

A STRATEGY FOR EU TRANSPORT SAFETY RESEARCH

- INTRODUCTION

The cost of transport crashes is estimated at around at 2 per cent of the GDP of the European Union – around twice the amount of the annual EU budget for all activity. Road crashes are the largest single cause of death for EU citizens under 45 years. One in three citizens will require hospital treatment during their lifetime following a road crash. Individual public transport tragedies are a major source of public concern.

Preventing death and disabling injury entails a transport system that is better adapted to the needs, errors and physical vulnerabilities of its users rather than one which expects users to cope with increasingly demanding conditions. It means working to reduce crash injury risk, mitigating the severity of injuries when accidents occur and trying to reduce the long term consequences of injuries through better post impact care. This involves addressing the design, interface, and operation of all aspects of the traffic system – vehicles, users and infrastructure. This holistic approach requires action at all levels of government – EU, national, regional and local levels and shared responsibility between public and private sectors.

In view of the size of this challenge to policymakers in EU countries and the need to increase knowledge about successful interventions, safety has to be at least an equal consideration to mobility and environmental considerations in EU transport research policy.

To date, transport safety research has been dealt with in a fragmentary way in EU research programmes, within the Transport Directorate's own programmes and in the programmes of other Directorates. It has received too low a level of support in EU research programmes. Projects need to attract a 100% level of Community funding to encourage participation by those who do not have a stake in the financial consequences of the research.

Transport safety research objectives need to be set for 6th Framework giving priority to areas where the casualty reduction benefit is high, where the Community can act to add value and where the implementation possibilities are good.

In view of the fact that over 90% of the costs and deaths in transport accidents occur in road transport, priority is given in this document to road safety research priorities.

- CROSS MODAL SAFETY RESEARCH

1. Safety impact assessment of transport policies

Safety-related research is not confined to research concerned explicitly with particular aspects of modal safety. On the contrary, all substantial policy initiatives related to the rebalancing of transport modes or to transport for citizens should be subject to safety impact assessment.

For this purpose, the ideas of safety impact assessment of transport infrastructure and programmes need to be explored further. Research is needed to develop a robust procedure for this purpose that will win cross-modal and cross-national acceptance; this

will involve among other things a technique for the assessment of risk for whole journeys or goods movements irrespective of how many or few different modes of transport are used in making them. Tools need to be developed, as a priority, for the safety impact assessment of changes in land use planning, urban planning and investments in the road transport sector.

2. Transport accident costs

Recent Commission Communications eg on road safety, have highlighted the importance of the socio-economic dimension in traffic safety work. However, there is still a wide variation in methodologies and insufficient information for the valuation of preventing fatalities and injuries on both road and the non-road modes across the European Union.

Studies are needed to collect data on the value of human life and the willingness to pay for safety measures for the road transport mode in countries where these data do not yet exist, as well as for the non-road transport modes. Acquiring data on the non-road modes requires very specialised and well designed surveys because the risks are small, and there are difficulties in envisaging or calculating very small probabilities.

Such research will contribute to more precise estimates for the costs of fatalities and serious injuries (including human suffering due to disabilities) in transport accidents, and provide underpinning for an economically rational allocation of resources to reduction of risk in transport.

3. Defining acceptable levels of accident and injury risk

In relation to the availability of transport to the citizen, to what extent is it acceptable for:

- people to expose themselves to risk?
- people to expose their close associates to risk?
- people to expose others to risk?
- organisations to expose their customers or employees to risk?
- organisations to expose others to risk?

The answers are relevant not only to increasing the effectiveness of safety measures where the risks are higher than is acceptable, but also to understanding when to stop imposing further costs for the sake of further reductions in risks that are already very small indeed.

4. Encouraging use of the safer modes of travel and safer trips

<u>Deaths per 100 million persons km ETSC (1999)</u>	
Motorcycle/moped	16
Foot	7.5
Cycle	6.3
Car	0.8
Bus and coach	0.08
All road use	1.1
Ferry	0.33
Air (public transport)	0.08
Rail	0.04

There are substantial differences between the safety of the different the modes of travel. Within road transport the highest death rate by far is for the two wheeled motor vehicle users. Motorcycle or moped travel death risk is 20 times higher than for car travel. Car travel is ten times safer than walking, but is also ten times less safe than bus travel. How much do people know about the safety of the different modes. Do people think about safety when they can choose between travel modes? How can use of the safer modes be encouraged? What are the issues which need to be addressed in seeking safer trips which combine several different travel modes? How can the safety of combining different modes be improved? Community research is needed in all these areas.

