Transport Research Knowledge Centre

USER ASPECTS
THEMATIC RESEARCH SUMMARY

Directorate-General for Energy and Transport
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Transport Research Knowledge Centre

Thematic Research Summary:

User Aspects

Prepared by Farid Debbah

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Foreword

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

The role 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 key research activities at national level in the European Research Area (ERA) and selected global 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 project life time; 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 DGTREN of the European Commission and a representative group of research users.

This Thematic Research Summary deals with User Aspects (for all modes and type of transport user). The aim is to provide the reader with a synthesis of completed EU-funded projects which have dealt with the theme. The paper is intended for policy makers at the European, national and local levels, as well as any interested reader from other stakeholders and from the academic and research communities.

Disclaimer and acknowledgement

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

The author would like to thank **Dr. Farida SAAD** (INRETS, France) for undertaking an external review of this paper.

Executive summary

This paper has been produced as part of the TRKC (Transport Research Knowledge Centre) project of the Sixth Framework Programme. The role of TRKC, as its predecessor project EXTR@Web, is to collect, structure, analyse and disseminate transport research results. TRKC provides comprehensive coverage of transport research in EU programmes as well as key research activities at national level within the European Research Area and selected global programmes.

The paper is one of the thematic research summaries (TRS). The TRSs aim at providing a synthesis of research results and policy implications from completed projects. Each TRS deals with a theme according to the classification which the TRKC project has adopted. The theme of this TRS is “User Aspects”.

The first part of the paper includes a brief analysis of the scope of the theme, and a policy review where the main policy developments at EU level are summarised. The paper then summarises results of 32 projects, spread across 5 sub-themes:

- The **scope of the User Aspects theme is transversal** and as such very wide ranging, covering all transport modes and overlapping with numerous other themes. The term "user" is split in 2 categories and reflects either a member of the general public for whom transport services are provided, or transport professionals. The theme includes mobility management aspects for passengers, accessibility issues, training schemes, as well as design-enhancing systems and the ways in which users interact with various transport systems, both on micro and macro levels.
- Set against the basic aim of completing the internal market, while promoting competition, **the EU has placed the user – either as citizen or transport professional – at the heart of its transport policy**. This leads to a set of specific policies dealing with congestion / pollution issues, mobility and accessibility promotion, safety enhancement, security enforcement, and the strengthening of a European transport sector.
- The first sub-theme summarises project results in the area of **decision support systems and the human-machine interface**, and split the results' analysis in 2 project clusters:
  - A cluster on decision support systems presents projects pertaining to air and waterborne modes. The projects are technical by nature and develop DSS prototypes. Furthermore, the projects also stress stakeholder involvement at the outset – including transport professionals' training – and insist on European-level impulse for the development of these systems.
  - The cluster on the human-machine interface analysed projects relating to the field of ADAS development, and incorporated end-user tests as part of their

methodology. They insisted on enhancing methodologies for relevant HMI building, as well as stressing the resolution of marketing / legal issues at the outset and on a European level.

- The second sub-theme studies the **effects of user behaviour** and its impacts on mobility trends, and **human-infrastructure interaction** in a broader perspective:
  - A first cluster of projects analyses the impacts of human behaviour on mobility, transport infrastructure, and the environment. The projects under review derived planning principles for inner cities and pointed at most relevant ADAS applications, in order to counter congestion.
  - A second cluster of projects assess the impacts of infrastructure on human behaviour. One major concern and guiding principle of these projects is to put forward a set of road infrastructure safety principles – in both urban and rural environments.
- The third sub-theme concerns **information management**. Projects in this sub-theme tackle both technical and institutional issues, for both categories of user. The projects provide customer and management information systems that are capable of providing comprehensive, up-to-date and reliable information on public transport services and the current traffic situation during all phases of a trip. Moreover, the projects stress the necessity of stakeholder and institutional cooperation at local, regional, sectoral and European levels.
- A fourth sub-theme deals with **user comfort and quality**. And draws on several inter-related policy issues on the European Commission's agenda.
  - A first cluster of projects produces a methodology for studying the environmental effects of different urban growth strategies, taking into account user comfort and quality.
  - A second cluster of projects, addressing users' specific needs, result in methodologies for the development of a user-friendly environment, and even prototypes, for persons with specific needs.
- A fifth sub-theme, concerns **user choice and incentives**, with the specific object of the factors that could influence user behaviour to switch to "greener" and/or public transport modes.
  - A first cluster of projects provides a set of specific criteria to enhance modal promotion and end-user modal switching. Moreover, novel approaches are tested, including a "marketing" approach to modal promotion.
  - A second cluster provides insights on users' behaviour and acceptance of incentive-based policies, and produces guidelines for implementing a coherent mix of coercive and informative measures, in order to achieve public acceptance, effectiveness, and political feasibility.
- In view of the projects reviewed in this TRS, **future research relating to User Aspects** would mainly concern:
  - sustainable urban mobility;
  - the further development of ADAS applications and their ergonomics;
  - multimodal freight handling;
  - the development of training / retaining skills for both categories of users.

Abbreviations and acronyms used

ACC	Adaptive Cruise Control
ADAS	Advanced Driver Assistance Systems
ATM	Air Traffic Management
AVG	Automated Vehicle Guidance
CEC	Commission of the European Communities
CFIT	Controlled Flight Into Terrain
DGPS	Differential Global Positioning System
DGTREN	Directorate General Transport and Energy
DPIS	Dynamic Passenger Information System
DRT	Demand Responsive Transport
DSS	Decision Support Systems
DVD	Digital Versatile Disk
ERA	European Research Area
ESoP	European Statement of Principles
ETCS	European Train Control System
ETP	European Transport Policy
EU	European Union
EXTR@Web	Exploitation of Transport Research via the Web (predecessor project to TRKC)
FP5 / 6 / 7	Fifth / Sixth / Seventh Framework Programme (EU R&D programmes)
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Global System for Mobile telecommunications
HGV	Heavy Goods Vehicle
HMI	Human-Machine Interface
ICT	Information and Communication Technologies

ISA	Intelligent Speed Adaptation
ISO	International Standards Organisation
IT	Information Technology
ITS	Intelligent Transport Systems
MPG	Miles Per Gallon
ODT	On-Demand Transport
PTA	Priority Thematic Area (sub-groupings in FP6)
R&D	Research and Development
SA	Situational Awareness
SDS	Sustainable Development Strategy
SRA	Strategic Research Agenda
TDM	Transport Demand Management
TEN	Trans-European transport Network
TM	Threat Management
TRKC	Transport Research Knowledge Centre
TRS	Thematic Research Summary
WP	Work Package

Table of Contents

1. Introduction

This paper provides a structured review of the research relating to User Aspects carried out in EU-funded research projects. “User Aspects” is one of thirty themes in the classification scheme adopted by the TRKC project, shown in the table below.

Table 1. The classification scheme adopted in TRKC

Dimension 1: sectors
• passenger transport • freight transport
Dimension 2: geographic
• urban transport • rural transport • regional transport • long-distance transport • EU accession issues
Dimension 3: modes
• air transport • rail transport • road transport (including walking and cycling) • waterborne transport • innovative modes • intermodal freight transport
Dimension 4: sustainability policy objectives
• economic aspects • efficiency • equity and accessibility • environmental aspects • **user aspects** • safety and security
Dimension 5: tools
• decision support tools • financing tools • information and awareness • infrastructure provision including Trans-European Networks (TENs) • integration and policy development • Intelligent Transport Systems (ITS) • regulation/deregulation • land-use planning • transport management • pricing and taxation • vehicle technology

The scheme has been adopted to enable search facilities in the TRKC portal, and to ensure comprehensive coverage of research results and appropriate policy analysis in the

Thematic Research Summaries (TRS). Definitions for each theme are found on the TRKC portal at http://www.transport-research.info/web/projects/transport_themes.cfm.

In the predecessor EXTR@Web project, TRSs were produced for 28 out of the thirty themes (resulting from merging of some themes into a single TRS). The TRKC project is producing first versions of TRS for a sub-set of themes for which a critical mass of results from projects is available by January 2009 (including this one on User Aspects). Final versions of TRSs for the full set of themes are planned for production in 2010.

A large number of research projects have dealt with the User Aspects theme and the nature of the TRKC's classification scheme is that all overlap with at least one other theme, and in many cases several themes. The “User Aspects” TRS produced in the predecessor project (EXTR@Web, 2006), reviewed research from 43 projects – European projects belonging to the Fourth and Fifth Framework Programmes for R&D (FP4 and FP5) and selected national projects. The present paper adds 27 previously unreported projects – European projects from FP5, FP6 and national projects.

The research reviewed in this paper does not represent the entire range of research dealing with User Aspects carried out in Europe. The paper focuses on research from those projects which have made documentation on results available to the TRKC team after the issue of the EXTR@Web paper in 2006. When relevant, a summary of the research on User Aspects topics reported on in the previous EXTR@Web paper is also included to make the reader aware of the full range of research which has dealt with the theme.

The paper is organised as follows. Sections 2 and 3 set the scene. Section 2 includes a brief analysis of the scope of the theme. Section 3 provides an overview of the policy priorities at EU level which underpin the research objectives. The sources for this section are principally European Commission documents which have set the policy agenda such as white papers, green papers, and communications.

Section 4 reports on the results from research. The section is structured into five sub-themes to make the broad area of research in the User Aspects field more manageable. For each sub-theme, overall research objectives are presented and linked to policy goals, then research findings are synthesised. A special focus is given to the policy implications of research results. Sources for Section 4 are documents available from the projects and reporting on their achievements, essentially the project final reports.

The sub-themes covered in section 4 are:

- Decision Support Systems & the Human Machine Interface;
- Effects of User Behaviour and Human-Infrastructure Interaction;
- Information Management;

- User Comfort & Quality;
- User Choice and Incentives.

The Annex includes the list of the research projects for each of the five sub-themes. Addresses of the websites of the projects are included with hyperlinks. In several cases these websites make the project documentation available to the public. This may include final reports and project deliverables.

2. Scope of the theme

The **User Aspects** of sustainable transport primarily concern the freedom and ease of mobility for any citizen, whatever their physical ability, income and social status. The users' **choice** and **rights** include the freedom of mobility, independent of where they live and work.

Transport services are judged by the **quality** with which they are made available to users, involving aspects such as safety and security, reliability, flexibility, comfort, accessibility, affordability, convenience and user-friendliness. The term quality is closely related to efficiency.

The use and operation of means of transport always involves human individuals. This is often an interactive process, and is strongly influenced by **human factors** such as professional training, adaptation to new technologies and behavioural responses. Human factors can refer to impacts on individuals who are directly concerned with the transport system, such as drivers and operators. Hence, the working conditions of employees and in particular the **ergonomics** of the working place are an important issue.

Therefore, the User Aspects theme is considered under two primary viewpoints: whether the user be a member of the public – pedestrian, passenger or driver – or a transport professional – driver/operator, transport system/vehicle designer. From the vantage of these two viewpoints, the User Aspects theme can encompass recent trends in the transport sector, most notably an increasing demand for transport services and a focus on new mobility needs in Europe.

