Transport Research Knowledge Centre

DECISION SUPPORT TOOLS
THEMATIC RESEARCH SUMMARY

www.transport-research.info
Thematic Research Summary: “Decision Support Tools”

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Foreword

This report has been produced as part of the activities of the TRKC (Transport Research Knowledge Centre) project of the Sixth Framework Programme, priority thematic area “Sustainable Development, Global Change and Ecosystems”.

The aim of TRKC (as its predecessor project EXTR@Web) is to collect, structure, analyse and disseminate transport research results. It covers EU-supported research as well as research financed nationally in the European Research Area (ERA) and selected global RTD programmes. The main dissemination tool used by TRKC is the web portal at www.transport-research.info.

The approach to dissemination of results of research projects adopted by the TRKC team includes the following three levels of analysis:

- Project Analysis, which provides, project by project, information on research background, objectives, results, technical and policy implications;
- Thematic Analysis, which pools findings of research projects according to a classification scheme based on thirty themes, fixed for the life time of the TRKC project; the product of this analysis activity is the set of Thematic Research Summaries (TRS); the present document belongs to this set;
- Policy Analysis, which pools findings of research projects according to combinations of themes based on ad-hoc policy priorities which are agreed with DG TREN of the European Commission and a representative group of research users.

This particular Thematic Research Summary deals with decision support tools (DST). The aim is to provide the reader with a synthesis of results of completed EU-funded projects and a selection of national projects related to the theme of decision support tools. The report is intended for policy makers at European, national and local levels, as well as any interested reader from other stakeholders and from the academic and research communities.

The authors acknowledge the review of an initial draft of this report by Professor Umberto Crisalli of university Tor Vergata, Rome.
Disclaimer

The TRKC team is fully responsible for the content of this report. The content of this report does not represent the official viewpoint of the European Commission and has not been approved by the coordinators of the research projects reviewed.
Executive summary

This Thematic Research Summary on decision support tools aims to provide the reader with a synthesis of results of completed European research projects related to this theme. It consists of two main parts. The first part includes a brief overview of the scope of the theme and summarises the relevant main policy developments at EU level. The second part contains a synthesis of the main findings and policy implications from research projects and identifies the implications for further research. The research projects for which the synthesis is provided are European EU-funded projects that are completed and with results publicly available. The EU projects have been funded by the Fifth and the Sixth Framework Programmes. Also a few national projects are reported on. Projects that were reviewed in the related report produced within the predecessor project EXTR@Web are only briefly summarised in the background section for each sub-theme.

Decision support tools are concerned with methodologies and information tools for transport policy making. The tools addressed by this TRS are those targeted to public decision makers concerned with transport policies and projects at all geographical scales (urban, local, regional, national, supranational), such as traffic studies on equilibrium conditions between infrastructure and service supply and demand, impact studies and evaluation studies of transport policies and projects, monitoring and benchmarking of transport systems.

In recent years, policy developments at EU level have stressed on the development of a European Transport Data System for evaluating the performance of the EU's transport markets and systems, in particular on the development of a European Transport policy Information System (ETIS) to support policy makers at European level to analyse European transport-related strategic issues with a view of deploying the EU Common Transport Policy. Other priority actions identified by the Commission have been the development of the European Local Transport Information System (ELTIS), and the application of benchmarking to transport systems. Furthermore, in view of the release of the new White Paper on transport policy, The Commission has highlighted the importance of harmonised appraisal methods (at EU level) for assessing the socio-economic benefits deriving from investments in transport infrastructure and public transport services, as well as the importance of adopting common methodologies in the appraisal of infrastructure projects across modes and countries.
Five sub-themes have been considered in this synthesis of findings from research projects. The main achievements in each sub-theme are as follows:

In the sub-theme concerning **transport planning tools**, research has produced forecasts for multi-modal passenger and freight using a combination of modelling tools, and has carried out a foresight exercise on the influence of non-transport factors and policy on mobility and transport. Thematic networks to compare and analyse results on transport demand forecasting and scenario building and to make advanced transport models more accessible to decision makers have been established, and investigations on how to improve decision making processes through effective stakeholders’ engagement have been carried out. Research has also produced a model to assess the potential impacts of e-Economy on future demand of passenger and freight transport. Possible future scenarios for the transport system and energy supply have been developed, compared and assessed, and scenarios for air transport and its emissions have been developed, quantified and tested.

In the sub-theme relating to **European transport information and assessment systems**, research has completed the clusters of project for the development of the pilot European Transport Information System (ETIS) and has investigated ways of improving comparability and reliability of sources for statistical data. Information platforms to provide policy makers with useful information on maritime transport, sustainable urban transport systems, intermodal passenger transport, road safety, cycling policy, and policy support and assessment tools have been established. Research has also made a contribution to the definition of common good practice principles for national and regional transport modelling to support model developers in new Member States, and has established a standardised approach for transport modelling in the European Union. An enhanced European transport network model for passenger and freight transport has been developed.

In the sub-theme concerning **project and policy evaluation methodologies**, research has been concerned with issues on ex-post evaluation of large infrastructure projects and the development of an approach to the funding of large transport infrastructure investments as well as a set of harmonised guidelines for project assessment and transport costing at EU level. Research has also developed a common approach for transport infrastructure development in the Mediterranean region, an approach and planning methodology for the analysis of urban transportation problems, as well as methodologies for ex-ante and ex-post assessment of transport policies and strategies. Research has also investigated the extent to which policy makers take into account quality of life effects of implemented policies.
In the sub-theme relating to **benchmarking in transport**, a benchmarking exercise involving Mediterranean Countries and EU cities has been carried out in order to assess the current condition of their transport systems and identify possibilities to improve these. Another benchmarking exercise has assessed how cycling is currently considered in urban planning processes of European cities.

In the sub-theme dealing with **planning for emergency conditions**, research has provided a definition and classification of disaster events and has identified incidents which have direct or indirect impacts on transport systems. Furthermore, methodologies, models and algorithms have been analysed in relation to the definition of probability of the occurrence of an event, vulnerability and exposure of transport systems, to such incidents, and the analysis of the interaction between supply and demand in case of evacuation. Finally, guidelines for evacuation plans by simulation of transport systems in emergency conditions have been developed.

Finally, research has also identified a number of areas for further investigation:

- studies for a more advanced vertical (EU, regional, local) and horizontal (energy, land use, environment) integration between models to provide a very powerful tool to assess regional impacts of European transport policies;
- improvement of software codes, data flows, user friendliness and modelling capabilities of the TRANSTOOLS planning tool;
- development of fully-fledged ETIS;
- further investigations on the impacts of e-economy on land use;
- studies to identify the optimal tax policy under different oil price scenarios;
- improvement of the assessment methodologies and creation of practical decision support tools to better tackle urban transport problems;
- investigations to get a better understanding of the relations between urban transport measures and urban development and land use planning;
- studies for providing more insight into the impact of demographic change on urban transport;
- introduction of the analysis of marginal opportunity costs of public funds in already existing models for assessing large energy and transport infrastructures projects;
- better understanding of issues concerning social equity and social cohesion and the development of appropriate policy measures for addressing them;
- further benchmarking of transport systems extended to a greater number of cities in the EU neighbouring countries in order to be able to carry out deep statistical analyses and get a better understanding and insight into the problems of their transport systems and identify possible areas of interventions;
- further studies to develop effective evacuation plans in emergency conditions.
Abbreviations and acronyms used

CBA  Cost Benefit Analysis
CEC  Commission of the European Communities
CEEC Central Eastern European Countries
CTP Common Transport Policy
DG TREN Directorate-General for Transport and Energy
DST Decision Support Tool
EC European Commission
ERA European Research Area
ERSO The European Road Safety Observatory
ETIS European Transport Information System
EU European Union
EXTR@Web Exploitation of Transport Research Results via the Web (DG TREN FP5 Accompanying Measure project – predecessor to TRKC)
FP Framework Programme
FP4 Fourth Framework Programme
FP5 Fifth Framework Programme
FP6 Sixth Framework Programme
ICT Information and Communication Technology
IT Information Technology
ITS Intelligent Transport Systems
LoLo Lift on – Lift off
MCA Multi-Criteria Analysis
MOS Motorways of the Sea
MTSO Maritime Transport Sector Observatory
NUTS Nomenclature of territorial units for statistics
OD Origin-Destination
PT Public Transport
QoL Quality of Life
R&D Research and Development
RoRo Roll on – Roll off
RTD Research and Technical Development
SoA State of the Art
SPI Safety Performance Indicator
SUTP Sustainable Urban Transport Plan
TEN-T Trans-European Transport Networks
TN Thematic Network
TRKC Transport Research Knowledge Centre; TRKC website at www.transport-research.info
TRS Thematic Research Summary
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1. Introduction

This Thematic Research Summary (TRS) on Decision Support Tools (DSTs), produced within the TRKC project, provides a structured review of the research relating to DSTs, carried out on EU-funded transport research projects. The theme “Decision Support Tools” is one of thirty themes in the classification scheme adopted by the TRKC project. The full scheme is shown in the table below.

Table 1. The classification scheme adopted in TRKC

<table>
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<th>Sectors</th>
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<td>passenger transport</td>
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<th>Modes</th>
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<td>rail transport</td>
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<td>road transport including walking and cycling</td>
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<td>waterborne transport</td>
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<td>innovative modes</td>
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<td>intermodal freight transport</td>
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<th>Sustainability policy objectives</th>
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<td>safety and security</td>
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<td>decision support tools</td>
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<td>information and awareness</td>
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<td>infrastructure provision including TEN-T</td>
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<td>integration and policy development</td>
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<td>Intelligent Transport Systems ITS</td>
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<td>regulation/deregulation</td>
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<td>land-use planning</td>
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<td>transport management</td>
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<td>pricing and taxation</td>
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<td>vehicle technology</td>
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The categories in the classification scheme shown in the above table have been adopted to enable comprehensive searching for project information available through the TRKC portal, and to ensure comprehensive coverage of research results and appropriate policy analysis in the Thematic Research Summaries. Definitions for each category (which is also a theme in its own right) can be found on the TRKC website available at [www.transport-research.info](http://www.transport-research.info).

In the predecessor project EXTR@Web, TRSs were produced for 28 out of the 30 themes (the reduced number of TRSs resulting from merging of some themes into a single TRS). The TRKC project has produced first versions of TRSs for a sub-set of themes for which a critical mass of results from projects was available by December 2008. For this subset of themes the preparation of final versions is planned by the end of the TRKC project in June 2010.

This is the final version of the TRS on the “Decision Support Tools” theme which includes results from projects available by October 2009. A large number of research projects have been related to the theme addressed by this report. The TRS “Decision Support Tools” produced in the predecessor project EXTR@Web (EXTR@Web, 2006) had reviewed research from European projects belonging to the Fourth and Fifth Framework Programme (FP4, FP5) and selected national projects. This report adds new projects to the analysis that have been reported since that report, including various European projects from FP5 and FP6, and a small selection of national projects.

The research reviewed in this report does not represent the whole gamut of research dealing with decision support tools carried out in the European Research Area (ERA). The report focuses on research from those projects which have provided documentation on results available to the TRKC team after the issue of the EXTR@Web report (EXTR@Web, 2006). A summary of the research reported in the EXTR@Web report on decision support tools is also included to make the reader aware of a wider range of research relevant to the theme. For completeness, FP6 projects, either on-going or for which results are not yet publicly available, have also been considered.

The report is organised as follows. Section 2 includes a brief analysis of the scope of the theme. Section 3 provides an overview of the relevant policy developments at EU level, explaining at the same time why the theme is important from a policy viewpoint. The sources for this section are principally European Commission documents which have set the policy agenda such as white papers, green papers, and communications. EU legislation - directives, regulations, etc - is mentioned where relevant.
Section 4 reports on the results from research projects. This section is structured according to sub-themes to make the broad area of research which has dealt with decision support tools more manageable.

The following five sub-themes have been considered:

- Sub-theme 1: Transport planning tools
- Sub-theme 2: European transport information and assessment systems;
- Sub-theme 3: Project and policy evaluation methodologies;
- Sub-theme 4: Benchmarking in transport;
- Sub-theme 5: Planning for emergency conditions.

For each sub-theme, research objectives are reported on and findings from research projects are synthesised. A special focus is given to the policy implications of research results. Section 4 concludes with an overview of the research gaps which could be identified from the projects, and hence topics for future research. Sources for Section 4 are documents available from the projects and reporting on achievements, essentially the project final reports and selected deliverables.

