“The sustainable safety approach to Road Transport and Mobility”

(Final Version, 23.01.09)

Preamble

This paper aims to elaborate on one of the four important areas of ERTRAC, namely Safety; whereas taking into account its impact to the other three priority areas, namely Urban Mobility, Long distance transport, Energy and Environment. It provides the collective views of several Research and Policy stakeholders in the area.

The paper was initiated as an answer to the EC request on research priorities and agendas input for the Research Workprogrammes of 2010/2011 and is triggered also by the aim of these calls (based on draft Call text), which is solely on energy and environment related issues. The above stakeholder groups consider Safety as an interconnected issue to the environmental issues and as an equally important priority and want to emphasize with this input to the EC (DG’s RESEARCH, INFSO and TREN) that Safety-related Research should not be abandoned or even minimized in the next 3 years (2009-2011) European Research Agenda for economic, societal and even environmental protection reasons.

1. Introduction

There is a vast collection of very thorough documents on Road Safety Action Programmes and Plans at the EC level. The following (indicative) list includes the ones that have been references for this particular document at hand:

- CARS 21, A Competitive Automotive Regulatory System for the 21st century, Final Report, Enterprise and Industry Directorate-General, European Communities, 2006.
  http://ec.europa.eu/enterprise/automotive/pagesbackground/competitiveness/cars21finalreport.pdf
- ECTRI Strategic Paper, "The ECTRI vision of a sustainable multimodal transport system in the Europe of the future" 'Steps to Implementation', October 2003.
  http://www.ectri.org/Documents/Publications/Strategic-documents/ECTRI-Strategic-Paper_English-version_October-2003.pdf
- ERTRAC Research Framework 'Steps to Implementation', March 2008.
  http://www.ertrac.org/pdf/publications/ERTRAC_Research_Framework_Implementation.pdf
- ERTRAC Research Framework, April 2006.
  http://www.ertrac.org/publications.htm
- ERTRAC Strategic Research Agenda, December 2004.
  http://www.ertrac.org/pdf/publications/ertrac_agenda_dec2004.pdf
- eSafety Initiative
  http://www.esafetysupport.org/
- FERSI Action Plan & Research Priorities for the period 2005-2007.
  http://www.fersi.org/?menu=fersi
- Intelligent Car "i2010" Initiative.
  http://ec.europa.eu/information_society/activities/intelligentcar/index_en.htm
- "Road Safety as a right and responsibility for all", A Blueprint for the EU's 4th Road Safety Action Programme 2010-2020, ETSC, Brussels 2008.
  http://www.etsc.be/documents/Blueprint_for_a_4th%20Road_Safety_Action_Programme_ETSC_Sept%2008.pdf
- "Road Safety evolution in the EU", CARE - European Road Accident Database, 2008.
  http://ec.europa.eu/transport/roadsafety/road_safety_observatory/care_reports_en.htm
- Racioppi F., Eriksson L., Tingvall C. & Villaveces A., Preventing Road Traffic Injury: A Public Health Perspective for Europe, World Health Organization, 2004.
  http://www.euro.who.int/document/E82659.pdf
- "Saving 20 000 lives on our roads", A shared responsibility, European Road Safety Action Programme, Communication from the Commission, COM(2003) 311 final, European Communities, 2003.
  http://ec.europa.eu/transport/roadsafety_library/rsap/rsap_en.pdf
- "Towards Europe-wide Safer, Cleaner and Efficient Mobility: The First Intelligent Car Report", Communication from the Commission, COM(2007) 541 final, Brussels, 2007.
  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0541:FIN:EN:DOC
- White Paper, "European transport policy for 2010: time to decide", European Communities, 2001.
  http://ec.europa.eu/transport/white_paper/index_en.htm

Thus, the current document does not aim to become yet another Roadmap or Safety Action Plan, but rather to underline the short-term (up to 2011) Research priorities that need to be established, in accordance to the above strategic plans and taking into account the recent research projects and initiatives results.