For example, in the passenger sector, the increasing importance of non-systematic mobility and trip-chains is associated with a growing demand for flexibility and dependability of transport systems. In addition, the increase in business mobility is associated with preferences for high-speed and high-comfort modes in view of the high value this market segment attaches to time and reliability. Moreover, increasing emphasis is being given to the importance of mobility – and the adequate service satisfaction – for those who, because of age, disability, income or personal preference, do not use a car.

Concerning transport professionals, human factors and the working conditions within the transport system are of decisive importance for the efficiency and safety of transport in Europe. An efficient transport system is considered to be essential for economic development and therefore for the prosperity of Europe. Transport provides services for industries and individuals to facilitate the production and distribution of goods and services.

Moreover, transport itself represents a major economic activity and source of employment within Europe. These economic issues have positive benefits for quality of life, accessibility and social cohesion.

Moreover, further development of transport systems and transport policy now is guided by the long-term goal of sustainable development, where economic, environmental and social aspects are all taken into consideration – including human factors in its widest sense.

However, coming to terms with these trends and the issues involved is not entirely straightforward, as behavioural responses can be a limiting factor in the introduction of new policy approaches. Indeed, technological innovations depend on public and worker acceptance, while theoretically beneficial measures designed to elicit a behavioural response (such as road pricing) will not be politically feasible if consumers and industry show strong resistance. Further, specific attention has to be given to the different cultures and histories within Europe that could have an impact on different human behavioural responses, in which settings policy implementation can be highly contingent.

In this light, the User Aspects theme encompasses a wide variety of topics, such as:

- Accessibility, comfort, affordability and convenience;
- Safety and security of people and goods;
- Reliability, dependability;
- Service flexibility, which is the ability to adapt to a variety of needs or travel conditions;
- Human learning and performance;
- Working conditions and ergonomics;
- Technical and safety standards/regulations.

In addition to these topics, and to complete a possible taxonomy, User Aspects can be broken down by transport modes (road, rail, air, pipeline, maritime, inland waterway, ports, and intermodal chains), by transport types (passenger, freight) and by transport ranges (urban, regional, interregional, corridor, Trans-European). This begs the question, not answered by this present report, of a cross-fertilisation of research findings.

From the scope of the topics that could be considered for User Aspects, it is clear this theme overlaps many of the other themes studied by the Transport Research Knowledge Centre, and, if interested in a specific topic, we recommend that the reader browses related Thematic Research Summaries for further insights, such as *Passenger Transport*, *Safety & Security*, *Equity & Accessibility* or *Intelligent Transport Systems*.

Last, it may be worth mentioning that projects tend to integrate User Aspects at the outset, a common example being tests carried out on a sample of users – however defined – and these tests being part of a Work Package of the project: it is an encouraging sign that users are put at the heart of research projects, in line with the EU's policy objectives.

3. Policy context

3.1 Background: the 2001 Transport White Paper[1]

User Aspects have been an integral part of the European Transport Policy (ETP), ever since the European Commission's Transport White Paper of 1992 (CEC, 1992) and – even more emphatically – the Transport White Paper of 2001 (CEC, 2001), stressed users at the "heart of transport policy, whether they be members of the public or transport sector professionals".

This statement was supported with a range of goals for 2010, and a set of specific measures targeting:

- Road safety;
- Infrastructure costs and charging;
- Intermodality;
- User rights enforcement;
- Sustainable, rational and efficient urban transport.

The 2001 Transport White Paper's objectives therefore put the Union's transport policy at the heart of the Lisbon agenda, balancing long-term imperatives of economic growth, social welfare and environmental protection in all policy choices, whether concerning the end-user or the transport sector professional.

These characteristics, namely the long-term view and the two-dimensional aspect of the "user" are reinforced by the Commission's mid-term assessment of the Transport White paper (CEC, 2006a).

3.2 The 2006 Mid-term Report

The Commission's mid-term report on Transport policy stated the validity of the 2001 White Paper's emphasis on the user and its policy measures, albeit restating the overall policy objectives as "reinforcing sustainable mobility, protection and innovation", these three objectives being interrelated and aiming at a decoupling of the relationship between transport growth and the EU's GDP.

[1] For extensive comments on the 2001 Transport White Paper, see "Third Annual Thematic Research Summary – User Aspects", (EXTRA@Web, 2006a)

Therefore, acknowledging that the availability of affordable and high-quality transport solutions contributes vitally to achieving the free flow of people, goods and services, to improving social and economic cohesion, and to ensuring the competitiveness of European industry, the Commission's first policy objective is to "offer a high level of Mobility to people and businesses throughout the Union". In particular, great emphasis is put on urban mobility, 80% of EU citizens living and working in an urban environment. Furthermore, this objective is sustained by measures aiming to develop and bring to market innovative solutions that are energy efficient or use alternative energy sources.

- The Commission's Protection agenda concerns the user as an EU citizen, and the user as a transport professional. In this respect, the Commission's policies aim to:Address environmental issues potentially affecting the health of EU citizens – air pollution being a vivid example – by promoting a high level of protection and improvement of the quality of the environment, thus disconnecting mobility from its potential negative externalities. In this respect, rail transport promotion for both passengers and freight is in important aspect of ETP.
- Promote minimum labour standards for the sector by highlighting employment quality improvement and better qualifications for European transport workers. Furthermore, a set goal is to attract skilled labour to the transport sector to overcome chronic labour shortages (in the maritime sector for example).
- Ensure passenger protection, by issuing guidelines and enforcing passenger rights on all transport modes, modelled on the Charter for Air Passenger Rights – this aspect is crucial to mitigate any negative impacts on service quality from increased competition between operators. Charters have since been introduced for long-distance rail travel and proposals were adopted in 2008 for the extension of EU passenger rights to coach and maritime travel.
- Promote safety and, more recently, security, of citizens as users and providers of transport services, while at the same time protecting data and users' privacy.

Last, regarding innovation – supporting the aforementioned policy objectives, while being a policy in its own right – the Commission's objective is to uphold and promote constant innovation processes throughout the Union, seeking to constantly improve the efficiency and sustainability of the transport sector. In this respect, the Commission shall continue to support projects that are energy efficient or use alternative energy sources and shall continue to support mature, large intelligent transport projects and frameworks, such as GALILEO (http://ec.europa.eu/transport/galileo/programme_en.htm), SESAR[2], and CIVITAS (www.civitas-initiative.org).

[2] SESAR initiative - Research paves the way for the Single European Sky (2006), European Communities

3.3 Future policy trends for User Aspects

It is in this general policy framework that the Commission has published in 2009 a final review of the Common Transport Policy (CEC, 2009a), assessing the policy objectives set in the mid-term review of the White Paper and those set for transport by the Sustainable Development Strategy (SDS) of the Council of the EU (CEC, 2006b).

The Commission has launched a reflective process stressing the "need to focus future European transport policy on the pursuit of an integrated, technology-based and user-friendly transport system", while ensuring that "users and employees, with their needs and rights, are always kept at the centre of policy making" (CEC, 2009a).

The method used for this preparatory work is to assess major trends affecting the transport sector, identify likely scenarios, and to respond with a set of policy proposals.

The Commission put forward six causal factors likely to impact transport evolution scenarios, and thus appropriate policies: ageing, migration, environmental sustainability, fossil fuel scarcity, urbanisation, and globalisation (CEC, 2009b).

- These trends could at least call for the following policies, regarding user aspects: upgrading and expanding the infrastructure to create a single, integrated transport network exploiting the strengths of each mode, giving particular attention to the system's nodes and intermodal platforms;
- Introducing a better pricing system with incentives for users, planners and investors, while providing the resources for sustainable transport;
- Completing the internal market and promoting competition, without compromising safety, security standards, working conditions or customer rights;
- Promoting technological development and the switch to low-carbon transport, with a clear legal and regulatory framework, standards and funding for demonstration projects and R&D;
- Raising public and employee awareness/involvement in transport policy development;
- Avoiding uncoordinated action and conflicting approaches by coordinating the policies of different actors involved at various levels of government;
- Raising awareness of EU transport policy internationally to ensure further integration with neighbouring countries and extend Europe's economic and environmental interests.

It should be noted that this draft of future possible actions does not call for a revision of previous policies, but rather, sets them in an extended time-scale and geographical setting. However, bridging together the Commission's policy objectives has sometimes

been a somewhat tricky task: as an obvious, the advancement of Driver Assistance systems has often been met with reluctance on behalf of EU citizens.

At this stage, the Commission has not provided a detailed programme of policy measures, but rather, has tried to identify a strategic vision for the future of transport, aimed at identifying possible policy options.

Next year this work is expected to give rise to a formulation of concrete policy proposals and to the subsequent adoption of a White Paper.

4. Research findings

4.1 Introduction

The structure of the sub-themes in this report differs from the previous on, as research undertaken in this last period has been more active in some fields than in others.

Therefore, in this present TRS, some sub-themes pertaining to the previous one have been spilt and /or expanded:

- Some of the projects included in the previous sub-theme "'Driver/operator behaviour" have been merged with the previous sub-theme "Human Role and Human-machine interface", and are covered in the sub-theme 1: "Decision Support Systems & the Human Machine Interface".
- Other projects of the previous sub-theme "Driver/operator behaviour" have been included in the sub-theme on "Human-Infrastructure interaction".
- The previous sub-theme "User comfort, quality and choice of use" has been split into "User comfort and quality" and also "User choice and incentives".

Other sub-themes of the previous TRS have been discarded until future research results are made available: "Education / Qualification / and Training / Retaining skills" and "Operational procedures".

The research which is reviewed in this Thematic Research Summary (TRS) deals with 5 sub-themes.

The first sub-theme deals with **decision support systems and the human-machine interface**, with the aim of improving human actions and behaviour in their relation to machines. Readers interested in this sub-theme are also referred to the Thematic Research Summaries (TRS) on Intelligent Transport Systems (TRKC, 2009a), the TRS on Safety & Security (TRKC, 2009b) and the TRS on Decision Support Tools (to be published in 2010).

The second sub-theme studies the **effects of user behaviour and human-infrastructure interaction**,, the ultimate goal of these studies being the design of safer, greener, more accessible, environments and applications. Readers interested in this sub-theme are also referred to the Thematic Research Summaries on Equity & Accessibility (to be published in 2010) and on Transport Management (TRKC, 2009c).

The third sub-theme concerns **information management**, with respect to the design of transport systems' general architecture. Further information on information management can be found in the Intelligent Transport Systems TRS, the Safety & Security TRS and the Transport Management TRS.

The fourth sub-theme concerns **user comfort and quality**, a major concern for EU policy. Related topics are also discussed in the Intelligent Transport Systems TRS, the Passenger Transport TRS (to be published in 2010) and in the TRS devoted to rail (TRKC, 2009d), road (TRKC, 2009e), and air (to be published in 2010).

The fifth sub-theme concerns **user choice and incentives**, aimed at designing efficient modal-switching schemes. Interested readers may also refer to the TRS on Pricing & Taxation (to be published in 2010) and Transport Management.

