SUSTAINABLE TRAFFIC SAFETY POLICIES AND RESEARCH PRIORITIES FOR SAFE AND SECURE EUROPEAN ROADS

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Summary: *The European goal of reaching 50% reduction of road traffic accidents is eluding us and efforts on national as well as European level need to be climaxed to even coverage towards this goal. This paper performs a brief state of the art on recent (up to 6th FP) efforts on European level to enhance road safety (including passive safety, active safety, training and other measures) and then key priority areas towards the future (with reference also to the 7th FP) are proposed along 5 axes: harmonised and complete traffic accident database, passive safety systems, ITS and active safety systems, measures for dangerous goods, simulation models and use of driving simulators. The paper concludes with detailed research priorities, reflecting the author's views and over 20 years of experience in Traffic Safety Research in Europe.*

I. INTRODUCTION

During the last fifteen years, research efforts in transportation have considerably evolved at the international, European and national level. The focus of the research in all fields of automotive industry and transport has been the application of technological and operational advances that will permit the safest, most comfortable and most cost-efficient possible mobility of people and goods by private and public transport means, while at the same time respecting the environment and natural resources. Relevant to that has been the development of an integrated multimodal intelligent transport system, that will be efficient in terms of safety, effectiveness, cost and options provided to the public with respect their mobility.

The White Paper on Transport "European Transport Policy for 2010: Time to decide" and its mid-term review set out clearly those objectives to be addressed at a pan-European level. The Technology Platforms set up in the Transport sectors (ACARE for aeronautics and air transport, ERRAC for rail transport, ERTRAC for road transport, WATERBORNE for waterborne transport, Hydrogen and Fuel cells) have elaborated long-term visions and strategic research agendas which constitute useful inputs to the approach and activities of the Transport theme and complement the needs of policy makers and expectations of society.

In the 6th European research framework, the core objective of the activities carried out was the promotion of road safety by means of

the use of new technologies (e-safety). The main objectives of the 6th framework were reflected in the following research initiatives:

- Creation of advanced vehicle applications for accident prevention.
- Creation of communication channels among the vehicles for the decentralised management of traffic.
- "Intelligent" communication between the vehicles and the infrastructure.
- Cooperation between vehicles and mobile devices (PDA and mobile phones) aiming to support the driver or any other user in a seamless and dynamic way.
- Development of a unified system for road users charging and electronic toll collection in Europe, via the use of satellite GNSS technologies.

The industries in the automotive sector have been the main actors motivating the rapid progress. Aiming at safer driving and at provision of added value services to the driver, the automotive industries have focused on the development of holistic systems for the management of the info provided in the vehicle, the in-vehicle navigation and the communication.

The intelligent transport systems (ITS) applications have started since 30 years ago, aiming, initially, to address the need for the efficient management of road infrastructure and, especially, of the urban network, i.e. roads and interchanges with traffic signs. Indicatively, one may refer to SCOOT (Split, Cycle and Offset Optimisation Technique) and SCATS (Sydney Coordinated Adaptive Traffic System) applications.

Progressively, and as the telematics and digital technologies were being improved more and more, the ITS applications were expanded in all transport means and addressed a wide range of operational functions. In specific, the development of digital frameworks for navigation, enabled the development of in-vehicle applications and of other applications providing services out of the vehicle. The advanced localiSation and navigation technologies, the wireless technologies for mobile devices, the DSRC, RFID, DAB and RDS/TMS technologies have been considered the most significant landmarks in the area. According to market estimates, in 2010, the demand for navigation devices will be around 12 millions per year.

II. THE RESEARCH ROAD TOWARDS SAFER TRANSPORT

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. Concerning the vehicle passive safety systems, the most considerable progress has been made in relation to preventive 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, semi-trucks 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) 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. Great progress has been made in the s/w programs that simulate incidents/accidents scenarios, providing the potential for the new technologies in passive safety to be 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 of the 5th FW program, 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 addressing human concerns 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.