The focus given in this document to Road Safety priorities, relies on the concept of "Sustainable Safety", meaning that in order to provide an increasingly safer road traffic system, not only for the present but also for its future users, an approach is needed which encompasses combined, multidisciplinary and integrated actions leading to long lasting safety improvements. For example, local enforcement by more police on the road is not an economic viable action sustainable on the long-term (when the number of controls is decreased the accidents will return), whereas electronic and automated means of enforcement can be considered as sustainable measure. In this context, the actions proposed in this document aim exactly to reach (all together) a sustainable safety traffic system.

2. Quo Vadis?

Road safety needs more priority in the transport policies of EU Member States and the EU, because 97% of all transport fatalities in the EU are caused by road transport. Road transport accounts for 88% of all passenger transport in the EU, but accounts for over 100-times more deaths than all other modes together (ETSC, 2008).

We have come a long way in reducing road deaths in the European Union (EU) over the past fifteen years. In 1995 in the fifteen Member States of the European Union there were around 45,000 reported deaths and 1.5 million casualties as a result of road traffic accidents (ETSC 1997). This figure is higher than the current total for a larger EU now of 27 Member States. Nevertheless in 2007 around 43,000 people were killed in road traffic collisions in the European Union (28,791 in the EU-15) (ETSC 2008). The year 2010 is a deadline for both reaching the EU's target of halving road deaths (set in 2001). The momentum of preventing further deaths and disablement is in danger of being lost and new impetus is needed in considering a new European Action Programme for the period of 2010 to 2020.

The following figure shows where we are and where we're going in relation to fulfilling the 50% fatalities reduction (ETSC).

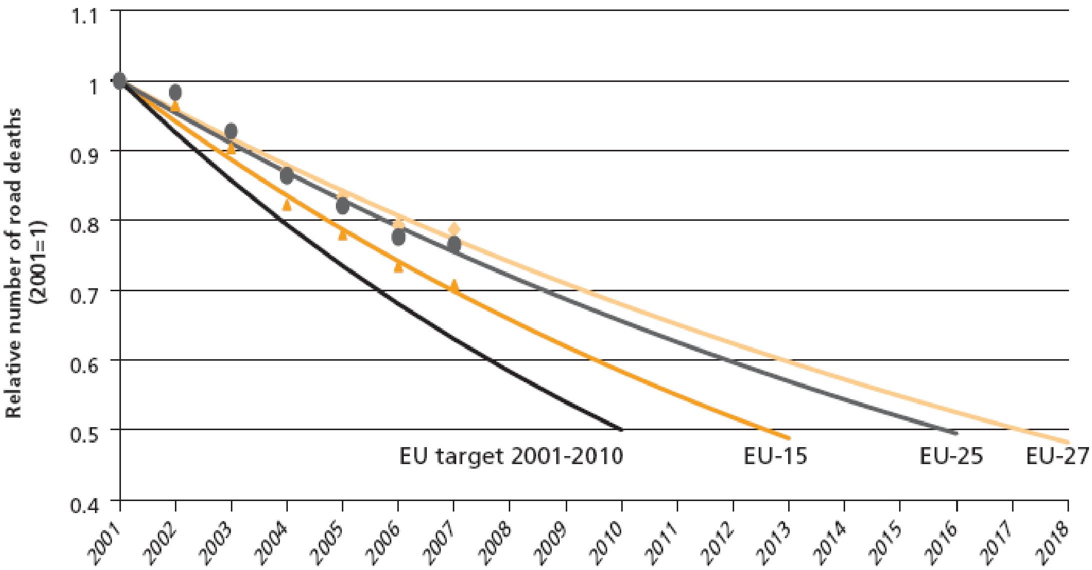

Figure 1: Estimated Trends in road deaths in EU 27, based on developments 2001-2008 (ETSC, 2008a).

Furthermore, the figure below shows how the real reduction is moving in relation to the planned one (CARE).

