exceed 20%, although this is dependent on the local situation (e.g. if the alternative routes are also bus routes, the net benefits can be negative).
- *Fully integrated traffic management systems (UTC, PTS and DIS)*. Sharing of data and control signals between sub-systems in Turin has reduced travel times for both general traffic and public transport by 20%, with an accompanying modal shift of 3% to public transport. Local pollutant emissions were estimated to fall by 21%. Modelling work for Gothenburg indicated a 9% modal shift, but smaller improvements in other indicators.

POLICY IMPLICATIONS

Urban traffic management systems are one of the key tools under the control of city authorities that can be used to support local policy objectives for mobility and the environment. Moreover, they can be implemented in the short term. INCOME has provided evidence of the additional benefits that can be achieved by using advanced systems in an *integrated* way.

Nevertheless, one of the lessons from INCOME is that the benefits must be estimated for the *local* situation. For example, public transport journey-time savings are dependent on congestion levels and the number of traffic junctions where systems can be used, and heavy congestion reduces the scope for some forms of bus priority. Simulation can provide a cost-effective means of screening alternative solutions prior to pilot-scale or full-scale implementation.

INFOSTAT:

Information systems

KEY RESULTS

The planned European Transport policy Information System (ETIS) is intended to support decision-makers in both public and private sectors in understanding changes in mobility, logistic patterns and the effects of policy measures. INFOSTAT has defined the principles and concepts for ETIS, assessed the adequacy of existing data, and prioritised the data gaps requiring immediate action.

The basic principle of ETIS is to support European policy formulation, using an open structure that is complementary to national and other information systems (and consistent where possible). It will handle new statistical concepts such as transport chains, intermodality, families of commodities with the same logistical requirements, performance indicators for transport quality, congestion and environmental hotspots, corridors and networks, and the accessibility of regions and cities.

Project acronym and title	Key results and policy implications

The most significant data gaps and harmonisation needs concern:

- the social determinants of transport;
- origin-destination flows, especially for transit flows and transport chains;
- intermodal transport demand;
- infrastructure for transport networks;
- data on transport prices and reliability;
- data on the economic and land-use impacts of transport.

A pilot database has been developed to demonstrate the feasibility of ETIS, focusing on freight movements along transport chains.

POLICY IMPLICATIONS

INFOSTAT has recommended immediate action in the following areas, in order to support policy-making in the short term:

- the collection of origin-destination data for both passenger and goods transport at various geographic levels of aggregation;
- establishing requirements and a data bank for data related to major infrastructure projects;
- assessing the means of collecting data on intermodal flows, particularly from private sector companies by exploiting telematics and electronic data interchange;
- reviewing the existing INTRASTAT system for the collection of trade statistics.

In the longer term, ETIS is intended to support any transport policy decision that has a European dimension, notably the development of the Common Transport Policy and the Trans-European Transport Network.

INFREDAT:

Methodology for collecting intermodal freight transport data

KEY RESULTS

The project has provided an overview of data needs and data availability concerning intermodal freight transport data at a European level, defined an appropriate data collection methodology, and tested the methodology on some case studies of transport chains.

The data collection methodology describes how to define a complete database structure, and how to develop a model for the estimation of missing data. It also specifies the data requirements – the data records should include all relevant variables to follow consignments along the transport chain from the place of production to the place of consumption. The suggested record structure was tested on freight flows from Poland to the Netherlands. This pilot study showed that by combining data sources it is possible to analyse market shares, container flows and transhipments on different routes along a corridor.

The basic level of data collection was proposed to involve collation of published statistics, supplemented by periodic interviews and counts (which were evaluated to be less cost-effective). INFREDAT concluded that advanced information technologies such as tracking and tracing and Electronic Data Interchange could be used in the future to enhance the available data and/or or to replace other more expensive collection methods. However, this is not practical at present.

There are a number of problems with direct data collection from operators. The most critical is the issue of data confidentiality. Also there are incompatibilities between information systems and data formats used by different companies, and market actors use a variety of concepts and definitions (rail wagons, lorries, loading units etc.) to count their traffic. INFREDAT concluded that the data collection process needs to be

Project acronym and title	Key results and policy implications
	done by a neutral organisation, providing guarantees of confidentiality for specific variables, and offering mutual benefits in terms of data access. Much of the required data already exists, but simply is not available to external bodies for confidentiality reasons. ***POLICY IMPLICATIONS*** The main user group for intermodal freight data was identified as the national and European planning/policy levels. Many operators and shippers reported that they generally have the data they need for business purposes. Therefore INFREDAT concluded that the responsibility for the co-ordination of data collection and processing lies in the public sector, with the data quality and content focused on policy needs. Of course, the collection of freight data is just a part of the wider requirement for transport statistics. Therefore the INFREDAT results feed into the overall effort to develop a European Transport policy Information System (ETIS). One of the major growth areas for long-distance freight transport is across the borders with Central and Eastern Europe. At present, customs data provide a good source of statistical information. However, this source could disappear as a result of EU enlargement, therefore special attention will have to be given by ETIS to the specific conditions of these transport markets and their statistical systems. ***PROJECT WEB PAGE:*** http://www.infredat.ptv.de
INPHORMM: **Information and publicity helping the objective of reducing motorised mobility**	***KEY RESULTS*** INPHORMM aimed to bring together existing knowledge on the use of communication tools to influence travel behaviour, evaluate the effectiveness of previous actions, and provide a general model for developing campaigns in the future. The project compiled a review of over 120 transport information and publicity campaigns, mainly European in origin. Good practice guidelines were developed for such campaigns, targeting a range of organisations. These include recommendations for local authorities, public transport operators, major institutions and their site managers, and environmental, cycling and walking groups. Three types of campaign are described in detail – public awareness campaigns; campaigns for targeted groups and settings (such as schools and workplaces); and campaigns aimed at individual travellers and households. The analysis of previous experiences showed that: • Communications as part of an integrated transport plan can enable changes in travel behaviour. • Practical advice and ongoing support are essential to maintain such changes. Complementary measures to restrain traffic may also be required. • Among the most effective campaigns are those co-ordinated by partnerships (such as between operators, site owners and local authorities). • There is evidence of success in carefully targeted sectors, such as schools, workplaces and neighbourhoods. Mass media campaigns targeting the general public are receiving less emphasis. • Times of change for individuals, organisations and communities are worth targeting. Examples include people moving house or changing jobs, businesses moving site and new housing developments. • Many organisations do not adequately assess the effects of campaigns.

Project acronym and title	Key results and policy implications

Critical success factors for campaigns and programmes include:

- building support for the campaign itself;
- co-ordination between stakeholders and linking to other measures;
- providing evidence of success, both to sustain political and financial support and to fine-tune the campaign process.

The INPHORMM guidelines were tested in a pilot study in Chisinau, Moldova. This resulted in a new public transport information strategy and publications, implemented by a new unit created within the public transport authority.

POLICY IMPLICATIONS

The project found that co-ordination of national and local campaigns and their messages leads to greater media coverage and contributes to building a climate for change.

Information, marketing and community education programmes need to become an integral part of transport policy and planning, to raise public acceptance of other (restraint) policies and increase knowledge of travel alternatives. This includes writing campaign budgets into the broader strategy to which they relate, such as the traffic reduction or city regeneration budgets.

Good practice in the formulation of campaigns needs to be disseminated. Many organisations have failed to research the needs of their target audiences, and messages are often communicated without pre-testing. Evaluation of campaigns is often lacking.

PROJECT WEB PAGE: http://www.wmin.ac.uk/INPHORMM

INTERNAT:

Integrated Trans European Network assessment techniques

KEY RESULTS

The guidelines for the development of the Trans-European Transport Network (TEN-T) require the development of methods for strategic environmental assessment (SEA) of the network and individual corridors (Decision 1692/96/EC). This is to ensure that the full environmental impacts of the policy initiative are assessed, and not just the impacts of individual sections of infrastructure.

INTERNAT has assessed the potential for new and improved methods as part of an integrated tool for SEA in the following areas:

- evaluation of the impacts of transport infrastructure on the landscape, differentiating different types of landscape according to their value and vulnerability;
- the use of indicators for spatial impacts, such as land take, noise, pollutant emissions and visual impact;
- the choice of methods for cumulative impact analysis, designed to take account of long-term effects and existing conditions (such as global warming, forest die-off and development of new settlements in response to easier access);
- the integration of recent standards for life cycle analysis (defined in ISO14040) into SEA methods, to take account of the environmental impacts of the production and disposal stages in a product’s life as well as its use;
- combining remote sensing for data capture with geographic information systems for data handling;
- the modelling of the effects of terrain gradients on vehicle emissions.

In developing the state-of-the-art in these fields, INTERNAT has:

Project acronym and title	Key results and policy implications
	• proposed indicators for impacts on landscape; • proposed a framework for cumulative impact assessment within the SEA methodology for the TEN-T; • developed prototype software for the use of a geographic information system in SEA, applicable on EU (network), regional and local (corridor) levels; • demonstrated that digital representations of the elevation of terrain can be combined successfully with representations of transport networks and corridors for the purpose of emissions modelling. ***POLICY IMPLICATIONS*** INTERNAT has identified new techniques and methods that can be used to broaden the scope of SEA, so that it gives a broader and more accurate assessment of current and future impacts of the TEN-T. The project highlighted the need for research to develop complex spatial models of biodiversity, as this is an important area of impact assessment for SEA where standardised and user-friendly methods are missing. In addition, more spatially detailed databases are needed on land use, and quality control procedures should be used to ensure consistency between different databases. Further work is needed to make lifecycle and cumulative impact analysis methods practical.
INTRAMUROS: **Integrated urban transport concepts and market orientated urban transport systems / on-demand urban transport systems**	***KEY RESULTS*** INTRAMUROS has produced and site-tested a multi-criteria decision support tool that helps organisations responsible for different aspects of urban transport systems to identify areas where greater co-operation is possible. The current situation in a city is assessed against best and worst case scenarios according to selected criteria and objectives. A set of indicators relating to cost, operational performance, environmental impact, socio-economic effects and safety consequences has been developed. The criteria can be weighted according to the value judgements of individual actors in each city, although default weights provide a useful means of cross-city comparison. The assessment helps users to prioritise potential changes to the urban transport system. At the same time, it is a tool to enhance co-operation between the local actors. A survey together with investigations at six test sites showed that: • most organisations perceive the need for co-operation, and some are installing institutional arrangements and common procedures as a result; • competition between operators often acts as a brake on technical and financial integration; • the efficiency benefits of public-private partnerships have been demonstrated. ***POLICY IMPLICATIONS*** The INTRAMUROS decision support tool provides city and regional traffic planners with a means of comparing quantitatively the relative benefits of different local strategies for improving the co-ordination and integration of the urban transport system. It has been designed as a flexible tool that can be applied to any city situation, or even for cross-city comparison (in support of national and European policy making). The project concluded that there is no single organisational, financial and legal structure that will best encourage transport integration for all the different types and sizes of urban areas in Europe. Activity-based organisation, where actors have powers

Project acronym and title	**Key results and policy implications**
	extending over different transport modes and across wide geographic areas, may be regarded as the most likely to induce better transport integration. However, such a structure cannot be imposed abruptly, and major transition may not be as sensible as lesser modifications to existing structures.
LEAN:	***KEY RESULTS***
Introduction of lean logistics into urban multi-modal transport management	Concepts for city logistics were studied in abstract and with reference to approaches being considered in eight cities (Seville and Cordoba, Spain; Norwich, UK; Vienna, Wiener Neustadt and Linz, Austria; Regensburg and Halle, Germany). Estimates of utility value showed that integrated strategies combining infrastructure, information technologies and the provision of door-to-door freight services are the most effective in meeting stakeholder objectives. In Vienna, the introduction of a city freight terminal was estimated to offer a cost saving of 10% to freight service providers. Two concepts were developed in greater detail – load zone management and electronic logistic management. Load zone management is a system for automatic reservation of space in a city centre zone for loading and unloading lorries, supported by stricter enforcement of regulations to prevent illegal parking by private cars in that zone. It aims to reduce traffic jams due to parked cars and lorries blocking the street. A system was designed based on Internet access, making it available to a wide range of users without them needing special software. Messages would be transferred from the central reservations system to a display panel at the loading zone via the mobile phone network. A logistic management system provides a basic structure for electronic data processing from source to destination along a logistic chain, to facilitate integrated planning, monitoring and control of the movement of goods. This can support the consolidation of goods into fewer vehicles. A prototype system was developed, tailored to the needs of a logistic service provider. The system was shown to manage the required tasks with full functionality. ***POLICY IMPLICATIONS*** LEAN concluded that public administrations need to give active support in promoting the co-operation between market actors that is essential in establishing city logistic solutions and providing multi-modal hubs for freight transfer. The setting-up of regular stakeholder meetings is one aspect of this. In addition, promotional and restrictive measures may be needed to control freight traffic, such as the enforcement of loading zone regulations. A change in modal split between road and rail and the use of low-emission vehicles are also likely to need some policy-based encouragement. However, the case studies suggested that city authorities have only limited understanding of freight transport issues, and focus their planning effort instead onto passenger transport. Therefore LEAN recommended a Europe-wide information campaign targeted on city planners to address this problem.