However, the most recent trends focus on active safety systems, that will be able, not only to provide the maximum possible safety after the accident, but furthermore act such as

to prevent it.

Typical applications of Advanced Driver Assistance Systems (ADAS), also commercialised nowadays, are the Adaptive Cruise Control systems (ACC) or the Advanced Vehicle Control Systems (AVCS). ADAS function is based so far on the utilisation of the info that is logged by the sensors, with which the transport means (e.g. passenger vehicle, truck, etc.) are equipped. In parallel, each year, more vehicles are equipped with various navigation systems, which make use of digital maps and vehicle positioning. The capability of such systems to be aware of the geometry and other properties of the road infrastructure, with the respective guidance and warning, reflects the sense of cooperative systems and is estimated that may have significant positive impacts on traffic safety and efficiency through the whole transport network.

However, it must be pointed that there are no ADAS systems today that take into account the geometry of the road since there exist no digital maps with information about the curvature or other characteristics of the road. One possible application is headlights that turn in advance according to the curvature of the road, advanced warning to the driver if a dangerous or abrupt turn is ahead, etc. Development of maps with detailed information about road characteristics, geometry and condition of pavement is very costly if carried out with traditional methods. An open research objective is the development of methods for the production of advanced maps that will be emi-automatic and based on the analysis of paths of vehicles collected via GPS with on-board units.

Given the fact that the possibility of implementing large infrastructure problems is limited (because of limited funding and technical restrictions), **the development of integrated intelligent transport systems applications is encouraged by the national and regional governments, infrastructure operators and public authorities.**

The use of sensors for traffic measurements, the detection of incidents/accidents and the use of Variable Message and Directional Signs (VMS/VDS) are already used in Europe in great extent.

Currently, the most dominant trend is the integration of existing or under implementation projects in an interoperable framework that will allow the cross-border adoption of ITS.

The most innovative projects are those dealing with electronic tolls collection (PISTA, MEDIA), e-ticketing and the exchange of traffic and other info among several actors (cities, districts, etc.).

The major scope of ITS is the increase of mobility of goods and people, in such a way, as to be in favor of all involved actors and the environment. This is especially applicable in the field of dangerous goods transport, where the traffic incidents have multiple negative impacts with regard to safety (of the drivers and the third party) as well as the financial status and the marketing profile of the transportation and the dangerous goods companies, but also to the environment.

For the above reasons, European projects aim at the development of such technologies and integrated services that will allow the safe and more cost-efficient transport of dangerous goods through the whole transport network. Most of them deal with the development of the technological framework that is required for the dynamic management of the dangerous goods fleet and the seamless provision of reliable info for the vehicle, the driver and the

cargo status, the time of delivery, the potential of terrorism action (i.e. SAFESEANET, TEMPO ARTS, MITRA, RIS, MVS, SHAFT, DETRACE, ULISSE, etc.), whereas in recent research initiatives, more integrated services are designed, including emergency services (Police and Ambulance reaction) and route guidance with advanced Decision Support Systems, that take into consideration operational, financial and the environmental info, real traffic conditions and risk assessments (i.e. GOOD ROUTE project). Common ontologies with regard to the classification of the dangerous goods according to ADR («Agreement concerning the international carriage of Dangerous goods by Road»), security and authentication systems for the privacy data protection (of users, companies, etc.), advanced navigation systems and user interfaces for all involved actors, reliable localisation, positioning and communication technologies, traffic management information centres and improved vehicle tracking technologies constitute only part of the existing and future technological development in this area.

In parallel, some research initiatives (i.e. INFORMED project) have focused on the training of the professional drivers and their instructors, developing training programs that include training in advanced techniques (i.e. anti roll-over, antiskid, defensive driving, etc.) of several types of vehicle, incorporating the use of multimedia software training tools, training with simulators and practical training (i.e. in test trucks), whereas have formulated a set of policy recommendations for the improvement of the relevant European Directives dealing with training issues in this field. The need for the formulation of a common European training, assessment and certification framework for the professional and for all other types of drivers is emerging and obvious.