5. Transport safety performance indicators

For decades, the concept of utilising indicators for the continuous monitoring and analysis of processes has been standard practice in industrial quality management. The safety community should exploit this simple and robust concept. Once introduced and established for all the transport modes, the application of safety performance indicators will further stimulate safety work and thus reduce crash rates across Europe.

At EU level, a scientifically established set of safety indicators for all transport modes needs to be established. These are defined as any measurement that is causally related to crashes or injuries, used in addition to a count of crashes or injuries, in order to indicate safety performance or understand the process that leads to accidents. At the same time, recommendations should be developed concerning harmonised methodologies for sampling to estimate the indicators, and for application of the indicators in the development and monitoring of safety programmes.

Further research is needed into running and benchmarking integrated road safety management programmes, with a view to the causal relationships between safety performance indicators and crashes or injuries.

For the non-road transport modes, there is a need to develop a comprehensive set of performance indicators covering the whole sector and to use that information to improve safety and for more transparent and rational decision making. This requires a generally accepted model of why accidents occur and how to prevent them effectively and efficiently. It is recommended that such a model is developed and that performance indicators are derived from it.

6. Design of elderly road user friendly urban transport systems

Elderly road users face a disproportionately high fatal and serious injury risk as a result of their physical vulnerability. With the very large increases in elderly road users projected over the next twenty years, it is important that transport systems are made safer for elderly people in the context of policies to enable them to maintain as nearly as is practicable and for as long as is practicable the levels of access and mobility enjoyed by younger people.

7. Research into the role of fatigue in transport accidents

Research is necessary into the role of fatigue in transport safety. In particular, to quantify more precisely the incidence of fatigue-related crashes and then to identify the associated social, economic and commercial costs. Furthermore, there is a need for greater understanding of both the parameters that govern the influence of fatigue and to evaluate the effectiveness of regulatory interventions and other countermeasures in reducing fatigue-related accidents

- ROAD SAFETY RESEARCH

According to Commission figures during the first call for the 4th Framework Programme only 2 per cent of the 1050 MECU allocated to transport went to road safety research. Only 6 per cent of the allocation realised for transport safety went to road safety research, despite the fact that road accidents bear around 97 per cent of the socio-economic cost of transport accidents (ETSC 1997). Research is required in all the main strategic fields. Research towards the development and improvement of vehicle safety standards for EU Whole Vehicle Type Approval, an exclusive EU responsibility, is particularly important.

- **Establishment of data systems:** The lack of disaggregated exposure data has been a major obstacle to the understanding of casualty levels and trends. Research is needed urgently towards an EU system for exposure data. Economical but statistically sound techniques of survey and analysis need to be developed and tested for
 - comparing the risks of travel on foot or by cycle with those of realistic travel alternatives in a range of specific situations;
 - monitoring the amounts of walking and cycling locally in urban areas;
 - assessing patterns of potential movement on foot or bicycle in each part of an urban area.

In addition, in respect of the use of motor vehicles, for which techniques for measuring exposure to risk are quite highly developed, these techniques need to be harmonised across the EU so as to yield comparable data on the basis of adoption of agreed best practice by each Member State.

There is also an urgent need to establish the extent of underreporting of accidents and casualties in different Member States for different casualty and accident types and to develop techniques for filling the resulting gaps in the picture of risk of accident, injury and death with the most accurate practicable estimates using data from hospital records, insurance claims and other sources, taking full account of the respective shortcomings of these other sources of data and the difficulty of accessing them reliably and systematically.

The ETSC 1993 vehicle safety report concluded that the absence of an injury causation database at EU level had been a major obstacle to progress. Eight years on it is still the case that crashes are investigated in-depth and by independent researchers in too few Member States. There is a need to have a more representative view of what is going on across the EU. Having agreed research protocols for in-depth injury causation work, the STAIRS group recommended recently that a new monitoring system should be set up to provide data on the causes of injuries in crashes and the role of the vehicle in preventing or minimising them. ETSC hopes that the Commission will support this recommendation and provide the necessary funding.

- **Crash prevention measures:**

Continued research is needed on methods of influencing road user behaviour through modification of the road environment, the vehicle and through driver qualification, information and education, training and enforcement to minimise human error.

Driver training and testing Fundamental research is needed to improve understanding of the process of learning to drive to provide a scientific basis for the development of effective training and testing.