Project acronym and title	**Key results and policy implications**
LEDA:	***KEY RESULTS***

LEDA: Legal and regulatory measures for sustainable transport in cities

KEY RESULTS

To help cities learn from each other, LEDA developed a database covering experiences with over 200 legal and regulatory measures used in 41 European cities. This is available at the project Web-site identified below. It enables stakeholders at a city level to search for examples of experiences with measures that interest them. A downloadable brochure is also available, covering 20 less well known but effective measures.

Analysis of national political systems showed large variations in the legal, financial and administrative powers granted to city authorities. For example, UK cities are subject to comparatively tight control from central government, whereas Swiss and Scandinavian communities exercise greater autonomy. There is a discernible trend towards delegation of power from the national to the regional level.

There was found to be no simple correlation between city characteristics and the transferability of measures between cities. Therefore LEDA devised a set of guidelines to aid cities in assessing the transfer of experiences to their own situation. The most significant barriers to transfer proved to be political and public acceptance (which themselves are often closely related). The keys to gaining acceptance include a thorough consultation process and a targeted public awareness campaign.

POLICY IMPLICATIONS

Certain gaps were noted in national frameworks that inhibit the introduction of alternative transport concepts – such as car sharing, demand responsive public transport and mobility management services. For example, it may not be possible to grant preferential parking to vehicles that are used for car sharing, and information and awareness campaigns are often not covered by legislation.

The lack of region-wide co-ordinated public transport was also noted. This can result from the lack of funding authorities at a regional level. The observed shift towards greater competitive tendering of public transport services is likely to have made co-ordination more difficult.

Planning systems were noted as often being weak, in that they fail to integrate spatial development with transport and environmental aspects. For example, planning approvals may not require new developments to be sited adjacent to public transport or to have limited parking provision. The Netherlands and the UK were noted as examples of promising practice in this respect.

LEDA made a number of recommendations for policy action:
- to seek greater consistency between transport policies at national, regional and local levels;
- to transfer competencies to the local level, including decision-making authority and the power to use income from transport measures such as parking tariffs;
- to avoid a *rigid* link between government funding and strict compliance with government guidance on how to implement measures (such as traffic calming);
- to focus on structures that would improve regional transport development and encourage joint working between local authorities.

The project identified the need for research results such as the LEDA database to be placed on a central European Web-based platform, with some infrastructure for stimulating and accepting new inputs from cities.

PROJECT WEB PAGE: http://www.ils.nrw.de/netz/leda

Project acronym and title	**Key results and policy implications**
LOGICAT: **Concerted action on logistic, supply and demand chain management in Europe**	*The final results of this project were not available when this Thematic Paper was prepared.* ***PROJECT WEB-PAGE:*** http://www.innovation.eutelis.fr/logicat/
MAESTRO: **Monitoring, assessment and evaluation of transport policy options in Europe**	***KEY RESULTS*** MAESTRO developed, tested and documented a set of guidelines as a reference text for the selection, design and evaluation of transport-related pilot and demonstration projects. These guidelines cover the various decision moments and evaluation phases through the entire life-cycle of a project, from the definition of the transport problem, through project design and initial evaluation, to implementation, final evaluation and exploitation of the results. The guidelines can be found on the project web site: http://www.europrojects.ie/maestro. The expected groups of users are: decision-makers; project managers; experts in the project team; and other stakeholders. The guidelines provide an overall framework as well as checklists for particular stages in the project. It is anticipated that they will be used in conjunction with other texts dealing in more detail with particular aspects of project management and evaluation. The guidelines identify three main stages of evaluation: • an initial evaluation of the selected site and preliminary design for the project, looking at the expected impacts of the project in mainly qualitative terms; • an "ex-ante" estimate of impacts, based on the detailed design in comparison with a "do-nothing" option; • an "ex-post" evaluation of the actual impacts and the extent to which the project has realised its objectives. The outcome of this stage will influence the decision on whether or not to proceed to full-scale implementation. A vital feature of the MAESTRO methodology is the clear definition of the project objectives. These objectives need to be framed to address the policy goals and questions of interest, and they must be explicit enough to guide all the subsequent stages of design and evaluation. ***POLICY IMPLICATIONS*** The MAESTRO guidelines are intended to act like a quality assurance framework, ensuring that pilot and demonstration projects are run: • *efficiently*, utilising funding resources in a way that is closely related to objectives and project plans; • *effectively*, such that the project results give clear-cut answers to the policy-related questions/issues that called for (the piloting of) a new transport solution. The guidelines advise projects how they can add value at a European level, for example by making findings more transferable between different city and national contexts. Advice is also given on taking the decision whether or not to proceed to full-scale implementation of tested policies. ***PROJECT WEB PAGE:*** http://www.europrojects.ie/maestro

Project acronym and title	**Key results and policy implications**
MEST: **Methods for European surveys of travel behaviour**	***KEY RESULTS*** MEST aimed to develop a common European survey methodology for long distance trips, based on the recording of travel diaries. In addition, it aimed to provide a methodology for sampling and analysing the diary data that would be more cost efficient and accurate than previous methods. The project produced detailed recommendations for: • the design of a travel survey (such as the minimum journey length to be covered, and the survey duration); • the protocol and data collection forms for conducting the survey (involving a combination of telephone and postal contacts); • the co-ordination of survey procedures across Member States; • weighting and correction methods for data analysis; • sampling methods for selecting a representative set of respondents to provide the travel diary data. Trials with a variety of survey methods across four Member States revealed a series of constraints and problems in data collection, such as the unwillingness of households to participate in survey work. This can often be attributed to suspicion and fatigue concerning such unsolicited contacts. The MEST research has indicated how telephone and post can best be used to improve response rates. ***POLICY IMPLICATIONS*** The common European survey methodology provides a benchmark for evaluation and improvement of the current survey work of Member States and commercial data providers. At a European level, it will support the collection of robust data as an input to the new European Transport Information System (ETIS) being developed by the European Commission to support transport policy making. Such data on long distance trips form a crucial element of decisions on European transport policy for: • infrastructure planning, such as the Trans-European Transport Network; • monitoring the success of policies on Community cohesion (e.g. access to and from peripheral regions); • monitoring the development of transport markets (e.g. quality of services and competitiveness of modes). The project noted that further work is needed to integrate the survey data into a coherent software framework through appropriate interfaces, if ETIS is to work effectively. In addition the contribution of new technologies for data gathering, such as Web links via the mobile phone, will need to be kept under review. ***PROJECT WEB PAGE:*** http://www.fundp.ac.be/~grt/mest.html
MESUDEMO: **Methodology for establishing a database on transport supply, demand and**	***KEY RESULTS*** The aim of MESUDEMO was to identify and recommend methods for compiling and processing information on transport networks and on flows of goods and passengers as part of the European Transport policy Information System (ETIS). MESUDEMO proposed a general architecture and structure for ETIS and a process

Project acronym and title	Key results and policy implications
modelling in Europe	for its development. A critical conclusion underlying the methods put forward is that data can best be supplied at the national level, but processed at different levels, rather than being assembled into a single centralised and fully harmonised data system. The data architecture should be based on the (top-down) policy questions to be addressed, while working within the (bottom-up) constraints of data availability. The suggested form of ETIS is that of a network of interconnected co-operating systems, allowing access to external databases, processing that data to create a structured core database, and supporting the analysis and viewing of subsets of data that relate to specific policy issues at regional, national and European levels. MESUDEMO recommended that Geographic Information Systems should be used for the visualisation of data, and not for the internal organisation of the data core. Agreement will be needed with Member States on a unique and unambiguous coding scheme for identifying each network link and node in the data core, rather than using geo-referencing. Pilot studies found that existing national data are too heterogeneous to be harmonised and too scarce to provide European coverage at a satisfactory level of geographic detail for ETIS. Therefore some effort will be needed to encourage countries to enrich and adapt their present systems of data collection. There are also problems with the confidentiality of operators' data to be overcome. Nevertheless, trade and transport databases were successfully harmonised in a demonstration tool focused on trans-Alpine traffic. ***POLICY IMPLICATIONS*** MESUDEMO concluded that national backing for ETIS is essential, as data will mostly be compiled at that level. However, ETIS will still have to cope with incompatible data collected to meet specific national interests, and therefore should provide data translation facilities. In addition, ETIS should be developed as a set of methods and open and adaptive computational tools, able to cope with changes in policy issues, information technologies and availability of transport databases. Preparatory actions for ETIS by the European Commission would include the creation of a data dictionary, defining a basic common set of transport information that corresponds to the policy issues to be addressed. A permanent solution is also needed for the institutional arrangements to create and maintain ETIS.
MINIMISE: **Managing interoperability by improvements in transport system organisation in Europe**	***KEY RESULTS*** MINIMISE identified impediments to interoperability in the European transport system, and evaluated the costs and benefits of changes and policy actions that would improve interoperability and economic efficiency. The project generated detailed case studies and policy recommendations for seven (trans-European) transport applications: parcel services, road freight, rail transport, waterborne transport, intermodal transport, air transport, and urban/inter-urban public transport. Cost-benefit evaluations were produced for individual measures to improve interoperability (such as improved border control facilities, harmonisation of regulations and investment in Electronic Data Interchange). In a second step, benefit/cost ratios were assessed for packages of policy measures: • 26 (of 28) measures were shown to have a positive benefit/cost ratio;

Project acronym and title	**Key results and policy implications**

- 19 measures would require little public investment;
- 21 measures have a benefit/cost ratio greater than 20;
- 17 of the measures would give significant reductions in environmental impacts;
- only 14 measures would provide benefits for both the consumers and the service providers.

POLICY IMPLICATIONS

The project made recommendations for actions by the European Commission in the following areas:

- stimulating the use of telematics;
- stimulating the increased use of modern transport equipment;
- promoting improved interconnectivity and interoperability of transport networks;
- harmonising organisational structures;
- harmonising regulatory frameworks.

Specific policy recommendations included:

- for **parcel services**, further liberalisation of the letter market, simplification of border crossing procedures, and abolition of regulatory requirements for documentation of parcels in some Member States;
- for **road freight**, funding the faster introduction of information technology, investing in border crossing facilities with Eastern Europe, and reform of regulatory controls on vehicle operations;
- for **rail transport**, applying a competition regime (e.g. concerning State Aid and market organisation) that creates an efficient single market;
- for **waterborne transport**, promoting the use of information technology, reducing and harmonising customs paperwork, and harmonising port and customs operating practices while minimising restrictive labour regulations and practices;
- for **intermodal transport**, setting up a competitive and non-discriminatory process for the management of infrastructure (such as rail freight freeways) and for the allocation of scarce capacity;
- for **air transport**, improving the systems for pricing the use of infrastructure and for slot allocation, improving air traffic control, and collecting more extensive statistical data to support policy development;
- for **public transport**, encouraging deregulation through franchising of routes, and promoting the appointment of transport authorities to manage through-ticketing structures and the use of smartcard ticketing.

MOMENTUM:

Mobility management for the urban environment

KEY RESULTS

MOMENTUM compiled a survey of mobility management approaches in use across Europe, and beyond. From this, together with its sister project MOSAIC, integrated concepts were defined for mobility management strategies and mobility centres, and for the transfer of strategies between locations. These concepts address all types of traffic and trip purposes.

A range of strategies were demonstrated at 13 test sites (Leicester, UK; Leuven, Namur, BE; Graz, AT; Munster, Essen, Potsdam, DE; Bologna, IT; Corfu, GR; Coimbra, PT; Zurich, Zug, SU; Goteborg, SE). These focused in particular on the use of mobility centres and the targeting of commuter trips. The successes and problems at each site have been documented in detail to provide guidance to other cities.

The following general lessons were drawn on the implementation of mobility management strategies at a site level:

- The creation of partnerships between stakeholders (including transport operators,

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community groups, local councils and local businesses) is crucial.

- Target efforts onto selected users (such as companies or young people) rather than spreading efforts across a wide range of user groups.
- Establish networking opportunities such as the European Platform on Mobility Management (EPOMM) to learn from other people's experiences.
- Treat the implementation as an ongoing process rather than a discrete project, for instance building political support over time.
- Select the strategy according to the national context, such as the attitudes of users and their reaction to "push" measures such as car parking restrictions.
- The use of promotion and awareness-raising campaigns is a key element in the successful delivery of mobility management schemes.

Project outputs have included a user manual aimed at initiators of mobility management and scheme managers, and a brochure for policy-makers and the owners of major traffic-generating sites (hospitals, companies etc.). (Dissemination has been developed jointly with the project MOSAIC – see http://www.rwth-aachen.de/isb/Ww/mosaic/).

POLICY IMPLICATIONS

MOMENTUM and the parallel project MOSAIC have been influential in raising the awareness of mobility management practices and promoting their acceptance across Europe. Many of the demonstration sites are continuing to operate and expand, and mobility management is being incorporated in local and regional transport strategies in the EU.

MOMENTUM concluded that the procedures for evaluating the success of mobility management projects need further development. This is to facilitate learning from cross-comparison of projects, but also to give a broad picture of the current and future return on the investment.