The abovementioned documents are available on the TRKC website at:

http://www.transport-research.info/web/publications/

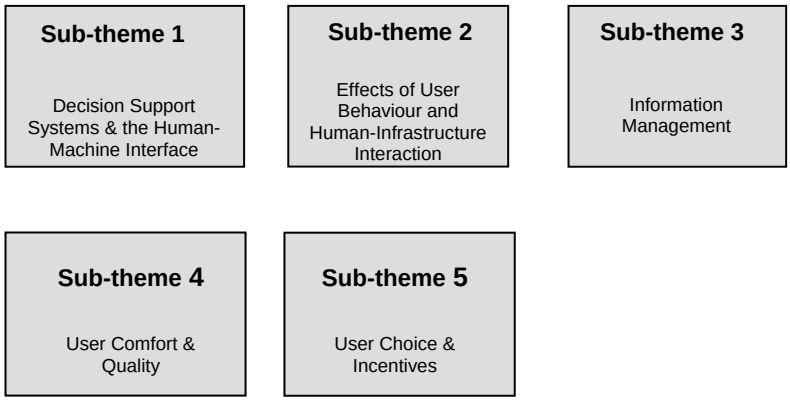

Table 2 shows the projects (both EU-funded and national projects) which have dealt with each sub-theme. The table includes completed projects which are synthesised in this TRS and for which the following sub-sections report on research objectives, research results, policy implications and implications for further research.

Table 2. Projects relevant to the theme

Sub-theme	Contributing projects
Decision Support Systems & the Human Machine Interface	EU projects covered in this paper: AIDE, SPADE, ADOPT, HUMANIST, APRON. Other projects covered in this paper: IVHW (DE, FR). Projects covered by EXTR@Web paper: ADVISORS, IMCAD, RESPONSE 2, VINTHEC II.

Sub-theme	Contributing projects
	Projects covered by EXTR@Web paper not mentioned in this report: TSE Outward Facing Research: Managing Integration (UK), ATOMOS I Other FP6 projects with results not yet available: SPADE-2
Effects of User Behaviour and Human-Infrastructure Interaction	EU projects covered in this paper: RANKERS, STARDUST, RIPCORD-ISEREST. Other projects covered in this paper: SVI_2001_515 (CH), S224J (UK), Towards a Walkable City (ES). Projects covered by EXTR@Web paper not mentioned in this report: IMMORTAL, INDRIS, VIRTUAL, The long term effects of hands free legislation on mobile phone use (FI) Other FP6 projects with results not yet available: HILAS
Information Management	EU projects covered in this paper: TRAINCOM. Other projects covered in this paper: FOKAT (SE), Integrated rural public transport – part one: Evaluation of "Byabussen" in Ystad (SE). Projects covered by EXTR@Web paper: NIM (A3) (CH), CESAR, CESAR II, MATKA.FI (FI), UG423i (UK) Projects covered by EXTR@Web paper not mentioned in this report: E1(NRP1) (CH), NAVIfuture (FI), SVI 200/442 (CH) Other FP6 projects with results not yet available: eMOTION, KITE
User Comfort & Quality	EU projects covered in this paper: BUGS Other projects covered in this paper: FRAMSYN (SE), Integrated Public Transport (SE). Projects covered by EXTR@Web paper not mentioned in this report: 212034: Extending CabinAir, FACT, GOING-SAFE, HITRANS, UG395 (UK), Air travel & venous thrombolism Other FP6 projects with results not yet available: ATPI, B-COOL, CREDO, E-CAB, FRIENDCOPTER, ICE, MESEMA, MOBILIS, SEAT
User Choice & Incentives	EU projects covered in this paper: MOSES Other projects covered in this paper: EMMA (SE), Public Transport in the Future (SE), SVI_2001_504 (CH), Breaking the habitual choice og the private car (DK) Projects covered by EXTR@Web paper not mentioned in this report:

Sub-theme	Contributing projects
	A2(NRP41), D5(NRP41), IVMC, NETMOBIL, UG207 (UK), UG293 (UK), An assessment of the effects and cost-effectiveness of a public transport journey planner (FI), Effects of cycle parking arrangements on bicycle use (FI), The promotion of walking and cycling on village roads (FI) Other FP6 projects with results not yet available: HOST, PROCEED,

4.2 Sub-theme 1: Decision Support Systems / Human-Machine Interface

4.2.1 Background

This first Sub-theme[3] deals primarily with the way humans interact with machines in order to conduct their activities in the most effective manner. It can therefore be seen from two complementary perspectives[4]:

- The machine as an intermediary between human conduct and a specific task or activity: one must therefore question – and eventually strive to enhance – the efficiency of such an intermediary. In this view, one is viewing the machine as a tool in its role as a Decision Support System.
- The quality of the interaction between Humans and a machine, where the focus is set on the human's behavioural response. In this sense, the quality of the Human-Machine Interface lies within its capacity to enhance "optimal" behavioural responses to given situations – in particular in risk-prone situations.

Using this first set of definitions, this sub-theme brings together the sub-themes in the previous EXTR@Web TRS on User Aspects (EXTR@Web, 2006) “Human Role and Human-machine interface" and “Driver/operator behaviour". Research reported in these sub-themes of the EXTR@Web paper covered a wide range of topics, including, as prominent examples, improving processes for cockpit applications' development, and enhancing situational awareness in a risk-prone environment, developing actions for the implementation and standardisation of Advanced Driver Assistance Systems (ADAS) and vehicle control systems, and considering certification and human error aspects for the implementation of new safety critical technologies.

The projects covered in this sub-theme develop on these previous projects. However,

[3] For further in-depth coverage, the reader may consult the TRS devoted to Decision Support Systems.
[4] Of course, the separation presented here is for analytical reasons only, as a Decision Support System often requires a Human-Machine Interface.

while all modes could be considered, there has been – regarding Decision Support Systems and Human-Machine Interface – great emphasis on airport design and ship building management on the one hand, and ADAS related to road transport on the other.

Indeed, one of the major challenges in the Strategic Research Agenda for European Aeronautics is that airport utilisation will be able to accommodate rising traffic without undue delays, while preserving safety, improving efficiency and service, and reducing the burden of operations on the environment.

In the same idea, due to the expansion of world-wide shipping, modern ship types are developing rapidly. Consequently, the experience gained by a crew on a certain ship does not necessarily apply to another vessel, even to vessels of the same ship type. Recent data proves that commercial losses and loss of life can potentially be reduced by introducing this kind of decision support system. Losses pertinent to the motion of ships in heavy seas recorded from April 2005 until March 2006 are 43 lives and an estimated € 100 million[5].

As for road transport safety, any accidents are due to the difficulty drivers have in anticipating a dangerous point on the road. Therefore inappropriate driver behaviour, poor visibility or temporary loss of visibility due to obstacles or bad weather conditions can generate pile-up accidents. These are statistically not very frequent but often very serious, and could be avoided if a warning message were delivered in time.

Today, a wide range of Advanced Driver Assistance Systems (ADAS) are being developed for enhancing the driver's perception of the hazards, and/or partly automating the driving task. These include speed alert, lane support/blind spot detection, automated safe following, pedestrian detection, vision enhancement and driver impairment monitoring. These systems have great potential for reducing accidents, in particular the great portion related to human error.

It is therefore important to closely monitor and assess the quality of these messages and, perhaps more importantly, drivers' reactions to warning messages, as the design of the human-machine interface of these systems and nomad devices is of key importance for minimising the workload and distraction that they impose on the driver. Methods and criteria are needed to validate these systems with respect to their potential negative safety effects.

[5] Source: www.janmaat.de from ADOPT project, covered in this report.

4.2.2 Research objectives

Building on previous research on airport design and management[6], the APRON project recognised the necessity of an airport observatory network allowing decision-makers and stakeholders, notably the European Commission, direct access to an airport performance information system to withdraw policy-sensitive information. In this context, APRON's objectives were to:

- Review, assess and collect existing data and information to satisfy user requirements.
- Work out all matters concerning the establishment of an airport observatory network.
- Produce a technical environment to maintain, access and provide the observatory data and information in a user friendly way.

Along the same lines, the SPADE project (Spade, 2006) recognised that airport stakeholders and policy makers face challenging airport decision-making problems with strong interdependencies and with often conflicting objectives. To support them, SPADE observed the absence of a user-friendly, fully integrated tool-set supporting strategic-level and tactical/ operational-level decision making related to airport (airside and landside) planning, development and operations, and allowing an integrated impact analysis in terms of capacity, delay, level of service, safety, security, environmental impact and cost-benefits. SPADE's objective was therefore to address a number of important decisions (or "use cases") regarding airport development, planning and operations via a pre-structured, pre-specified and guided "wizard-type" human-machine interface in a single run, and in a back-office routine.

With today's modern ship types, the captain and his crew can be faced with 'new' phenomena like parametric excitation and pure loss of stability. Situations have been reported where vessels have entered dangerous situations without any warning. Generally, guidance on how to identify such problems and resonance is not available or appropriate, mainly due to the highly non-linear roll motion and lack of development (i.e. the means to use the theoretical knowledge for practical application). Also, phenomena like slamming and excessive vertical accelerations at the bow are not simple to detect on large modern ships. In this context, the need was felt for a risk-based system that could assist the captain in deciding safe and efficient ship handling with respect to the motions of an intact ship in severe seas, based on the risks arising from:

- the identified hazards and their formulation of limit states;
- the actual sensed environmental situation;
- the ship's condition;
- the ship's behaviour;

[6] See, for example, FP5 EU project OPAL (Optimisation Platform for Airports, including Land-side)

- the expected sea state on all possible courses;
- the prediction of ship motions on all these courses caused by the prevailing conditions, etc.

The ADOPT project (ADOPT, 2006) therefore sought to build a toolbox for sensing the environment, predicting the vessel's response, and support for decision-making and selection of appropriate risk control options, in order to present relevant information on predicted sea-keeping behaviour and risk control options to the captain in real-time. This toolbox was to be provided with interfaces for operational use, use in design and approval, and use in training, along with a user display, able to communicate the relevant parameters and their real meaning to the crew, especially in extreme conditions.

Many research projects have dealt with ADAS applications' development in the past, and some projects have even reached the industrial development phase. However, these previous projects focused primarily on assessing the technical feasibility of the application. Interestingly, more recent projects have tackled user aspects of ADAS at the outset, taking into account user acceptance of the human-machine interface, accident statistics and even proceeding to examine marketing and liability issues. As an example of this methodological approach, the IVHW project (IVHW, 2004) sought to explore every facet of an ADAS application's introduction[7].

Specifically, regarding user aspects, IVHW's objectives were to:

- assess the efficiency of alert messages, by developing a model of driver's reaction;
- conduct a survey of safety issues using statistical analysis determining which accidents could be avoided;
- assess the IVHW system's impact on safety, by studying drivers facing a dangerous situation and assessing why and when a driver can send an alert message.