Police enforcement Further research is needed to understand the effectiveness, efficiency, time-halo and distance halo effects of police enforcement activity and the relationship between enforcement and publicity.

Intelligent Speed Adaptation The most important concept in applying new information and communication technologies for crash prevention is Intelligent Speed Adaptation (ISA). ISA is the global name for systems that “know” the permitted maximum speed and use that knowledge to inform the driver and/or to intervene in the vehicle’s control to prevent the vehicle from being driven faster than the permitted limit. Continued research and development needs to take place towards agreement on standards for such aspects as the road maps, driver interface, vehicle control and, for Dynamic ISA communications.

Intelligent driver impairment systems

Further work is required to develop practical driver impairment systems and to understand their effectiveness and acceptability. Consideration should be given in developing such systems in combination with an electronic driving licence system.

HMI issues

In-car devices that demand attention from the driver technology, especially information technology, is advancing so rapidly that in-car devices to inform or entertain the driver or to provide the opportunity to progress other tasks while driving are evolving faster than their implications for safe driving can be assessed and regulations on their installation and use can be developed where safety is threatened. This calls for an ongoing programme of investigation of compatibility between capability to drive safely and the operation of such devices, based on generic demands that devices make on drivers’ attention rather than upon the characteristics of particular devices that happen to become available. In this way, an effective framework might be developed within which suppliers of devices could develop them in confidence that use of the devices they develop will be consistent with safe driving.

Road safety engineering

- **Speed management in rural areas**

Most fatally injured road users are killed in accidents on rural roads. Speed is a very important factor. How can speed be managed in an acceptable way outside urban areas? Setting up a framework for development and implementation of speed planning programmes for rural roads as well as development of effective speed management measures are needed. Some EU Member States are dealing with this problem and a EU research programme on this topic will be of great importance.

- Road design and road user behaviour

Much more needs to be known about the relationship between “Road design principles” and “Road user behaviour” and the influence on road safety. It is indeed a very complex research area – and the need for more research is strengthened by the strong trend towards an ageing population in the EU. How can we design the road network in a way to be able to guide the road users through in a safe and comfortable manner.

- “Distractors” and information overload in the road environment.

A lot of information in the road network addressed to drivers is useless and does not offer support to the drivers. In some cases it might even be confusing and make it more difficult for drivers to select the necessary information for safe and effective driving through the road network. How can the road be made self-explaining to drivers without creating information overload?

- Injury reduction measures:

Improvements in vehicle crash protection have delivered large reductions in road user injury. A study by the UK Transport Research Laboratory has estimated that it has contributed around a 15 per cent reduction in injury since the 1980s, a far higher contribution than any other type of measures such as road safety engineering or measures to reduce driver impairment. Since most vehicle safety legislation in the Single Market is agreed at EU level, this area is particularly important for Community research.

Specification for smart audible seat belt warning devices

Studies from Sweden and Australia have shown that by installing audible and visual seat belt reminder systems, belt use could be increased to at least 95%. An EEVC Working Group is currently working on a test specification for seat belt reminder systems and this work should continue to be supported towards mandatory adoption in EU Type Approval.

Car frontal and side impact compatibility and advanced protection

Protection in side impacts needs to be made effective at higher severities and for occupants on the side of the vehicle further from the impact. Research should be carried out to determine the best method of increasing the severity of the side impact test to be more able to address the accident problem.

Greater understanding of “whiplash” injuries, their causes and prevention

In Sweden approximately 60% of all injuries leading to long-term disability from car crashes are AIS1 neck injuries, often called whiplash injuries. Of all reported whiplash injuries, between 5% and 10% lead to long-term disability. While from an epidemiological standpoint reducing whiplash injuries is a key action of major importance, there is still no consensus concerning injury mechanisms and, thus, effective countermeasures. In view of the importance of these injuries, continuing research at EU level should be a priority action.

Measures to improve motorcycle leg and upper torso protection

In view of the very high accident risks of motorcyclists and social costs of disabling injury, an EU research programme is urgently needed to develop the following areas:

- Better seating positions with a relatively high seat elevation and upright body position to reduce the possibilities for lower leg entrapment on impact
- Leg protection to protect the wearer from the impact of external forces and to serve as an element that affects the trajectory in a positive way
- Supporting the path of movement and cushioning the impact by means of suitable airbags

Criteria and instrumentation for frontal impact injury to the abdomen and knees

Research is needed to develop criteria and instrumentation to assess the risk of injury to the abdomen and knees.