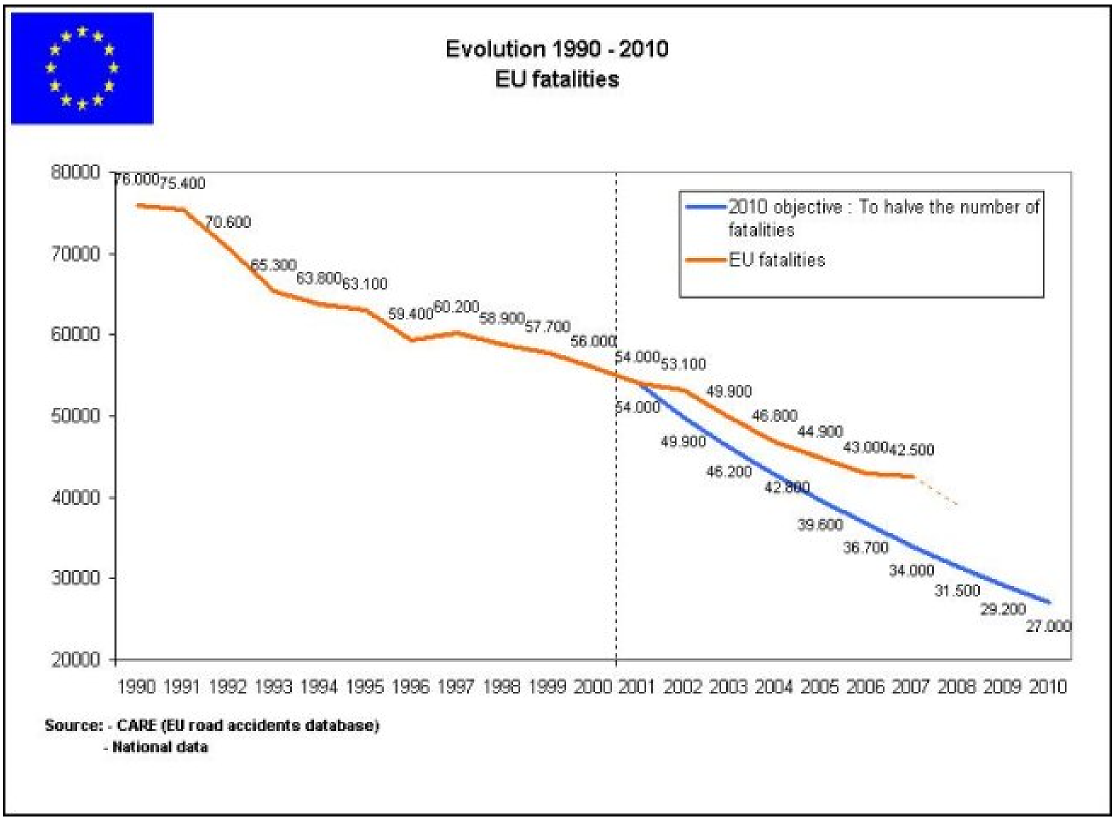

Figure 2: Foreseen vs. actual reduction of EU road accidents between 1990-2010 (CARE, 2008)

To be on course to reach the EU target in 2010, a reduction of at least 37% between 2001 and 2007 corresponding to an annual average reduction of at least 7.4% is needed. Between 2001 and 2007, however, road deaths have been reduced by 20% only. The European Union's yearly reduction in road deaths is no more than 4.2% on average (ETSC, 2008a).

Also, new targets and measures beyond 2010 have been proposed. Indicatively, ETSC proposes a shared target of 40% reduction of deaths with a further target to reduce injuries with lasting effects in each Member state by 20% (ETSC, 2008).
However, the overall issue is much more complex and there are clear areas (transportation means and traveller cohorts), where the need for research and intervention are much more pressing, namely:

- Emphasis should be put not on to deaths reduction, but also on injury prevention. The annual monetary valuation of road injury prevention in EU countries has been estimated to exceed 180 billion Euros, less than half of which is accounted for by deaths, and this figure may well undervalue the prevention of injuries leading to permanent impairments (ETSC, 2003).