Before any other process, the appropriate collection, reporting and in-depth analysis of accidents, the reduction of which is the objective of each system under development, is the first mandatory step. The accident analysis may be performed in several scales, varying from the analysis at national level, where the total number of one country accidents is investigated and international comparisons are further made, to the scale of individual accidents, where representation and in-depth assessment of the accident is realized aiming at the identification of the root causes leading to that.

A series of research projects have been funded for this purpose (i.e. STAIRS, EACS, PENDANT, SAFETYNET, TRACE, etc.), whereas in several databases, accidents in Europe and, in some cases, in the rest of the world, are reported (e.g. FACTS, NHTSA, MHIDAS, GES, etc.).

Simulation and modeling techniques of the vehicle and the traffic environment are also considered to have a significant contribution to preliminary research phase, during the last decades.

Traffic simulation models are distinguished in microscopic (e.g. PARAMICS, RuTSIM, VISSIM, etc.), mesoscopic and macroscopic (e.g. VISUM, SATURN, etc.). Each of these categories deals with different level in research. For example, the microscopic models are based on the principles and the sense of vehicle sequence, analyse the individual behaviour of each vehicle, providing great accuracy by means of dynamic simulation and are used mainly for the evaluation of the proposed strategies and policies in middle and small networks. The significant computing time that is required makes the simulation of large networks unprofitable or even totally unfeasible (e.g. in urban areas level, or for the assessment of several attributes, such as mean

speeds of vehicles, traffic distribution throughput the network, etc.). The latest mentioned are addressed by macroscopic models that are static and are based on the behaviour of the average vehicle population, following fluid dynamics theories. Such models require less computing time; however their accuracy is not so good. In addition, the traffic simulation models are used for the new and innovative technologies (e.g. ADAS, AVCS) to perform impact assessment and to estimate the magnitude of various environmental impacts (CO_2 emission, fuel consumption, noise, etc.).

An indicative European project, within the framework of which, microscopic and macrospopic models have been developed is the ADVISORS project (GRD 1 1999 10047), whereas the IN-SAFETY project (FP6-2002-506716) aimed at the development and evaluation of microscopic and macroscopic models that assess the behaviour of users of ADAS/IVIS in several penetration rates, to enable the impact assessment in road safety.

Driver simulators simulate the vehicle operation and the respective traffic environment. The accuracy of the simulation, their technical characteristics and their cost may differ significantly, depending on the purpose of use. Driver simulators are used for several reasons, as for example, for the training of all drivers' categories (e.g. novice drivers, elderly drivers, professional drivers, etc.), for the assessment of their skills and their driving behaviour, for other research purposes like the design and development of vehicles and parts of them (e.g. user interfaces, ADAS, etc.), games and entertainment, etc.

The undergoing research in the areas of drivers' simulators has provided evidence that, within the different research and training contexts of use and for the achievement of the different goals each time, different simulators, scenarios and environments are required, adjusted to the concrete needs of the application. Driver simulators may be single display simulators, static, dynamic, semi-dynamic, virtual reality simulators, etc. Some of the best research driver simulators are those of VTT in Sweden, of Daimler Chrysler in Germany and of NADSin the U.S. Work towards interoperable, multi-tasking and with a common reference architecture simulators is currently coordinated in TRAIN-ALL initiative, involving most major simulator manufacturers in Europe.

E-112 is a European directive requiring mobile and fixed operators to make available the location of every caller placing an emergency call. Mobile handsets are currently located through the mobile operators who make use of various techniques based on the known locations of network antennas. While all European countries have in principle adopted the directive the system is not fully operational yet and is facing severe delays.

E-112 will form only part of e-call a chain of actions that will bring rapid assistance to any motorist who experiences an accident or mechanical failure on the road. E-call is a EU high priority initiative and significant research has been already undertaken.