The research projects listed under each of the five sub-themes are shown in the Annex to this report. Hyperlinks to project websites (if available) are also included. In several cases these websites make the project documentation available to the public. This may include final reports and other project deliverables.
2. Scope of the theme

**Decision Support Tools** deals with methodologies and information tools for transport policy making, and include:

- traffic studies providing the equilibrium conditions which are set between a given supply of infrastructures and services and the demand using them;
- impact studies providing the environmental, safety and socio-economic impacts of transport policies and projects;
- ex-ante, on-going and ex-post evaluation studies of transport policies and projects;
- monitoring and benchmarking of transport systems.

The tools addressed by this TRS are those targeted to public decision makers concerned with transport policies and projects at all geographical scales (urban, local, regional, national, supranational). Therefore, tools specifically designed for operators in the transport and logistics markets, and tools for traffic management are not considered in this TRS. The reader interested in research results relating to these tools may refer to the TRSs on “Transport Management” and “Intelligent Transport Systems”¹.

**Information systems** on transport supply and demand are essential to help policy-makers in their planning activities, especially at European networks level. Decision support tools rely on data collection, methodologies and algorithms for data processing, as well as a user interface for data input and output. Unfortunately, the existing data, as well as the data structures and models in use are generally inconsistent, incompatible and property rights protected. Developing transport policy support systems at a European level is therefore a priority.

**Mathematical models** are conventionally used to forecast traffic flows of the various transport modes on the networks. Furthermore, mathematical models provide forecasts of flows for the services of urban and inter-urban public transport. Such models are used for planning problems in urban, regional, national and supranational contexts when the effects of changes in the supply of transport infrastructures and services must be assessed. Performance models build on traffic flow forecasts and provide estimates of both the costs for travellers and operators, and the impacts on safety and environmental pollution.

¹ These documents can be downloaded from the TRKC web page [http://www.transport-research.info/web/publications/thematic.cfm](http://www.transport-research.info/web/publications/thematic.cfm)
Evaluation is an activity which seeks to determine, as systematically and objectively as possible, the relevance, efficiency and effect of a policy or project in terms of its objectives. Evaluation of a policy supports the decision making process in all its phases from the agenda setting or problem definition phase to the policy implementation phase. Furthermore, evaluation can serve several purposes such as:

- assessment of the impacts of a policy intervention, and, in connection with this, provision of information for using and allocating public resources;
- assessment of the acceptance of an intervention among citizens and stakeholders in order to provide feedback as part of a monitoring exercise.

Benchmarking is a technique which extends performance measurement and can support the development and implementation of the various elements of a European sustainable transport policy. It aims at improving policy implementation and the performance of transport systems by a dynamic process including:

- identification and development of best practice standards;
- comprehension of the reasons for differences in performance;
- improvement of performances and processes by adapting the lessons learnt to local circumstances.

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

The EU and its Member States have a joint commitment to the principles of sustainable development in the transport sector and the EU Common Transport Policy (CTP) serves as a framework for achieving it (CEC, 1992; CEC, 2001).

The Action Programme 1998-2004 which translated policy objectives into action (CEC, 1998a) includes as a main task, under the area of efficiency and competitiveness, the evaluation of current and possible future mechanisms for market observation, including the need for and feasibility of a European Transport Data System to provide an objective basis for evaluating the performance of the EU's transport markets and systems.

Since then, the development of a European Transport policy Information System (ETIS) has been a priority action. ETIS is a European strategic decision support and information system in the field of transport for policy makers, authorities, industry and operators. ETIS will support the development of the CTP by assisting policy makers at European level to analyse European transport-related strategic issues. ETIS will be an information system of integrated tools including databases, modelling, GIS and presentation tools to interface users with other elements.

Research into the development of ETIS has become a major element since the FP4 Transport Programme (CEC, 1994) which, under the area of strategic research, investigated the requirements and structures associated with data collection, retrieval, updating, displaying and analysis of European databases.

The research programme within the Sustainable Mobility and Intermodality key action of the FP5 Growth programme (CEC, 2000) has identified as a priority the development of the building blocks for ETIS. The three major building blocks are (i) quantitative tools, (ii) knowledge of today’s and tomorrow’s driving forces in transport and (iii) effective policies.

In order to anticipate, orient and respond to mobility needs, the aim of the first building block (i.e. quantitative tools) is to refine and develop transport models to explain and predict the user's travel and transport decisions in a reliable way. The block will also have to allow the evaluation of the impact of different transport policies and developments in terms of economic effects, employment, environment, safety and cohesion so that comprehensive assessment can be made. In particular, priority is assigned to the design of...
models and other evaluation tools that facilitate priority setting in the further development of the trans-European networks and the elaboration of other elements of the Common Transport Policy.

The strategic information and evaluation systems to be developed will support higher-level customised applications, guide decision makers in planning transport systems and operations, and enable the assessment of projects and initiatives. The development of these systems require new methodologies for data collection for specific transport domains where information is not available for use at European and global level such as mobility trends, origin-destination matrices, accidents, internal and external transport costs, emissions from both passengers and freight. It also requires setting up of coherent market observation tools and benchmarking methodologies, integration of assessment tools and models responding to policy-related queries, as well as improved models and evaluation methodologies.

The second building block is research into the driving forces in transport. Their adequate assessment with appropriate quantitative forecasting tools will permit to timely identify challenges and bottlenecks and thus enable decision makers to better cater for current and future mobility needs.

The third building block consists of efficient policies for sustainable mobility. Research on policy evaluation, implementation, acceptance and their further development will enhance the decision making process and the execution of policies at pan-European, EU, national and regional levels.

Two priority actions in the area of local and regional transport were identified in the 1998 Communication on “Developing the Citizens Network” (CEC, 1998b). The first is the development of the European Local Transport information System (ELTIS) which the Commission has contracted with the POLIS network of cities and regions and the International Union of Public Transport (UITP). This consists of a database of information about local and regional passenger transport of all types. Its contents include service design, accessibility, planning and land use, and pricing. The database draws from newly collected examples of good practice and project descriptions submitted by users of the service. The service can be consulted electronically via the web.

The second action is benchmarking to improve transport systems. In other sectors, organisations have used benchmarking to drive continuous improvements in service quality and commercial performance. Public authorities and operators responsible for local and regional passenger transport should be able to compare the performance of their

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2 Polis is a network of European cities and regions from across Europe, which promotes, supports and advocates innovation in local transport (www.polis-online.org).
transport system with good practice elsewhere. This will help them to understand how they can improve and give them an incentive to act. Good performance should be recognised and rewarded. Benchmarking has been a topic for research since then.

Since the ten-year period covered by the White Paper for transport policy issued in 2001 (CEC, 2001) is close to its end, the Commission is making reflections on future policy for sustainable transport. In the document “A sustainable future for transport: Towards an integrated, technology-led and user friendly system” (CEC, 2009a), stress has been put on the adoption of common methodologies and similar assumptions in the appraisal of infrastructure projects across modes and countries. This requires the definition of common data and indicators, as well as suitable methodologies and tools to select projects on the basis of comparable cost-benefit ratios and assessment of impacts. Appraisal methods harmonised at EU level are also needed to assess the socio-economic benefits (e.g. regional development, public goods) deriving from investment in transport infrastructure and PT services (CEC, 2009a).

The creation of the Trans-European transport network (TEN-T) has been established by a decision of the European Parliament and the Council in 1996 (CEC, 1996), and its amendment in 2004 (CEC, 2004). So far, about 400 billion Euro has been invested to fund a large number of projects for the development of the TEN-T. In the meantime, the social, economic, technological and environmental context has changed, and the Commission is undertaking a fundamental review of TEN-T policy (CEC, 2009b) and its priorities. In this respect, a review of the process for the selection of priority projects with reference, for example, to the methodological soundness of their selection and the evaluation of the potential for interconnection and extension (to other modes or other geographical areas) is envisaged (CEC, 2009b). To efficiently and effectively carry out these activities, it is necessary to develop appropriate decision support tools.
4. Research findings

4.1 Introduction

The research which is synthesised in this report is reported according to 5 sub-themes (see Figure 1).

The first sub-theme deals with transport planning tools. Research is always committed to the development of transport planning tools in order to improve the effectiveness and efficiency of decision makers' planning activities. To improve the reliability of forecasts concerning traffic flows, transport impacts and costs it is necessary to develop appropriate models.

The second sub-theme reviews research on European transport information and assessment systems. Information and data are the basic requirements and affect the quality of decisions. In order to make optimal transport policy decision at European level, it is necessary to develop adequate information and assessment systems, which permit to make national data and information consistent and compatible.

The third sub-theme deals with project and policy evaluation methodologies. Transport policies address complex issues and articulated problems which often require the use of huge resources. The development of valid evaluation methodologies can significantly contribute to make more effective and efficient the planning and implementation of transport policies.

The fourth sub-theme relates to benchmarking in transport. Benchmarking exercises have been successfully carried out in sectors other than transport. The comparison of the performances of a transport system with other and the exchange of information on good practices permit and encourage the identification of strengths and weaknesses and possible ways of improvement.

The fifth sub-theme is concerned with planning for emergency conditions. More frequent terrorist attacks and natural calamities have resulted in an increased research
interest in studying ways of effectively, efficiently, and safely managing flow of people and goods in emergency conditions. This sub-theme includes the development of emergency policies, as well as planning and prediction tools.

Figure 1: Sub-themes considered in the synthesis of findings from research projects

Table 2 below shows the EU-funded projects together with a selection of national projects, which have dealt with each sub-theme. The table includes:

- completed projects which are synthesised in this TRS and for which the following sub-sections report on research objectives, research results, policy implications and implications for further research;
- projects which were synthesised in the EXTR@Web TRS on urban transport and which are briefly summarised in the background of the following sub-sections;
- other EU-funded projects which have not yet made results publicly available.

Table 2. Research projects relevant to the theme

<table>
<thead>
<tr>
<th>Sub-theme</th>
<th>Contributing projects</th>
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<tr>
<td>Transport planning tools</td>
<td>Projects covered in this report: CONSAVE 2050; EXPEDITE; FORESIGHT FOR TRANSPORT; GUIDEMAPS; POET; SPOTLIGHTS-TN; STEPS; THINK-UP. Projects covered in the EXTR@Web report: H102N (UK); ISHTAR; MOSCA; PROSPECTS; UG220 (UK); VELO INFO; Guidelines for programming local transport services (IT); Multi-modal freight model for distance-based HGV charging (UK). Other FP6 projects with results not yet available: PEPPER.</td>
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</tbody>
</table>
The research projects listed under each of the sub-themes are shown in the Annex to this report. Hyperlinks to project websites (if available) are also included.

### 4.2 Sub-theme 1: Transport planning tools

#### 4.2.1 Background

A first strand of research reported in the Thematic Research Summary on DSTs produced in EXTR@Web (EXTR@Web, 2006) was concerned with the development of models to forecast transport demand and transport network flows at national level. Another strand of research carried out a review of modelling techniques used in transport planning, and focused on the development of modelling tools to support the assessment of sustainable transport policies in urban transport. Furthermore, tools to support decision makers in the assessment of sustainable urban freight distribution strategies, and tools to support
authorities and operators in planning local public transport services have been developed. Finally, an expertise centre to support cities to incorporate cycling in urban planning has been created.

### 4.2.2 Research objectives

The efficient and effective planning and deployment of transport policy relies upon transport demand forecasts. Consequently, a first group of research objectives within this sub-theme has been concerned with the provision of transport demand forecasts (EXPEDITE, 2002), as well as a foresight exercise on the influence of non-transport factors and policy on mobility and transport (FORESIGHT for TRANSPORT, 2004).

Since there are different organisations which provide this kind of forecast operating at different levels in Europe (European, national, regional), in order to promote cooperation and coordination, it is necessary to ensure a common understanding of transport evolutions. Furthermore, transport policy making processes are becoming more and more complex, and decision makers need advanced tools and models to cope with their demanding tasks. Consequently, a second group of research objectives has been concerned with the establishment of thematic networks to improve plan-related decision making processes and in particular to provide a common platform of understanding for transport forecasts to encourage and facilitate co-operation in the development of transport policy (THINK-UP, 2003), as well as to investigate how to make advanced transport models scientifically reliable, fully transparent to end-users, and better integrated with policy-making processes (SPOTLIGHTS-TN). Research has also investigated how to improve decision making processes through effective stakeholders’ engagement (GUIDEMAPS).