- In the EU 27 in 2006 at least 1,000 children died in traffic collisions. Children in cars or taxis account for more than two-fifths of child deaths, whilst child pedestrians account for just over a quarter (ERSO, 2007). Thus, Great Britain set a target in 2000 reduce by 50% the number of children aged 0-15 killed and seriously injured by 2010 (and is well on target), whereas ETSC recommended the EU to adopt a target of 60% reduction between 2010 and 2020.

- In 2006 at least 6,200 Powered Two Wheeler (PTW) riders were killed in road collisions in the EU25 representing 16% of the total number of road deaths while accounting for only 2% of the total kilometres driven (ETSC, 2008a). For the same distance travelled, the risk for PTW riders to be killed in road accidents is on average 18 times the risk of being killed in traffic for car drivers.

- Correspondingly, the risk of being killed in traffic per kilometre travelled is more than 9 times higher for pedestrians than for car occupants and more than 7 times higher for cyclists than for car occupants (ETSC, 2003a).

- In the European Union 60% of citizens live in urban areas of over 10,000 inhabitants (Eurostat). Moreover about two thirds of the accidents and one third of the road deaths are in urban areas and affect the most vulnerable road users. In 2008 the EU adopted a Green Paper: "Towards a New Culture of Urban Mobility". Thus, urban safety is clearly a priority area for actions.

- Traffic collisions are the single largest killer of 15-24 years olds (ERSO, 2006b). Thus, effective novice drivers training and retraining schemes, merged with appropriate and sustainable enforcement policies, need to be in focus.

- The risk of an elderly road user being killed in a road accident is on average 16 percent higher than the corresponding risk for a younger road user. Elderly people are more vulnerable to trauma than other age groups, taking into account both their increased accident exposure and their higher vulnerability (AGILE, 2005).

- The differences in road safety levels between various EC countries are as big as 500%, thus focused research measures per European area need also to be supported.

In conclusion, both accident prevention and mitigation should be focused. According to ERTRAC Strategic Agenda of December 2004, accident prevention could contribute 55-65% and mitigation 35-45% of the overall gain in fatalities and injuries reduction.

A short overview of the previous research, leading to the identification of gaps and priorities can be found in Annex A: Short Overview of the previous Research, at the end of the document.

3. Towards an Integrated and Sustainable Safety Research Agenda

Road Safety and the Environment

To a great extent it seems today that the proposed research agendas view Environmental Protection and Energy Efficiency in the Transportation domain as a separate issue from Road Safety. This however is not true. Traffic Accidents (as the PRESTIGE maritime accident but also the big fires at Gotthard and Mont Blanc tunnels) constitute one of the major menaces to the environment, maybe bigger than the collective sum of use of oil for transportation. Accidents cause serious bottlenecks and disruption to the transportation network. Even the simple novice drivers training at urban roads corresponds to roughly 2% of the everyday traffic volume. And, vice versa, the introduction of new types of fuels and vehicles may cause significant impact on traffic safety. For example, electric or hybrid vehicles that run silently up to a certain speed (when running on the electric motor, roughly up to 70 km/h for hybrids) may endanger pedestrian that didn’t “hear them coming” or provide false concept of speed to novice drivers (i.e. IMMACULATE project results). On the other hand, eco-driving, due to low speeds and conservative nature, is also improving the proactive safety of the driver, so it is obvious that the connection between safety and environmental awareness is a working combination that will improve the twofold of accident reduction and CO_2 reduction immensely. Thus, road safety and environmental protection are the two sides of the same coin and can’t be viewed in isolation.

a) FP7 RTD/ TREN WP 2010 Call(s)

Within the 2010 Call(s) of FP7 RTD, an action line on “Sustainable Safety” should be included (STREPs, for about 15-20 M€ out of the 120 M€ total), focusing upon:

(a) Collection, typology and in-depth analysis of Urban Accident data (of all types, including damage only ones), covering all transportation modes and with emphasis on those of vulnerable road users (pedestrians, bicyclists, PTW riders, …).