An e-call can be initiated manually by the vehicle occupants or triggered by an accident and placed automatically by a black box connected with sensors that detect a collision. A voice and data connection is established with the closest Public Service Answering Point, which deploys and dispatches assistance to the location communicated by the call. Furthermore, it is envisioned that relevant data are transferred to a Service

Provider that provides additional services such as towing or notification of next-of-kin for which the caller subscribes. Initially, it was forecasted that e-call would be operational in Europe by 2010. Since there are significant delays to the deployment of E-112, it can be expected that the deployment of e-call will be further delayed.

The problems can be partly attributed to the fact that the techniques used for the calculation of location of mobile phones are not very accurate or require significant investments from the mobile operators in order to be acceptably accurate. Many operators choose the cell id method, which does not require additional equipment but provides the position of a handset within a cell. Cells are small enough in urban areas, but cover big areas outside of the cities resulting in positioning with large margin of errors where is needed more, e.g. in rural areas.

The increased availability of mobile handsets with GPS capabilities (and later Galileo) will solve the location problem. It is expected that within the 3-5 next years all mobile handsets will be GNSS capable.

Significant research efforts should be made in solving problems such as the protection of privacy and developing services that will make the whole concept of e-call commercially viable. Since additional services (towing, notification) will be offered on a subscription basis, a whole bouquet of related services must be on offer that will be attractive for the average driver and could sustain business cases for the future Service Providers. Perhaps, initially Service Providers would be insurance companies or roadside assistance companies, but the real challenge is to develop and offer truly innovative services that will create a new telematics-related industry based on e-call. At the same time, the benefits would be the reduced response time and the fast arrival of medical assistance at the accident, which is known that highly improves the chance of survival.

III. THE ROADMAP TO THE FUTURE

Future research, already under implementation in the 7th FP of the EC, aims towards a system that will enable the incorporation of the most recent evolutions and achievements in the passive and active safety fields, into the traffic safety arena. The benefited groups will be the society as a whole, the enterprises, the competitiveness of which will rise in such a way, as to allow their penetration to the European and the international arena, with the adequate capacity and know-how. More precisely the following priority research areas are correlated with high potential impacts:

The complete recording and analysis of traffic accidents, will result in the identification of the major problems and needs that will be targeted by the several systems under development.

Research around passive safety systems and the respective implementations are expected to:

- Reduce the severity of the injuries from collisions corresponding to passengers of vehicles and all other road users.
- Motivate the further development of the technologies and sciences (finite elements, etc.), which are used within the framework of the passive safety systems at national level.

The focused research on ITS and the relevant implementations, especially those concerning cooperative systems, are expected to:

- Improve the traffic flow and reduce

the negative environmental impacts in the transportation sector (especially in an urban environment) via the new combined mobility services.

- Achieve considerable improvements with regard to the safety, efficiency and competitiveness of the transport systems, the traffic efficiency and in general the feasibility in transport (in compliance with the European vision for the reduction of fatal accidents by 50% until year 2010 and by 100%, "0 fatal accidents" in long term perspective).

- Demonstrate, qualitatively and quantitatively, via large scale Pilot trials, the positive impacts of ITS in all aforementioned, encouraging the funding and the coordination of all relevant initiatives on behalf of all involved actors.

Research with regard to the development of integrated services for dangerous goods fleet management and the improved training, assessment and certification of the drivers and their instructors are expected to:

- Allow all dangerous goods vehicles to be continuously tracked and monitored, providing the relevant notification, information or warning to all involved actors automatically, with no physical intervention and vehicle immobilisation and loss of time and with no occurring problems and risks in the traffic flow, which are very common in cases, where heavy vehicles are put aside the road.

- Increase safety of the drivers and third parties that are directly influenced (especially in urban areas), to face the terrorism in this area and the considerable environmental pollution due to the occurring accidents.