A critical aspect of transport planning is the possibility to estimate the impacts caused by the implementation of policies and develop and investigate future scenarios, consequently a third group of objectives in this sub-theme has focused on the development of tools, models and scenarios to perform impact assessments which are as accurate and reliable as possible. In this respect, research has produced a model to assess the potential impacts of e-Economy on future demand of passenger and freight transport in cities and regions (POET, 2005a). Research has also developed, compared and assessed possible future scenarios for the transport system and energy supply (STEPS, 2006), as well as for aviation and its emissions (CONSAVE, 2050).
4.2.3 Research results

4.2.3.1 Transport demand forecast

Research has produced multi-modal transport forecasts for passengers and freight up to 2020, using existing European and national transport models, such as SCENE\(^3\) and NEAC\(^4\), and developing new ones (EXPEDITE meta-model for passenger transport and the EXPEDITE meta-model for freight transport) to combine information from these models (EXPEDITE, 2002). Using the NUTS2 zoning system for Europe, this forecast exercise has involved about 250 zones, including member states (EU 15) and accession countries (CEEC 8 and Norway and Switzerland), and has chosen the SCENES Reference Scenario for 2020 to develop its own Reference Scenario.

Regarding freight transport forecasts, an increase by 41% in tonnes generated (domestic and international transport) has been forecasted by 2020, for the considered countries across all transport modes. However, these forecasts are characterised by considerable differences between countries (from 23% in Germany to 150% in Latvia), and show that increase by over 100% concern CEEC countries only. In terms of tonnes-km, the forecasted increase is by 79%, which almost doubles the increase in tonnes (this means that the average transport distance is expected to significantly increase). Forecasts have also been provided considering the different modes and distance ranges in terms of tonnes and tonnes-km (EXPEDITE, 2002).

With respect to passenger transport, the increase in the annual number of round trips for distances below 160 km is forecasted to slightly increase (by 5%) in the observed countries in the period 1995-2020, when considering all transport modes (car driver, car passenger, train, PT - bus, tram, metro -, and non-motorised – walking and cycling) . However, there are significant differences between countries, for which this increase ranges from negative values (-26% in Estonia) to 28% in Luxembourg. The mode which is expected to increase the most is car driving (+22%), especially in the CEECs. In terms of passenger-km, always for distances below 160 km, an increase by 10% is expected in the same period. Therefore, not only is an increase in the number of round trips expected, but also in the average trip distance. The increase in passenger-km for car driver mode is expected to be the largest. These high growth rates of car use are mainly caused by the expected increase in car ownership and income in the CEECs (EXPEDITE, 2002).

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\(^3\) SCENES - Modelling and methodology for analysing the interrelationship between external developments and European transport. [http://www.iww.uni-karlsruhe.de/SCENES/](http://www.iww.uni-karlsruhe.de/SCENES/)

\(^4\) NEAC model and information system. [www.nea.nl/neac/](http://www.nea.nl/neac/)
Research has also carried out a foresight exercise on the influence of non-transport factors and policy on mobility and transport (FORESIGHT for TRANSPORT, 2004). The identified non-transport factors that may have a direct or indirect impact on mobility and transport include the following eight classes:

- demographics;
- attitudes (e.g. to time and speed, to new technology, etc.);
- social developments (e.g. more flexibility of jobs, the distribution of economic resources, etc.);
- institutional arrangements (e.g. the process of European integration is producing regulatory overload, making decision rules and reforms necessary at national level);
- science and technology (e.g. e-commerce, teleworking, etc.);
- politics;
- environment;
- and economy.

The foresight exercise has also identified the key indicators that need to be monitored for assessing developments in these external policy fields. It has also shown how specific elements of external policy domains impact on transport and mobility either directly or indirectly, by mediating other effects, whilst it has outlined alternative scenarios (FORESIGHT for TRANSPORT, 2004). A main conclusion is that individual mobility is much more open to external influences from areas such as socio-demographic developments and the labour market than freight transport, which can be more directly influenced by transport policy. The management of individual mobility should be better coordinated with the labour market, and housing and urban planning policies (FORESIGHT for TRANSPORT, 2004).

### 4.2.3.2 Improving decision making processes

A thematic network (TN) has been established to compare and analyse results on transport demand forecasting and scenario development (THINK-UP, 2003). The TN has analysed the segmentation of demand and supply of passenger and freight transport markets, as well as policy variables for mobility prediction, and has also provided a state of the art of forecasting tools currently used at European and national scale, analysing their capabilities and limits (THINK-UP, 2003).

A first finding concerning the analysis of the segmentation of passenger transport market is that fiscal inequalities (e.g. those between air and rail modes) are very likely to result in market distortions. Another finding is that land use and settlement patterns have prevented
PT operators from providing efficient and user-friendly services. Furthermore, “hard measures” (i.e. changes in relative costs between modes) risk failing to obtain the expected impacts on individuals if they are not able to properly deal with the subjective sphere of individuals (e.g. perceptions, attitudes and values, lifestyle, level of information on services, and the attitudes towards modes). Significant modal shifts can only be achieved by adopting approaches which combine classical transport policy measures with “soft measures” which can influence individuals’ perceptions and attitudes towards more sustainable modes (e.g. awareness arising campaigns, more information on PT services and more user-friendly and easy-to-understand tariff systems) (THINK-UP, 2003).

With respect to the freight transport market segmentation, a first finding is that a sectoral approach and a disaggregation per type of products is preferred in industrial logistics privilege, while spatial aspects are preferred in distribution logistics with polarisation in specific European zones. For policy impact analysis, it is necessary to consider all alternatives modes (in particular inland waterways and Short Sea Shipping) and not only the rail mode. Finally, the assessment of policy implementation (or policy context) must take into account the influence (through lobbying) of actors like mode operators and industrialists (THINK-UP, 2003).

Concerning mobility prediction, it has been found that strategic models with a strong conceptual and theoretical basis and an understanding of policy can reduce the gap between policy assessment and mobility prediction due to differences of scope between the two exercises, the constraints of technical tools or the unavailability of comparative data. As for projection tools and trend estimations, it has been found that, in the definition of a scenario, it is important to concentrate not only on macro-economic variables, but also on other variables such as urbanisation, household income distribution, and sectoral changes) (THINK-UP, 2003).

The review of the state of the art of projection tools and the comparison of inputs and outputs of national and European models has led to the identification of differences between traffic reference data, and scenario hypothesis for both socio economic and transport variables. It has been found that there is a need for a common set of data in Europe that can be shared in studies, with a set of workable scenarios relevant for the present European context. Once harmonisation in scenario definition has been achieved, different models could be run and the differences between models analysed. The comparison between the different results can improve the understanding of alternative developments of the transport system (THINK-UP, 2003).

Another thematic network has been devoted to making advanced transport models more accessible to decision makers (SPOTLIGHT-TN). A first group of activities has focused on the development of standard quality control guidelines (called “Dcode”) supporting
modellers in creating robust models which ensure the scientific consistency and policy relevance to end-users. As a result, the Dcode was proposed as standard mandatory or voluntary annex to be included in modelling contracts between client institutions and modellers. A second group of activities have focused on developing clear, fair and harmonised information concerning advanced transport models. As a result a first directory of transport models providing a harmonised description of such models (called “Mdir”), has been produced, and thought to be useful to European policies. A third group of activities has explored the feasibility of adopting a generalised transport data format (called “GTF”) as an import/export process allowing communication between advanced transport models. The final goal has been to reach an overall agreement in relation to a generalised data model. A final group of activities has explored new software and modelling solutions to improve a model's usability. As a result, a long-term assessment of problems and opportunities of using advanced software technologies to make modes more friendly and interactive to end-users has been provided (called “LTVisions”) (SPOTLIGHTS-TN).

The development of sustainable transport strategies and transport policies involve a broad range of stakeholders, from local politicians and the media, through local residents and businesses, to national pressure groups. The understanding of subjective factors is as important as the objective measurement of performances and impacts for the successful implementation of transport schemes to promote behavioural change. However, relatively little guidance has been available so far on how to engage stakeholders in the different transport strategies and schemes. Consequently, research has produced the handbook of ‘Successful transport decision-making’, which provides an overview of good practices in stakeholder engagement, public participation and project management for local and regional transport projects. More specifically, it includes general principles for improving transport project management and stakeholder engagement; descriptions of the most essential project management techniques; details of the most commonly used stakeholder engagement tools; indications on the costs of tools and techniques; and advice about how to identify and overcome barriers (GUIDEMAPS).

4.2.3.3 Tools for impact assessment

Research has developed a tool to support decision makers in assessing the impacts of e-economy on passenger and freight transport. The tool actually uses existing transport models, which calculate the number of trips by travel purpose and the distribution and mode choice, and provide routines to assign traffic flows to the networks. The inputs to these models have been modified by developing ad hoc front-end models on the basis of information collected in virtual case studies in order to simulate e-economy impacts on mobility pattern, activity pattern and travel pattern. Furthermore, evidence from studies was combined with the transport models to assess the impacts in terms of energy, noise, accidents and polluting emissions. In each of the five urban areas selected for the
simulations (Naples, Randstad, Paris, Stockholm and Hamburg), different scenarios have been defined characterised by medium and high adoption of e-economy (e.g. ICT capabilities at competitive prices, smooth delivery of goods, payment security in teleshopping) and relocation of population (shift of citizens from/to urban, suburban, and other areas) (POET, 2005b).

As for the simulation of freight transport, the impacts caused by e-economy on the level of service (improved transport times, reduced costs, improved reliability and flexibility, etc.) have been simulated. This simulation also considers the impacts caused by e-shopping and the fact that e-economy developments applied to information systems influence the load factor by reducing the share of circulating empty or partially loaded vehicles (POET, 2005b).

The main results from the application of the model are that, in the High Adoption scenario, the development of e-economy will lead to a reduction of the passengers-km in all five cities mentioned above, and larger reductions in passenger-km were seen where ICT would lead to the relocation of population from outer zones to suburban and urban areas and from urban to suburban areas. The reduction of the passengers-km in the Medium Adoption Scenario is somewhat smaller but substantially similar to that of High Adoption. Concerning freight transport, the simulations have shown that the number of vehicle-km in the studied cities (Hamburg and Naples) will increase in both the Medium Adoption and High Adoption scenario as a consequence of the development of e-economy. This increase has been ascribed to the fact that the positive effects of the developments in e-economy on the efficiency of freight transport (increase in efficiency due to, for example, the optimisation of delivery trip planning) are less significant than the negative effects (decrease in the efficiency due to, for example, smaller inventories, and smaller and more frequent deliveries, as well as widespread adoption of just-in-time management), (POET, 2005a).

The relatively cheap availability of petroleum has permitted a great expansion of the transport system, mainly based on internal combustion engines. However, there is an increasing concern about the environmental impacts caused by this fuel technology and the future availability of resources of petroleum. Therefore, a wide range of new or alternative or improved fuel technologies are being developed, which will in turn cause impacts and raise issues in case of their adoption and spread of use. In this respect, research has investigated a series of scenarios to make estimations of future conditions in the energy, transport, economic and social fields to provide a basis for the development of future policies and give insight into research requirements in the area of transport and energy scenarios (STEPS, 2006). The scenarios have been mainly described by two variables: fuel price, which is directly related to energy scarcity; and transport and energy policies that authorities deploy in response to variation of fuel price. The scenarios were
simulated with existing integrated land use and transport models at both a European and regional scale. The modelling exercise has provided indications about a number of variables (transport demand, economy, energy consumption, emissions, etc.) over the period from 2005 to 2020 or 2030, when considering different scenarios. The assessment and comparison of scenarios has been made via a multi-criteria analysis, involving energy aspects (e.g. reducing energy consumption and dependence on import), environmental aspects (e.g. emission reduction, global warming), social aspects (e.g. safety) and economic aspects (e.g. competitiveness, employment, GDP and the decoupling of transport growth and economic growth).