(b) New concepts, materials and electronic measures towards self-explanatory road signing and forgiving road environments, including personalised and safe provision of road traffic (i.e. VMS/VDS) info to drivers and riders and safer road furniture.

(c) Cooperative active safety systems focusing on specific challenges, such as pedestrians’ protection, riders’ safety, roundabouts, intersection and other black spots support.

(d) Vulnerable traveller’s compatible vehicle design, for the elderly; children and other fragile user groups, both as passengers or traffic opponents.

(e) New tools, curricula and systems for long-life training of novice drivers, with emphasis on multimedia, driving simulators, VR/AR simulation tools and the use of new active safety systems (i.e. ADAS/ IVIS) as on-the-job training tools for driver behaviour improvement and promotion of eco-driving concepts.

(f) To further develop accident prediction models for a number of European countries slinking combinations of (elements of) road design, traffic and driver behaviour and to formulate criteria for benchmarking the safety performance of the different categories of roads in Europe.

b) FP7 RTD/ TREN WP 2011 Call(s)

For the 2011 Call(s), a more significant focus on "Sustainable Safety" is proposed (targeting both IPs (2), STREPs and CSAs for about 50 M€), focusing upon:

(a) SAFETYNET II (IP)

(b) Driver/ rider monitoring technologies and tools, to prevent accidents due to driver/rider inattention, excessive workload, fatigue, drowsiness, alcohol, illegal or medical drugs abuse (IP).

(c) Joint research initiatives to optimise urban safety, mobility and environmental protection by new TMIC services and coordination of all traffic modes and participants.

(d) Individualised and personalised safety measures, adaptable to each traveller/driver cohort, European area and even individual preferences and needs.

(e) Focused research on enhancing safety and security of dangerous, high value and high risk (i.e. flammable products, such as tires, plastics, etc.) goods throughout the transportation corridors, with emphasis on specific areas (i.e. tunnels, bridges), urban agglomerations and areas of environmental protection.

(f) Development and deployment of automated enforcement control systems, based on existing and new technologies, with focus on legislative and regulatory barriers.

(g) New site-specific measures planning procedures and tools to support effective and efficient countermeasures identification, implementation and results evaluation, also including tools for the assessment of impacts on road safety of modifications of transport demand and/or supply (RIA).

(h) Optimal configuration of Integrated Safety Agenda (including use of new technologies for vehicles, infrastructure, as well as cooperative ones, enforcement, training and awareness creation) for sustainable road safety enhancement (CSA). This can be linked to the European Road Safety Observatory.

(i) Large-scale study in 6-10 countries on Naturalistic Driving on driver behaviour and its effects on safety, environment and accessibility, in close cooperation with SHRP2 (U.S.) and several European FoT initiatives (IP).

List of Abbreviations

ADAS	ADVANCED DRIVER ASSISTANCE SYSTEMS
APM	ACCIDENT PREDICTION MODELS
AR	AUGMENTED REALITY
CSA	COORDINATION AND SUPPORT ACTIONS
ECTRI	EUROPEAN CONFERENCE OF TRANSPORT RESEARCH INSTITUTES
ERSO	EUROPEAN ROAD SAFETY OBSERVATORY
ERTRAC	EUROPEAN ROAD TRANSPORT RESEARCH ADVISORY COUNCIL
ETSC	EUROPEAN TRANSPORT SAFETY COUNCIL
FERSI	FORUM OF EUROPEAN ROAD SAFETY INSTITUTES
FOT	FIELD OPERATIONAL TESTS
IP	INTEGRATED PROJECT
ITS	INTELLIGENT TRANSPORTATION SYSTEMS
IVIS	IN-VEHICLE INFORMATION SYSTEMS
PTW	POWERED TWO-WHEELERS
STREP	SPECIFIC TARGETED RESEARCH PROJECT
TMC	TRAFFIC MANAGEMENT CENTER
TMIC	TRAFFIC MANAGEMENT AND INFORMATION C
VDS	VEHICLE DETECTION STATION
VMS	VARIABLE MESSAGE SIGNS
VR	VIRTUAL REALITY

Annex A: Short Overview of the previous Research

Over the last decade, the technological developments addressed mainly the passive safety systems, with regard to the human (mainly the driver), the vehicle and the environment.