Emphasis on the HMI was also a key aspect of the AIDE (AIDE, 2008) project that sought to generate the knowledge and develop methodologies and human-machine interface technologies required for safe and efficient integration of ADAS and nomad devices into the driving environment. Specifically, AIDE's aim was to:

- maximise the efficiency, and hence the safety benefits, of advanced driver assistance systems;
- minimise the level of workload and distraction imposed by in-vehicle information systems and nomad devices;
- enable the potential benefits of new in-vehicle technologies and nomad devices in terms of mobility and comfort.

[7] See also the SafeMAP project (SafeMAPSocio-economic assessment of a dedicated digital map for road safety applications (2006), DEUFRAKO - German-French cooperation for land transport research) as an other example of this "holistic" approach.

However, all these research topics draw heavily on the research on Human Factors, calling for a more active participation of the Human Sciences in the various stages of systems' conception, and for a concept of technological development determinedly centered on Humans, in which the assistance is designed according to the needs and the capabilities of the human being and not driven by the technological offer. Observing that human factors' competencies exist in Europe, but are scattered through various countries and various research institutes or universities, the HUMANIST project (HUMANIST, 2008) sought to integrate research capacities in this field throughout Europe.

4.2.3 Research results

4.2.3.1 Decision Support Systems

The APRON project brought together and harmonised data not only from the individual airports participating so far in the observatory, but also data coming from other sources, e.g. Eurostat, Eurocontrol, ACI, etc. Using these input sources, APRON built an Observatory, a tool to retrieve the necessary de-central, dispersed data from the participants in order to produce requested analyses for the user.

SPADE started by building a list of 18 different use cases – in itself a primary result – by matching demand-side and supply-side analyses of tools for assisting airport-domain experts. The demand side analysis consisted of interviews with a selection of stakeholders, resulting in a prioritised list of potential use cases for the SPADE system.

The supply-side analysis prepared a list of state-of-the-art decision-support tools and a structured template for a systematic description of these tools. Each of the identified tools was described, addressing its capabilities, integration constraints and requirements, as well as its potential contribution to the SPADE system.

The 18 use cases were subdivided into:

- "strategic" use cases, providing decision-support for a medium or long-term time horizon through the use of macroscopic, low level-of-detail tools (airport capacity management, landside and airside infrastructure development, capacity bottlenecks and shortage identification,…);
- "operational" use cases, providing decision-support for a short- to medium-term time horizon through the use of microscopic, high level-of-detail tools (impact of fleet characteristics, allocation of flights, taxiing methodology, airport capacity determination, analysis of impact of new procedures,…).

This first result allowed for the specification of SPADE's system architecture, specification evaluation, and system design. An early prototype of the SPADE system was then

developed, in order to validate the concept, using real airport data. The prototype allowed for the design and implementation of tools, adapted to either the "strategic" or "operational" use case.

Extensive validation by airport stakeholders was carried out, from technical and end-user perspectives. Airport stakeholders expressed a positive attitude towards the SPADE system, and perceived it as user-friendly. Stakeholders acknowledged SPADE will solve complexity, a key problem that airport stakeholders have with current information and software support tools. Further, SPADE can helpfully support airport modelling decisions and identify potential sources of inefficiency in airport operations, improving operations as well as safety and security of air transport. However, a need was expressed to pay more attention to clarifying how it would fit within an organisation and on business models for its operation – a theme taken on by the ongoing SPADE-2 project.

The ADOPT project showed that a risk-based, ship specific Decision Support System (DSS) regarding the assessment of ship responses is by today's knowledge feasible. Specifically, ADOPT provided a process of DSS creation with 3 major process elements:

- design;
- training;
- operation.

The ADOPT DSS provides information and guidance through an evaluation of consequences and insight on the uncertainty related to the information.

Of particular interest for the user Aspects TRS is to focus on the "Training" element of the ADOPT project. The general approach is not only the familiarisation with the system itself, but also to give advice on the background of phenomena (like parametric rolling), as the purpose of the DSS only can be fully encompassed when the theoretical foundation is available. Using this approach, the training does not only familiarise the user with the system, but also contributes to an improved situational awareness of the risks in specific sea states.

The training concept consists of two modules with two sessions each, starting with general ship theory. Since the ADOPT-DSS is ship specific, the theory will afterwards be consolidated by exercises in a simulator, demonstrating the vulnerability of the specific ship in particular seas. In the next session, the crew itself is familiarised with handling the DSS. This again starts with the theoretical description how the DSS works, which are its limitations, which are its modules, and in which situations it can help. In the final module, the user is set in a simulator environment in order to gain experience in using the system and improve his behaviour in critical situations.

4.2.3.2 Human-Machine Interface

The IVHW project developed a common and interoperable concept of inter-vehicle hazard warning to reduce risks of accidents, to measure its effects and identify possible conditions of commercialisation. In so doing, IVHW went a step further, studying the human-machine interface and users' reactions, and conducting market studies and comparisons with the introduction of previously new technologies in the automotive sector (airbag). The project was therefore able to provide a complete set of recommendations for the IVHW system's commercial deployment.

The IVHW system provides an in-vehicle warning in the event of an accident or incident ahead: if a driver witnesses a dangerous situation, he/she can alert upcoming vehicles well before they reach the risk-prone zone.

Regarding user aspects, the first result was a statistical estimation of the types and categories of accidents that could be avoided as a result of implementing the IVHW system (or the pile-up effects which could be alleviated). This allowed for the identification of relevant accident categories – rear-end accidents, pile-ups after rear-end accidents and other complex accidents involving more than two vehicles, where the initial accident was not a rear-end accident.

The second result of the project was the development of standardised icons for in-vehicle display. These icons were tested on user groups in order to evaluate their reception and efficiency, as, clearly, the effectiveness of IVHW relies on the drivers' capacity to correctly activate the system in hazardous situations.

Furthermore, the project yielded several insights as to:

- users' basic reactions in hazardous situations and the conditions under which they send a warning message;
- their reactions to the system (e.g. when to trigger the alert);
- their attitudes towards such on-board applications in general and their willingness to pay.

Last, based on market-penetration and user acceptance scenarios, the project produced a cost-based estimate fatalities' reduction owing to IVHW's commercial introduction.

These results can be compared to those of the AIDE project that produced specific knowledge and methodologies as to human-machine interface technologies required for safe and efficient integration of ADAS and nomad devices into the driving environment. These developments were implemented into a simulation model in order to understand the behavioural effects of ADAS and related systems. Moreover, AIDE emphasised the temporal dimension of behavioural adaptation, in effect studying the learning component of

ADAS adoption by drivers.

It is however worthy to note that these projects focused mainly on the Human-Machine *Interface*, disregarding somewhat Human-Machine *Interactions*: the notions of usability and integration in drivers' activities are not part of these projects' focus. The project HUMANIST made a step towards overcoming this caveat by building a matrix of methods for the assessment of ADAS, and software for the analysis of traces of activity for cognitive modeling of the car driver. These results were complemented by a book on "Modelling driver behaviour in automotive environments: Critical issues in driver interactions with intelligent transport systems"

4.2.4 Policy implications

Overall, these projects each contributed to highlight the need for a European-level impulse prior to the introduction of the systems developed by the projects.

APRON and SPADE, for example, showed the need for harmonising and rationalising the data-gathering and the decision-making process at a European level, through addressing a standard set of questions or use cases related to airports – cases and problems that are common to European airports. These projects are complementary, in that SPADE contributed to improving the decision-making process' quality through integrated and systematic impact analyses, highlighting the prior requirement of intra-European data comparisons between airports, a feature precisely provided by APRON.

The AIDE and IVHW projects both developed answers to policy issues.

The AIDE project develops on the eSafety Support Working Group[8] that identified the potential safety benefits of driver information and assistance systems for the driver and has recommended that HMI issues be given urgent attention, and this was one of the main implications of the HUMANIST project.

Indeed, throughout its four years of activity HUMANIST promoted a new system of research governance through a transnational network. This enabled HUMANIST senior researchers, to set up the Expert Group for HMI under the eSafety initiative, effectively addressing HMI safety issues as the 'next steps' to the outcome of the EC ESoP[9] agenda.

The IVHW project's scenario-based simulations showed that, if ADAS applications are to

[8] The interested reader may download the brochure at : http://www.esafetysupport.org/en/news/news_archive_2008/esafety_working_group_brochure.htm

[9] In 2006 the European Commission (EC) upgraded the European Statement of Principles (ESoP) in acknowledgement of the importance of Human-Machine Interaction (HMI) safety for in-vehicle telematics.

be efficient, their market penetration rate must be high, as these systems usually involve a terminal unit that is only useful if a certain proportion of vehicles on the road are equipped. In effect, this observation called for a European-wide stimulus in favour of rapid market adoption, *due to the systemic nature of these applications*, and the integration of a time-factor. Practical ways of overcoming this start-up problem could be to provide incentives to:

- the end user (e.g. through tax reduction rather than direct subsidy);
- car manufacturers to fit IVHW systems into their vehicles;
- road and motorway operators to deploy roadside warning beacons interoperable with the IVHW in-car equipment.

However, both projects bring to light potential conflicts between the efficiency of driver assistance systems (e.g. in terms of safety rules enforcement) and user acceptance: what policy measures could be devised to resolve this potential conflict?

As for the ADOPT project, it typically contributed to building a commercial advantage for shipping companies, more safety of crew and cargo, pollution prevention, and training of crews, thus aiding a European transport sector and attractiveness, which is one of the European Commission's stated policy objectives.

4.3 Sub-theme 2: Effects of User Behaviour and Human-Infrastructure Interaction

4.3.1 Background

Numerous projects focus on the effect of users' behaviour on their environment and, generally speaking, seek to understand the effects of the interactions between humans and the infrastructure. The ultimate object of such studies is to develop sound infrastructure guidelines, be they for city mobility or road infrastructure.

Abundant empirical evidence suggests that many accident types tend to happen due to a road infrastructure element: for example, it is a well-known phenomenon that certain roads induce driver drowsiness or, worse, mislead the user into inappropriate driving choices (RANKERS, 2008).

Moreover, European cities have realised the importance of implementing efficient strategies in order to improve mobility, whilst reducing social inequity, increasing the participation of citizens in decision-making process, and finally contributing to improve the economic competitiveness. However, to be effective, these objectives of a sustainable

urban mobility, have to take into account behavioural trends (STARDUST, 2004; *Towards a walkable city*, 2008).

A typical example of these trends is the way forms of work are currently changing in response to globalisation and flexibility trends. Working hours have become more flexible, work locations are changed more frequently, the proportion of part-time employees is increasing and new technologies have led to the development of new forms of work such as telecommuting, video conferences and remote maintenance. These behavioural trends and their traffic impacts have been analysed in various studies, allowing for an assessment of their affects and general planning directives (SVI 2001/515, 2005).

Last, knowledge of how urban planning and design influence pedestrian mobility is crucial to drawing up and improving guidelines for planning and architectural work (S224J, 2004).

4.3.2 Research objectives

For analytical reasons, we identify 2 clusters of projects, those dealing with the impacts of human behaviour on transport and infrastructure, and those treating the impacts of infrastructure on human behaviour.