The use of simulation models may lead to significant savings in resources and increased road safety since it is expected to:

- Contribute towards the evaluation of various transportation policies before they are applied thus providing decision makers with a tool that permits them to perform "what-if" scenarios and permits them not only to estimate traffic loads congestion etc. but also various environmental indicators (e.g. CO2 emissions, etc.).

- Permit the simulation of the impacts of new technologies (ADAS, IVIS) in the existing road networks, before these are applied.

- Make feasible the construction of new and/or the improvement of existing infrastructure, in the less expensive way, since the s/w for transport modelling may prove to be especially effective tool in the context of RSA, RSI and black spots management.

The utilisation of driver simulators is expected to:

- Increase the safety of the drivers, mostly of the candidate and elderly ones, since the driver will have the opportunity to experience a series of driving tasks and traffic environments, before s/he drives in real traffic conditions and also situations, which are very difficult or totally unfeasible to be tried in real traffic conditions (e.g. driving with fog, snow, collision with another vehicle, pedestrian, etc.). In this way, the training procedure and content are also improved.

- Make feasible the detection and the adoption of corrective measures for new systems and infrastructures (being simulated via the proper s/w modeling), before these are applied, by means of their evaluation from all aspects, including the investigation of the target users acceptance, leading to potential avoidance

of accidents and unsuccessful investments

IV. CONCLUSION AND RESEARCH PRIORITIES

The priorities outlined above are consistent with those set by the European Commission. EC supports the implementation of such projects that comply with the identified political priorities for the unification of the transeuropean transport networks, as these are expressed through a series of Directives, or studies that are related, for instance, to: The Pan-European adoption of e-Call, the creation of a common service of road users charging, the plans for the GNSS technologies adoption (Directive 2004/52: Interoperability of Electronic road toll systems), the creation of common services for drivers and passengers, accessible by all (according to "Article 169 of the Treaty" and the priorities of the "Ambient Assisted Living" area and the "European Statement of Principles"), GALILEO adoption, the eSafety initiative, the activities of the recently developed 'Agency for ITS implementation', etc.

A series of European Technological Platforms are related to the long-term goals of all transport fields and modes (ACARE for air transport, ERRAC for railway transport, ERTRAC for road transport, WATERBORNE for seaways transport, etc.). ERTRAC is the one related mostly to Road Safety, where relevant research priorities are defined.

According to the author, the most relevant research priorities follow below:

1. Sufficient collection of detailed accident data, based on the current needs in research. Location of accidents should be registered with detail preferably with GPS. Moreover, it has to be stressed out that besides traffic accident data, exposure data are also needed. Through analysis of traffic accidents data will permit the pinpointing of the reasons they occur and result in the adoption of appropriate measures (both policy related as well improvements in the infrastructure). Specifically the following activities should be supported:

- Research for the development of national database that contains information on all accidents that is regularly updated.
- Development of a GIS database that could be used to analyze the occurrence of accidents taking also in account the location, the geometric characteristics of the road, etc.

2. Further research, development and evaluation of advanced passive safety systems for the vehicle, the driver and the environment, which will reduce considerably the severity of accidents and will contribute to their avoidance, as much as possible. In specific, at national level, the following activities should be supported:

- Research for the development of safer road side furniture and passive safety systems for the driver and the vehicle.
- Research for the development of new structural frameworks and the utilisation of new material for the aforementioned and the reduction of the incompatibility between several types of vehicles.
- Evolution of the crash tests requirements and validation of them (via accident analysis, s/w simulations and short term trials in real conditions).
- Evolution and improvement of s/w programs for simulation scenarios (accident/incident scenarios) and for the

structural analysis making use of the new composite materials.