The EU FP6 project SafetyNet, which ran between 2004 and 2008, has contributed largely to the available methodologies to harmonise a wide-range of road-safety related data within Europe. Standards were developed for the collection of accident data, risk-exposure data, safety performance indicators, and in-depth data. Furthermore, recommendations were given for independent and transparent accident investigation in Europe. Methods for the analysis of the data using time-series and multi-level methods were developed and reported. Finally, as SafetyNet also aimed to prepare the European Road Safety Observatory as recommended in the 2003 EC Road Safety Action Plan. This materialised into a rich and - in the meantime – well-recognised and well-appreciated website. During the course of SafetyNet, strong relations with (representatives from) all Member States were built, including Switzerland and Norway. The EC has recognised the need to keep alive, build out and apply the work done in SafetyNet. To this end, in 2009 the FP7 project DaCoTA (Data COllection, Transfer and Analysis) will start. While the European Road Safety Observatory website will be hosted by DG-TREN, DaCoTA will be one of its major deliverers of knowledge and data in the coming years. Within DaCoTA, the harmonising data methods will be further applied within Europe, resulting in more and more standard data products on a European level, and in-depth investigations will be built out. Furthermore, the possibilities for uniform Naturalistic Driving observations within Europe will be studied. With the latter, DaCoTA will link the more traditional accidentology data to data that now come within reach due to new and upcoming technologies.

However, to solve a problem one has firstly to analyse and understand it. Therefore, the creation, update and maintenance of reliable, pan-European **accident databases,** is a preamble to any further research. Current ones (i.e. IRTAD, CARE) do not go to the required deapth for research purposes. To this end, a series of research initiatives have been funded (i.e. STAIRS, EACS, PENDANT, SAFETYNET, TRACE, etc.), whereas in several databases, accidents in Europe and, in some cases, the rest of the world, are reported (e.g. FACTS, NHTSA, MHIDAS, GES, etc.). Still, there is significant lack of accurate geographical (i.e. on urban accident databases, including damage-only ones) and sectorial (i.e. Dangerous Goods transport, Heavy vehicles of various types, PTW's of various types) data; in order to support in-depth accident analysis, and root causes investigations.

Concerning the vehicle **passive safety** systems, the most considerable progress has been made in relation to protective car bodies, multiple airbags and advanced seat belt systems. New structural frameworks (i.e. Honicomb) and materials (i.e. composites) have been developed for the front part of the vehicle (mostly of the passenger vehicles, semitrucks and trucks) so as to be, among others, user-friendly to the vulnerable road users (e.g. motorcyclists, pedestrians, etc.) as well as for the lateral part of the vehicle (mostly that one of the passenger vehicles) for the damping of the maximum possible energy during collision and the reduction of the vehicle speed with the minimum possible deceleration.

The requirements of the crash tests have been further elaborated and are re-evaluated and re-adjusted according to real accidents' results. The incompatibility among the several types of vehicles, which is critical during collision (e.g. height difference in kinematic energy absorption ranges during the collision of a passenger vehicle with an off road vehicle or truck) has been addressed sufficiently, whereas a variety of research initiatives has dealt with the material fractural toughness and the reinforcement of the vehicle cabin for vehicles with high centre of mass (i.e. trucks, buses, off road vehicles, etc.) in roll-over cases, with the development and utilisation of more advantageous materials for the construction of the cabin, special seats, etc. In addition, the potentials for the readjustment of the passive safety systems in case the passenger is out of position (the original position upon which the system was designed and developed) have been investigated. New technologies in passive safety have been applied and further investigated in a cost-efficient and less time consuming way (i.e. finite elements, "Multi Body Models", etc.). Indeed, the vehicles produced during the last decade increased passive safety in comparison to the older technology's vehicles.