The main findings are (STEPS, 2006):

- Most experts believe that fuel prices will continue to rise in the medium and long term because of increasing scarcity of petroleum oil and increased global energy demand and greater supply disruptions.
- All trends in economic activities, freight transport and passenger transport involve more and longer distances, which implies more energy consumption in spite of possible energy efficiency improvements.
- In spite of all the profuse efforts, the decoupling of economic growth and energy consumption as well as the reduction of greenhouse gas emissions has not been achieved.
- Demand management policies to make road transport slower and more expensive (push measures) are more efficient in reducing transport fuel consumption than policies encouraging the use of sustainable transport modes, such as walking/cycling or public transport (pull measures). Furthermore, integrated strategies are more successful than isolated individual policies.
- Technology development policies (encouraging the use of more energy-efficient vehicles or promoting alternative fuel powered vehicles) are successful in reducing fuel consumption per km, but considering the above mentioned trend towards more and longer distance trips for passenger and freight, the energy consumption will increase.
- All dominant push measure policies resulting in lower fuel consumption for transport negatively affect accessibility and consequently economic activities, while pull measures (like PT fare reductions) can have good impacts on accessibility and lower fuel consumption.

Research has also developed and tested quantified scenarios on aviation and emissions focusing on the year 2050, with a look at the short term (year 2025) for aviation industry planning and the long term (year 2100) for climate model development. Instead of looking for a combination of mixed 'realistic' future scenarios developing along 'most-likely' paths, research has focused on designing a set of 'pure', even extreme, scenarios, which outline robust boundaries for the range of possible developments in aviation and its emissions.
These scenarios are (CONSAVE 2050, 2005):
- Unlimited Skies” (ULS); global, dominant actor: market;
- “Regulatory Push & Pull” (RPP); global, dominant actor: policy;
- “Fractured World” (FW); regional, dominant actors depending on regions;
- “Down to Earth” (DtE); global, dominant actor: society.

This approach has contributed to a common European understanding of the critical aspects of long-term development of aviation and its related emissions. The development of these scenarios has shown the sensitivity of air transport to technological and social changes and political measures, as well as the future need for adequate political activities, at the European level, supporting the sustainable development of air transport and the aviation industry in the European Union (CONSAVE 2050, 2005).

4.2.4 Policy implications

4.2.4.1 Improving decision making processes

The thematic network for understanding mobility prediction has given the chance to national experts of different countries to present and compare their methods, results and questions on the topic, and exchange their experience and knowledge in order to gain a better understanding of the capabilities and limits of currently available modelling and assessment tools. The modelling experience of Member State representatives and consultants has been a crucial input to the discussions. This “common working model comparison platform” can avoid many future misunderstandings when looking for consensus in data, scenarios and market segment definition. Therefore, funding is essential to ensure the continuation of these exchanges on a regular basis in the future. (THINK-UP, 2003).

The provision of user-friendly and on-line access to transport models is beneficial to transport planning decision-makers, since they can access a large number of operational tools, avoiding the installation of each model (and all related databases) into their own computer system. This will allow transport planners to make a more effective and efficient use of planning tools (SPOTLIGHTS-TN).

The European Commission should further encourage the exchange of knowledge and experiences in the field of stakeholder engagement and project management for transport projects, especially in new member states and accession countries (GUIDEMAPS).
4.2.4.2 Tools for impact assessment

The result of the modelling of the impacts of e-economy on passenger and freight transport in urban areas is an overall reduction in the number of vehicle-km. This is achieved above all by using electronic communication instead of physical communication, which will permit the performance of activities at home, reducing the need for travel, and increasing social welfare. Furthermore, a reduction in the number of trips will result in a decrease in travel times as a consequence of the reduction of the level of congestion. Such reduced travel times are also likely to result in reduced transport externalities (energy use, emissions and accidents). Considering the positive impacts of e-economy, transport policies should encourage its adoption, especially by private households which can achieve more significant reductions in travel demand (POET, 2005a).

In summary, research on the assessment and comparison of future transport and energy scenarios, has made the following recommendations (STEPS, 2006):

- The sustainable use of energy resources on the one hand and the ever increasing global energy demand on the other hand call for immediate and probably unpopular policy action. The common transport policy of the European Union needs to be reviewed in the light of these demanding issues.
- A harmonised system of vehicle taxes, fuel taxes and road pricing for cars and lorries on all types of roads should be introduced in all EU member states to achieve the necessary energy savings and emission reduction targets. A unified fuel tax policy throughout Europe is recommended.
- The need in designing and implementing integrated strategies, combining policies from different policy fields (such as transport policy, regional policy, urban land use policy and environmental policy) requires co-ordination between different government sectors and levels. The encouragement of this cooperation is recommended.
- In order to reduce car dependency, national, regional and local governments should be encouraged to support domestic economic links, regional and local production circuits, more compact forms of settlements and pedestrian-friendly neighbourhoods.
- The EC should vigorously adopt a long-term goal to drastically reduce CO² emissions from transport.
- The combined impact of energy scarcity and growing greenhouse gas emissions are bigger than their individual contribution. Therefore, a comprehensive policy approach should be developed to deal with these simultaneously.
4.3 Sub-theme 2: European transport information and assessment systems

4.3.1 Background

Research reviewed in the EXTR@Web Thematic Research Summary on DSTs (EXTR@Web, 2006) has developed databases and information systems (European Transport Policy Information System – ETIS) to support planning and policy making at EU level. Research has also contributed to the creation of a European database for long-distance travel.

4.3.2 Research objectives

The free and coordinated flow of goods and people in the European Union requires that activities concerning transport planning, monitoring, and evaluation at all levels (i.e. European, national, regional and local) are carried out from a European perspective in order to achieve widespread benefits when implementing transport policy measures. However, this requires consistent data on traffic flows covering all Member States and potential New Member States. This issue has been addressed by the European Commission by launching a cluster of projects to develop a European Transport Information System (ETIS). A first research objective has been the promotion of the European Transport Information System (ETIS) to potential users (ETIS-LINK, 2005). Research has also investigated ways of improving comparability and reliability of sources for statistical data, even though these are limited to the transport flow of freight goods (Integration of Foreign Trade and Commodity Transport Statistics).

Tools for the assessment of transport policies of Member States also needs to be developed in a European dimension, in order to ensure consistency and common understanding of strategic policy issues. As a consequence, another research objective has focused on the definition of common good practice principles for national and regional transport modelling that satisfy immediate needs of model developers in new Member
States\textsuperscript{5}, as well as on the establishment of a standardised approach for transport modelling in the European Union (MOTOS, 2007). Research has produced an enhanced European transport network model covering passenger and freight transport (including intermodal transport) (TRANSTOOLS, 2008).

Finally, a further research objective has been the development of information platforms and initiatives to provide policy makers with useful information for their activities. Research was motivated by the need for creating reference points to discuss issues and make available information and data to help policy-makers to perform more effective and substantiated impact assessments. In particular, these activities have focused on maritime transport (MTCP, 2007), sustainable urban transport systems (NICHES, 2007; ECOCITY, 2005), intermodal passenger transport (KITE), road safety (SafetyNet, 2009; PENDANT, 2006; RANKERS, 2008), cycling (BYPAD, 2008), transport infrastructure cost estimation and charge calculation (GRACE, 2008; IMPRINT-NET, 2008), policy support and assessment tools (TRANSFORUM, 2007), and on issues concerning institutional arrangements and interactions in the implementation of transport policies (TIPP, 2005).

4.3.3 Research results

4.3.3.1 European transport information systems

A pilot version of ETIS has been developed by a cluster of three projects: ETIS-BASE, ETIS-AGENT and ETIS-LINK. The former issue of this TRS (EXTR@Web, 2006) reviewed research carried out by the first two projects. ETIS-BASE has developed the ETIS system reference database, which gathers, harmonises and makes available transport data and information covering the EU 25, while ETIS-AGENT has developed the interface of the ETIS system which allows policy makers to make queries on policies, policy-specific performances, and performance indicators. The role of ETIS-LINK has been to guide and coordinate the development of the system ensuring the quality and usefulness of the system, to promote the ETIS concept to potential users, getting their consensus, and to encourage an effective up-take of the results by the Commission, Member States and other users. The joint activities carried out by this cluster of projects have led to the creation of the Pilot ETIS to demonstrate the feasibility of the concept of ETIS and its usefulness as a decision support tool to European policy-makers. This pilot, which has been successfully demonstrated and has attracted the interest of a number of Member States, already provides the core elements of ("the complete") ETIS (ETIS-LINK, 2005).

\textsuperscript{5} Model developers in the new Member States are faced with poor availability of data and a lack of adequate tools. As a consequence, policy makers are not confident about the appropriateness of the impact assessment of socioeconomic and environmental indicators.
including:

- a reference database with indicators, data variables and metadata;
- a software environment for accessing, analysing, downloading and visualizing data;
- a methodology for updating data and constructing indicators;
- guidelines for the harmonisation and validation of data collected by different providers, that are often following different underlying methods.

Transport planning activities require comparable and reliable sources of data. Unfortunately, both at a European and national level, statistical data and information are not sufficiently reliable and comparable, and therefore research has investigated ways of improving this situation, even though it is limited to freight goods transport flows. A literature review has been carried out to study the documentation used in the elaboration of statistics on external trade, as well as that of different freight goods transport flows by mode. A comparative analysis of the available statistics has also been made, and, successively, codes have been shared among data sources and identified in order to establish standardised information. Finally, a computer application that permits the collection of data from different data sources in a single data source and in which trade flows and transportation statistics are integrated has been developed (Integration of Foreign Trade and Commodity Transport Statistics).

4.3.3.2 European transport assessment systems

Transport scenarios and other tools used for effectively assessing impacts of policies must take into account emerging trends (e.g. globalisation, variation in energy prices, and EU enlargement). Nonetheless, currently used European transport network models present a number of shortcomings such as unsatisfactory representation of the mix of traffic (short/long distance and freight/passenger); inadequate consideration of intermodality and freight logistics; outdated features; an insufficient linkage of network-based transport models with socio-economic effects and external effects. In this respect, research has developed a European freight and passenger transport network model which includes all modes (cars, trucks, trains, canal ships, sea ships and air transport) and which overcomes these shortcomings. It is the largest and most comprehensive European transport model in terms of covered countries and population, as well as geographical scale. Furthermore, the model is IPR (Intellectual Property Rights) free (TRANSTOOLS, 2008).

This model, which integrates existing models (NEAC, SLAM, SCENES, VACLA V, ASTRA) and considers ETIS as the basis for assessing transport performances, provides a valid support to policy makers in assessing large scale policy questions raised by the challenging environment of a larger and more populous European community. This new modelling tool, consisting of 4 main modules (the Freight Demand Module; the Passenger
Demand Module; the Economic Module) represents the first step towards the development of an integrated transport policy support tool at the EU level. Its main features include: a new set up of a demand/supply model; intermodality for passenger and freight transport; consideration of intercontinental flows; full coverage of Central and Eastern Europe and integration of the new Member States; feedback concerning infrastructure development economy; logistics and freight chain; coupling method with local traffic in order to address the effect of congestion on long-distance traffic (TRANSTOOLS, 2008).

Research has also produced a handbook which provides guidelines on the development of transport models to support an effective and successful transport policy. More specifically, it provides a review of the state-of-the-art modelling techniques and describes the process of model construction and the steps that need to be taken to develop a transport model. Furthermore, the modelling process is analysed in terms of different policy indicators, in order to provide a better understanding of the specific modelling issues that are related to the policy indicators. This handbook also includes a detailed description of best practices in transport modelling and a list of existing models, providing for each model a summary of its main purpose, policy relevance (the policies for which the model can be useful) scope of application, basic construction principles and added value. This handbook provides the reader with a better understanding of the different aspects involved in constructing a transport model, and, therefore gives a contribution to improve transport modelling in Europe, making it more transparent and efficient. This will permit, among other things, cost savings at the modelling stage and improved decision-making at a European level (MOTOS, 2007).

4.3.3.3 Information platforms and thematic networks

Research has created information platforms which provide policy makers with useful information for their activities. In particular, research has developed a Maritime Transport Sector Observatory (MTSO) to provide access to knowledge, information and data concerning maritime transport. Within the activity of this platform, a study has been carried out to develop a structured approach for cost-effectively monitoring and measuring the economic impacts of EU Maritime State Aid schemes. This approach allows decision makers to assess the benefit/cost ratios of individual schemes and assess their impacts at national and European Levels (MTCP, 2007). Furthermore, a desk study on goods flows in Europe has been carried out to simulate the potential for Motorways of the Sea (MOS) and links between different port regions in order to estimate the potential transport demand for the MOS and possible modal shift effects on road transport. The study has shown that there is an evident demand for Motorways of the Sea in Europe, which depends on what regions and what transport chains are linked to each other. The simulation has also permitted the identification of links with strongest potential freight flows in the Baltic Sea area and in the Western Europe MOS area. Another study has analysed market
tendencies and trade flows of intermodal loading units (i.e. containers and swap bodies) and of the corresponding vessel fleets in Europe (MTCP, 2007).