PROJECT WEB PAGE: http://www.ils.nrw.de/forsch/96-vi-3.htm
EPOMM WEB PAGE: http://www.epomm.org/

MOSAIC:

Mobility strategy applications in the Community

KEY RESULTS

Mobility management aims to make more efficient use of existing transport facilities and minimise the number of vehicle trips through strategies such as better information on available public transport and the co-ordination of car pooling and public awareness campaigns. MOSAIC has produced a brochure, user manual and CD-ROM that define the different elements of mobility management. In particular, roles are identified for:

- a Mobility Manager, responsible for introducing initiatives within a particular area;
- a Mobility Consultant, responsible for providing mobility management services at an urban/regional level, and encouraging their adoption at site level (e.g. business park, major company, school);
- a Mobility Centre, offering information services to the public;
- a Mobility Co-ordinator and Mobility Office, promoting activities at a particular site according to an agreed Mobility Plan.

Demonstration projects were run in Germany, the UK and The Netherlands:

- the Wuppertal Mobility Centre achieved a small shift from private to public transport;
- the Mobility Consultant in Nottingham persuaded more than 20% of organisations

Project acronym and title	Key results and policy implications

with more than 200 employees to develop Green Commuter Plans;
- initiatives in Utrecht and Leiden achieved some modal shift and increased company involvement in mobility management.

The project concluded that Mobility Consultants appear to be most successful with the largest organisations (500+ employees), and such organisations should be targeted first. On sites employing over 1000 staff and where there are severe access or parking problems, it is suggested that little progress will be made unless a full-time Mobility Co-ordinator is employed (preferably in the Estates or Facilities Management functions at the site). The voluntary approach to encouraging Mobility Plans is favoured (rather than political mandate or pressure), in order to ensure a longer-term sustainable drive for implementation.

POLICY IMPLICATIONS

MOSAIC has concluded that mobility management is a long-term approach that requires long-term political support as well as bottom-up local initiatives. In itself, it will probably make a measurable but not really significant impact on the choice of transport modes. However, it also raises awareness of transport alternatives that may then be more strongly stimulated by other policy measures such as road pricing.

At the European level, MOSAIC recommended:
- the setting up of an umbrella organisation offering information on best practice in mobility management;
- support for demonstration initiatives in the freight transport sector.

At the national level, MOSAIC recommended:
- enactment of supporting legislation and fiscal policies;
- research into the national obstacles to implementation of mobility management;
- initiation of freight sector actions;
- promotion of mobility management at leisure and retail sites (to extend previous work-site experience).

PROJECT WEB PAGE: http://www.rwth-aachen.de/mosaic
EPOMM WEB PAGE: http://www.epomm.org/

MOTIF:

Market orientated transport in focus

KEY RESULTS

The aim of MOTIF was to find ways of improving the market orientation of urban public transport, through a better matching of service characteristics with the requirements of different groups of users.

Through the analysis of previous practice and 33 city case studies, MOTIF identified market research methods and segmentations that will allow effective discrimination and valid conclusions to be drawn when targeting improvements in public transport services.

Important findings included:
- Passenger priorities differ substantially between countries, with only punctuality/reliability commonly achieving a high ranking. The postulated importance of travel speed in modal choice may be over-rated. Therefore user needs must always be confirmed locally.
- Previous market research has often focused on frequent travellers, and thereby failed to spot the different needs of other user groups. For example, only low importance is attributed *on average* to pre-trip information, but this aspect is

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significant for infrequent and potential users.

- The dependence of passenger requirements on socio-economic and journey characteristics is rather small, with only a 3-6% variation in the perceived importance of service attributes.
- A useful definition of good practice operation (i.e. indicators and benchmarks) on a European level is hard to find. This reflects the weakness of the correlation between delivered and perceived quality. Direct measurement of satisfaction will remain the more reliable indicator of product quality as seen by the customer.

POLICY IMPLICATIONS

MOTIF concluded that:

- If a detailed segmentation of consumer preferences is required, the survey should be carried out *on a local basis*. There are no standard European solutions.
- Market studies should ensure that adequate *discrimination* is obtained between different user groups and service attributes. Otherwise, crucial information disappears in the mean values. For feasibility reasons, the extent of segmentation must be limited. Pilot tests with the methodology can help to avoid wasting effort on low quality results. For example, primary and secondary requirements can be distinguished, so that secondary needs such as passenger information are not under-estimated.
- The level of fares is important, but users *are* prepared to pay for good quality on important features. Therefore surveys should be geared towards quantifying the willingness of the customer to pay for certain improvements.

Further work is needed to improve the ability of public transport operators to use market research effectively. For example, a standardised set of dimensions/segments would aid comparability of results and cross-operator learning, even though the finer detail of each survey must be determined locally. Also, a better understanding is needed of the relations between results from different market research methods, between delivered and perceived quality, and between perceived quality and modal choice.

MYSTIC:

Towards origin-destination matrices for Europe

KEY RESULTS

In order to develop effective transport policies and assess infrastructure needs, reliable data collection systems and databases are essential. Therefore MYSTIC has developed methodologies for building origin-destination matrices for passenger and freight transport at a pan-European level from currently available data, and charted a process for updating matrices in the future.

On the basis of data sources existing in 7 European countries (Denmark, Finland, France, Germany, Great Britain, Norway and Sweden), MYSTIC demonstrated a data harmonisation process to produce a European passenger trip matrix, mainly for road and rail transport. A case study in the UK showed how more detailed data sets can be combined in a database to provide trip matrices suitable for infrastructure design and assessment.

A survey of electronic data interchange (EDI) systems showed that the information required to build freight trip matrices often exists in the computer system of the originator of the consignment, although automation of data collection from these systems would be difficult without standardisation.

A survey of freight shippers found that shipments could be successfully traced from origin to destination through each link of the transport chain using telephone

Project acronym and title	**Key results and policy implications**
	interviews. This methodology allows matrices to be built for each commodity flow, and could be scaled up to the European level. Such a methodology has hitherto eluded researchers. MYSTIC highlighted the importance of establishing an organisational structure for data management that safeguards sensitive data and ensures quality. For example, in the freight sector, it appears that surveys among shippers need to be sponsored by official agencies, since companies are reluctant to respond to non-governmental initiatives. ***POLICY IMPLICATIONS*** Pan-European passenger and freight origin-destination matrices could help governments to plan their economic and transport policies in an effective way. MYSTIC has demonstrated viable methodologies to support this. For the freight sector, the project showed that paper and telephone-based interview methods could be used to estimate pan-European trip matrices. However, there is an immediate opportunity to introduce an EU-wide standard for freight data collection formats, to feed into the new EDI products being developed at a time of rapid change in freight logistics systems. MYSTIC highlighted the need to collect a consistent set of new data for the European level. For this purpose, it has recommended and specified a rolling programme of new pan-European origin-destination surveys for both the passenger and freight sectors
OD-ESTIM: **Cost-efficient origin/destination estimator**	***KEY RESULTS*** The aim of OD-ESTIM was to provide methods for constructing flow data for inter-regional passenger and goods transport, in a cost-efficient way, based on economic data for each region. This was based on the premise that adequate economic data are often accessible when transport flow data are missing. Methods were devised for estimating both passenger and freight transport flows, based on a quantification of the relationship between socio-economic variables and the associated demand for transport. The methods operate at the NUTS2 level used in statistics, which generally corresponds to the administrative regions of a country. Origin-destination data are produced, disaggregated by transport mode and type of commodity for freight, and by mode and trip purpose for passenger transport. The methods were calibrated on data for France and The Netherlands, and then tested on data for Spain and Italy. In general terms, the validation results were better for the Spanish case than for Italy. This could relate to the availability of more extensive data for Spain, but it may also reflect different characteristics of these countries (such as the current modal shares and the relative importance of different sectors of the economy). Due to the limited availability of transport data (especially for long-distance flows), the calibration of the passenger method could not be fully validated. However the method does give acceptable results for highly aggregate information, such as the total generation of trips by region. The freight methods could be validated, though. ***POLICY IMPLICATIONS*** The project concluded that direct collection of transport data provides the best basis for policy decisions. However, the OD-ESTIM methods do provide an adequate, fast

Project acronym and title **Key results and policy implications**

and economical procedure where such data are not available. This is particularly relevant to EU Member States that do not yet collect detailed data on inter-regional flows, and for Central and Eastern European countries that need to evaluate investment in strategic infrastructure (such as the extension of the TEN-T network eastwards). The methods could also be used in developing countries that receive EU aid for new infrastructure.

One limitation of the new methods is that they give estimates only for the fraction of total traffic on transport links that consists of long-distance traffic. Surveys indicate that up to 70% of daily traffic may relate to short-distance intra-regional traffic. This means that to get a complete view of transport demand, this short-distance traffic should be added to the results from the OD-ESTIM methods.

OD-ESTIM highlighted the need to assemble data on long-distance international passenger transport, with consistent data collection across different countries.

OPIUM:

Operational project for integrated urban management

KEY RESULTS

OPIUM evaluated a range of physical measures for traffic management through their practical implementation in a number of cities (Gent, Heidelberg, Liverpool, Nantes, Patra and Utrecht).

Schemes to restrict road space and parking space for private cars proved very successful in terms of their impact on travel behaviour and consequent environmental benefits. The main difficulty lay in opposition from shopkeepers, although residents and visitors were generally supportive.

Traffic calming reduced overall traffic speeds and noise at a local level. This was perceived to benefit vulnerable users and could reinforce measures to promote modal shift. However, there may be negative effects on vehicle emissions unless overall car use is restricted.

Parking management and guidance appeared successful in reducing circulating traffic at a local level, and could influence modal split if implemented widely across a city. Parking measures were generally self-financing.

Public transport priority did not have a strong influence on modal split, but improved the speed and reliability of bus services. Greater modal shift might have been achieved if priority measures were implemented more extensively or integrated with traffic restrictions and improvements to bus services.

Measures to favour cyclists and pedestrians had only limited effect on modal shift when used in isolation, but were perceived by users to improve safety.

The greatest environmental benefits were achieved where road space was closed to private cars or where traffic volumes were reduced. Park-and-ride and parking schemes were successful in this respect. However, measures that led to slower speeds and increased journey times, such as traffic calming and bus priority, resulted in an increase in pollutant emissions.

All the schemes within OPIUM had a positive cost-benefit ratio, with payback periods of ten years or less.

Project acronym and title	Key results and policy implications
	POLICY IMPLICATIONS OPIUM concluded that public consultation needs to play an increasingly important role in the development of traffic management measures. It is needed to gauge public opinion during scheme design and implementation, to educate the public about the likely benefits, and to take account of the needs and concerns of specific stakeholder groups such as shopkeepers. Stakeholder opposition proved to be the main hurdle to the schemes tested by OPIUM. Individual measures can yield benefits in their own right, even if used only locally, but their deployment as part of an integrated strategy has the potential to yield significantly greater benefits. In particular, public transport priority and bicycle measures are increasingly effective at larger scale. OPIUM recommended a number of areas for further research, particularly in relation to public consultation and the evaluation of user needs.
OPTIMA: **Optimisation of policies for transport integration in metropolitan areas**	***KEY RESULTS*** Optimal city transport strategies involve a combination of measures. Also, there is no single best measure or strategy for general application. Nevertheless, some general recommendations can be drawn: • *economically efficient* strategies can be expected to include low cost improvements to road capacity, improvements in public transport (increased service levels or reductions in fares), and increases in the cost of car use (either road pricing or increased parking charges); • public transport infrastructure investment is not likely, in most cases, to be a key element in these strategies; • reductions in capacity to discourage car use are not likely to be economically efficient; • the optimal changes in service levels and fares for public transport will depend on the current level of subsidy - in some cases a reduction in service levels or an increase in fares may be justified on economic grounds; • the optimal increase in costs of car use will depend in part on current levels of congestion; • in most cases, economically efficient strategies can be designed which are financially feasible, provided that revenues can be used to finance other strategy elements; • the pursuit of *sustainability* (rather than pre economic efficiency) is likely to justify investment in public transport infrastructure, further improvements to public transport services and/or fares, and further increases in the cost of car use; • availability of finance will be a major barrier to implementation of many sustainability-optimal strategies. ***POLICY IMPLICATIONS*** The main implications are: • legislation will be needed to enable implementation of road pricing and to control parking charges; in the UK and Italy there is also a case for changing legislation to permit economically more efficient public transport strategies; • public acceptability will be a significant barrier with those measures which reduce service levels or increase costs - this implies the need for effective public relations campaigns, and carefully designed implementation programmes; • detailed local measures to improve the environment and provide better facilities for cyclists, pedestrians and disabled people should be determined once the optimal

Project acronym and title	Key results and policy implications
	strategy has been defined at a more aggregate level.
PASTEUR: **Policy assessment, scenarios, transport economics research in Europe**	*The final results of this project were not available when this Thematic Paper was prepared.* ***PROJECT WEB-PAGE:*** http://projects.nei.nl/pasteur/
PATS: **Pricing acceptability in the transport sector**	***KEY RESULTS*** The goal of PATS was to identify the reasons for acceptance/non-acceptance of new forms of transport pricing, to find ways of increasing their acceptability, and to identify the legal and political barriers to the implementation of new pricing schemes. A variety of survey techniques were used to study the perspectives of around 1500 people across six Member States, covering policy-makers, citizens, transport operators and other stakeholders. Important conclusions from these surveys were as follows: • The objectives behind pricing measures must be clear and reasonable to those affected by the measures. For this reason, *new* types of measures should be preceded by awareness raising campaigns on the targeted problem and the effectiveness of the proposed measures. • In order to make new or higher charges acceptable, the price should be seen to relate to the real (e.g. environmental) costs of transport. For example, users favour differentiating charges with respect to time and pollution. (However, it is not *universally* true that this will benefit collective modes of transport.) • Pricing measures need to be perceived as effective in solving transport-related problems – for instance based on evidence from pilot applications. • The transparent use of revenues raised by pricing measures is essential in securing acceptability. In general, the paying users want to see that revenues are used in the transport sector, especially to cross-subsidise public transport (although this may not be appropriate from an *economic* viewpoint). There is strong opposition to using the revenues outside transport. • Protection of privacy is a necessary precondition for an acceptable pricing scheme. • Pricing measures should be introduced in a stepwise way, avoiding price shocks. Compensation measures should be considered for disadvantaged groups. • There are widespread suspicions of governments' motives for increasing prices, and a widespread belief that transport is already too heavily taxed. • The authority chosen to run a pricing scheme should be seen as capable, trustworthy and accountable, with the power to integrate pricing with other policies to tackle transport problems. ***POLICY IMPLICATIONS*** PATS made a series of policy recommendations: • Ideally, the introduction of new or higher prices should be preceded by or done in parallel with measures that will provide a better service, ideally with some *guarantee* of the higher levels of service. • Even with an increase in quality, the introduction of pricing may be perceived as contributing to the exclusion of less affluent members of society. A possible non-distorting method of compensation is the allocation of a free ration of consumption (although this requires a more complex system of control).