Performance and concerns regarding European air bags

Frontal driver airbags are now standard on almost all European cars. Frontal passenger airbags are mainly standard in some countries and an option in others. Side airbags are optional or limited to top-of-the-line models. It is necessary that "smart" airbags be introduced to address the problems associated with the interaction between passenger airbags and children who are 'out-of-position'. Furthermore, ETSC recognises the need to improve the protection offered by restraints. There is a wide range of users and crash conditions and there is recognition that a restraint, such as an airbag, that can modify its crash characteristics in response to the particular crash conditions may have benefits over a conventional restraint system. ETSC recommends that the casualty reduction effect of a variety of types of restraints be assessed with the aim of fitting the most effective systems into vehicles as soon as possible.

Development of advanced intelligent restraints

There is much scope for seats and belts to adapt to different sizes and weights of occupants and research is needed to find ways of realising this potential.

Front underrun protection for heavy goods vehicles

In view of the large casualty reduction benefits, the development of a test specification for energy-absorbing front underrun protection is needed towards a mandatory fitment requirement.

More comprehensive biomechanical data, injury performance criteria and improved crash dummies

Biomechanical research focuses on human response and injuries sustained in crash conditions taking into account the variety of occupant-vehicle interactions seen in real world accidents. Up-to-date biomechanical knowledge is important to understand the efficacy of passive safety measures in vehicles and to help improve these measures. The foundation of biomechanics research continues to lie in pulling together the human response and injury data required to develop tools such as crash test dummies and computer models. Important areas of research are biomechanics of children, head injuries, human-airbag interaction and whiplash injury. In parallel, further attention needs to be paid to methodology development such as advanced scaling techniques and human tissue characterisation. Updated and renewed biomechanical insight will have to find its way more quickly into the design of new crash test dummies.

Pedestrian head protection measures for the windscreen surround

Further research on head injuries caused by the windscreen surround towards the further upgrading of EEVC WG 17 test methods is needed.

Specifications for on-board crash recorders for all motor vehicles

Develop specifications for the fitment of on-board crash recorders on all motor vehicles. This would reveal important information about impact severity and aid the development of restraints and other safety features.

- **Post-accident care:**

Post accident care is an effective strategy which aims to reduce death and the onset of disabling conditions within minutes of the crash occurring. The need to obtain new knowledge is urgently required to develop and evaluate best practice procedures. In particular a system for the uniform reporting on injury severity and outcome needs to be established which would contribute to the optimisation of trauma care systems. In addition an EU standard for GPS based warning of accidents needs to be developed.

- **Road safety management:**

Monitoring needs to be carried out of the different approaches to road safety planning in different Member States and the characteristics and effects of targeted road safety programmes. Research should also be carried out examining the organisation of road safety activity between central and local government, and examining which of the various institutional arrangements can be helpful.

In addition, it is necessary to explore the public acceptability of different ways of managing road use in the interests of safety, and how their acceptability might be improved. For example, what are the principal obstacles delaying or preventing implementation of safety measures (especially road safety measures) that are known to be cost-effective even after the full costs of any inconvenience they impose on people has been taken into account. How have obstacles been overcome in the past, to what extent can the same methods overcome present obstacles, and what further methods can be found to tackle present obstacles?

- **AIR SAFETY RESEARCH**

Preventing accidents

EU research is needed to address the following areas:

- Improved operational procedures and situational awareness
- Better crew selection and training
- New technological aids to the crew to identify and avoid reduced safety situations
- Procedures for assessment of safety impact on new technologies
- Preventing cumulative fatigue in flight operations

New operational concepts

The need to reduce environmental impact and the demand for increased air transport system capacity will inevitably lead to new concepts of operation that will potentially have an impact on safety. Research is needed to ensure that such concepts can be implemented efficiently, effectively and, above all, safely.

Injury causation in air accidents

While about 40 per cent of air transport fatalities worldwide die in technically survivable air accidents, relatively little attention has been given to date to independent assessment in EU research of the potential for better survivability design in new aircraft.

Systematic information on injury causation should guide EU air crash protection policies. Steps should be taken as soon as possible to establish EU mechanisms for the collection and analysis of such information.