Research has also been concerned with an initiative to encourage stakeholders from different sectors and disciplines across Europe to discuss innovative urban transport and mobility (NICHES, 2007), for the development of sustainable settlements and for the improvement of urban environments (ECOCITY, 2005).

The adoption of innovative technology and policy-based urban transport concepts is fundamental for the development of sustainable urban transport systems. After having provided a state of the art on innovative urban transport concepts, this initiative has assessed success factors, barriers and transferability issues concerning these concepts, and has discussed ways of integrating them into coherent transport strategies through in-depth interviews, expert working groups, validation and dissemination workshops, desk research and identification of good practices. The main outcomes have been the release of the report “Success factors and transferability of innovative urban transport concepts”, which provides detailed information on the implementation of innovative urban transport concepts, along with conclusions concerning success factors and barriers for their implementation and transferability, as well as the “Guide to Innovative Urban Transport Strategies”, which helps urban transport decision makers and practitioners in finding innovative urban transport concepts that could be applied in their cities. Finally, the document “Mobility trends and visions” contains an analysis of the mobility trends and visions on urban mobility (NICHES, 2007).

In recent years, suburbanisation has produced spatially spread and functionally segregated settlement structures around cities and towns, with the concomitant decrease in populations in the historic parts of cities (generally more compact). This trend has led to growth in traffic volumes, and, as a consequence, negative environmental impacts and excessive use of resources, such as land and energy, as well as negative impacts on human health and overall quality of life. Research has developed settlement patterns for sustainable cities to demonstrate the feasibility and desirability of future urban living compatible with sustainability requirements. It has created the model of an ECOCITY, which is an urban environment characterised by sustainable lifestyles resulting in higher levels of quality of life and reduced consumption of resources (ECOCITY, 2005). Concepts for sustainable model settlements have been elaborated and evaluated according to appropriate criteria and indicators in the cities of Bad Ischl (Austria), Barcelona (Spain), Gyoer (Hungary), Tampere (Finland), Trnava (Slovakia), Tuebingen (Germany) and Umbertide (Italy).

The lack of integration of transport modes or the limited capacities of individuals to combine different modes by themselves often result in modal choice for car or airplane,
also in cases where reasonable modal alternatives exist. Furthermore, transport operators have only limited information about the market potentials for integrated transport services, and significant deficiencies still exist in knowledge about current and potential intermodal demand and supply. In this respect, research has developed and made available on the web (http://ifv-kite.ifv.uni-karlsruhe.de/kite/wiki/) a Knowledge Base on intermodal passenger travelling in Europe, which provides all relevant information about passenger intermodality, and allows stakeholders to develop and evaluate intermodality-related measures (KITE).

Policy initiatives to improve vehicle safety, and consequently reduce the number of casualties and injuries, must be based on sufficiently detailed accident data to also support test procedure development. In order to harmonise accident data available at the national level, the STAIRS project\(^6\) has developed a standardised protocol for gathering in-depth accident data relating to injuries of car passengers and pedestrians and has produced guidelines on statistical approaches required to develop a road accident database at the European level. In addition, this research has addressed issues such as methods to calculate collision severity, protocols to record the details of sustained injuries and the development of estimation methods to predict casualty reductions from new technologies (PENDANT, 2006), as well as developing the framework of the European Road Safety Observatory (ERSO) (SafetyNet, 2009).

As for methods to assess collision severity, guidelines for accident reconstruction have been produced, which provide an overview of methods for crash analysis, and a crash test database has been developed (accessible at: www.crashtestdb.com) providing new access to EuroNCAP\(^7\) and other crash test data. A review of the available injury scales has identified that the Abbreviated Injury Scale\(^8\) is the most appropriate tool to describe the nature of injuries and measure threat to life. Furthermore, crash modelling methods have been used to predict changes in the typology of crashes and injuries resulting from the use of new technologies. Over 1100 crashes have been examined, gathering extensive information about the nature of the collision (vehicle damage, performance of safety systems and the sustained injuries). Research has also explored and demonstrated the possibility of linking hospital data system to police data system and has analysed linked accident data to evaluate priorities in injury prevention and to identify issues related to under-reporting of crashes (PENDANT, 2006).

\(^{6}\) STAIRS - Standardisation of Accident and Injury Registration Systems - FP4 - TRANSPORT RTD - Transport Research and Technological Development (www.transport-research.info)

\(^{7}\) Euro NCAP provides motoring consumers - both drivers and the automotive industry - with a realistic and independent assessment of the safety performance of some of the most popular cars sold in Europe (source: www.euroncap.com).

\(^{8}\) The Abbreviated Injury Scale is an internationally accepted tool for assessing and ranking injury severity (www.aaam1.org/ais).
As for the ERSO, it brings together harmonised safety related data to support policy makers at European and national levels, allowing them to make common decisions and proposals for a unified European approach in several areas, including exposure data and Safety Performance Indicators. The ERSO has set up a comprehensive statistical framework for collecting road accident data among the EU countries, extending the CARE database\(^9\) (which includes the EU-25 Member States) to the new EU Member States. The Observatory has assisted the new EU Member States in making their national accident data compatible with the CARE system, by developing appropriate statistical outputs based on CARE data and establishing a common accident data collection set and methodology. The ERSO has also performed a detailed analysis of Safety Performance Indicators (SPI) for road safety at the EU level, developing an SPI Manual which provides useful indications for establishing the necessary systems of data collection in a particular country for producing and estimating SPIs at national level and making them comparable at European level. Furthermore, a European Road Safety Information System (EuroRIS) has been created, which permits potential users to easily retrieve up to date information on road safety in the European member states (SafetyNet, 2009).

Research and empirical studies to provide new insights into the interaction between roads, drivers and vehicles, addressing both passive and active safety measures have also been carried out. A “road safety index” for assessing and monitoring the status of road infrastructure and its relationship with road safety has been produced, as well as a comprehensive catalogue of road infrastructure safety recommendations, ranked according to their cost-effectiveness, which permits the prioritisation of the different solutions and optimisation of fund allocations (RANKERS, 2008).

Research has established the BYPAD platform for the exchange of experiences and good practices in cycling policies. BYPAD (Bicycle Policy Audit) is an instrument for the evaluation of successfully applied local and regional cycling policy. It has been continuously developed from 1999, and has become a European quality standard for cycling policy\(^10\). BYPAD platform has established a network of about 100 cities, towns and regions, spread in 21 European countries, who are involved in activities to improve the quality of their cycling policies. 58 certified auditors have been trained to supervise the

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\(^9\) CARE is an EC database which gathers information only on road accidents resulting in death or injury (accidents with only damages to vehicles or infrastructures are not considered). The major difference between CARE and most other existing international databases is the high level of disaggregation (i.e. CARE comprises detailed data on individual accidents as collected by the Member States (source: http://ec.europa.eu/transport/road_safety/observatory/statistics/care_en.htm).  

\(^10\) More information on the BYPAD (Bicycle Policy Audit) project, which is the predecessor of BYPAD Platform project is available at www.transport-research.info.
audit process. The exchange of knowledge via a website, newsletters, regional workshops and international seminars has been enhanced by creating a good practice database (BYPAD, 2008).

Research has also developed a discussion platform for policy makers and other stakeholders to exchange experiences and opinions on the implementation of new pricing regimes, cost calculation methods, derivation of tariffs to be levied and other pricing aspects (IMPRINT-NET, 2008), as well as further knowledge on transport infrastructure cost estimation and charge calculation (GRACE, 2008). The platform has encouraged the transfer of research findings to policy makers and stakeholders involved in the formulation and implementation of transport pricing reforms, as well as the debate among stakeholders about the principles and practice of transport pricing. Particular emphasis has been laid on links between infrastructure charging and investment needs (IMPRINT-NET, 2008). A number of case studies on transport infrastructure cost estimation across modes and cost categories have also been analysed. This analysis has shown that different methodologies are used to estimate marginal costs, and these methodologies are strongly influenced by the availability of data and by the type of transport mode considered. As for road and rail modes, the main findings are that optimal charges for the use of transport infrastructure are below average maintenance and renewal costs, and that charges should be higher for low quality infrastructure (because it is more subject to damage). Regarding port, inland waterways and airports, the main findings are that efficient charges for ports and inland waterways must include a wear and tear charge for the use of locks as well as congestion, scarcity and environmental charges. Airports generate substantial environmental costs which are not usually internalised (GRACE, 2008).

With respect to the analysis of the socio-economic impacts of pricing traffic by the marginal external cost, the main findings are that replacing all existing taxes on transport with a fuel tax equal to the external costs would result in an unrealistically high fuel tax and would not bring welfare improvements. However, it is suggested that the introduction of a flat kilometre charge, differentiated by type of vehicle (and by country) would generate substantial revenues and would significantly increase welfare. Furthermore, the smart use of the revenues generated by a pricing reform has been found to be as important as its design (GRACE, 2008).

- Policy development should be based on transparent, consistent and generally accepted information and indicators. It should also should make use of state-of-the-art forecasting tools and use transparent methodologies consistent with the principles of sustainable development. Research has addressed the need to verify the scientific consistency and transparency of policy support and assessment tools, and their ability to match the needs and expectations of policy-makers, users and stakeholders. In this respect, an innovative knowledge forum has been created in which the fitness-for-purpose (FFP) of tools developed for transport
policy support is being assessed by encouraging communication between the EC and the Member states, between EU member states themselves, and between policy-makers, policy analysts and transport modellers (TRANSFORUM, 2007).

Part of this approach has been to facilitate a shift from separation of methodological development of transport related indicators, modelling tools and assessment methods towards a wider perspective of developing them together, in a way that the can complement each other (TRANSFORUM, 2007).

Research has also investigated how institutional arrangements and interactions affect the implementation of transport policies, covering all levels of policy-making (local, regional, national and European) and their interactions. The focus has not been on assessing transport policies, but on analysing how institutional settings contribute to the effective implementation of the policies and the achievement of policy goals. More specifically, research has:

- provided a comprehensive picture of institutional framework conditions (constraints and enablers) for implementing transport policies throughout Europe;
- developed an approach for studying the range of institutional implementation issues covered, by combining elements from different fields;
- derived results regarding the implications and impacts of different organisational and regulatory constraints and settings (TIPP, 2005).

4.3.4 Policy implications

4.3.4.1 European transport information systems

This pilot ETIS is a basic step of the process for the creation of ETIS. Member States administrations and other stakeholders have stressed on the importance and added value of a system like ETIS. Research has also elaborated a roadmap for the future of ETIS, which outlines the necessary steps to take to transit from a research project to a fully-fledged information system. However, in this respect, it is necessary that the EC takes the necessary actions to establish a framework for the future of ETIS. More specifically, an organisational and institutional framework for operating, updating, and expanding the ETIS system is necessary, whilst the cooperation of different stakeholders in particular national transport ministries and statistical offices is also desired. It is recommended that the EC takes the initiative in supporting the next steps and in involving Member States and other relevant stakeholders.
4.3.4.2 European transport assessment systems

Recommendations concerning the developed European transport network model are that (TRANSTOOLS, 2008):

- the Commission should be aware of the capabilities of the model and how it can be integrated in policy analyses;
- the reliability of the model results depends on the accuracy of the information on the base-year and forecasting-year, which consequently need to be frequently updated (to this aim a user group with representatives from the Commission and Member States should be established);
- passenger flow data of ETIS have been used for calibrating the model, so a new calibration every 5 years is recommended (in line with the ETIS update timing).

Concerning transport modelling, it is necessary to raise awareness of the importance of good transport modelling as well as deploying knowledge management activities through specific initiatives and funds (e.g. creating knowledge education courses, making it compulsory to use existing guides/results on transport modelling, organisation of a transport modelling conference on a yearly basis). Furthermore, it is necessary to define standard methods for data collection and to establish a European legal framework to regulate data exchange, especially in terms of minimum requirements and public access (MOTOS, 2007).