Project acronym and title	Key results and policy implications

- If there is no *direct* added value to users from higher prices, acceptability is harder, but may be improved by a transfer from fixed to variable components of price.
- Pricing should discriminate between vehicles according to the costs they impose, with the same principles being applied to all regions but taking account of variations in e.g. traffic and population density.
- Stakeholder involvement is needed in the policy decision-making process, varying according to the local political and cultural context.
- Transparency in handling the revenues is vital for public acceptability.

The variations between Member States in methods for evaluating costs and prices were noted as raising problems for acceptability, owing to the effects on market competition – harmonisation of methods across Europe would be valuable in this respect.

Sophisticated technical systems are expected to play an important role in the application of new pricing principles, for instance in road pricing. However, concerns over privacy are often raised in opposition. The evidence from PATS suggests that, provided conditions are set to guarantee privacy, this issue does not appear to be a show-stopping obstacle for users.

PROJECT WEB-PAGE: http://www.tis.pt/proj/pats/pats.html

PETS:

Pricing European transport systems

KEY RESULTS

The main objectives of PETS were:

- to report on the current pricing situation of passenger and freight transport in Member States;
- to assess whether such prices provide appropriate price signals in the light of all relevant internal and external costs;
- to forecast the consequences of moving to a more appropriate price level and structure in the face of external constraints and developments.

Through case studies on five transport corridors, PETS has shown that a practical methodology to calculate marginal social cost (the basis for efficient pricing policies) for all modes does exist, although many of the valuations remain subject to considerable uncertainty.

The case studies covered cross-Channel passenger and freight, Transalpine freight, Finnish passenger and freight, Tagus passenger crossing and Oslo-Gothenburg passenger traffic. Four pricing scenarios were used, comparing current pricing with “pure” marginal cost pricing and “full” cost recovery from users.

PETS demonstrated that a purely commercial approach to transport pricing is not appropriate and may push prices in the wrong direction. However, the effects of moving to a more efficient pricing system are likely to be diverse, depending on the national context and the current level of prices and subsidies. Thus it is not universally true that the more environmentally friendly modes would uniformly benefit at the expense of other modes.

For instance, the current price of inter-urban car travel is estimated to be too high relative to the marginal social cost in 2010, partly as a result of tighter vehicle emissions regulations. On the other hand, PETS confirmed the case for urban road pricing in congested cities. Similarly whilst there is generally a case for lower prices for public transport (bus, rail and air), in some places existing subsidies are already excessive. A substantial switching of trips onto public transport is justified only in the

Project acronym and title	**Key results and policy implications**

urban case, with a reduction of car traffic of up to 40% and a similar percentage increase in public transport.

In the case of road freight, long-distance freight is generally under-charged (with the exception of the Transalpine corridors through Switzerland), because taxes do not increase sufficiently with vehicle weight and distance travelled. For the cross-Channel services, the existing charges for Le Shuttle (for both passengers and freight) are significantly above the marginal cost-based charges that would maximise economic efficiency.

The modelling results also indicated that further extension of deregulation might not necessarily benefit rail transport in terms of the relative pricing compared with other modes, reflecting the different starting points in terms of pricing policies and subsidies between the modes.

POLICY IMPLICATIONS

The evidence from PETS demolishes the argument that marginal cost pricing cannot be implemented in practice because such prices cannot be measured. However, this does not mean that all the relevant agencies currently possess the information and ability to estimate marginal social cost, so further efforts will be needed on disseminating the methodology. In addition, further research is needed, for instance to refine the estimates of external costs and the estimation of prices on a countrywide basis.

One of the critical conclusions is that the appropriate level of charges is *strongly* dependent on the *local* context. Current charges can be too high in sparsely populated regions with limited traffic, and too low in busier areas.

PETS concluded that there is a clear case for reform of road freight vehicle taxation, to introduce a charge based both on vehicle characteristics and distance travelled.

POSSUM:

Policy scenarios for sustainable mobility

KEY RESULTS

POSSUM developed so-called Policy paths (comprising packages of policy measures) linking Images of the Future in 2020 to the present day. The project showed that this methodology provides an effective means of establishing options for transport development in relation to developments in society.

Three Images were prepared, involving different combinations of technological innovation and decoupling of transport growth from economic growth. POSSUM then applied “backcasting” techniques to work backwards from the desirable future end-states to determine feasible means of achieving those outcomes. In this way, POSSUM provided a set of policy scenarios for the European transport system through to the year 2020 that could meet CTP objectives for economic efficiency, regional development and environmental protection. The scenarios explore alternative social and political developments outside the transport sector, and show what transport policies would then deliver the targeted outcomes. In particular, the relative roles of technology and reductions in the transport intensity of the economy are described.

The project identified a number of early policy actions that would be appropriate across all scenarios:

- Tax reform – a shift of the tax base from labour to the use of natural resources in order to strengthen incentives for dematerialization and energy conservation.
- Experiments with low emission zones – providing an incentive for the market to

Project acronym and title	**Key results and policy implications**

select clean vehicle technologies.
- Tele-commuting – experimenting with tele-working options in conjunction with land-use planning.
- Road pricing – taxation on the use of congested urban roads, coupled with measures that provide alternatives (such as quality public transport).
- Actions to provide integrated information systems.

Stakeholder consultations indicated that scenario building does generate innovative thinking on longer-term transport issues.

POLICY IMPLICATIONS

POSSUM characterised the CTP as facing large uncertainty with high potential impact. In this situation, the appropriate strategy is to proceed in small steps with frequent re-evaluations. It is also preferable to try several solutions in order to learn – the role of public policy is then to set targets that promote innovation and selection through market forces.

The main policy conclusions were:
- Both new technologies *and* the decoupling of transport growth from economic growth are needed to achieve sustainability targets.
- For technological innovation, action is needed at the European level to build consensus and provide incentives for rapid movement along clear technology trajectories. Support for innovation may need to precede open market developments.
- The CTP must be complemented by measures outside the transport sector (such as tax reform, regulation of information technology, and land-use planning).
- Those measures that have a long lead time (e.g. aimed at changes in behaviour) must start early.
- Measures should be adapted to local conditions where uniform national or European policies would be inefficient.
- The Trans European Networks must form part of an integrated transport strategy, such that they do not simply encourage more travel overall.
- The growth in air travel and the increased demand for leisure activities (e.g. from an ageing population) will act as other major constraints on the achievement of sustainable mobility targets.

PRIMA:

Pricing measures acceptance

KEY RESULTS

The objectives for PRIMA were to identify the reasons behind the acceptance or non-acceptance of road pricing and to produce recommendations for the implementation of urban road pricing in Europe.

PRIMA provided a databank of results from public surveys and interviews with stakeholders, leading local politicians and experts. Data were collected from 500 citizens and 30 interviews in each of eight urban regions in autumn 1999. From this stock of information, a three-stage decision process was developed. This process can be adapted to local situations to support any city that considers introducing road-pricing schemes. It not only concerns the schemes themselves, but also the design of the public decision-making process in the run-up to their introduction.

The interviews and public surveys identified the following key results:
- Acceptance depends on stakeholders perceiving that there are severe and urgent traffic problems and that pricing is an effective part of the solution.
- Acceptance requires alternative modes of transport to be available. For example,

Project acronym and title	**Key results and policy implications**

investment in public transport should accompany the introduction of pricing.

- Charges should start low, and compensating measures should be considered for social groups that are disadvantaged by the pricing scheme.
- The introduction of road pricing should be done in a stepwise manner to allow gradual adjustment. For example, a financing toll system may form the starting point, as this is more readily accepted than congestion charging.
- The initiative to introduce road pricing should (be seen to) come from the urban area. In addition, national legislation will have to be changed in many countries, and financial support from the national government may be needed to ease the change in costs for car users.
- Acceptance requires public participation in the decision making process. The starting point must be open discussion of traffic problems and the objectives for urban transport policy.
- The success of earlier road pricing schemes influences acceptance. Therefore the dissemination of results between cities is important.
- The increased use of information technologies and electronic payment systems in other applications is expected to improve acceptance of the technologies needed for efficient road pricing. The privacy issues linked to road pricing do not seem to have an important negative influence.
- Acceptance from a majority of citizens cannot be expected from the outset. Experiences from several cities show that acceptance tends to increase after the implementation, but this is quite sensitive to the level of charges.

POLICY IMPLICATIONS

PRIMA found that, in general, public opinion is against congestion charging, although the polluter pays principle is broadly accepted as a general guideline for policy making. On the other hand, there is considerable support for road pricing as a way to finance investment in transport. This includes the funding of public transport and the construction of road bypasses, with some preference for the former. Therefore implementation of road tolls can be a stepping stone to raising acceptance for congestion charging.

At the time of the project, the law in some Member States did not provide for the implementation of road pricing. It was legal in other countries as long as the pricing scheme was related to the financing of new roads. However, congestion charging would need changes in legislation.

PROJECT WEB PAGE: http://www.certu.fr/internat/peuro/prima/prima.htm

PRIVILEGE:

Priorities for vehicles of essential user groups in urban environments

KEY RESULTS

PRIVILEGE has defined "default" levels of priority to be accorded to different road user groups when they are competing for road space in congested urban areas. It is recognized, however, that cities will need to adjust these weights according to local conditions. Public transport commonly receives the highest priority in the cities studied.

A catalogue has been provided covering 31 individual measures for urban road traffic priority management. This includes implications for fleet management, information management, enforcement and integration into the existing system. Skeleton plans for the introduction of various packages of measures have been devised. Specific city case studies have been developed, showing how a package of measures can be tailored to a given situation

Project acronym and title	Key results and policy implications

The potential impacts of the various measures have been characterised, and implementation issues described. Critical local conditions and obstacles were identified. All this information is provided in a structured format as a guide to local authorities considering prioritising certain user groups.

POLICY IMPLICATIONS

In order to prioritise the use of the existing road network, regulations have to be considered which result in restrictions in general road use. Thus this is essentially a political issue, depending in part on social acceptance.

For a number of measures, the legal framework has not yet been put in place. This situation varies from country to country. Certain measures may therefore require legislative amendments (to remove barriers) or new local regulations before they can be implemented effectively.

As a result of interviews with local transport policy makers and practitioners, PRIVILEGE also found wide variations in the political and social acceptability of the various measures, including differences between countries. In all cases, public awareness campaigns to inform drivers and residents about the benefits of such schemes were found to be essential.

PROMOTIQ:

Conditions for the promotion of a new generation of intermodal transport services and operators

KEY RESULTS

PROMOTIQ aimed to identify the opportunities for companies seeking to develop a new generation of door-to-door multi-modal transport services, and propose guidelines for their introduction to the market. Through a series of case studies, the project made a detailed analysis of (a) current trends, (b) opportunities for new intermodal services, and (c) barriers to these services, for each of six promising market segments:

- rail traction;
- short distance (<300km) intermodal transport;
- small shipments in intermodal transport;
- segments where quality (speed, reliability etc.) is at a premium;
- integration of air transport into multi-modal chains;
- short sea shipping.

An Action Plan has been devised, recommending policy changes at European and Member State levels to promote intermodal transport in each of the six segments. Each policy action has been characterised according to its objective, the responsible stakeholders, time scale for implementation and estimated cost.

PROMOTIQ concluded that deregulation and competition are the key to new intermodal services, with the shippers and transport providers developing joint operations.

POLICY IMPLICATIONS

Priorities for policy changes were proposed to be:

- early moves towards the fair and efficient pricing regimes already proposed by the EC (e.g. for track access and terminal use);
- establishing a pan-European regulator for intermodal transport (with the task of harmonising market liberalisation and access to infrastructure in the EU Member States);
- encouraging public-private partnerships along the transport chain, particularly involving door-to-door shippers;

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- providing limited subsidies for new and improved intermodal infrastructure;
- establishing and promoting standards (e.g. for loading units, electronic data interchange and harmonised procedures/documentation at transhipment points and border crossings);
- allocating further funding to research and development, particularly concerning information systems and technologies for faster transhipment;
- continuing the EC PACT programme for pilot actions in combined transport, with specific targeting of the market segments identified by PROMOTIQ as being promising;
- organising roundtable meetings between stakeholders in each Member State, tasked to identify and remove barriers to intermodality.