As identified in the accident analysis realised within the framework of the project PENDANT, the severity of the accidents, dealing actually with the severity of injuries, in which the users of the passenger vehicles, constructed one year after 1998, were involved, was not as high as that one corresponding to vehicles, constructed earlier than 1998.

Research in passive safety is recently mainly addressing mainly vehicles, where the passenger is not surrounded by structures (i.e. cabin in passenger vehicles), and deals mostly with the safety of bicyclists and motorcyclists. More specifically, extended research has been realised in these fields during the last years (ARPOSYS, TIP-CT-2004-506503), especially regarding the protection of the rider head. Recently, the utilisation and evolution of reinforced polymers (e.g. "Carbon Reinforced Epoxy", "SiC/Sic Ceramic Matrix Composites", "GLARE") has led to helmets, which are more resistant to collisions and friction and also much lighter. Furthermore, the utilisation of materials that absorb energy (while falling) for the protection of knees, elbows, metatarsus, shoulders, pelvis and backbone has been investigated and some minimum requirements regarding quality and effectiveness have been set by the EU.

Investigation has been also held for the participation and behaviour of the road side furniture in accidents (e.g. RISER project), either concerning those that aim to reduce the severity of the consequences of an accident (i.e. safety islands), absorbing the greatest possible kinematic energy during the collision with any type of vehicle (e.g. motorcycles, passenger vehicles, trucks, etc.) or those that aim to prevent accidents beforehand (e.g. traffic signs, light pillars, etc.).

In the last category, research has focused on the detection of the most appropriate spots for their placement, by means of the investigation of the most common accident scenarios taking into consideration the specific characteristics of the road/environment, as well as on the structural framework of the object and the materials used, aiming at the prevention from high instantaneous decelerations, that can result in physical damages, and the prevention from the penetration of the road side furniture in the passenger cabin. The above are evaluated either using feedback from accident statistics, or, after the implementation of the application, via crash tests.

From the above it is clear that research needs to continue on vehicle compatibility, conspicuity and new materials, with emphasis on the least research – but most vulnerable – transportation means; that of pedestrians, bicyclists and motorcyclist protection.

Furthermore, Road safety management may be improved if quantitative assessment of safety levels is carried out, in a similar way to what presently is done as regards the costs of interventions or the estimation of their future impact on mobility (levels of service and travel times) or on land use. In practice these safety assessments are required for the full application of the recently approved Directive on the safety management of road infrastructures.

According to the current state-of-the-art, the safety level of a road traffic element (for example, a driver or an intersection) may be assessed combining its recorded accident experience with existing knowledge on the safety of similar elements (for instance, the other drivers or other intersections of the same type), using empirical or full Bayes methods. In these methods existing knowledge is incorporated and summarized through accident prediction models (APM) – also designated as safety performance functions –, which are mathematical expressions developed from data on accidents, traffic, road geometry and (in some cases) driver behaviour characteristics.

In a recently finished 6th FP research project, a need was identified for further development of APM at the European level; and a concerted effort to develop APM for different types of EU Member States’ roads was recommended.

Road safety impact assessments, blackspot management and network safety assessment are tools of the above mentioned Directive where APM are mandatory in state-of-the-art methods; APM may also be useful when benchmarking the safety performance of different road categories across Europe.

Research on **infrastructure** should aim towards **“self-explanatory”** and **“forgiving”** road environments (see RIPCORD and IN-SAFETY projects, for definition and proposed measures), not only for the “average” vehicle drivers, but also for all other traffic participants, with emphasis on the most vulnerable of them (i.e. pedestrians, cyclists, elderly drivers, PTW riders, novice riders and drivers, etc.).