4.3.4.3 Information platforms and thematic networks

Experts involved in the initiative aimed at stimulating discussion on innovative urban transport and mobility, have made the following recommendations (NICHEs, 2007):

- Even though it has been proved that soft measures are efficient and effective tools to tackle urban transport problems, they are not given the attention they deserve in discussions about the future direction of EU policies on urban transport. Therefore it is necessary to strengthen the status of soft measures in EU policies.
- It is advisable to encourage the development of Sustainable Urban Transport Plans (SUTP).
- It is recommendable to support EU-wide networking activities which are an efficient way to exchange experiences.
- EC should play a stronger role in providing practical guidance on implementing innovative urban transport measures, for example by providing more project funding.
- Lack of standardisation at a European level for clean vehicles and road pricing schemes hinders their uptake. EC should support standardisation activities.
The legal framework for transport pricing at European level is still incomplete. EU should provide a complete legal framework for urban road pricing.

In order to facilitate the uptake of urban transport innovations, a review of their current legal and regulatory frameworks (e.g. licensing issues, competition rules, tendering, taxes, incentives) at the EU and national level is recommended.

The development of model settlement patterns has aimed at demonstrating that taking into account ecological constraints can actually improve the quality of life and health of citizens. Incentives and legal/administrative instruments are needed to encourage, support and promote sustainable urban development and design, and for discouraging the development of urban sprawl (ECOCITY, 2005).

Research has also provided a set of recommendations concerning road accident investigations in all Member States, using a common methodology in order to have detailed, public, transparent and independent road accident data available at European level (SafetyNet, 2009):

- A European safety oriented road accident investigation programme should be established (Member States will carry out safety oriented investigations and will provide data to a European road accident database).
- Safety oriented road accident investigations should be carried out as openly and transparently as possible.
- The European safety oriented road accident investigation programme should be independent
- The European safety oriented road accident investigation programme should have enough financial resources
- Safety oriented road accident investigations should be carried out by dedicated multidisciplinary teams.

The BYPAD-project has established a European network of experts in cycling policy, who lead the audit report and the audit process in the participating cities, towns and regions providing useful advice on cycling policies and knowledge transfer. Therefore, the use of the BYPAD policy audit tool, which introduces Total Quality Management in cycling policy, can be used by decision makers and transport planners to improve local and regional cycling policies (BYPAD, 2008).

The main policy recommendations produced by the activities carried out to verify the scientific consistency and transparency of policy support and assessment tools are (TRANSFORUM, 2007):

- Transport policy research projects might have more impact on policy decisions if their main outputs is presented to decision-makers in a clear form.
Systematic ex-ante assessments followed by ex-post evaluation of economic, social and environmental impacts should become a normal part of policy making procedures.

Innovation networks, targeted at cooperative policy formulation and mutual learning of researchers and civil servants should be established.

To achieve consistent, transparent and accepted assessments, policy-makers, civil servants and researchers must use a common set of definitions and indicators, which describe the achievement of policy objectives, the implementation of policy measures and the development of relevant external influencing factors.

An important step towards a more unified application of European and national models would be the creation of a common reference scenario. A common reference database (ETIS) is already available.

European and national models should not compete with each other, but should complete each other. Therefore, initiatives should be taken to understand the discrepancies between European and national transport models.

The investigations on how institutional arrangements and interactions affect the implementation of transport policies, has produced many policy recommendations (TIPP, 2005) among which are:

- The role the European Union plays in the specification of common approaches and Europe-wide regulations for competition policy, safety and the environment should be maintained.

- The European Union also plays an important role in specifying and financing international infrastructure projects, as well as in supporting projects at regional level.

- National governments play a key role in providing effective institutional structures at national, regional and local levels, in facilitating an integrated approach to transport and land use policy, in providing an appropriate legislative and regulatory framework.

- Decentralised structures are better able to identify local preferences and to adopt a flexible approach to implementation.

- Where governments decentralise decision-making to regional and local government, they need to ensure that appropriate levels of funding are also devolved, or to provide effective revenue raising powers.

- Centralised structures are preferable for planning, financing, executing and maintaining long distance infrastructure investments, such as national and international corridors, for which the benefits and costs have a strong inter-regional component, and comprehensive information is required for sound decision-making.
The private sector can offer particular benefits in the financing and procurement of new infrastructure, but it will be important to ensure that such infrastructure is commissioned and designed in ways which satisfy public policy objectives.

An important element of private sector involvement in investment and service operation is the sharing of risks between private and public sector. A greater understanding is needed of the effectiveness of different types of contract with the private sector.

In specifying the regulatory framework, it is important to avoid structures which are unduly authoritarian and which create unnecessary distortions in the free operation of the transport market.

4.4 Sub-theme 3: Project and policy evaluation methodologies

4.4.1 Background

Research reported in the former Thematic Research Summary on DSTs (EXTR@Web, 2006) performed an assessment of existing evaluation methodologies for projects and policies and developed a framework for the integration of different policy and project evaluation methodologies. This research has also created new methodologies for the evaluation of both the socio-economic development impacts and the indirect and network effects of transport policies and investment projects. Finally, research has focused on developing methodologies for assessing the efficiency of road safety measures, and for assessing ITS.

4.4.2 Research objectives

A first group of objectives has focused on issues concerning large infrastructure projects. More specifically, issues on ex-post evaluation of large infrastructure projects have been explored (EVA-TREN, 2008), a scientifically sound approach to the funding of large transport infrastructure investments in the EU has been developed (FUNDING, 2007), and a set of harmonised guidelines for project assessment and transport costing at EU level has been produced (HEATCO, 2006). Research has been motivated by the fact that, to date, work has mainly dealt with ex-ante appraisal of the impacts of large transport and energy infrastructure projects, while ex-post evaluation issues have been neglected. In addition, finding investments to fund large transport infrastructure projects is of particular concern to the EU (CEC, 2001). Research has also developed a common approach for
transport infrastructure development in the MEDA\textsuperscript{11} area to ensure a better integration of transport networks in the Mediterranean area (MEDA TEN-T, 2006).

A second group of objectives has been concerned with approaches for assessing the sustainability of transport policy as well as quality of life issues. Research was motivated by the fact that policy makers must face the challenging task of developing transport policies capable of providing the right trade-off between satisfying the increasing demand for transport and mobility and reducing the negative transport impacts by developing sustainable transport systems. Furthermore, tools currently available to evaluate the effectiveness of transport policies are still inadequate. Their main weakness include bad links between transport models and sustainability indicators, incompleteness, and reduced capability in assessing cumulative and cross-over effects caused by the implementation of packages of measures. As a consequence, research has developed a consistent framework for the assessment of policy options for promoting sustainable transport and mobility (SUMMA, 2005), and a consistent and comprehensive approach and planning methodology for the analysis of urban transportation problems, that helps to design strategies for sustainable cities (SUTRA, 2005). Research has also made a contribution to the development of a comprehensive methodology for assessing the impact of various transport policies and strategies on sustainability, which allows a solution to the aforementioned weaknesses (REFIT, 2008).

Quality of Life (QoL) of citizens significantly depends on transport and mobility. Appropriate assessment of transport policies from the point of view of the impacts on QoL of citizens is important for an effective and efficient transport planning because of the increase in the acceptability of measures. In this respect, it is crucial that there is a good level of communication between decision makers and users in order to properly take into account the needs and interests of the segments of the population affected by the implementation of a specific transport measure. Therefore, research has investigated the extent to which policy makers take into account QoL effects of implemented policies and measures and the development of tools to assess such effects (ASI, 2005).

A third group of objectives has been concerned with the development of a methodology for a common evaluation of transport measures implemented by a cluster of projects. The development of such a methodology has been necessary to evaluate the impacts of the 212 transport measures implemented within the CIVITAS I Initiative\textsuperscript{12} (METEOR, 2006).

\textsuperscript{11} The MEDA programme is the EU main financial instrument for the implementation of the Euro-Mediterranean Partnership.

\textsuperscript{12} Launched by DG-TREN from 2002 to 2005 this initiative has involved 19 cities.
4.4.3 Research results

4.4.3.1 Large infrastructure projects

Starting from a review of the approaches currently used for ex-ante assessment of large infrastructure projects and a selection of best practices, research has made an attempt to improve the assessment methodologies for the ex-ante evaluation through the ex post evaluation. This has permitted the development of criteria, indicators and "good practice" for the appraisal of complex projects and allows a better understanding of critical aspects for the successful implementation of transport and energy schemes. Guidelines for the ex-post evaluation of projects have also been developed (EVA-TREN, 2008).

The analysis of the state of the art has shown that the most commonly used approaches for transport infrastructure assessment are Cost Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA). Furthermore, methodologies for transport project assessment in the European countries are different, but most countries adopt an approach based on the Cost-Benefit-Ratio or the Net-present value. The main findings concerning the ex-post analysis of eleven transport and energy projects are the following (EVA-TREN, 2008):

- project objectives vary across stakeholders (EC, national and local authorities may have different objectives for the same project) and over time (when projects require very long decision-making processes, the reference context might change and the initial objectives must be revised). Such changes in the project objectives negatively affect costs;
- decision-making processes are strongly country-specific;
- project dependency issues (projects financial and economic performances are influenced by the implementation of other projects in the same network) have never been investigated with sensitivity analyses and/or scenario analyses;
- interoperability is crucial for the implementation of European-wide railway networks;
- actual demand has been overestimated for almost all projects within the sample, and it is reasonable to think that this is the result not only of technical weaknesses, but also of the will to demonstrate ex-ante the convenience of projects;
- almost all projects in the sample experienced cost overruns (due to delays in project implementation and changes in project design and in environmental requirements) and revenue overestimations (mainly due to demand overestimations);
• the main reasons for deviations between ex-ante and ex-post economic performances are the overestimation of demand and the underestimation of investment costs;
• in all considered countries, environmental assessments are mandatory but to very different extents;
• project uncertainties (such as implementation delays, investment costs, demand and tariffs) have mainly been assessed through sensitivity analyses and only in two cases using scenario analyses (moreover the analysis of the uncertainties mainly concentrates on a project’s economic performance to the detriment of the financial performance).

With respect to the funding of large transport infrastructure projects, research has reviewed the literature on economics of infrastructure funding and mark-up methods and the development of scenarios to address the problems of the current funding framework. Research has made a contribution to the development of a methodology for mark-ups to marginal cost pricing, applicable to all modes as well as links and nodes, which involves a more detailed analysis of network aspects, the division of power between several governments and operators, quality aspects and uncertainty issues (FUNDING, 2007).

Furthermore, a methodology for creating a European multi-infrastructure fund has been developed and tested, which considers possible structures of such a fund, the decision criteria, acceptability, efficiency and spatial equity effects. A spatial computable general equilibrium model has been used to compare pricing and revenue use strategies, assessing the economic impacts of these measures and their distribution. This methodology has been demonstrated for a number of selected scenarios and geographical areas. In particular, this methodology has been used to assess the impacts of the priority projects for the regions of the European Union, comparing the scenarios with and without EU subsidies (FUNDING, 2007).

Research has also developed harmonised guidelines for assessing European infrastructure projects and transport costing at EU level, starting from a comparison and analysis of the current practices in project assessment in Europe. The main elements of these guidelines are (HEATCO, 2006):

• general issues (e.g. non-market valuation techniques, benefit transfer, treatment of non-monetary impacts, treatment of indirect socio-economic effects, etc.);
• value of time and congestion (e.g. commercial goods traffic time savings and treatment of congestion, unexpected delays and reliability);
• value of changes in accident risks (e.g. valuing accident costs);
• environmental costs (including air pollution, noise, global warming);
• costs and indirect impacts of infrastructure.
These guidelines, which can be used for TEN-T projects and for other transnational projects, have been successfully tested in 4 case studies, comparing them to national methodologies. The most important differences between these guidelines and the national methodologies include: the market prices used in some national appraisals and the factor costs recommended by the guidelines; choice of the social discount rate; and the duration of the appraisal period (HEATCO, 2006).