Specific recommendations for individual market segments were:
- to ensure full and uniform liberalisation of rail track access across all Member States;
- to set up a fair and open system under which different operators can bid for capacity (railway slot allocation);
- to ensure adequate priority is given to freight trains (in competition with passenger services), by setting up rules or establishing freight freeways;
- to improve the quality and capacity of rail links, and add rail links to major airports;
- to promote short sea shipping and improve its quality (e.g. through harmonisation of opening hours, operating procedures and equipment).

PROJECT WEB PAGE: http://www.gruppoclas.it/projects.htm

PROTEE:

Procedures for transport evaluation and monitoring of radical innovations in learning experiments

KEY RESULTS

PROTEE developed and tested a new methodology for the management and evaluation of (transport) projects involving radical or break-through innovations. The core idea behind the methodology is to consider a project as an exploration of alternative possible outcomes. Whereas most other evaluation methods try to gain as much information as possible on these outcomes, PROTEE ranks projects by the quality of this exploration itself.

Therefore PROTEE developed a methodology and indicators to structure the learning process within a project to develop a radical innovation. This is based on facilitating the relationship between the project leader (an *innovator* with a close knowledge of the technology, its potential and its problems) and the external decision-maker or sponsor (an *evaluator* knowing little about the project but who is experienced in evaluating projects and knows the generic risks). It requires the innovator and evaluator to enter into a learning pact, periodically meeting to evaluate the project's progress along an uncertain exploration path. This relationship covers the early phase of the project before it is abandoned or matures to the point where more traditional project management methods can be used.

The methodology is based on lessons drawn from many case studies in the field of intermodal transport, as well as more fundamental insights into the innovation process. It establishes a paper trail that progressively builds up a description of the project as learning proceeds, according to defined indicators. These indicators are based on key factors that influence the probability of failure of an innovation. The paper trail allows the innovator and evaluator to assess the "quality" of the learning curve of the innovation, and thereby decide whether or not to continue the exploration.

The methodology has been tested on several completed and ongoing projects involving

Project acronym and title	Key results and policy implications
	freight transfer centres and the automated handling of freight. Its principles and know-how have been captured in a preliminary electronic user manual.
	POLICY IMPLICATIONS
	PROTEE provides an alternative way of structuring the dialogue between project managers and evaluators concerning radical and risky innovations. The most important practical outcome of PROTEE is the procedure for organising evaluation meetings and documenting a project, which is rather different from the conventional requirements for technical work plans and progress reports. It involves an *innovator* and an *evaluator* in defining and re-defining their own descriptions of the project, with the risks made explicit, and working together towards a consensus description.
QUITS:	***KEY RESULTS***
Quality indicators for transport systems	Decision-making on mode, technology and journey choices will be improved if all costs are taken into account - for a single journey, this means the direct costs (e.g. fuel and highway tolls), the value of travel time, and the external costs (e.g. air pollution and climate change). QUITS has demonstrated the viability of making a detailed bottom-up assessment of a wide range of such cost factors specific to individual journeys/routes, for different modes of transport, trip purposes, desired times of arrival and expected lengths of stay at destination. The QUITS methodology focuses on modal comparison, and therefore is useful for benchmarking purposes.
	Case study calculations showed substantial reductions in external costs (due to air pollution, global warming, noise and accidents) for rail compared to road transport on selected major European routes. This applied to both passenger and goods transport, with savings of 50% or more. The total external costs for road transport on selected major European routes lay in the range 20-45 Euro per 1000 passenger/tonne-kilometres. The relative importance of each cost category varied with mode and route.
	The bottom-up approach has provided far greater accuracy than previous top-down approaches, but includes the risk that the data collection effort could exceed the potential benefits. To overcome this issue, an intermediate approach is recommended, where "typical" values are identified for clusters of routes with similar characteristics and then used to generalise cost valuation on all routes.
	POLICY IMPLICATIONS
	The ability to value external costs is an essential prerequisite to the use of pricing measures to control environmental damage (as foreseen in the EC Green Paper "Towards Fair and Efficient Pricing in Transport"). QUITS has demonstrated the feasibility of evaluating external costs for journeys along specific routes, as part of the research base for the implementation of economically-efficient pricing measures in the European transport sector. However, the project has also identified the need for further research - both on the valuation methods used, and on the generalisation of the methodology for simplified application to other journeys. For example, the evaluation of *perceived* quality and security requires development work.

Project acronym and title	**Key results and policy implications**
RECONNECT:	***KEY RESULTS***
Reducing congestion by introducing new concepts of transport	RECONNECT aimed to identify and assess new means of transport that have potential to ease congestion, including their feasibility, suitable areas of application, impacts and needs for policy intervention.

The project provided a structured overview of the potential of new transport concepts, with a particular focus on innovative concepts that are already significantly advanced (such as elevated public transport, underground freight systems and airships). Some 100 concepts were surveyed, and 21 concepts were selected for comparative assessment (as representatives of classes of new means of transport).

High capacity elevated passenger transport systems (such as the H-Bahn Dortmund and the Wuppertaler Schwebebahn) offer good potential for reducing congestion in urban environments, as the backbone of the public transport system. Nevertheless, the infrastructure needs and total costs are high. Guided and road-based people movers are seen as complementary solutions for feeder and shuttle services.

Underground concepts (such as the Underground Logistics System proposed in Amsterdam) provide an efficient means of freight distribution. They rely on automated and driver-less electric vehicles that run in tunnels. Again, infrastructure costs are fairly high, but can be reduced using new small-bore tunnelling technologies.

Finally, airships are promising for point-to-point operations in both passenger and freight transport, and their costs are not particularly high. For example, the CargoLifter allows bulky and heavy items to be taken to the final destination, replacing a whole shipment chain. Other versatile airships may contribute to traveller intermodality in remote regions.

Financial and commercial hurdles pose the biggest obstacle, particularly for public transport. However, tailor-made transport services such as airships are proving more attractive to private investors. Regulatory barriers are also significant, particularly for automated and driver-less concepts.

POLICY IMPLICATIONS

To overcome the barriers to market penetration, the priority is to make “seed” funding available. Public-private partnerships are seen as one way forward on this. Regulatory barriers need stakeholder consultation at an early stage, and would benefit from Government agencies (such as strategic rail authorities) being assigned responsibility to tackle the legal issues.

Further RTD is needed to reduce uncertainties and technology costs. Important areas for research are:

- vehicle automation and guidance systems, communications and control systems;
- development of standards (e.g. for the safety requirements for new vehicle concepts);
- in-depth assessment of the environmental, noise and safety impacts of new concepts;
- the development of technologies for underground infrastructure (ground exploration, tunnel driving, tunnel lining and standardisation of dimensions).

RECONNECT proposed that demonstration projects be funded for the most promising ground level concepts ready for market introduction in the near future: road-based people movers, on-demand rental cars (like Praxitele), automated vehicle guidance for cars on public roads, and man-wide cars.

Project acronym and title	**Key results and policy implications**
	PROJECT WEB PAGE: http://www.etsu.co.uk/reconnect/reconnect.html

REDEFINE:

Relationship between demand for freight transport and industrial effects

KEY RESULTS

REDEFINE aimed to model and quantify the factors relating changes in the structure of industry and supply chain logistics to changes in road freight demand.

The project examined the economic, trade and freight transport data of France, Germany, the Netherlands, Sweden and the United Kingdom for the period 1985-1995. The relationship between the value of produced and imported goods and the consequent vehicle kilometres was shown to be complex, with different behaviour in different countries and between different types of commodity. *Simple* explanations, such as ascribing traffic growth to the increase in Just-In-Time production, were shown not to be valid – multiple factors have to be considered. An increase in the average length of haul (typically 20-40%) was identified as the single most important contributor to increased road freight demand.

Forecasts were prepared for the growth in road freight from 1995 to 2005 for the sectors of agricultural products, food and drink, building materials, and transport equipment. In a majority of cases, tonne-kilometres are expected to grow faster than production, but vehicle-kilometre activity will show a similar growth path to production. Sweden is the exception, requiring fewer vehicle-kilometres per unit of production as time progresses.

The marginal costs of congestion due to increased freight traffic are expected to increase by nearly 50% over the forecasting period. CO_2 emissions will follow the growth in vehicle kilometres, while regulated pollutants such as NO_x will decrease dramatically as cleaner vehicles are introduced.

POLICY IMPLICATIONS

REDEFINE assessed policy measures aimed at reducing transport intensity (i.e. the amount of transport needed per unit of production), shifting freight between modes, increasing the efficiency of transport organisation, making better use of vehicles, and using better vehicles and fuels. The following measures were found to be highly effective in almost all supply chains (in descending order of effectiveness):

- Introduce on-board measuring and debiting for emissions.
- Increase fuel tax generally.
- Introduce an "eco-label" for companies achieving best practice in their logistic operations.
- Introduce tradeable emissions permits.

The following measures were evaluated as effective across a significant number of supply chains (again in descending order of effectiveness):

- Introduce road pricing.
- Introduce tradeable vehicle-km permits.
- Introduce congestion pricing.
- Co-ordinate land-use planning and transport planning.
- Encourage the siting of transport-intensive production and logistics activities at suitable locations.
- Standardise load units (intermodal equipment, pallets etc.)
- Introduce annual road prices.
- Increase vehicle tax generally.

Project acronym and title	Key results and policy implications

REFORM:

Research on freight platforms and freight organisation

KEY RESULTS

Freight platforms are transhipment areas where many transport companies (such as forwarders and logistic service providers) are located, and ideally where at least two transport modes are connected. A database of 96 European freight platforms was created by REFORM, identifying key characteristics such as transhipment volumes, infrastructure, on-site company interactions and financial arrangements.

Based on this analysis, a handbook was developed for local authorities and transport sector companies. The handbook provides guidance and evaluation methods for establishing new freight platforms. Topics include:

- financial and organisational issues, and their impact on the efficiency of platform operations;
- the impact of technology, equipment and design on platform efficiency;
- evaluation of potential impacts on urban traffic and the environment.

The guidelines were successfully tested by computer simulation at sites in Berlin, Brussels, Rome and Madrid. Depending on the local situation, the introduction of freight platforms was estimated to have different levels of benefit:

- In Rome, a network of platforms could reduce the total truck-kilometres driven within the city by 15%;
- In Brussels, transhipment from heavy trucks to vans would actually increase vehicle-kilometres and pollutant emissions, although action against illegal parking would significantly reduce congestion and fuel use;
- In Madrid, the number of delivery trips would be reduced by higher load factors and a cut in the number of empty truck movements, although traffic levels would rise in the vicinity of the platform (reducing speeds by 3%);
- In Berlin, the location of freight forwarders within the city would reduce their truck mileage by more than 40%, yield cost savings for the forwarders and increase the competitiveness of intermodal transport.

POLICY IMPLICATIONS

City-based freight platforms can reduce urban delivery traffic and emissions, as well as facilitating a switch from road to rail. However, experience to date has shown a need for better design work to improve efficiency and financial viability. Many local authorities and operators had requested an evaluation scheme – the REFORM project has met this need.

The handbook does not replace a detailed analysis of the regional characteristics, which is essential for the optimal design of freight platforms. Rather, it provides a structured framework of how to plan platforms according to the specific regional issues. Similarly, the handbook supports, but does not replace, the critical interaction processes between public and private partners to reach agreement on their individual and mutual interests.

Freight platforms support economic as well as traffic policy objectives. Logistic centres may help to attract industry. Transport operators can achieve cost savings through co-operation agreements with other on-site companies. The provision of on-site services also increases operational efficiency.

The role of local authorities, guided by the handbook, would include the provision of:

- suitable sites;
- appropriate regulations;
- transport infrastructure;

Project acronym and title	Key results and policy implications
	• subsidies for other infrastructure, such as the establishment of bi-modal transhipment terminals.
SAMI: **Strategic assessment methodology for the interaction of CTP instruments**	***KEY RESULTS*** SAMI developed guidelines, tools and software to assist the development of transport policy in complex situations. The main elements are: • *A conceptual approach for setting transport policy targets*, first clarifying the issues and possible ways forward, and then evaluating stakeholder acceptance. • *A framework for assessing interactions between targets* (such as conflicts between economic and environmental objectives). • *The definition of performance indicators for a range of policy issues and targets,* covering both the achievement of targets and operational progress towards those targets. • *An optimisation method* for determining the levels of implementation of individual policy measures (such as road pricing), within a larger package, that maximise specified social objectives. • *Scenarios*, or Images of the Future, that describe alternative possible political and socio-economic contexts within which the impacts of policy options can be evaluated. • *A transport model* with a short run time that allows the rough screening of the effects of a large number of policy variables on the European transport system. Output data include aggregate volumes of traffic flow and CO_2 emissions in the target year of 2015. (This model will require further calibration before being used as a forecasting tool.) • *An evaluation methodology and software* for comparing different transport strategies (each based on a package of policy measures). This includes a number of approaches, such as multi-criteria analysis, the evaluation of uncertain or fuzzy data, and the determination of the acceptability of policy options against threshold criteria. ***POLICY IMPLICATIONS*** SAMI aimed to support decision-making on the Common Transport Policy, by providing tools that can be used for testing various strategies before implementation. In addition, the project compiled an extensive presentation of background information and methods developed in other research projects. The tools have mainly been tested separately, and their use as an integrated framework for strategic transport planning has still to be demonstrated. The significance of SAMI lies particularly in the growing acceptance of the need for *packages* of policy measures. The formation of packages can be an extremely complex process, with many different combinations and variables. The structured framework provided by SAMI can help decision-makers to handle this complexity. It may also be useful in Strategic Environmental Assessment of policies and programmes of major investment.
SCENARIOS: **Scenarios for trans-European network**	***KEY RESULTS*** To support decision-making on transport policy, SCENARIOS developed a “reference scenario” (i.e. the projection of current trends for selected variables for a future horizon year) for the European transport sector for the year 2020. This scenario covers: • socio-economic variables;

Project acronym and title	**Key results and policy implications**

- regional dynamics and spatial elements;
- transport supply and demand;
- transport policy trends (e.g. European liberalisation and harmonisation policies).