Preventing and mitigating the effects of fire and smoke

- ◆ Safe operation of external camera/cockpit monitors
- ◆ Ergonomic study of stowage and accessibility, and suitability to an acceptable proportion of passengers of smoke hoods in all commercial aircraft;
- ◆ Watermist systems in new types of commercial aircraft
- ◆ Fire protection in Very Large Aircraft

Emergency evacuation

- ◆ Evacuation from wide bodied airframes;
- ◆ Finding ways to reduce the interference of the noise of water spray systems with cabin crew members' oral commands;
- ◆ Determining optimal technical specifications for additional tactile cues in the cabin to assist passengers evacuating when visibility is poor;
- ◆ Evaluation of new technologies for the presentation of safety information to passengers, such as airport training mock-ups.

Impact protection

The appropriate development work towards international standards should be carried out as soon as possible to:

- ◆ Improve seat-floor strength;
- ◆ Occupant restraint issues
- ◆ Improve the strength of overhead stowage.
- ◆ Determine impact protection needs in Very Large Aircraft

- AIRPORT SAFETY RESEARCH

Effective policy making on several of the safety concerns identified in this paper is impeded by a lack of essential knowledge. In order to bridge those gaps in knowledge the following issues require further research:

- ◆ The establishment of common methods and tolerability criteria for third party risk.
- ◆ The development of adequate methods and models to incorporate the role of human operator and procedural aspects in formal safety assessments.
- ◆ The safety aspects of new technologies such as enhanced and synthetic vision systems, Head Up displays for civil cockpits.
- ◆ Airport wind and turbulence environments and their dynamic effects on aircraft in take-off or landing
- ◆ The operation of safety systems in a multi-organisational environment
- ◆ Methods of analysis of organisational precursors of accidents and incidents
- ◆ Evaluation of planning for disasters

- **MARITIME SAFETY RESEARCH**

- ◆ Further study is urgently required concerning the relationship between the individual seaman and his environment onboard and factors adversely affecting safety. Examples include human behaviour and stress impact onboard high-speed surface craft and low-manned vessels, the impact of language barriers onboard, and work to enhance understanding of the occurrence and causes of fatigue, and its effect on performance and accident causation in maritime shipping
- ◆ Impact on safety at sea of (recent international) regulatory safety measures
- ◆ Development of a risk analysis programme for EU maritime transport safety.
- ◆ Survivability in high speed craft.
- ◆ Current stability requirements for ro-ro ferries state that ships should be able to stay afloat with 50 cm water on the deck. However, research is needed to find out how the stability of ro-ro ferries can be optimised further. To this end, the use of dynamic, rather than static simulation is essential and ETSC recommends that EC research is carried out in this area as soon as possible.
- ◆ Research into ship equipment aboard low-manning ships and high speed ferries;
- ◆ Continuation of research into advanced technologies and HMI.
- ◆ Research needs to be continued in the area of information and telematic technology which provides real-time details on the position and safety condition of vessels and in the area of emergency response decision support systems.

- **RAIL SAFETY RESEARCH**

The European Commission is becoming far more involved in railways than in the past, and this justifies more European-level research. The primary purpose of EC intervention is not currently safety, but to improve the competitiveness of railways relative to other modes, specifically by improving the ease with which passenger and freight trains can cross national borders, and by creating a single market for railway equipment. However, there is a desire to improve safety as part of the intervention. The two key Directives are the Interoperability Directives 96/48/EC for High-Speed lines and 2001/16/EC for conventional lines. Both Directives are supported by Technical Standards for Interoperability (TSIs); the TSIs for High Speed lines are almost complete, and those for conventional lines are now being developed. Although not primarily concerned with safety, they do have safety implications, and they inevitably increase the involvement of the EU with railway safety matters.

Later this year, the EC is expected to bring forwards a Railway Safety Directive, which will cover a variety of matters, including the promotion of harmonised and transparent risk-based safety acceptance criteria, common methods of risk assessment, and independent accident investigation.

A prime need in EU rail safety research is for the assembly and analysis of accident data at the European level. Much of these data already exist at the national level, but there are no satisfactory analyses at the European level. Such data are needed not only to support the European-level policy initiatives, but also to enable the national railways to learn from each others' experience with regard to common problems, such as level crossings or trespassers. The recent statistical regulations will assist with the provision of statistics, but it is not retrospective, and it will not provide an accident database.

More detailed research is needed into the nature of the differences between the various national railway safety requirements, the extent to which they are compatible or incompatible, and the scope for cost-effective harmonisation measures to improve safety.

Research on risk assessment methodologies for use on railways, including cost benefit analysis, and learning from the methods used both in other transport modes, and in other European regulated industries such as the process industries is required.

ETSC
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