The work programme of the Barcelona Declaration which formalises the intentions of the Barcelona Process\(^\text{13}\) includes, among other things, the development of efficient interoperable transport links between the EU and its Mediterranean partners (CEC, 1995). In order to develop a common approach for transport infrastructure in the Mediterranean area, research has reviewed and compared the assessment and evaluation methods used by the Mediterranean countries with those used by EU, and it has developed a multi-criteria assessment framework suitable for all relevant stakeholders. This framework can be used to identify priority projects involving cross-national investments for future research and transport policy analysis. Research has also elaborated a strategy for achieving integrated infrastructure planning, interconnectivity and interoperability of transport systems in the Mediterranean areas and between the EU and the Mediterranean countries (MEDA TEN-T, 2006). The result has been a comprehensive analysis of the Euro-Mediterranean transport system, which provides a qualitative and quantitative description of the transport sector in the Mediterranean area. Furthermore, an assessment of the performance of this transport system against international and regional indicators has been completed, and the developed evaluation methodology has permitted the identification of major bottlenecks, and issues to be addressed. Also, actions to improve the overall efficiency of the transport sector in this area have been proposed (MEDA TEN-T Strategic Master Plan).

4.4.3.2 Approaches for assessing sustainability and quality of life

Research has developed a methodology and a user friendly and easy to use tool which integrates demand generation and policy assessment capabilities and allows policy makers to assess the impacts of policy measures. However since the quality and availability of data is not the same for all countries, the best way to use this tool is to compare the relative performance of policies, rather than assessing the absolute level of

\(^{13}\) The Barcelona Process launched by Euro-Mediterranean Foreign Ministers in 1995 has established an innovative alliance based on the principles of joint ownership, dialogue and co-operation between EU member states and Mediterranean partners (at that time respectively 15 and 14 in numbers). For further information, please visit the web page: http://ec.europa.eu/external_relations/euromed/barcelona_en.htm.
an impact of a given policy. This tool also permits the ranking of policies on individual outcome indicators and permits an integrated policy analysis using the systems approach by means of scorecards which show the performance of multiple policy measures on different outcome indicators, and make the tradeoffs among the different outcomes (SUMMA, 2005).

The application of this tool to assess the impacts of policy measures inspired by the goals in the White Paper on transport policy has produced the following results (SUMMA, 2005):

- an effective policy for achieving the goals expressed in the White Paper is to increase the price for using the road infrastructure (it was found that a policy based on charges performed better than a policy based on subsidies);
- policy for improving the level of service for road transport hampers the achievement of goals in the White Paper, because it attracts transport demand from rail and inland waterways;
- policies addressing urban transport problems need to be tailored to the local conditions and situation in a city.

Research has also developed and successfully tested an approach to design consistent policies and strategies for sustainable urban transport and land use. Based on a broad integration of socio-economic, technological and environmental issues, this approach makes use of a scenario analysis together with a set of sustainable urban transport indicators. A set of common scenarios has been defined across all case study cities using the basic set of indicators to specify consistent change and development of scenarios. The impact assessment includes emission calculations, environmental impacts (air quality), population exposure and public health impacts. The resulting set of indicators are then used in a multi-criteria analysis to define sets of solutions, which are also compared in a benchmarking exercise with a much larger set of cities across Europe. The impact of the measures included in the scenario definitions demonstrate that no single measure can have a significant impact by itself, but only a combination of measures works best (SUTRA, 2005).

By combining the SCENES, TREMOVE and CGeurope models, research has developed a comprehensive transport policy assessment framework which consists of (REFIT, 2008):

- European transport objectives and indicators, and tools and expertise developed by European projects;
- new additional evaluation modules to produce data for those policy objectives and indicators so far hard to address quantitatively (namely impacts on regional development, employment, fair competition between modes, noise and air pollution exposure, personal health, safety, equity and income distribution);
- a methodology for the assessment of policy packages in terms of economic, environmental, and social impacts.
This assessment framework can be used for all sustainability impact assessments within the EU, although it is necessary to use updated data and in some cases to make new calibrations of parameters.

Research has also provided decision-makers with tools to better address QoL issues in land use and transport planning before and after the implementation of transport policies with a view of ensuring their public acceptance and encouraging changes in users’ behaviour (ASI, 2005). More specifically, a compact, practical and user-friendly toolbox has been developed consisting of:

- a basic set of QoL indicators (which can be integrated with new ones defined by the user);
- a databank concept with results of assessments and evaluation of urban planning and design, transportation and mobility measures in terms of their effects on QoL;
- guidelines for the transformation of QoL assessment results into policies and measures.

The use of this toolbox before implementing a policy allows policy makers to assess how and to what extent these policies may affect QoL, to identify aspects which need to be improved, and to establish what can be done to prevent or reduce possible negative effects. The use of this toolbox after the implementation of policies helps to evaluate whether the changes introduced have improved QoL or not, and consequently develop plans to improve the policies, or to implement additional ones. Furthermore, this toolbox can be used for benchmarking exercises, by comparing QoL indicators in different cities, regions and countries (ASI, 2005).

4.4.3.3 Methodologies for common evaluation

Research has developed a methodology to carry out a process evaluation, to assess the impact of the 212 transport measures implemented in the 19 cities involved in the CIVITAS I initiative, and to assess their transferability to other contexts (METEOR, 2006). The 212 different innovative measures have been pooled according to 11 clusters (Transport information and Management; Multimodal interchange; Mobility management; Cycling; Car sharing and car pooling; Zones with controlled access; Clean vehicles and fuels; Public Transport; Goods distribution and logistics services; Parking management; Road Pricing).

The process evaluation has identified typical patterns of barriers and drivers that have affected the implementation of the measures. 12 barrier/driver categories have been defined. The assessment of the level of influence of each barrier/driver has been used to obtain a weighted ranking of barrier/driver categories. A general assessment of the
numbers of barriers and drivers identified within each cluster provided an indication for the expected success and failure rate: high success rate, i.e. drivers surpassed barriers; proximity of success and failure, i.e. balanced influence of barriers and drivers; high failure rate, i.e. barriers surpassed drivers.

The cross site impact evaluation was based on the MAESTRO approach developed within the 4th EU Framework Program. Essential elements from MAESTRO that have been applied are the application of an ex-ante and an ex-post analysis, the distinction between the before and after comparison and the project impact by comparing the project results with the results of a do-nothing scenario. Evaluation at measure and city level was performed by the cities according to the evaluation plans. The cross-site evaluation focused on the analysis at cluster level.

The approach towards transferability was based on identifying relevant information from the data accumulated during CIVITAS I, in order to replicate such measures in any new target cities. Findings suggest that clusters of measures can indeed be characterised with respect to their ability to be successfully transferred to different cities. The most important driver in a successful transferability process is predominantly the ability to adequately replicate the context, namely physical, cultural and institutional conditions. The success of a number of individual measures within a certain policy cluster is sensitive to several different, specific conditions (METEOR, 2006).

4.4.4 Policy implications

4.4.4.1 Large infrastructure projects

The ex-post analysis of several case studies to improve the effectiveness of the assessment of large energy and transport infrastructure projects has highlighted the necessity to make compulsory the application of ex-post analyses, to make assessment independent from decision making, and to develop transparent evaluation tools (EVA-TREN, 2008).

Concerning the issues on funding large transport infrastructure projects, research has made the following recommendations (FUNDING, 2007):

- Since it is costly to gather extra tax revenues from general income taxes, an increase of taxes on road use in the EU (for example, adding a small additional excise to motor fuel) might be the best way to generate extra revenues.
- The lack of a generally accepted cost benefit guide for assessing transport infrastructure projects at EU level can result in high risks of a positive bias in
project assessments. It is therefore necessary to develop appropriate models that can help to form a second opinion on projects that apply for EU funding.

4.4.4.2 Approaches for assessing sustainability and quality of life

The operational methodology and tool for assessing the sustainability impact of all transport policies within the EU provides policy makers with a clear overview of the indicators and their individual and total response to transport policies. The main implication will be an improvement of the quality of their decisions (REFIT, 2008).

Currently, social scientists are not really involved in the evaluation of transport policy impacts on quality of life (QoL), even though they can provide useful contributions to this debate. In fact, most experts involved in these evaluation activities have a technical background (such as engineering and/or architecture). A sustainable transport development requires balancing economic, environmental and social costs and benefits, consequently the creation of multidisciplinary teams including, in particular, social scientists is recommended (ASI, 2005). Furthermore, the current lack of a general concept or operational definition of QoL makes it difficult to establish the correct impacts of policies on the evaluation of QoL. Experts have different disciplinary backgrounds (e.g., architecture, town planning, transportation planning, civil engineering, economy) which lead to different (and sometimes divergent) ideas on QoL. This prevents not only makes communication difficult, but also hampers the development of appropriate instruments to assess QoL. Interdisciplinary work and communication between experts is therefore recommended, as well as the harmonisation of definitions concerning QoL issues (ASI, 2005). Finally, it is recommended to consider with much emphasis the subjective aspects of QoL when assessing transport policy by involving the people affected in the design, planning and implementation of transport policies (ASI, 2005).

4.4.4.3 Methodologies for common evaluation

The main recommendations from the evaluation of the measures implemented in the CIVITAS I initiative are (METEOR, 2006):

- The CIVITAS policy fields (clusters) ensure a comprehensive coverage of all possible actions to increase the sustainability of urban transport systems.
- The results of the implementation of CIVITAS I have shown that the critical success factors to deliver higher sustainability levels are basically the modal split and vehicle fleet performance. These 2 factors should drive policy formulation and the identification of priorities.
- CIVITAS I has confirmed that the exchange of best practices among cities is highly beneficial.
Harmonisation at the technical, institutional and regulatory levels can significantly help to reduce implementation costs, and should be forcefully pursued.

Technology is crucial to many of the CIVITAS policy fields, but is often expensive.

CIVITAS I has shown that human and social capital can be more important than financial resources.

4.5 Sub-theme 4: Benchmarking in transport

4.5.1 Background

Research reported in the former Thematic Research Summary on DSTs (EXTR@Web, 2006) assessed how performance measures and benchmarking can support the development and implementation of the various elements of a European sustainable transport policy by means of practical pilot studies. Research here also investigated the role of benchmarking in the development and implementation of sustainable transport policies.

4.5.2 Research objectives

Potential sources of economic development for the countries of the Mediterranean area are their natural resources and their historic and cultural heritage. Unfortunately, their transport systems are inadequate. In order to improve the efficiency and effectiveness of the transport systems of the tourist areas of the Mediterranean countries, research has evaluated the possibility of transferring to those countries transport measures successfully implemented in European cities. In this respect, a research objective has been the need to carry out a benchmarking exercise involving Mediterranean Countries and EU cities in order to assess the current condition of their transport systems and identify possibilities for improving them (EMERET, 2002).

Research has also carried out a benchmarking exercise to assess how cycling is considered in urban planning processes. Research here was motivated by the fact that to achieve a larger use of bicycles in European cities and encourage their use as a daily transport mode, it is crucial that cycling becomes an integral part of urban planning policies (SpiCycles, 2006).
4.5.3 Research results

The benchmarking exercise has compared the transport systems of Mediterranean and EU cities which all share an interest from tourists, but may belong to two different political, social, cultural and religious contexts. The criteria for the selection of the cities have been: their location around the Mediterranean, that they have a population ranging between 20,000 and 100,000 inhabitants, that they are actual or potential tourist destinations. The two European cities (Orvieto in Italy - and Évora in Portugal), have been used as a reference model to try to identify possible solutions to transport problems of the selected Mediterranean cities (Bethlehem in the Palestinian Authority, Jerash in Jordan and Valletta in Malta). The use of Orvieto and Évora was motivated by their involvement in several European research projects, involving the testing and implementation of innovative transport systems (funicular, escalators, electric buses), as well as the use of restriction measures for private vehicles.

15 indicators for describing the features of the cities’ transport system were identified and a questionnaire was created and circulated among the participating cities. The questionnaire consisted of five sections (General information, Transport modes, Social impacts, How the situation is perceived). Comparison of the five transport systems permitted the identification of some differences between the EC and Mediterranean (MED) cities (EMERET, 2002):

- the number of vehicles per head is much higher in the EC cities;
- motorcycles and mopeds are practically absent in the MED cities;
- in the MED cities, the number of taxis per 1,000 residents is higher than in the EU cities and shared taxis are widely used;
- the length of the PT route per resident in the MED cities is much shorter than in the EU cities;
- the two Middle Eastern cities cannot provide local transport information on the Web, although in Bethlehem transport information is available in many languages;
- both MED and EU cities perceive air pollution and congestion as a serious problem;
- noise and visual intrusion are perceived as serious problems in the MED cities;
- in the MED cities trucks and vans are viewed as contributing significantly more to the local air pollution than in the EU cities;
- more accidents per 1,000 residents occur in the MED cities, with a much higher rate of injuries and deaths than in the EU cities.