For a 2020 horizon, GDP is expected to increase steadily, but population will decline slightly from around 2010, although with significant regional variations. The growth of cities is expected to continue, especially at the periphery.

For passenger transport, anticipated trends are:
- increasing journey lengths, due to improved transport links and urban sprawl;
- increasing car dependency, due to ageing of the population, lifestyle changes and income effects;
- increasing long distance trips, due to globalisation of business and growing demand for international holiday travel.

For freight transport, key influences are:
- globalisation of production and markets;
- networking to rationalise business processes;
- new information and communication technologies;
- "greening" of the business context.

Most of these influences point to an increase in freight transport, especially long-distance trips. Electronic commerce and "green" pressures may slightly reduce the growth rate.

The project also developed projections of the evolution of technologies, not based on trends, but rather on the conditions for their entry to the market. The main conclusions are as follows:
- Intelligent transport systems will have the most significant impact on transport in the year 2020. Their use for traffic and safety regulation will depend on European-wide agreement on standards and financing schemes.
- The contribution of intermodality will be a matter of improved organisation rather than technology, and will depend primarily on the extent of policy support.
- Information technologies (teleservices) are expected to play a key role in society as a whole, but not so much in the transport system. Teleworking and videoconferencing may become a substitute for some business traffic, but they may also foster traffic generation by making more time available.
- Magnetic levitation technologies are difficult to finance and environmental concerns are leading to the development of underground solutions. They will not have a significant influence on transport supply in Europe by 2020.
- Autonomous urban transport systems are expected to spread from 2010 onwards. This will follow the standardisation of telematic systems, especially automatic debiting systems, on which they rely heavily for operation.

POLICY IMPLICATIONS

SCENARIOS concluded that, in the current political climate in Europe, the most likely policy measures for transport involve demand regulation and pricing to alter modal shares. Support for public transport infrastructure seems less likely.

SCENARIOS also defined a "European trend policy scenario", assessing the effects of current policies on liberalisation and harmonisation. This policy scenario was applied in the European Commission's pilot Strategic Environmental Assessment of the trans-European transport network. For the road sector, the scenario showed a decrease or no change in costs under liberalisation policy, followed by an increase in costs due to harmonisation measures. For rail, costs will increase under liberalisation but remain

Project acronym and title	Key results and policy implications
	stable under harmonisation. *PROJECT WEB PAGE:* http://www.inrets.fr/infos/PCRD/4eme_pcrd_mc.html
SCENES: **Modelling and methodology for analysing the interrelationship between external developments and European transport**	*The final results of this project were not available when this Thematic Paper was prepared.* *PROJECT WEB-PAGE:* http://www.iww.uni-karlsruhe.de/SCENES/
SESAME: **Derivation of the relationship between land use, behaviour patterns and travel demand for political and investment decisions**	*KEY RESULTS* SESAME has provided: • A recommended set of indicators on transport and land-use. • A sample database of values for those indicators, covering 40 European cities. • Analysis of the relationships between indicators. • Recommendations concerning data collection methods and policy measures. The main findings concerning land-use/transport interactions are as follows: • **Use of modes**: the car faces strong competition from non-motorised modes, particularly in the city centre and for trips of less than 5 km. Lower population densities and a higher concentration of jobs in sub-centres tend to increase the use of the car relative to public transport. Small cities have a higher share of car use than larger cities • **Public transport provision**: the level/frequency of service in public transport has a strong effect in increasing patronage and decreasing the use of private cars. The length of public transport lines is not the key issue. • **Vehicle ownership**: car ownership per household is strongly correlated with car use. A similar relationship holds for bicycle ownership and use. Recommendations about data collection mainly concern availability, harmonisation and zoning: • Travel demand surveys should be harmonised, should include all age groups, weekend days and the separate transport modes, and should be repeated every five years. • Data are needed concerning the travel behaviour of people coming from outside the urban area. • Public transport suppliers should use a single definition for vehicle-kilometres, with a complete tram or train defined as a single vehicle. • Improved data are needed on parking places. • Data about the built-up surface should be collected on the basis of a common definition. *POLICY IMPLICATIONS* Provision of new transport infrastructure clearly affects the pattern of travel and therefore urban form. SESAME has shown that the supply of primary road kilometres is associated with a higher share for cars in the modal split. In contrast, cities actively promoting public transport seem to be achieving higher shares for this mode. SESAME has particularly pointed to the benefit of improving service levels, without

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the need for additional service lines, in encouraging a modal switch. Strategies such as benchmarking and the provision of better information can be effective low-cost measures in this respect.

Cities with parking management and traffic calming policies seem to be associated with lower shares of car use. Cycle promotion policies seem to have had a similar effect in the cities studied.

One of the major outputs of SESAME has been to illustrate the relationship between urban form and mode use. Mode share is especially related to city density, the concentration of urban activities and the concentration of jobs in sub-centres. City planners therefore have a powerful means of influencing mobility through their control of new developments.

SITPRO:

Study of the impacts of the Transport RTD Programme

KEY RESULTS

SITPRO aimed to develop and apply a method to assess the impacts of the Transport RTD Programme, and identify ways in which these impacts can be enhanced.

The "research impact pathway" is the key concept developed in the project, and describes the mechanism by which the ultimate impacts of RTD are eventually reached. Since many impacts of research (including work within the Transport RTD Programme) do not necessarily materialise for several years, assessment of progress along the pathway has to substitute for an assessment of real-life impacts.

The stages of the pathway are production of research outputs, dissemination outside the immediate project environment, exploitation or use of the output, and policy-relevant impacts on society in the longer term. Evidence suggests that the strength of the relationship between the promoters and the users of the research is a key determinant of the rate of progress through these four stages. Thus where the few target users are involved in the project, impacts can occur easily and quickly. This is typical of rail and air sector research. In contrast, where there are many potential stakeholders (the majority of whom do not know of the project's existence), the barriers to exploitation are greater. This is the case for much of the strategic and urban research.

1300 institutions participated in the Transport RTD Programme. Evidence was found for widespread collaboration being promoted, with partners planning to work together again both within and outside the Framework Programmes.

For most of the projects sampled, it was too early to tell the extent to which real-life impacts had occurred or would occur. Much dissemination had taken place. However, users and national representatives perceived poor availability of project results and interim outputs to be a major problem.

At the project level, the most credible and robust indicator of project performance is the exploitation to date (relative to expectations). Evidence of exploitation means that the outputs have a value, which can be verified.

POLICY IMPLICATIONS

The key recommendations of the SITPRO study for RTD management are:

- Require the **research impact pathway** to be set out at the project's inception.
  - Check the mapping between project objectives, Programme objectives and potential impacts.

Project acronym and title	Key results and policy implications

- Check the feasibility of the impact pathway.
- Require the objectives, indicators and targets for project exploitation to be defined.

- **Encourage links with target users** for those projects that have a limited set of stakeholders.
  - Include some target users in the consortium.
  - Require formal liaison with target users that allows them to influence project output.
- **Minimise barriers to dissemination and exploitation** for those projects that have a wide range of stakeholders.
  - Provide the infrastructure for Web-based access to project Deliverables at a Programme level, and provide a structured information system to help potential users determine what research may be useful to them.
  - Make Deliverables available during the course of each project.
  - Encourage dissemination to the research community, as well as workshops and networking for more in-depth investigation by lead users.

SMARTEST:

Simulation modelling applied to road transport European scheme tests

KEY RESULTS

The application of Intelligent Transport Systems (ITS) in traffic management, control and information is expected to make more efficient use of the existing road infrastructure and reduce congestion and externalities.

The SMARTEST project was directed towards the modelling and simulation of dynamic traffic management problems caused by incidents, heavy traffic, accidents and road works. The SMARTEST application areas were incident management, intersection control, motorway flow control, dynamic route guidance and regional traffic information.

The project studied micro-simulation models. Micro-simulation can provide a more effective tool than traditional traffic models for the assessment of the effectiveness of ITS, which often requires the interaction between individual vehicles and the new systems to be modelled. Micro simulation can be used to develop new ITS systems, optimise their effectiveness and provide realistic training for system operators and users prior to operation in the real world.

A review revealed the existence of fifty-seven micro-simulation models which mostly use a time stepping approach and simple car following, lane changing and gap acceptance laws to govern vehicle movements. Most of the models have animation capabilities but very few have a graphical network builder. Most provide outputs that allow efficiency indicators to be assessed, about half allow environmental objectives to be assessed, and very few produce outputs to measure safety or comfort.

The gaps identified between existing capabilities and users' requirements relate to incident management, adaptive signal control, public transport priority, ramp metering, variable message signs, dynamic route guidance, public transport stops, vehicle detectors, roundabouts, parking and traffic calming measures. Better user interfaces and more work on validation of the existing models are also needed.

Generic models and procedures have been developed to fill the most important gaps. Improvements have been made to four models: AIMSUN2, DRACULA, NEMIS and SITRA-B+.

A best practice manual has been produced, covering all the SMARTEST application areas. It includes:

Project acronym and title	Key results and policy implications

- methodology for defining scheme objectives and relating them to performance indicators;
- guidelines for selecting a suitable micro-simulation model;
- calibration and validation procedures;
- procedures to help ensure that scheme evaluation tackles issues such as robustness of conclusions, introducing variability and statistical significance;
- recommendations concerning when and how micro-simulation should be used.

POLICY IMPLICATIONS

The SMARTEST project has provided road network managers with an improved set of tools and procedures to assess the impacts of road transport schemes and interventions. Considerable economic savings could be made, as the assessment will be possible without field experiments. The assessment of the usefulness of improved urban traffic control, and information and guidance systems may lead to new industrial developments. Improved micro-simulation tools will result in better knowledge and understanding of mobility, traffic flows, their interactions and interdependencies. Further developments are required in the assessment of environmental and safety impacts.

PROJECT WEB PAGE: http://www.its.leeds.ac.uk/smartest/

SOFTICE:

Survey on freight transport including cost comparison for Europe

KEY RESULTS

SOFTICE had two main goals:

- to identify the factors affecting road freight costs and their interaction with production costs and demand;
- to identify the consequences of different policies for taxation on the freight market.

Survey results showed that drivers' wages are the largest single cost factor (especially for collection/distribution operations), and fuel is the next largest factor (especially in long distance haulage). These factors vary substantially between countries. Total tax costs also vary between countries, ranging from 10% to 25% of the total operating cost of long haulage trucks. For 100km distance, EU prices are between 3 and 8 times higher than in Eastern European countries, but prices are closer for long distance freight. Typically, transport costs account for around 3% of the total costs of industrial production, but with significant variations by industry sector.

Shippers were asked about the expected effects of a reduction in the allowable number of working hours. Less than 10% suggested lower demand and/or modal shift, while around 60% foresaw only cost increases. Case studies suggested that systematic violation of traffic rules could reduce costs per tonne-kilometre by up to 30-40% in some countries.

Feedback from shippers indicated, when faced with policy changes or traffic problems, they are more willing to consider measures like increasing transport prices or changing shipping times than anything to do with modal transfer. The unwillingness to change mode is largely attributed to bad experience with other transport modes, no matter whether that experience has been directly suffered or just reported by other companies.