Focusing on the consequences of human behaviour on the environment, transport management and infrastructure design, 2 projects are considered here. STARDUST's aim was to assess the extent to which ADAS (Advanced Driver Assistance Systems) and AVG (Automated Vehicle Guidance) systems can contribute to a sustainable urban development not only in terms of direct impacts on traffic conditions and environment, but also in terms of impacts on social life, economic viability, safety, etc.

The *SVI_2001_515* project provided an overview of new forms of work and showed the present state of research regarding their impacts on transport. It also provided a basis for deriving the necessary adaptation of the planning principles relating to private transport, public transport and pedestrian/bicycle traffic. The preliminary study derived from the project was carried out in order to determine if a primary research phase was feasible and which direction it should take.

Focusing now on the way human behaviour can be derived from infrastructure, the RANKERS project's was to develop scientifically researched guidelines on road infrastructure safety enabling optimal decision-making by road authorities in their efforts to promote safer roads and eradicate dangerous road sections. RANKERS aimed at gaining new knowledge in meeting the needs of road operators by offering a set of practical recommendations to avoid the constitution of accident cluster zones through preventive identification mechanisms and remedial measures, ranked according to cost-effectiveness criteria.

In a similar vein, the RIPCORD-ISEREST project (RIPCORD ISEREST, 2008) aimed to develop best practice guidelines, based upon the current research results, on road safety impact assessment tools and accident prediction models, road and environment design, and road safety audit and inspection. Further, filling a research gap on road safety, RIPCORD-ISEREST sought to develop a Safety Handbook for Secondary Roads.

As for urban mobility issues, the *Walkable City* Project had two main goals (Towards a walkable city, 2008):

- to investigate how urban characteristics affect pedestrian mobility;
- to prepare a set of guidelines for a more pedestrian oriented urban design.

These goals can be compared to the objectives set by the *S224J* project which were (S224J, 2004):

- to compare the road behaviour of children who have grown up in traffic calmed areas with those who have grown up in untreated areas;
- to assess whether the adaptations and cognitive rules developed in traffic calmed environments are sufficient to protect children in more dangerous environments;
- to try and relate any differences in child behaviour to the differences in road design and the differences in the behaviour of other road users in these areas.

4.3.3 Research results

4.3.3.1 Impacts of human behaviour

STARDUST carried out a global and quantified evaluation concerning the deployment of selected ADAS/AVG systems. The selection of the systems evaluated is made on the basis of a review of ADAS and AVG options to 2010. The project assessed the impacts of the systems at a city-level, in three case study cities, using an evaluation framework specifically set up, which included efficiency, safety, energy consumption, pollutants emission and legal aspects. The systems analysed were:

- *Intelligent Speed Adaptation (ISA)* -ISA was fund to be more effective in non congested traffic conditions when drivers are able to exceed a speed limit, thus the effects of ISA are sensitive to traffic demands;
- *Stop&Go on urban roads* -when 80% of vehicles operate the system, the network queuing times were reduced by up to 19%- 25%, and a reduction of journey times of 7.5%-15% (it is assumed that the system characteristics and traffic benefits lead to general use);
- *ACC+Stop&Go on urban arterial and motorways* - the combination of ACC+Stop&Go can have positive impacts on traffic efficiency in terms of reduced network journey times which depend on the headways chosen by drivers and how extensive the system is used;

- *Lane Keeping* - a Lane Keeping based bus service has the potential to reduce the private car use when urban roads become heavily congested or become restricted (e.g congestion charges), but to make it effective, large modal shifts are needed from private car to public transport;
- *Cybercars in city centre area* - the simulation has shown Cybercars have positive impacts on traffic at a network level in terms of reduced total trips and increased speeds.

The SVI_2001_515 project showed that the influence of new forms of work on transport is substantial, not so much because of the total traffic volumes but rather in view of their spatiotemporal distribution. In particular, the study revealed that (SVI_2001_515, 2005):

- The new forms of work based on socio-economic changes (part-time work, flexible work and opening hours) have a significantly greater impact on passenger transport than those based on the new technologies (e.g. telecommuting). However, the latter still need to be kept in mind over longer time periods as significant variables with a view to their future growth potential.
- Taken together, these new forms of work have less influence on the total transport demand than their spatiotemporal allocation. They mainly extend the morning and evening peak hours. However, they are more likely to extend the capacity limits rather than alleviate them in any absolute sense (taking into consideration a further general increase in transport volume). In general, there is more pressure on late-evening and (secondary) weekend traffic.
- Spatially, the new forms of work primarily affect densely populated areas. As a result of overlay effects – especially between flexible working and opening hours – the spatial impacts are greater on specific densely populated areas in urban centres and agglomerations than across the entire region. Over the long term, many of the new forms of work will actually be able to support these spatiotemporal changes thanks to the acceptance by commuters of longer distances between home and work locations.
- A factor common to all new forms of work is increased flexibility. Individual transport offers greater advantages than public transport in this respect. With regard to choice of transport mode or future services, therefore, public and combined transport faces a major challenge in preventing the loss of market share to individual transport.

From these conclusions, the project derived several "Planning principles" in public and road transport and their potential need for adaptation, in particular for public transport. Indeed, because public transport loses out to individual transport as forms of work become more flexible, its managers must pay especially close attention to developments in this area: the more flexible the working hours the greater the demand for optimised transfers between public transport and individual motorised transport, between public transport and pedestrians/cyclists and within the public transport system (rail-bus).

4.3.3.2 Impacts of infrastructure on human behaviour

The RANKERS project's main result was a contribution to the emergence of a European culture of safe road engineering. In this framework, the tangible outputs were threefold (RANKERS, 2008):

- a "road safety index" used for assessing and monitoring road safety;
- a catalogue of road infrastructure safety recommendations ranked according to their efficiency;
- an interactive application of the catalogue ("the eBook"), extended to urban vulnerable road users, available through the Internet.

These outputs were due to several key results. First, the project adopted an integrated approach, addressing human (driver) behaviour, vehicle response and infrastructure with an emphasis on infrastructure, and its interactions with humans and vehicles.

This allowed to address both active (i.e. accident preventing) and passive (i.e. mitigating the effects of accidents) safety measures. As a final consequence of these activities, the project developed a performance-based ranking of safety recommendations, helping to prioritise the different solutions and optimise allocation of funds.

Furthermore, RANKERS detailed experimental protocols to be conducted in field tests, based on an extensive review of the literature on accident statistics, infrastructure characterisations, human behaviour, and cost-benefit analysis. The tests clearly indicated that road infrastructure factors provided improvement opportunities to reduce accident risk. RANKERS therefore developed a measurable parameter in road infrastructure that can be used for assessing and monitoring the safety of a road segment (site inspection).

RIPCORD-ISEREST gave scientific support to the European transport policy road-safety target of 2010 by establishing two fundamental achievements:

- Best practice tools and guidelines for road infrastructure safety measures concerning accident prediction models, road-safety inspections, and black-spot management.
- Tools for cost-efficiency assessment of different safety measures in order to develop and manage a safe road infrastructure in a cost-effective way.

The project reached these 2 results in a harmonised way, building a "common practice" approach for accident prediction models, road-safety audits, road safety inspections and black-spot management. Considering half of all road traffic fatalities and injuries in rural areas in Europe occur on secondary roads, the project developed specific software tools and a handbook for local road authorities.

The *Walkable City* project identified 7 main variables to be considered in the urban environment prior to a pedestrian-oriented urban policy (Towards a walkable city, 2008):

- density - relation between urban trace, usually number of buildings and surface;
- mixture of land-uses - proportion between different land-uses in a specific area (the relationship between the residential use and other land-uses was studied);
- distribution of the land-uses and services - distribution of the services, equipments and other trip generators in a zone, and distance from them to the buildings;
- urban morphology - indexes with the type of intersections, length of the section, size of the block, connectivity, local centrality, etc.;
- urban landscape - relation between the building and street, spatial definition of the street or road, urban landscape ("avenue corridor", “garden street”, etc);
- configuration and uses of the ground floor of the building - uses (commerce, building, private garden, public garden, inter-block space, etc.), accesses, visibility;
- Street geometry - dimensions in a longitudinal and transversal section, street type (kerb, coexistence of vehicles/pedestrians, etc.).

However, in order to be effective, these variables need to be refined with an approach in terms of social and personal necessities, and the need to consider the social group in relation to the activity developed and the location in the metropolitan area.

The *S224J* project yielded somewhat mixed results, after conducting 2 series of tests, the first in a compulsory low traffic zone ("calmed area"), the second in a random zone ("control area") (S224J, 2004).

Pupils from the calmed area generally scored very slightly higher on the safety score than those from the control area, although the difference rarely reached statistical significance. Moreover, there were no differences between scores of pupils from different school years or of different rated abilities. The interviews with parent/guardians suggested that the children from the calmed and control areas were reasonably well matched on factors other than the traffic calming in their street. Overall the results of the interview survey suggest little difference in the exposure of children on local roads in calmed and control areas.

The study concluded that little difference in the road safety skills of those living in a trafficcalmed area compared to those living in an un-treated area could be observed. It is likely that individual differences in pupils' road safety skills due to, for example, the attitudes of parents towards safety, and differences between schools are greater than those resulting from living in a calmed or un-calmed environment.

4.3.4 Policy implications

As many European cities are facing the problems of increasing congestion and pollution, restricting private car trips to city centre areas has been recognised as a fundamental measure to control traffic demands (e.g. congestion charge in London and Stockholm). It is expected that the idea of “A car free city centre” would be accepted by more and more

cities to protect urban environment. Under this condition, ADAS/AVG technology could be one of the solutions, for example by using High Capacity Bus (based on ADAS technologies such as Lane Keeping or Platoon) and Cybercars.

These projectd showed that certain negative effects can be avoided through coordination between stakeholders (for example operators or manufacturers) and government, based on mutual compromise. To reach efficient understanding and develop effective policies and strategies, these projects advocate cooperation between local/regional/national/European authorities – and all relevant stakeholders in general.

In particular, the RIPCORD-ISEREST project addressed important policy issues, stressing regulatory actions necessary for Safety Impact Assessment. From a local policy point of view, the project's tools allow road-safety results to be compared with road safety goals made by regional or national policymakers, thus allowing for a "fine-tuning" of road-safety infrastructure design and European-wide comparisons.

Last, underlying these projects is the fundamental proposal for modifying existing guidelines in order to improve and harmonise future EU standards. This is idea is strongly relevant to introducing new criteria for road signs and infrastructure.

4.4 Sub-theme 3: Information management

4.4.1 Background

The previous EXTR@Web TRS on user aspects dealt with a wide variety of issues related to information management from a user's point of view, focusing on deploying a seamless travel environment. However, these projects were very technically oriented:

- enhanced electronic data exchange for seamless multi-modal freight transport efficiency (CESAR, 1999 ; CESAR II, 2002 ; A3 (NRP 41) - New, Integrated Mobility Services – NIM, 2001);
- building real time passenger information systems (UG423I – Bus Real-time Information - Business Case Research, 2003 ; MATKA.FI - Journey.fi Public Transport Portal, 2005).