3. The development of integrated ITS solutions, that will result in a more efficient and sustainable use of transportation and to traffic accidents reduction. This will be achieved by means of advanced warning strategies and risk detection, a reliable network of sensors, technological integration of so far independent ADAS and interaction of them with the user. The proposed solutions have to be highly efficient, reliable and contribute to the increase of safety and comfort during driving and also friendly to the environment. Activities to be supported include the development of:

- European Strategic Research, Development, Implementation and Use of ITS, in order to meet national priorities and to achieve multiple benefits.
- European Architecture, common requirements (Quality of Service and Interoperability) and ontologies (databases and web services) for the seamless, interoperable and cost-efficient use of ITS anywhere, any time and from anyone.
- Identification of critical thematic areas of ITS and the establishment of a focused development and application framework per area, via the adoption of "umbrella" projects.
- Deployment of new sensors and the improvement of already existing ones for the most reliable possible perception of the environment and the fulfillment of complex scenarios of use interfering with intersections, interchanges, tracking of vulnerable road users under several traffic conditions (normal, adverse, low visibility conditions, etc.).
- Driver warning strategies, automatic control of the vehicle and interactive user interfaces (with haptic, acoustical, visual channels) as well as of evaluation frameworks for their assessment in Pilot trials and large-scale Field Operation Tests (FOTs).
- Smart parking management systems that permit trip makers to check availability of parking through a centralized parking system and permits them to make reservations in advance, or in real time through a bidding process.

4. Especially, for the cooperative systems area, the development of integrated cooperative systems which will provide advanced, reliable, fast and safe vehicle to vehicle communication and vehicle to infrastructure communication in real time, aiming at the provision of information and warning to the users in time and the automatic or semi-automatic ADAS activation, via localisation and positioning technologies and advanced sensor networks. The proposed solutions need to be financially feasible, aiming at the most limited possible intervention in the existing national infrastructures. In specific, at national level, the following activities should be supported:

- The recording of the cooperative systems applications, the identification of deficiencies and insufficient or complete lack of technological implementation (whenever this is considered necessary from socioeconomic aspects and also technically feasible), the formulation of concrete proposals for the improvement or the full implementation of infrastructure and the determination of the respective short term and long term technological plan.

- The development of a normalised Architecture, common requirements (Quality of Service and Interoperability) and ontologies (databases and web services) for the seamless, interoperable and cost-efficient use of ITS anywhere, any time and from anyone.

- According to the above ITS Architecture, the development and interfacing of traffic and information management centres in urban, extra-urban, rural and interurban networks.

- The development of simulation tools and evaluation platforms, which will allow the technical and socio-economic evaluation of the proposed solutions.

5. The execution of large scale Pilots in simulators and test tracks for the evaluation of ITS applications (addressing also cooperative systems), with regard to the reliability of their performance and their user friendliness and acceptance. In parallel, feasibility studies for the proposed solutions will be conducted in the national and European market. The following activities should be supported:

- Evaluation frameworks and test plans for Pilots (FOTs) impact assessment with regard to safety and the traffic environment, which will include, among others, the experimental and statistical planning and in advance simulation, techniques for the measurements gathering, addressing subjective and objective criteria, methodologies for the selection of the statistical sample, the scenarios of use and the timetables according to scientific methods, methods for the trials conduct and finally the drawing out of quantitative and qualitative conclusions dealing with the expected impacts of the tested and demonstrated applications.

- The compatibility check of ITS applications against the policies set in the areas of Transport and Environmental protection in Europe before their approval and funding.

- Large scale ITS applications Pilots and impact assessment. In specific, for the cooperative systems area, pilots for the evaluation of solutions dealing with vehicle to vehicle and vehicle to infrastructure communication and comparison of them to existing solutions (via s/w for transport micro/macro-modeling) should be encouraged.

In the European Research area, the above Research priorities are already addressed within the relevant Research programmes of DG INFSO, DG RESEARCH and DGTREN; whereas their implementation is under the umbrella of an EC Agency, that develops an 'Action Plan for the deployment of Intelligent Road Transport Systems for more efficient, safer and cleaner transport'.

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