POLICY IMPLICATIONS

The analysis of cost factors shows different levels of cost-competitiveness between Member States – but the underlying reasons for this require further study. Uniform

Project acronym and title	Key results and policy implications
	changes in taxation across the EU would penalise those countries where the tax burden is already relatively high. Harmonising the enforcement of regulations such as driving hours, speed limits and maximum loads is important in ensuring fair competition in the EU internal market. In addition, safety and CO_2 improvements would arise. On average, a 10% increase in total taxation would increase the operating cost of long distance hauliers in the EU by 1.7%. However, the diversity and adaptability of road freight operations generally makes it difficult to produce quantitative estimates of reactions to policy. SOFTICE found that internalisation of external costs of road transport (environmental damage, infrastructure costs) is increasingly considered as a fair principle and an effective means of fighting congestion. However, the expected magnitude of price increases in inter-urban transport is not such that it will cause major modal transfers – and there is a lack of non-road alternatives for urban freight. More generally, the project concluded that the application of intensive policy measures to "push" freight off the roads, for example through higher taxation, is insufficient to achieve significant changes in modal split. A strong improvement in efficiency and quality from other modes is necessary in parallel for shippers to consider the scale of modal transfers thought desirable to meet policy goals. This implies changes such as liberalisation of access to the railways. SME's are particularly reluctant to change mode.
START:	***KEY RESULTS***
Development of strategies designed to avoid the need for road travel	START found that the most cost-effective policies to reduce road traffic and deal with congested traffic in cities are based on pricing. Road pricing per kilometre or at a city cordon is favoured, while parking charges have a less direct impact and may not work where there is extensive private off-street parking within the congested area. Subsidies to urban public transport are considerably less effective. On inter-urban roads, the use of tolls to reduce traffic is more problematic. The dominant response from users is likely to be a diversion to alternative routes rather than a switch to alternative modes or a reduction in the total amount of travel. This is likely to be counter-productive in terms of environmental and congestion costs. In addition, it would create a barrier to the use of private finance in the development of road infrastructure, requiring the public sector to take on the financial risk associated with uncertainties in future traffic levels. In general, "push" measures to deter the use of vehicles (e.g. fuel taxes) are seen as more effective than "pull" measures (e.g. improving alternative modes). Nevertheless, successful strategies are likely to contain a mixture of both "push" and "pull" measures, with the revenue from the former being used to fund the latter. Experience has also shown that a mix of different types of measure works best – pricing, capacity management, public transport, telecommunications and land use planning. "Push" measures face problems of public acceptance. However, research has indicated that as people become better informed about the likely cost-effectiveness of ways of dealing with transport problems, their opposition to restraint measures tends to decrease. The project devised four scenarios of traffic reduction in the short and medium term,

Project acronym and title	**Key results and policy implications**

identifying packages of measures required to achieve certain economic and environmental objectives. Compared to "do-minimum" and "green" strategies, the best outcome was assessed to result from a strategy based on internalisation of congestion costs and environmental costs by the road user.

Most of the reported travel reductions are only of the order of one or two years' growth in (unconstrained) demand. Policy actions may still be desirable, but the lesson is that there is no *simple* strategy that will dramatically affect levels of urban congestion.

POLICY IMPLICATIONS

The design of packages of measures is the key to success in travel reduction. Evidence suggests that a combination of constraints on vehicle use and provision of attractive alternative modes work well. In addition, land use planning measures are needed to constrain the decentralisation of population and economic activity to locations beyond the area in which the restrictive policies apply. Fuel taxes, vehicle taxes and road pricing need to be co-ordinated so that the right signals are sent to vehicle users in congested areas, while avoiding inefficiently high taxation in uncongested rural areas.

Within a policy framework that aims to reduce growth in road traffic while maintaining private sector interest in the financing and management of road infrastructure projects, the public sector will need to develop new ways to pay for roads. Otherwise would-be investors will be deterred by the sensitivity of income projections to new traffic reduction initiatives.

PROJECT WEB PAGE: http://fpiv.meap.co.uk/fpiv/START.htm

STEMM:

Strategic European multi-modal modelling

KEY RESULTS

The objectives of STEMM were to develop models of intermodal transport, and to assess barriers to intermodality and appropriate policy actions.

Computer models have been developed for passenger and freight transport to simulate mode and route choice for European networks and specific major corridors. These models have been calibrated for selected countries and routes. In addition, a modelling tool has been devised for assessing the political and social acceptance of transport measures.

Case study results indicated the following:
- Charging road and air passenger transport with emissions-dependent costs provokes stronger changes in modal split than infrastructure investment, and leads to the development of lower-emission vehicles and aeroplanes.
- New connections from Scandinavia to continental Europe may increase car trips, but passenger train trips would increase even more.
- For cross-Channel freight traffic, any move towards greater use of combined transport and rail must take positive measures towards rail – purely restrictive policies towards road transport would have little effect.
- For trans-Alpine freight traffic, the share of intermodal transport can be increased substantially (e.g. from less than 15% to more than 50% in 2010), particularly by a strong pro-rail strategy.

Surveys of operators indicated that the highest barriers to intermodality are associated with organisational/institutional problems and inappropriate price signals. High investment costs can be a problem, and improved information systems are needed.

Project acronym and title	Key results and policy implications

Technical barriers (e.g. standardisation) are less significant, but “hardware” deficiencies are apparent in Nordic countries.

POLICY IMPLICATIONS

A set of policy actions to improve passenger intermodality have been identified:
- internalisation of external costs through pricing measures;
- harmonisation of fiscal conditions for transport across Europe;
- stimulating investment in the infrastructure of modal interchanges;
- improving information systems, especially on the overall transport chain;
- encouraging transport operators to supply services based on chains (e.g. by forming partnerships to co-ordinate flows) – by making sure that enough incentives arise in the market place.

In the freight sector, policy conclusions were:
- Rail deregulation and the introduction of freight-ways could be crucial in increasing intermodality for trans-Alpine traffic. Important complementary measures would be the extension of the rail network and a mileage tax to internalise the external costs of road freight. Any strategy needs to be co-ordinated between the Alpine countries to avoid undesirable detour traffic.
- Rail deregulation, rail access subsidies, terminal subsidies and improved logistics can all contribute in increasing the use of rail from Scandinavia.

STIMULUS:

Segmentation for transport in markets using latent user psychological structures

KEY RESULTS

STIMULUS aimed to improve ways of structuring the behavioural responses of different stakeholders to transport measures, and assess information systems and policies for their level of acceptance by different user groups.

Particular types of users have been classified within a new set of distinct market segments, and their interests and attitudes described. STIMULUS found that the most acceptable traffic management measures are likely to be speed cameras, bus lanes and restrictions on freight delivery times. The least popular measure is parking pricing. The car is the most attractive mode, with the train as second choice. Congestion and air pollution are the most recognised problems related to transport.

On the basis of the research database developed in the project, STIMULUS has demonstrated that attitudinal and latent psychological structure segmentation leads to better understanding and prediction of the target audience than behavioural segmentation. This involves the identification of natural groupings of people with a particular psychological outlook on the world.

For example, segments such as car users and public transport users have *traditionally* been regarded as different target audiences with different preferences and requiring different communication campaigns. However, surveys showed that very few differences exist between these groups.

STIMULUS has provided PC-based software that analyses databases in four ways:
- lifestyle and demographics;
- attitudes towards variables such as transport mode, policy measure and transport user;
- importance of different issues;
- latent psychological structures common to groups or segments of the population.

Project acronym and title	Key results and policy implications

POLICY IMPLICATIONS

Being mainly the development and validation of a tool, STIMULUS in itself has an impact on the possible evolution of the decision making processes in the application of policies. Having been developed and demonstrated for transport information systems, this tool is ready to be extended to other elements of the transport sector and is capable of application to other markets than transport.

STREAMS:

Strategic transport research for European Member States

KEY RESULTS

The main goal of STREAMS was to develop a prototype model to predict the demand for transport across the EU and its broad distribution across the transport network. In addition, STREAMS aimed to produce a "reference scenario" for the year 2020, providing an initial forecast for selected transport variables.

The project developed and validated a model covering all travel within EU Member States and across its borders (all modes, passenger and freight transport, including short trips and walking). There are two main modules – one determines transport demand, and the other assigns the demand to the transport network. The model is disaggregated at the NUTS2 level used in transport statistics, dividing the EU into some 200 zones and thousands of links representing physical connections and terminals (such as roads and airports). The model is therefore suitable for forecasting *aggregate* transport statistics for the EU as a whole.

The model was calibrated for a base year of 1994. The resulting output data were shown to match well with various sets of "observed" transport statistics. Projections for 2020 were reasonably comparable with those from other smaller-scale models.

The reference scenario for 2020 gave the following key results for passenger transport:

- an increase in passenger-kilometres of 50% from 1994 levels, due to increases in trip distances (primarily) and in the number of trips;
- a 5% overall increase in the modal share of the car (e.g. due to increases in business, shopping and leisure trips), largely at the expense of walking and cycling;
- significant increases in the modal shares of rail and air for longer trips.

For freight, the 2020 projection indicated:

- a doubling of freight tonne-km, and a 60% increase in tonnage moved, with the greatest increases in the international sector (especially exports/imports to the EU);
- only minor changes in overall modal shares, with trucks gaining share in the intra-EU freight market but losing share to rail transport in the international market.

The STREAMS model can make rough estimates of the proportion of the road network that is congested. Between 1994 and 2020, the number of kilometres of "overloaded" links is predicted to double to 9% of the network.

POLICY IMPLICATIONS

The STREAMS model has been used by the European Commission to produce traffic forecasts for the whole of the European Union, as part of a pilot Strategic Environmental Assessment of the Trans-European Transport Network. The model has since been developed further in the SCENES project.

The model is best suited to applications which require an overview forecast of

Project acronym and title	Key results and policy implications
	transport in the EU or Member States as a whole. For example, it can be used to look at policies aimed at modal shift and demand management, or the impacts of socio-economic change. On the other hand, it is less well suited to studying local policy options or assessing the effect of a particular piece of infrastructure. ***PROJECT WEB PAGE:*** http://fpiv.meap.co.uk/fpiv/streams3.htm
TASTE: **Analysis and development of tools for assessing traffic demand management strategies**	***KEY RESULTS*** With increasing travel demand it is becoming a priority for many European regions and cities to introduce Traffic Demand Management (TDM) policies and strategies. TDM aims at managing travel patterns by a range of measures influencing the generation of transport demand and its distribution on different transport modes and routes. There are still gaps in the assessment of TDM, in particular concerning the integrated use of assessment tools and the evaluation of recently-devised TDM strategies. TASTe developed recommendations on the use of TDM assessment tools by both analysing and developing such tools. The TASTe guidelines form the main output. These guidelines provide a general procedure for using assessment tools and in particular help to identify: • TDM measures against types of problem; • performance indicators; • tools against input/output data and the main types of assessment; • criteria for selection of assessment tools; • tools for handling and visualising data efficiently. The experiences in the TASTe case studies indicated that efforts invested in tools can be justified economically as achieving pay-back periods of one year or less. General development needs identified for software tools to be of the most practical use were: • standardising the definition of transport networks; • building common databases to store input data in standardised formats; • making the operating environment compatible for all tools to facilitate integration of tools; • making better use of available information (e.g. from GIS databases); • encouraging the use of GIS products. ***POLICY IMPLICATIONS*** Potential users of the guidelines are road authorities, public transport authorities, scientific institutions, industries and consultancies. The TASTe guidelines will help them to select tools, develop data sets and apply tools. As a result, surveys can be better targeted and the cost of data collection reduced. The use of the guidelines will enable the interactions between TDM measures (when implemented in packages) to be investigated. This has the potential to improve the public acceptance of such measures.

Project acronym and title	**Key results and policy implications**

TENASSESS:

Policy assessment of TEN and Common Transport Policy

KEY RESULTS

TENASSESS had two main objectives:
- to characterise policy processes and identify implications for decision-making on the Trans-European Transport Networks (TEN-T) and the Common Transport Policy (CTP);
- to develop and test decision support tools.

TENASSESS found that many of the problems with CTP development relate to the variation in policy processes between Member States. The following aspects have specific importance:
- the distribution of responsibility between national and lower levels;
- the extent of master planning and evaluation frameworks for transport;
- the degree of stakeholder (including public) involvement in decision processes.

This leads particularly to conflicts over the relative role of European, national, regional and local levels, the trade-off between economic and environmental objectives, and the rate of deregulation and restructuring of the transport market.

A policy assessment model has been developed for assessing the effectiveness of different policy measures and projects against CTP objectives. The model helps users to make explicit the extent to which an option fulfils stated objectives, and the influence of wider socio-political considerations on an otherwise "objective" decision. The critical feature is a transparent weighting system that shows how different decision-makers rate specific policy objectives and project impacts. The model has been tested and refined on a series of case studies.

Another software tool has been developed to help anticipate barriers in the *implementation* of transport infrastructure projects and policy initiatives. Through interactive gaming, the user is able to understand where to concentrate efforts to deal with likely problems. The analytical model was based on case study evidence and then tested on further case studies to show that it is robust.

POLICY IMPLICATIONS

TENASSESS concluded that the goal of sustainable mobility requires a more integrated approach to transport policy. This can only be realised by organisational reforms – the responsibilities of different political levels need to be clarified, and stronger procedures introduced for strategic co-ordination.

A clearer distinction is needed between policy plans and infrastructure plans. Policy plans should be enhanced to include measurable objectives and performance indicators. Infrastructure plans should show a closer consideration of strategic policy goals, e.g. through the process of Strategic Environmental Assessment. The links between national and European policy plans should be made explicit, so that variations in national strategies can be understood and co-ordinated where appropriate.

Mechanisms should be established to make effective the participation of citizens in decision processes on transport policy. Information dissemination and project-specific public enquiries are insufficient to build trust in radical changes. Communication with the public should be entrusted to an organisation that is not involved in the decision process.

Many of the barriers in TEN-T and CTP implementation have emerged in the area of financing. TENASSESS recommended that the evaluation of costs and benefits of different options should be separated from the question of how to arrange the funding.

Project acronym and title	Key results and policy implications

Nevertheless the expert appraisal of projects should address these issues in parallel, with input from potential financiers. Where partnerships emerge to share the financial burden, the sharing of risk should be specified alongside the sharing of costs.