Technical research is still necessary, especially regarding seamless integration of transmission and communication infrastructures and protocols. This issue was tackled by the TRAINCOM (TRAINCOM, 2003) project, which aimed to define a standard communication infrastructure, in order to seamless interconnect train equipment and ground facilities, so as to support a wide range of applications – for operators, drivers and the public.

However, recent projects also focused on the institutional and organisational factors influencing the development of a seamless travel environment, recognising these issues as equally important and therefore bridging information management with transport integration and coordination[10]. Furthermore, several projects related these issues to sparsely populated and rural areas.

As an example, the Swedish FOKAT project, in addressing the need for more flexible and personalised public transport services – especially for elderly persons – recognised that coordination requirements will have to become more stringent in order to co-ordinate minimum transport services in sparsely populated areas and to integrate demand responsive services with regular public transport systems (rail, tram, bus) (FOKAT, 2006).

4.4.2 Research objectives

Projects in this cluster share a common underlying goal: to implement a customer information system that is capable of providing comprehensive, up-to-date and reliable information on public transport services and the current traffic situation during all phases of a trip. The implementation of such a system needs to address technical, organisational and economic feasibility. Developments have been gradual over the years, and in effect have started with basic trip related information, extending the system into a whole communication network.

TRAINCOM's objectives were to open and integrate the railway equipment market for transmissions, in order to favour the interoperability at train, vehicle and equipment level. This was meant to address needs for users in the "public" sense, and also railway professionals.

For the public, TRAINCOM's deployment would:

- improve services for citizens;
- allow new value added services;
- improve passenger comfort.

For railway professionals:

- make railways more competitive (increase of market share);
- enhance attractiveness of public transport;
- prepare the next generation of railway vehicles;
- allow train fleet management based on remote diagnostics and maintenance.

The Swedish FOKAT project, in addressing the need for more flexible and personalised public transport services – especially for elderly persons – recognised that coordination

[10] This implies research has been taken further than the sole deployment of Journey Planning Information Systems – already in the commercial phase in several European cities.

requirements will have to become more stringent in order to co-ordinate minimum transport services in sparsely populated areas and to integrate demand responsive services with regular public transport systems (rail, tram, bus). The project was established to study the preconditions and requirements for IT support systems for demand responsive transport (DRT). It considered a new generation of appropriate systems to increase efficiency of DRT for users with special needs in a national perspective. The possibility to simultaneously offer differentiated and integrated public transport services (door-to-door) also to other groups such as the general public was also considered. To achieve its aim, the project focused on describing conceivable modules for IT-systems that would be able to complete the necessary management and operational processes, in order to provide an integrated transport concept with broad user appeal.

The *Byabussen* experiment in the Swedish town of Ystad (Byabussen, 2006) set out to implement and operate a new form of local public transport (*Byabussen* meaning "The Village Bus"). This project explicitly encompassed the transport integration and information exchange issues, seeing it as a solution to achieve increased efficiency and usage of passenger transport in rural areas. At the outset, the project adopted a "holist" vision by seeking to encompass all forms of existing transport services and underlying information flows. Involving all relevant stakeholders – planners and operators in the transport and planning sector, organisations within development or rural transport and other national, regional and local decision-makers – the project aimed to enhance planning and operational experience and knowledge. Further, service usage and the economics of the project were also studied for future reference.

4.4.3 Research results

TRAINCOM's results regarding user aspects can be split into 3 categories:

- train-ground communication infrastructure - TRAINCOM designed and deployed a communication infrastructure allowing for both a Dynamic Passenger Information System and Remote Diagnostics and Maintenance;
- on-board dynamic passenger information system (DPIS) - The DPIS application may be regarded as a first implementation of an European interoperable system for the exchange and cross-usage of dynamic PIS data through different communication relations (such as ground-to-ground, train-to-ground, train-to-train, etc.);
- remote monitoring and maintenance - TRAINCOL achieved architecture specification and the building of a laboratory prototype, leading to a possible European-wide maintenance organisation.

The FOKAT study shows that demand responsive transport could gain in efficiency by being more uniform, stating on obvious need for standardisation. In effect, integration between general public transport and DRT puts stronger demands on a functional interplay

within the local IT-systems. The study also showed that an important prerequisite to the functioning of DRT services is that they should be fully integrated with line-haul scheduled transport, and that both these forms of transport should be planned and executed together.

However, FOKAT also demonstrated that effective planning tools are currently lacking for simulating new traffic concepts and strategies for the execution of DRT – a caveat that could be overcome with GIS-based tools to plan and evaluate different transport solutions.

The results of the Byabussen experiment were somewhat mixed. Praised by its users, the service suffered of a lack of co-ordinated integration due to the low level of investments made in new vehicles in order to adapt them to meet the needs of disabled people, undermining the very concept of "integration".

4.4.4 Policy implications

These projects all entail policy implications for user aspects, regarding information management. First, TRAINCOM represents a first step toward a trans-European fleet maintenance infrastructure, able to support rail vehicles even when they are running outside the State where they are registered, allowing mutual recognition of maintenance and repairs and so contributing to the objectives of the proposed directive on interoperability of the conventional railway system and of the directive on interoperability of high speed trains.

One of the most interesting policy implications of the FOKAT project is that it concluded that DRT services should be in the purview of the public transport authority, seen as DRT services are connected to scheduled transport and must be planned accordingly. Alternatively, the possibility for combining trips would be made more difficult as a result of vague areas of responsibility[11].

The *Byabussen* project also focused on governance issues, advocating the creation of an organisation that enables integration through multi-level agreements (municipality, regions, etc.).

[11] We remind the reader that FOKAT is a national project conducted in Sweden. That this conclusion be extrapolated to other areas of the Union is of course, a matter to be studied further.

4.5 Sub-theme 4: User comfort and quality

4.5.1 Background

This sub-theme deals explicitly with several of the targets put forward by the European Commission since the 2001 White Paper for Transport[12], and covers projects relating to:

- the promotion of the freedom of mobility (or accessibility) for any citizen, whatever their physical ability, income or social status;
- users' freedom to choose any type of transport service independent of where they live and work;
- improvement of quality aspects such as safety and security, reliability, flexibility, comfort, affordability and convenience.

The many research projects spawned by these policy objectives, deal with user comfort and quality in a mostly technical and/or institutional manner and their framework takes its roots either from the environment surrounding the user, or from the goal of addressing specific user needs.

The BUGS project (Bugs, 2005), for example, addresses the inter-related issues of urban sprawl, traffic congestion, noise, and air pollution as major socio-economic problems faced by most European cities. The originality of this project is its commitment in seeking active involvement of users (i.e. EU citizens) at the outset.

Addressing specific users' needs, the Integrated Public Transport project's rationale (Integrated Public Transport, 2003) was to develop attractive transport in the context of an ageing population in the EU, and more generally people with specific mobility needs. The project's specific background was to study the integration of well-functioning flexible traffic needs with low floor buses and other possible new solutions concerning public transport.

On a more micro-oriented scale, FRAMSYN (, 2005) addressed the specific needs of the visually impaired. Indeed, for this population, one major barrier to an accessible public transport system is the fact that a majority of the information regarding public transport is visual. The visually impaired are therefore by default less mobile and often avoid travelling with public transport by themselves[13].

[12] See Section 3 of this present document "User Aspects' Policy Context".
[13] It may be worthy to note FRAMSYN is a national project spurred by an act of the Swedish parliament stipulating that public transport should be available to disabled people by 2010.

4.5.2 Research objectives

We identify 2 clusters of projects in for this sub-theme:

- projects addressing user comfort and quality, and the environment;
- projects addressing users' specific needs.

The aim of the BUGS project was to construct a set of guidelines regarding the use of green space as a design tool for urban planning, at scales ranging from a street canyon or a park to an entire urban region. The project's specific methodology was to address the impact of green areas on various environmental fields, such as traffic flows and emissions, air quality, microclimate, noise, accessibility, economic efficiency, and social well-being, by bringing together at the outset a multi-disciplinary, complementary, and task-oriented team. BUGS therefore sought to consider social and economic sustainability issues as well as environmental aspects of land use – thus developing a comprehensive view on environmental facets of urban planning.

The aim of the *Integrated Public Transport* project was to propose and demonstrate practical solutions for how a 'whole-journey-concept' could be realised. The key target user group was passengers experiencing difficulties with their journey to and from bus stops in the ordinary public transport system, but who are able to make the actual trip on their own by available low-floor vehicles. The rationale for the project was to establish a connection between conventional public transport and on-demand transport (ODT). The underlying problem concerns the journey home, when the passenger needs to commute between the public transport system and the ODT network. The project therefore sought ways through which each passenger would be able to book the entire journey from the actual starting point, knowing there will be an ODT vehicle waiting at a suitable changing place.

The FRAMSYN project was based on a previous development by one of the project's consortium members to develop a guidance system using spatial information and real-time public transport information to enlarge the possibilities for the visually impaired to travel alone[14]. Building on these previous developments, FRAMSYN's objectives were to design, construct and evaluate a prototype consisting of standard components, which include a small wearable computer, GPS, DGPS, digital compass, GIS and program for speech recognition and speech synthesis.

4.5.3 Research results

4.5.3.1 User comfort and quality, and the environment

BUGS provided insight in the environmental effects of different urban growth strategies, including the effects of green areas. It was based on advanced technologies, including

[14] The project consortium's member, TFK, started this long-term project in 2001.

GIS, remote sensing, and computer modelling of environmental processes. Its flexible character, together with the expertise generated during the BUGS project, has turned it into a unique instrument, a virtual laboratory of the urban environment. As a result, almost any situation can be dealt with using the BUGS methodology, including long-term scenario studies.

4.5.3.2 Users' specific needs

The results of the Integrated Public Transport study show that in order to increase the possibilities for a person to use the regular public transport system, significant improvements have to be made, moreover at several levels.

In-vehicle improvements:

- low floor in 95% of all buses and trams on the main lines;
- special reserved seats in the front of the vehicle, near the driver;
- a fare ticket system that makes it possible to quickly reach the seat without too much distress.

Drivers training:

- special education for all drivers in order to make the key groups feel safe during the whole trip, but also to make sure that the reserved seats are used by those in need.

Interchange locations:

- strategically chosen changing points have to be found all over the city;
- the distance between the two vehicles should not be more than 25 ÷ 30 m;
- there is a need for some sort of restroom with access for this group, only were it is possible to easily reach the booking terminal by phone.

The evaluation of the demonstrations for the FRAMSYN project showed that users encouraged the development of such a system. Further, the prototype's assessment showed that the response to the information given by the system were largely dependent on users' sight ability. Blind persons were able to follow the instructions better than the partially sighted persons who experienced a conflict between their own perceptions and the instructions given by the system. This especially applied in open surroundings without contrasts or guidance paths. The assessment also showed that a majority of the test persons felt safer with the system than when they usually do while moving in unknown environments.

Last, FRAMSYN concluded that information given by the system must be limited, in order to avoid distracting the user and overloading the system.

4.5.4 Policy implications

The BUGS project dealt with a key component of the EU's thematic strategy on the urban environment[15], specifically the sustainable urban design priority – referring to the pattern and type of land use within an urban area. The way land is used is explicitly recognised as fundamental for the environmental performance of cities, and green space is recognised for its strong influence on the quality of life of urban citizens.