Still, the best protection will be offered by accident prevention, based upon **active safety** systems. After decades of research, starting from PROMETHEUS and concluding recently in new sensors (PREVENT IP), HCI concepts (AIDE IP) and even cooperative systems (SAFESPOT, CVIS IPs), several ADAS and IVIS are already in the Market, with enhanced penetration rates every year. The inauguration of wide-range FOT’s (on ADAS, IVIS and soon Cooperative Systems) aims to provide a large pool of data for impact assessment. The recent extension of their scope to specific types of transportation modes which were not yet adequately covered (i.e. Dangerous Goods by GOODROUTE, SAFETUNNEL and CVIS, PTWs by SAFERIDER and 2BESAFE, school buses to be soon added) is expected to further promote active safety benefits in all modes of road transport.

Nevertheless, the above systems may have multiple use and have been seen so far from limited perspectives: some (i.e. TMC services, VMS/VDS) from a traffic efficiency point of view, others (i.e. ADAS) as traffic safety related; infomobility services (TMIC services, pre and during trip route guidance) as mobility facilitators and others (i.e. urban tolls, pay per use/ pollute schemes) as environmental protection utilities. Thus, we are missing the global picture, the effects of multiple use and integration of the above technologies. As an example, in-vehicle delivery of a VMS text in relation to the trip context (i.e. only if the driver’s path is relevant to this info), his/her language, driving task and in conjunction with energy efficiency guidance can promote traffic safety, while maximizing efficiency, mobility and environmental protection. Clearly, the synergetic effects of various ITS in safety versus mobility and environmental protection are still under-researched.

The above issues need to be complemented with (according to ERTRAC Research Framework 2008) ADAS/IVIS individualization (personalization) for optimal use, as well as further research systems for complex scenarios (intersections, school zones, roundabouts, etc.).

More specifically, **driver behaviour and training** have been significantly under-researched. The recent trend towards naturalistic studies indeed seems to bridge this gap, whereas exploratory use of modern technologies (mainly multimedia tools, driving simulators, VR/AR simulation environments) in driver training (i.e. in projects TRAINER, VIRTUAL, TRAIN-ALL, …) has proven the vast potential of new technologies in enhancing driver awareness and competences. Relevant initiatives need to cover all driver types and needs (i.e. novice drivers (TRAINER), professionals (INFORMED), elderly drivers (AGILE), … and take into account the optimal training and awareness of all driver types regarding use of ADAS/IVIS functionalities (that has been highlighted in HUMANIST NoE but still lacking relevant tools and validated curricula). Training needs also to extend to the rest stakeholder groups, such as engineers and human factor experts involved in new system development, infrastructure operators, driving instructors and assessors, authorities, etc. Given the decisive nature but also long-term effects of training as human behaviour influencing measure, it is quite strange that relevant research efforts have been to a great extend pushed back, towards the end of the research agenda and not selected among the first to be implemented.

Other initiatives to complement training in the area of human-based road safety enhancement are related to **enforcement** technologies (i.e. PEPPER, GOODROUTE projects), **public awareness campaigns** (i.e. BOB campaign) and **driving impairment prevention** (i.e. AWAKE and DRUID projects). Especially, driver monitoring (that is, on board recognition of driver's inability, drowsiness, distraction, fatigue, drugs and alcohol abuse) is among the key research priorities set up by the ERTRAC Research Framework of March 2008. Relevant systems seem to be at a peak, where significant breakthrough is to be expected after over 15 years of research and any regress of research momentum may cut short the expected impacts.

Finally, **mobility** measures need to be influenced by safety. A typical example is the development of new route guidance concepts, such as the safest route (i.e. from GODDROUTE project), the most secure route and other routing options (i.e. the accessible or elderly-friendly route, etc.). Modal shift to more safer routes and towards multimodal transport needs to be supported, taking however, into account the higher exposure of travelers when transferring from one mode to another (i.e. on foot or by bicycle) and taking safety measures to protect them along the route.