TEST:

Technologies for European surveys of travel behaviour

KEY RESULTS

TEST developed and evaluated ways of using new technologies to collect, analyse and disseminate travel survey data. The project focused on five areas:

- Using hand-held computers during trips as a tool for near real time data collection.
- Offering Internet-based forms for the completion of long distance travel surveys.
- Using geographical information systems (GIS) to improve the accuracy of recording place names visited during trips.
- Using artificial intelligence (AI) processes to correct erroneous data and impute missing data in travel diaries.
- Building a Web interface to provide access to stored data.

The project demonstrated the feasibility of the targeted approaches through pilot implementation:

- The computerised portable travel diary gained user acceptance in field tests and provided results consistent with those from more conventional methods.
- The Web-based travel diary was also successfully demonstrated in two countries.
- The GIS work showed that semi-automatic support for trip recording can be provided, although more accurate and comprehensive databases of place names are required to support this application.
- An AI-based system was developed for data correction that provides an audit trail for quality assurance.
- The Web interface demonstrated the feasibility of supervised remote access to stored analyses of travel diary results. This technology has been adopted by the ongoing Belgian national travel survey.

The user acceptance and access to the first two applications are expected to expand greatly as the generic technologies improve and increase their market presence over the next few years.

POLICY IMPLICATIONS

The project has demonstrated that new communication and information technologies can be used effectively to improve the quality of travel data surveys. A reduction in costs is also anticipated as data collection and transfer becomes more automated. At a European level, this will support the development of the new European Transport Information System (ETIS) funded by the European Commission.

TEST focused on data relating to long distance trips. Such results form a crucial input to decisions on European transport policy for:

- infrastructure planning, such as the Trans-European Transport Network;
- monitoring the success of policies on Community cohesion (e.g. access to and from peripheral regions);
- monitoring the development of transport markets (e.g. quality of services and competitiveness of modes).

PROJECT WEB PAGE: http://www.fundp.ac.be/~grt/test

Project acronym and title	Key results and policy implications

TRANSINPOL:

Transport information systems policies

KEY RESULTS

The main objective of TRANSINPOL was to identify policy requirements for the integration of information, communication and navigation (ICN) technologies in transport.

The project developed a framework for policy assessment. The framework includes three main components, the elements (the transport world, the CTP, the ICN technologies, the generic transport telematic services, and the integration process), the relations describing the way the elements interact, and the steps to policy formulation.

Two types of policy requirements have been identified:

- *Functional policy requirements to ensure that the integration contributes to transport policy objectives.* Six objectives have been identified: to change the transport demand, to optimise the Trans-European infrastructure services, to improve the efficiency of transport, to improve transport safety, to facilitate the integration of transport systems, and to facilitate fair and efficient pricing.
- *Operational policy requirements to overcome the barriers that may hinder the integration process.* Seven main barriers have been identified: gaps in standards and harmonisation, absence of high-level architecture, an insufficiently user-oriented approach, high user costs, insufficient information exchange, absence of an information and communication infrastructure, and a lack of harmonisation of legislation.

Detailed description of the need for policy intervention has been provided in the areas of information and communication services, comprehensive payment systems, and satellite communication and navigation systems.

POLICY IMPLICATIONS

Four legal aspects have been identified as being of high importance for the integration of ICN technologies:

- privacy issues raised by the European Directive on data protection;
- questions over methods of electronic payment (re-loadable instruments and credit cards);
- implications for competition law resulting from the potential for anti-competitive conduct, which could justify adaptations of the sector-specific regulations on access to infrastructure;
- lack of a liability framework in case of damage caused by errors or failures, which may be best addressed by a European Directive in the context of the Galileo satellite system.

The areas where integration of ICN technologies has effects on safety are recognised as priority areas for government intervention because road safety improvements account for a large fraction of the total potential benefits. However, gaps in the knowledge on their socio-economic impacts still need to be addressed through the application of models and the evaluation of pilot projects.

TRANSLAND:

Integration of transport and land-use planning

KEY RESULTS

TRANSLAND had two main objectives:

- to identify examples of (transferable) good practice in combined planning of land-use and transport;
- to advise on planning practice for the future and recommend further research.

A detailed review of 26 case studies and previous research led to the following conclusions:

Project acronym and title	Key results and policy implications
	• Combined land-use and transport policies are only successful in reducing travel distances and the share of car travel if they make car travel less attractive (more expensive or slower). • Land-use policies to increase urban density or mixed land-use (e.g. locating homes near factories and services) without accompanying measures to discourage car use have only little effect. • Transport policies to make car travel less attractive depend on trip start and end points not being excessively dispersed already. Co-location of specialist businesses in certain areas and the increase in multiple worker households also set limits on the co-ordination of work places and residences. • Large dispersed retail and leisure facilities increase the distances travelled by cars and the share of car travel. Land-use policies to prevent the development of such facilities are more effective than land-use policies aimed at promoting high-density mixed-use development. • Fears that policies to constrain the use of cars in city centres are detrimental to the economic viability of those centres have in no case been confirmed by reality, except where massive out-of-town retail developments have been approved at the same time. • Transport policies to improve the attractiveness of public transport have in general not led to a major reduction of car travel, but have contributed to further suburbanisation of the population. ***POLICY IMPLICATIONS*** Overall, TRANSLAND concluded that transport policies are more direct and efficient than land-use planning controls in moving towards a sustainable urban transport system. However, land-use policies are essential as an accompanying strategy for creating less car-dependent cities in the long run. Information policies are an additional tool, important for influencing behaviour and increasing social acceptance of other tougher measures. The institutional possibilities for co-ordinating land use and transport policies at the urban or regional level vary between EU Member States. Ten countries have formal regional planning with binding plans, and these have the highest potential for implementing effective policies and exchanging examples of good practice. TRANSLAND identified 16 areas for further study, ranging from the modelling of land use/transport interactions, to target setting and the redesign of the planning process. ***PROJECT WEB PAGE:*** http://www.inro.tno.nl/transland/
TRANSPRICE: **Trans modal integrated urban transport pricing for optimum modal split**	***KEY RESULTS*** TRANSPRICE assessed pricing strategies that are co-ordinated across the modes, identifying effects on modal split and public acceptance. User surveys in eight cities showed that public acceptability of *isolated* pricing measures is low. This can increase substantially when pricing is presented as the cornerstone of a package of measures that include revenue allocation to public transport investments and non-motorised modes. Hypothecation of road use pricing revenues is also becoming more acceptable to politicians. Demonstrations and modelling work in five cities showed that road use pricing is an effective way of changing modal split from private car to public transport and Park &

Project acronym and title	**Key results and policy implications**
	Ride, giving city centre traffic reductions of 5-25% (for charge levels of 1-3 EUR). Cordon pricing is particularly effective when applied to congested central areas and over peak periods (reducing car trips by up to 25%). Pricing of parking is also effective in restraining car trips, provided enforcement can be maximised. It works best as an accompanying measure rather than in isolation. Integrated ticketing and smartcard integrated payment systems have a small impact on modal split on their own (especially for Park & Ride), but more importantly support trans-modal pricing measures. Pricing of High Occupancy Vehicle lanes has a marginal impact on modal split, and seems applicable in special cases only (such as severe congestion). Various forms of road use pricing were assessed to be the most promising approach, followed by cordon pricing, in a multi-criteria evaluation across a range of policy objectives. ***POLICY IMPLICATIONS*** Transport pricing has potential for yielding significant changes in urban modal split towards public transport, Park & Ride and non-motorised modes, as well as providing substantial revenues. TRANSPRICE concluded that road use pricing should be considered when parking pricing measures alone have been found to have exhausted their effectiveness. Road use pricing should be promoted as part of a package of demand management measures, with hypothecation of revenues towards local transport and environmental improvements. This would substantially increase the potential public acceptability, as well as helping to overcome the resource problems that face demand management investments.
TRENEN II STRAN: **Models for transport, environment and energy – version 2 – strategic transport policy analysis**	***KEY RESULTS*** Econometric models have been developed which compute optimum prices for transport in specific cities and countries. These prices take account of external costs (such as congestion, pollution, noise and accidents) as well as taxes and resource costs. In a series of case studies, comparisons have been made between current and optimum prices. Typically, the consumer price for using a car in a city in peak periods covers only one third to half of the full marginal social cost. There are two main sources for this discrepancy: unpaid parking and the external costs of congestion. In off-peak periods, prices and social costs are much closer. By comparison, for bus travel, prices are similar to social costs. In an optimal pricing scenario, prices for car travel typically could rise by 100-250% in peak periods, depending on the city context. Current transport taxes in European cities are more or less equal between peak and off-peak. This implies that society would benefit from raising the price of using a car in peak periods. Cordon pricing (for urban access, differentiated between peak and off-peak) combined with charging for parking at resource cost is found to achieve the majority of the theoretical maximum benefit. For *inter-urban* transport, pricing inefficiencies are generally less significant. Prices of peak period car and truck use do not cover congestion costs. Bus transport is

Project acronym and title

Key results and policy implications

typically heavily subsidised and under-priced. Rail freight and inland waterways have prices that are reasonably in line with social costs.

POLICY IMPLICATIONS

The case studies indicate the relative performance of different pricing policy instruments:

- **Parking policies**: making all road users pay for the resource cost of their parking place plus an extra charge can be very effective, achieving 1/3 to 2/3 of potential societal benefits and reducing congestion.
- **Emissions taxes and standards**: stimulating the use of cleaner cars is important for urban areas, but may not be cost-effective in non-urban areas.
- **Fuel tax policies**: higher fuel taxes could reduce car traffic in urban areas and on peak period inter-urban trips. However, other traffic (such as off-peak road freight) may also be unjustifiably inhibited. Fuel taxes are therefore not a good instrument for pricing reform, due to the lack of differentiation between different transport markets. Tax evasion may also result, across international borders and through non cost-effective investment in highly fuel-efficient vehicles.
- **Reduced subsidies to public transport**: once the pricing of car transport can be corrected, public transport fares should not be set below the marginal social cost and should differ between peak and off-peak periods.
- **Simple congestion pricing**: cordon pricing in urban areas and congestion pricing on inter-urban highways can realise a substantial fraction of the benefits of optimum pricing.

UTOPIA:

Urban transport: options for propulsion systems and instruments for analysis

KEY RESULTS

The UTOPIA project aimed to provide project managers and policy-makers with the necessary information base, tools and guidelines to support the introduction of promising urban transport solutions based on cleaner vehicles.

The project developed four major outputs (available on the web at http://utopia.jrc.it/):

An assessment of the most promising applications for cleaner vehicles and supporting measures, from a city perspective
This report assesses fuel options and applications for cleaner vehicles, and describes how best to introduce clean vehicles into cities using well-targeted demonstration projects backed by policy actions. It is illustrated by examples drawn from across Europe.

Recommendations on policy actions at the European and national levels to promote or facilitate market introduction and demonstration
This report examines the potential benefits of cleaner vehicles, including the results of European-level modelling. It looks at government activities across Europe: programmes of pilot and demonstration projects, and supporting measures such as tax incentives, emissions standards and green procurement. Finally it presents recommendations for:

- best practice in the design of programmes of pilot and demonstration projects;
- key supporting policies which can make a major impact on the introduction of cleaner vehicles in European cities.

A good practice guide to setting up and running pilot and demonstration projects, aimed at potential project champions
These guidelines cover the decision points and evaluation phases through the entire lifecycle of a demonstration project. Guidance is given on what to do and consider at each stage. This is supported by examples and good practice recommendations

Project acronym and title	**Key results and policy implications**

derived from a wide variety of European project experiences. The guidelines focus on urban applications of two-wheelers, cars, buses, vans and trucks.

A software framework ("NAVIGATE UTOPIA") which provides information and assessment methodologies covering clean transport solutions
This is primarily to support people at the local level (such as city transport planners) in pre-screening options and building the arguments in favour of a local initiative. It is a user-friendly web-based tool. Within its structured framework, it provides a wide range of information, case studies and decision aids generated within the wider UTOPIA project. It also incorporates a multi-criteria tool for assessing the promising transport options for a specific city situation according to *local* policy objectives.

POLICY IMPLICATIONS

UTOPIA concluded that there is a need for alternative and renewable transport fuels. However, their current costs and other limitations in vehicle applications mean that market entry will be typically be via particular niches such as urban buses. Supporting policies were evaluated:

- The most important policy measures are *fiscal incentives*. A distinction is needed between incentives to kick-start the market for individual fuels, and efficient incentives in the longer term that are not technology-specific (e.g. differential rates of fuel taxation based on relative environmental damage).
- *Demonstration projects* have an important role in testing technologies, stimulating the market and raising consumer awareness.
- *Eco-labelling* and *green fleet certification schemes* are important, especially where the label remains on the vehicle in everyday use.
- *Green procurement* by Governments, whether voluntary or mandatory, can be significant in creating an initial market for new fuels and providing a signal to private consumers that these fuels are serious.
- *Standards* for vehicles and fuels are important in creating a unified market and ensuring consumer confidence.
- *Low emission zones* that allow city centre access only for clean vehicles, and *Quality Contracts and Partnerships* between local authorities and fleet operators, are new powerful tools for encouraging cleaner vehicles at a local level. Governments may need to provide the regulatory framework for their implementation and enforcement.

PROJECT WEB PAGES:
http://utopia.jrc.it/ (NAVIGATE UTOPIA decision support system)
http://www.utopia-eu.com/ (project description and results)