The core question addressed in the BUGS project was to what extent green areas and settlement patterns affect urban environmental quality. While performing the research, European policy with respect to land use, noise, and air quality was a permanent touchstone against which the spatial planning scenarios and the environmental simulation results were compared. In this respect, the BUGS has demonstrated to be a useful tool to assess the effects of urban growth strategies, particularly concerning the issue of urban sprawl.

The FRAMSYN project provided interesting insights as to public policy regarding the development of devices targeted to specific populations. It demonstrated that in many cases, technology should not replace existing means of assistance. In the case of a guidance system prototype, FRAMSYN asserts such a system should be regarded as supplementary to other navigational aids, such as white canes and guide dogs. However, the visually impaired taking part in the project saw a wide range of possibilities, using the system in their daily life, and believed such systems would provide them with greater freedom and should be encouraged.

4.6 Sub-theme 5: User choice and incentives

4.6.1 Background

Stressing the use of greener transport and the modal switch towards public transport – as opposed to the private car – is increasing throughout the EU, and this focus has logically translated in research projects. The underlying rationale is that technical advances towards sustainable transport have been achieved, and emphasis must now be put on changing users' choices and habits. Most of the projects related to this sub-theme therefore propose "soft" solutions, focusing on the promotion of alternative modes on the one hand, and, on the other hand, studying users' acceptance and feedback.

[15] See CEC (2004) "Towards a thematic strategy on the urban environment." COM (2004) 60, Brussels.

As an example, the MOSES (MOSES, 2004) project's underlying observation was that growing car numbers pose a serious threat to the ecological and social quality of our urban environment, and studied car-sharing schemes as a viable alternative to the private car, thus reducing the number of cars on European roads. Focusing on public transport, the *Public Transport in the Future* (2004) project studied how to increase travelling by public transport and the costs incurred, in order to help the public transport authority and other participants to make strategies and concrete measures to achieve an increased amount of travel by public transport. Last, a project carried out in Switzerland, (SVI 2001/504, 2006), observed that, even if the infrastructure necessary for cycling and walking is available, policies have usually failed to promote these modes.

However, projects have also focused on user acceptance and attitudes, recognising the importance of habits in the choice of modes of transport. The *Breaking the Habitual Choice of the Private Car* (*Breaking the Habitual Choice of the Private Car* , 2006) project's premise was that a habitual modal choice is independent of the actor's attitude towards transport modes, and therefore explored how such habits can be broken. Incorporating the time parameter into these lines of questioning, the EMMA project (EMMA, 2005) studied travel choice as an adaptation to changes where users select different available options over time, depending on particular and contingent activities.

4.6.2 Research objectives

This sub-theme regroups projects in 2 separate clusters:

- modal promotion;
- user acceptance of incentives' measures.

MOSES aimed at developing further and extending the concept of car-sharing to all Europe, including the EU candidate countries. A special emphasis was put on the integration of car-sharing into urban planning and development. More specifically, MOSES sought to define a set of technical and non technical (e.g. financial, regulatory) incentives to foster the diffusion of car-sharing. Such incentives pertained to the geographical, socio-economic and cultural conditions encountered in the different regions of Europe, taking into account an assessment of the needs of existing and potential car-sharing users and the impact of car-sharing on the quality of life in the urban environment. The project's guiding principle was to demonstrate that correct integration of car-sharing schemes into urban development and intermodal chains doesn't restrict individual mobility.

The *Public Transport in the Future* project's aim was to study the necessary conditions that could lead to more attractive public transport, in terms of accessibility and safety. This overall aim was to be achieved by assessing the relative importance of various criteria (e.g. safety, price, comfort, etc.), as judged by the end user.

The *SVI 2001/504*project aimed at presenting ways on how to promote "slow" traffic by marketing means, organised in a top-down approach – i.e. organised by the public authority involved. The project's main goals were to:

- develop a novel approach to induce modal shifts towards sow traffic;
- elaborate a manual or internet platform presenting a package of measures for target stakeholders;
- present the marketing-based approach and the mechanisms involved.

The EMMA project's basis was to investigate behavioural response to travel demand management (TDM) policy measures, as they have direct relevance on how to manage urban transport in the future. In particular, EMMA's aim was to provide a set of innovative solutions consisting of combinations of policy measures capable of effectively managing demand use of private cars in metropolitan areas. These measures were to stem directly from an analysis of user needs and an assessment of demonstrators on a wide selection of urban test sites (Bremen, Bucharest, Genoa, the London Boroughs of Southwark and Sutton, Palermo, Turin, Stockholm, the Walloon Region of Belgium).

The *Breaking the Habitual Choice of the Private Car* project's objectives were to develop intervention tools, effective in breaking car-driving habits, based on firm theoretical foundations resulting from research into how habits are formed, function and change. The project had 2 major components:

- by assessing the effectiveness and importance of naturally occurring events as well as promotion campaigns, EMMA strived to propose recommendations on the design of campaigns and the planning of public transport in order to attract more passengers;
- by studying the effects of promotion campaigns, such as free public transport for one month, the project sought to assess both the trial period and the period following it.

4.6.3 Research results

4.6.3.1 Modal promotion

MOSES established a list of relevant criteria related to car-sharing development. Among the most prominent there are:

- booking via mobile phone;
- open end booking and instant access;
- integration with public transport;
- integration into urban development;
- car-sharing and electrical vehicles;
- collective taxi;
- on-demand shuttle service.

However, aside from formulating general recommendations, the project also concluded there could be no single "best way" of efficiently introducing a car-sharing scheme, one that would be suitable for every urban transport situation, as such schemes were found to be largely context-dependant.

The *Public Transport in the Future* project study pointed at 6 areas that could have a positive impact on public transport travel increase:

- cost-efficiency with differentiated rates and marketing;
- increasing comfort and safety;
- re-routing and / or simplification;
- considering both frequent passengers and infrequent passengers;
- increasing marketing efforts;
- support investments in new technology.

The *SVI 2001/504* project started from the observation that traditional promotion measures do not lead to a significant change in mobility behaviour. The project therefore combined singular measures in coherent way in order to create packages, expecting synergy effects and a variety of differentiated approaches in order to access multiple target groups. The adaptation of the classic marketing approach (akin to sales promoting) is thus seen as a promising methodological approach to create these packages. Using this methodological tool, the project concluded:

- the adaptation of the marketing approach for pedestrian traffic and cycling proves to be a suitable instrument to increase the effectiveness of promotion measures through the creation of packages;
- the effectiveness and efficiency of packages (of measures) can be optimised if the main principles of package building that are derived from the research project are taken into consideration;
- the generated models of packages are too general to be made standard practice, due to local contingencies. This calls for an extension of the proposed method.

4.6.3.2 User acceptance

The empirical studies carried out by the EMMA project focused on how car users evaluate and respond to three transport demand management measures: individualised marketing, road pricing and prohibition. The proposed hierarchy of adaptations was investigated in focus-group interviews, other existing web-surveys, an experimental simulation, and also by analysing data of actual reported changes when road pricing was introduced. The project demonstrated that users accepted and adapted to the less coercive measures and that the adaptations followed a psychological cost-minimisation principle. However, the study also found that efficient car use, using public transport, or changing activity patterns were more dependant upon the age of the car users, the type of trip (work, shopping, leisure), and the type of TDM measure. These results are correlated with other findings, showing that car users' choices relating to short distance trips are influenced by perceived physical exertion.

The *Breaking the Habitual Choice of the Private Car* project provided improved insights into habits as a key factor, and also tested a novel practical tool for testing the specific influence of habits and behaviour on user choice. The project then investigated the possibility of applying these findings to develop policy interventions, with the aim of breaking transport habits and promoting public transport. However, the project could not conclude to long term effects of their findings and recognised future research must be carried out.

4.6.4 Policy implications

Cities throughout Europe are searching for sustainable solutions to the growing environmental and societal problems they are confronted with. The projects presented in this sub-theme demonstrate 2 major implications regarding possible policy measures:

- policy solutions – and their implementation – are normally to be carried out a the local relevant level of intervention, due to multiple contingent factors;
- policy measures adopted at the European level still have relevance, insofar as they support and encourage the development of methods and solutions that have the potential to be applied to various local situations.

For example, MOSES, proposed a specific policy methodology to limit the need for using motorised forms of transport. However, the project also insisted on increasing car-sharing awareness among local politicians, in order to change legislation and promote car-sharing.

Novel approaches to policy measures were also proposed in order to induce modal switching, as proposed by the "Marketing approach for the promotion of pedestrian and bicycle traffic" project. The "Marketing" approach advocated by the project showed that investments made for the promotion of pedestrian and bike traffic pay off in view of the superior goal setting of increasing the distances travelled. With pedestrian traffic it is leisure traffic, work traffic as well as urban space (net and combined pedestrian distances) that show the biggest potentials; with cycling it is leisure traffic, educational traffic as well as urban space (simple and combined cycling distances).

Furthermore, the EMMA project's results indicated that coercive TDM measures (prohibition and road pricing) need to be combined with non-coercive (information) measures in order to achieve public acceptance, effectiveness, and political feasibility. The project further pointed at studying car driver's adaptation rate as a possible leverage towards modal switching, in fact, making the switch to public transport seem less costly in psychological terms.

In England, efforts to encourage school children’s use of public transport and environmentally-friendly walking and cycling have led to the co-ordinated introduction of

4.7 Implications for further research

This section summarises implications and recommendations for further research, based on some key outputs of the projects reviewed.

One of the most prominent and urgent areas of research involving user aspects is the field of sustainable urban mobility, as European cities need to tackle congestion and pollution. Further research should address these issues through the development of more efficient and user-oriented systems, providing timely – even "customised" – transport to the end-user, while maintaining efficient transport coordination and flows. For example, previous research helped develop multimodal journey planning systems, which are now in commercial deployment in several European countries. The next step is now to enhance these systems by providing broader demand-responsive transport, based on personalised data collection. Projects in the FP7 call should address these issues, notably in the CIVITAS initiative[16].

Further research is also necessary regarding ADAS applications, mainly in the fields of systems' ergonomics and cost-reduction. Indeed, much mode data collection is needed in order to fully assess users' acceptance, as well as the systems' various interaction points, combining users, vehicles, and infrastructure. Wider-scale testing for these systems is also a necessary step towards full-scale industrial deployment. These issues are currently being taken on by the FOT-Net project[17], but at least another field operational test site may be needed, at least for data comparison.

Closely related to this issue, is the idea that longitudinal studies should also be carried out, in order to assess precisely the temporal dimension of usage and the acceptance of changes in mobility activities induced, for different categories of users and operators.

Another field where research is urgent is multimodal freight handling. Trying to improve freight efficiency is an important issue for European competitiveness, as well as for the environment. Research may be targeted at transport professionals, and in this area, both ergonomics development and efficient system building tools are key components that should rank high on the research agenda.