This benchmarking exercise has permitted the identification of areas of intervention to improve efficiency and effectiveness of transport systems in the Mediterranean cities. One
of the main problems identified is the lack of areas reserved for pedestrians and the unsafe walking conditions in the Mediterranean cities. Other aspects that need to be improved are the number of accidents per resident and their gravity, as well as the very poor user perception of transport systems and their externalities, especially noise, congestion and air pollution (EMERET, 2002).

The benchmarking exercise for assessing the status of cycling in urban transport processes has involved six European cities (Barcelona, Bucharest, Berlin, Göteborg, Ploiesti and Rome). These cities have been asked to fill in a questionnaire consisting of the following sections (SpiCycles, 2006):

- Preparation, which asks about background information and activities relating to consultation (gathering of information on user needs), partnership building (cooperation with stakeholders), political commitment, policy framework (objectives and actions);
- Planning, which asks about activities concerning the development of an action plan and a communication and marketing plan, scheduling, funding sources;
- Implementation, which asks about activities concerning the staffing structure, staff training and tools;
- Monitoring and evaluation, which asks about activities concerning monitoring, evaluation, reporting and review of the action plan.

On the basis of the given answers, a score has been calculated which shows the level of attention given by city authorities to cycling in their urban planning activities. The results have been that Barcelona and Göteborg perform much better than the other cities, even though there are activities that might be improved. In Ploiesti and Bucharest very little consideration is paid to cycling when considering their urban planning activities (SpiCycles, 2006).

4.5.4 Policy implications

The European Commission has invested a lot of research and financial effort in developing the TEN-T to allow people and goods smooth and quick circulation within Member States. However, the international dimension of transport is increasing more and more because of globalisation. Therefore, it is critical to ensure not only good connections and integration of transport systems within Member States, but also with neighbouring countries, in order to achieve economic and environmental benefits. As a consequence, benchmarking exercises extended to neighbouring countries could be useful to identify problems, find solutions, exchange experiences and best practices, and transfer advanced transport system concept.
The extension of the benchmarking exercise for assessing the status of cycling in urban planning processes to a greater number of cities could provide an overview of how projects and activities funded by the Commission are contributing to enhance the consideration of cycling in urban transport planning.

4.6 Sub-theme 5: Planning for emergency conditions

4.6.1 Background

Project results for this sub-theme were not available when the Thematic Research Summary on DSTs was prepared during EXTR@Web project (EXTR@Web, 2006).

4.6.2 Research objectives

A number of studies which have analysed transport systems in conditions of emergency are available in the literature. These studies have tried to identify a process to reduce the disastrous effects caused by a disaster event. Examples of the most important disaster events are seismic, volcanic, nuclear, hydro-geological, chemist-industrial pollution and fire.

European and Italian legislation include rules to reduce, on the one hand, the probability that catastrophic events will happen and, on the other hand, the vulnerability of systems exposed to such events. The risk associated with a disaster event depends on the vulnerability of a system and its exposure. Vulnerability is the capacity of buildings and infrastructures to resist a disaster event. The exposure is the number of people and the value of items/objects (including the transport system) which are in the area and can be struck by a disaster event. Different studies have dealt with vulnerability and many quantitative methods have been developed to estimate it (e.g. methods to test resistance of buildings to earthquakes), while there is still a need for quantitative methods for modelling exposure to the risk of disaster events. Exposure to catastrophic events can be reduced by planning adequate evacuation\textsuperscript{14} strategies and procedures.

Identification of the best evacuation strategies and procedures requires the understanding of how a transport system works in case of an emergency. In this respect, research has

\textsuperscript{14} The concept of general mobilisation of a city is expressed in the technical language by the word evacuation
developed guidelines to assess the performances of a road transport system in emergency conditions to reduce the risk of an event. This is defined in terms of the probability that an event take place in a transport system, the vulnerability of a transport system, and the exposure of the transport system (Guidelines for evacuation plans by simulation of transport systems in emergency conditions, 2006).

4.6.3 Research results

Research has analysed methodologies, models and algorithms concerning (Guidelines for evacuation plans by simulation of transport systems in emergency conditions, 2006):

- the definition of the probability that an event happens in a territorial area in emergency conditions;
- the definition of the vulnerability of a transport system interacting with a territorial system in emergency conditions;
- the definition of the exposure of a transport system interacting with a territorial system in emergency conditions;
- analysis and tests on the interaction between supply and demand in case of evacuation using a pseudo-dynamic approach and a dynamic approach.

Research has also provided a definition and classification of disaster events. Furthermore, events which have direct or indirect impacts on transport systems have been identified.

Finally, guidelines for evacuation plans with simulation of transportation systems under emergency conditions have been developed. These guidelines include, in particular, methodologies for (Guidelines for evacuation plans by simulation of transport systems in emergency conditions, 2006):

- the management of an urban area in conditions of evacuation;
- the analysis of the flow conditions of the network in emergency conditions and the evaluation of evacuation times for different demand and/or supply scenarios.

4.6.4 Policy implications

The guidelines for evacuation plans can be used during the design phase (when looking for strategies for optimising the evacuation of systems) and the analysis phase (when simulating the behaviour of a system).

These guidelines can support decision makers in identifying possible instabilities concerning the localised evacuation flows in the network, as well as alternative solutions for implementing the necessary measures (Guidelines for evacuation plans by simulation of transport systems in emergency conditions, 2006).
4.7 Implications for further research

4.7.1.1 Transport planning tools

Research has produced a new model, combined with existing ones, to assess impacts of e-economy on passenger and freight transport. Interesting results have been obtained, but it was found that the final outcomes of the model crucially depend on the impacts of e-economy on relocation. Consequently, further investigations on the impacts of e-economy on land use by using a full-scale residential choice model based on a larger database, and considering not only population shift but also employment shift are recommended (POET, 2005a).

With respect to the assessment and comparison of future transport and energy scenarios, research has made the following recommendations (STEPS, 2006):

- Performing forecasts of fuel price increases appears to be more difficult than forecasting their impacts. Therefore, further research is needed to better assess likely market responses to exogenous energy price shocks as well as those of the related policies.
- Further research is also needed to study more extreme energy price scenarios than those investigated so far, in order to advise policy makers about how to avoid or mitigate them through more energy-efficient technology, more sustainable transport and less car-dependent cities.
- Another topic for further research is the identification of the optimal tax policy under different oil price scenarios. A cost benefit approach could be used to find optimal prices/taxes.
- There is a need for studying a more advanced vertical (EU, regional, local) and horizontal (energy, land use, environment) integration between models to provide a very powerful tool to assess regional impacts of European transport policies.

4.7.1.2 European transport information and assessment system

A pilot ETIS has been developed and demonstrated. However, this pilot needs to be expanded to a fully-fledged system to become an effective policy support tool that provides policy-makers with the most up-to-date data and information on important transport related questions. Main upgrading involve the capability to remotely access dispersed data sources, automatically updating of the ETIS database, and inclusion of forecasts of important trends, as well as the models used to make these forecasts (ETIS-LINK).
Recommendations for further research concerning the developed European transport network model consist in (TRANSTOOLS, 2008):

- Optimisation of the software codes and data flows in order to reduce running times;
- Improvement of its user-friendliness;
- Improvement of its modelling capability by extending the network, estimating matrices for intra-zonal traffic, providing links to other models (e.g. energy models, environmental models, etc.), including neighbouring countries (near Europe), improving modelling air and sea transport modelling, including containerisation, enhancing links to national models, including generation and attraction information, making it possible for users to change model parameters.

As to transport modelling in the New Member States, a number of bottlenecks have been identified, which further research could help to overcome (MOTOS, 2007):

- lack of reliable, adequate and up-to-date information and data (there is low availability of high-quality data and a non-uniform structure of initial data), especially socio-economic data;
- lack of qualified personnel for using and developing transport models;
- Lack of applicable professional software/programmes and lack of resources for purchasing the software;
- Lack of standard types of transport models, which sometimes results in a lack of interest in transport modelling.

Concerning innovative urban transport and mobility, research has made the following recommendations (NICHES, 2007):

- In spite of the progress made in understanding the impact of measures to tackle urban transport problems, there is still a lack of adequate decision support tools. Therefore the improvement of assessment methodologies and creation of practical decision support tools is recommended.
- It is also recommended to strengthen research on relations between urban transport measures and urban development and land use planning.
- Low birth rates and increasing life expectancy will result in new mobility patterns and demand. So it is advised to better understand the impact of demographic change on urban transport.
- Research is required to better understand patterns of urban freight traffic.
- Even though behavioural aspects play a crucial role in transport and mobility, research is much more focused on technology, underestimating these aspects. Understanding can be enhanced by involving experts in social and behavioural psychology, economy, law, political and planning science and health science.
Urban transport research should not only focus on the urban core city but it should also consider the manifold interrelations with the surrounding regions.

4.7.1.3 **Sub-theme 3: Project and policy evaluation methodologies**

In the area of the assessment of large energy and transport infrastructures projects, research has pointed out the necessity to develop linkages between existing models and to introduce in existing models the analysis of marginal opportunity cost of public funds, which is currently missing (EVA-TREN, 2008).

The assessment of policy options for promoting sustainable transport and mobility has highlighted the need to better understand issues concerning social equity and social cohesion and the development of appropriate policy measures for addressing them. There is also a need to better understand cause-effect relations in the transport system and policy making. Furthermore, considering the multiple dimensions of sustainable transport, it is unlikely that any single policy measure can by itself help attain a sustainable transport system. Therefore policy makers should try to develop policy packages (sets of policy measures) to address the different dimensions of sustainability using various models and tools to assess their impacts (SUMMA, 2005).

Recommendations for further research to improve the operational methodology and tool for assessing sustainability impacts of transport policies are (REFIT, 2008):

- To identify further indicators to provide more detailed information on impacts at the sustainable impact assessment level;
- to review the current list of indicators in order to simplify it and integrate it with indicators belonging to sectors not addressed by the current framework (e.g. the energy sector), but that are relevant to transport policies addressing sustainability;
- to investigate the possibility of applying this methodology (developed at European scale) to other regional scale models to calculate local scale indicators.

As for the development of a common approach for transport infrastructure development in the Mediterranean area, further research is needed to (MEDA TEN-T, 2006):

- gather missing or insufficient data to support the decision making process and complete the design of the MEDA TEN-T Strategic Master Plan;
- establish transport sector priorities for possible investment measures using the criterion of sustainable mobility;
- encourage organizational and regulatory measures enhancing the Euro-Mediterranean transport network;
- enhance the evaluation methodology of projects and corridors;
- create a Transport Observatory in the Mediterranean area to monitor transport flows, transport services, implementation of transport investments and other
initiatives, as well as a list of all stakeholders for transport related activities and services.

4.7.1.4 **Sub-theme 4: Benchmarking in transport**

The benchmarking exercise has involved cities from a small number of Mediterranean countries, and this has only permitted the implementation of a qualitative analysis with quantitative data. Further research could extend the benchmarking exercise to a greater number of cities in neighbouring countries in order to carry out deep statistical analyses and get a better understanding and insight into the problems of their transport systems as well as identifying possible areas of interventions to improve their effectiveness and efficiency.

4.7.1.5 **Sub-theme 5: Planning for emergency conditions**

The more frequent terrorist attacks in densely populated areas on the one hand, and the relatively frequent natural disaster events on the other hand are a major concern for countries all over the world. Consequently, there is a need to study and plan effective procedures to evacuate people in emergency conditions. Further research is required to get an insight into the issues concerning this topic which will permit to develop effective evacuation plans.
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## Annex: List of projects by sub-theme

### Sub-theme 1: Transport planning tools

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Sub-theme 5: Planning for emergency conditions

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<td>Project from Italy</td>
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Note. The projects listed in the Annex are those that have had the focus on the theme “Decision Support Tools”, as well as those who have addressed Decision Support Tools as secondary topics to some extent. On the TRKC portal (www.transport-research.info) it is possible to use the “advanced search” functionality – with the option “Decision Support Tools” – and find all research projects, EU-funded and national, which have treated, to a variable extent, aspects that can be related to the theme.