Last, the development of training / retaining skills – mostly addressing the general public, but not limited to that user category – has been somewhat neglected in recent years. These issues are important regarding safety and security of EU citizens, whether on a micro-level, aiming at small population categories (such as schoolchildren seniors or disabled persons) or on a more macro level, for example in view of a harmonisation of procedures across the EU.

[16] See the FP7 CITYNETMOBIL (City network for fair mobility) project, for example.
[17] FOT-Net - Networking for Field Operational Tests (expected completion 2010), FP7

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APRON (Aviation Policy Information Resources based on Observatory Networks) Project, FP5 - GROWTH - KA2 - Sustainable Mobility and Intermodality

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BUGS (Benefits of Urban Green Space) Project. FP5 Energy, Environment and Sustainable Development Programme. www.vito.be/BUGS/index.htm

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Annex: List of projects by sub-theme

Sub-theme 1: Decision Support Systems & the Human-Machine Interface				
Project acronym	Project title	Programme	Project website	Coverage
ADOPT	Advanced Decision-support System for Ship Design, Operation and Training	FP6-SUSTDEV-3 - Global Change and Ecosystems	adopt.rtdproject.net	This paper
ADVISORS	Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety	FP5 - GROWTH - KA2 - Sustainable Mobility and Intermodality	www.advisors.iao.fraunhofer.de	Covered in EXTR@Web paper
AIDE	Adaptive Integrated Driver-vehicle Interface	FP6-IST - Information Society Technologies - Priority Thematic Area 2 (PTA2)	none	This paper
APRON	Aviation Policy Information Resources based on Observatory Networks	FP5 - GROWTH - KA2 - Sustainable Mobility and Intermodality	none	This paper
ATENAA	Advanced Technologies for Networking in Avionic Applications	FP6-AEROSPACE - Aeronautics and Space - Priority Thematic Area 4 (PTA4)	www.atenaa.org	This paper
HUMANIST	Human Centred Design for Information Societies Technologies	FP6-IST - Information Society Technologies - Priority Thematic Area 2 (PTA2)	www.noehumanist.org	This paper

Sub-theme 1: Decision Support Systems & the Human-Machine Interface				
Project acronym	Project title	Programme	Project website	Coverage
IMCAD	Improving the Cockpit Application Development Process	FP5 - GROWTH - KA4 (AERONAUTICS) - New Perspectives in Aeronautics	www2.nlr.nl/public/hosted-sites/imcad	Covered in EXTR@Web paper
IVHW	Inter-Vehicle Hazard Warning	DEUFRAKO - German-French cooperation for land transport research	none	This paper
RESPONSE 2	Advanced Driver Assistance Systems: From Introduction Scenarios towards a Code of Practice for Development and Testing	FP5 - IST - KA1 - Systems and services for the citizens	none	Covered in EXTR@Web paper
SPADE	Supporting platform for airport decision-making and efficiency analysis	FP6-AERO-1.4 - Increasing Operational Capacity and Safety of the Air Transport System	spade.nlr.nl	This paper
SPADE-2	Supporting platform for airport decision-making and efficiency analysis, Phase 2	FP6-AERO-1.4 - Increasing Operational Capacity and Safety of the Air Transport System	none	When report becomes available
VINTHEC II	Visual interaction and human effectiveness in the cockpit, Part II	FP5 - GROWTH - KA4 (AERONAUTICS) - New Perspectives in Aeronautics	www.vinthec.net	Covered in EXTR@Web paper

Sub-theme 2: Effects of User Behaviour & Human-Infrastructure Interaction				
Project acronym	Project title	Programme	Project website	Coverage
	Built environment variables influencing pedestrian trips: guidelines for the design of pedestrian-oriented urban development: **Towards a walkable city**	Spain: CEDEX - Strategic Plan of Infrastructures and Transport	none	This paper
HILAS	Human Integration into the Life-cycle of Aviation Systems	FP6-AERO-1.3 - Improving aircraft safety and security	www.hilas.info	When report becomes available
RANKERS	Ranking for European Road Safety	FP6-SUSTDEV-2 - Sustainable Surface Transport	www.rankers-project.com	This paper
RIPCORD-ISEREST	Road Infrastructure Safety Protection - Core Research and Development for Road Safety in Europe	FP6-SUSTDEV-2 - Sustainable Surface Transport	www.ripcord-iserest.com	This paper
S224j	Effects of Road Engineering Modifications On Child Pedestrian Skills Development	United Kingdom: DfT Road Safety - Department for Transport: Road Safety Research Programme	www.dft.gov.uk/rmd/project.asp?intProjectID=10115	This paper
STARDUST	Towards Sustainable Town development: A Research on Deployment of Urban Sustainable Transport	FP5 EESD KA4 - City of Tomorrow and Cultural Heritage	www.trg.soton.ac.uk/stardust	This paper
SVI 2001/515	New forms of work and their impacts on transport	Switzerland: SVI - Swiss Association of Transportation Engineers	none	This paper

Sub-theme 3: Information Management				
Project acronym	Project title	Programme	Project website	Coverage
A3 (NRP 41)	New, Integrated Mobility Services, NIM	Switzerland: NRP 41 - Transport and Environment (internal research plan)		Covered in EXTR@Web paper
CESAR	Co-operative European System for Advanced Information Redistribution	FP4 - TRANSPORT RTD - Transport Research and Technological Development	www.cesar-online.com	Covered in EXTR@Web paper
CESAR II	Co-operative European System for Advanced information Redistribution II	FP5 - GROWTH - KA2 - Sustainable Mobility and Intermodality	www.cesar-online.com	Covered in EXTR@Web paper
eMOTION	Europe-wide Multi-modal On-trip Traffic Information	FP6-SUSTDEV-2 - Sustainable Surface Transport	srvweb01.softeco.it/emotion/site/1/default.aspx	When report becomes available
FOKAT	Conditions and requirements on IT support for demand-responsive public transport	Sweden: VINNOVA - VINNOVA Transport Programme	none	This paper
	Integrated rural public transport – part one: Evaluation of "Byabussen" in Ystad	Sweden: VINNOVA - VINNOVA Transport Programme	none	This paper
KITE	A Knowledge Base for Intermodal Passenger Travel in Europe	FP6-SUSTDEV-2 - Sustainable Surface Transport	www.kite-project.eu	When report becomes available
MATKA.FI	Journey.fi Public Transport Portal	Finland: HEILI - HEILI The passenger information programme	none	Covered in EXTR@Web paper
TRAINCOM	Integrated Communication System for	FP5 - IST - KA1 - Systems and	www.traincom.org	This paper

Sub-theme 3: Information Management				
Project acronym	Project title	Programme	Project website	Coverage
	Intelligent Train Applications	services for the citizens		
UG423i	Bus Real-time Information - Business Case Research	United Kingdom: DfT Strategy Economics & Mobility - Department for Transport - Strategy Economics and Mobility	www.dft.gov.uk/rmd/project.asp?intProjectID=10279	Covered in EXTR@Web paper

Sub-theme 4: User Comfort & Quality				
Project acronym	Project title	Programme	Project website	Coverage
ATPI	High Performance Damping Technology for Aircraft Vibration Attenuation and Thermo-Phonic Insulation	FP6-AERO-1.1 - Strengthening competitiveness	www.aero-scratch.net/atpi.html	When report becomes available
B-COOL	Low Cost and High Efficiency CO2 Mobile Air Conditioning System for Lower Segment Cars	FP6-SUSTDEV-2 - Sustainable Surface Transport	none	When report becomes available
BUGS	Benefits of Urban Green Space	FP5 EESD KA4 - City of Tomorrow and Cultural Heritage	www.vito.be/BUGS/index.htm	This paper
CREDO	Cabin noise Reduction by Experimental and numerical Design Optimization	FP6-AEROSPACE - Aeronautics and Space - Priority Thematic Area 4 (PTA4)	none	When report becomes available

Sub-theme 4: User Comfort & Quality				
Project acronym	Project title	Programme	Project website	Coverage
E-CAB	E-enabled Cabin and Associated Logistics for Improved Passenger Services and Operational Efficiency	FP6-AEROSPACE - Aeronautics and Space - Priority Thematic Area 4 (PTA4)	www.e-cab.eu	When report becomes available
FRAMSYN	IT-based real time information guidance-system for the visually impaired	Sweden: Banverket 2000-2005 - Swedish National Rail Administration research and development programme 2000-2005	none	This paper
FRIENDCOPTER	Integration of Technologies in Support of a Passenger and Environmentally Friendly Helicopter	FP6-AERO-1.2 - Improving environmental impact with regard to emissions and noise	www.friendcopter.org	When report becomes available
ICE	Ideal Cabin Environment	FP6-AERO-1.1 - Strengthening competitiveness	www.bre.co.uk/ice/page.jsp?iol=660 www.ice-project.eu	When report becomes available
	Integrated Public transport	Sweden: VINNOVA - VINNOVA Transport Programme	none	This paper
MESEMA	Magnetoelastic Energy Systems for Even More Electric Aircraft	FP6-AERO-1.1 - Strengthening competitiveness	www.mesema.info	When report becomes available
MOBILIS	Mobility Initiatives for Local Integration and Sustainability	FP6-SUSTDEV-2 - Sustainable Surface Transport	www.civitas-mobilis.org	When report becomes available
SEAT	Smart Technologies for stress free AiR Travel	FP6-AEROSPACE - Aeronautics and Space -	none	When report becomes available

Sub-theme 4: User Comfort & Quality				
Project acronym	Project title	Programme	Project website	Coverage
		Priority Thematic Area 4 (PTA4)		

Sub-theme 5: User Choice & Incentives				
Project acronym	Project title	Programme	Project website	Coverage
	Breaking the habitual choice of the private car	Denmark: TRIP - Transport Research on environmental and health Impacts and Policy	www.akf.dk/trip/alle_projekter/14proj.pdf	Covered in EXTR@Web paper
EMMA	Evaluation of Measures for Controlling Private Car Use in Metropolitan Areas	Sweden: Formas - The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning	none	This Paper
HOST	Human Oriented Sustainable Transport mean	FP6-SUSTDEV-2 - Sustainable Surface Transport	none	When report becomes available
MOSES	Mobility services for urban sustainability	FP5 EESD KA4 - City of Tomorrow and Cultural Heritage	www.moses-europe.org	This paper
PROCEED	Principles of successful high quality public transport operation and development	FP6-SUSTDEV-2 - Sustainable Surface Transport	www.proceedproject.net	When report becomes available
	Public Transport in the Future	Sweden: VINNOVA - VINNOVA Transport Programme	none	This paper

Sub-theme 5: User Choice & Incentives				
Project acronym	Project title	Programme	Project website	Coverage
SVI_2001_504	A marketing approach for the promotion of pedestrian and bicycle traffic in Switzerland	Switzerland: SVI - Swiss Association of Transportation Engineers	www.aramis.admin.ch/default.aspx?page=Grunddaten&projectid=2426&Sprache=en-US	This paper

Note. The projects listed in the Annex are those that have had the focus on the theme “User Aspects”, as well as those who have addressed user aspects 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 “User Aspects” – and find all research projects, EU-funded and national, which have treated, to a variable extent, aspects that can be related to the theme.