# A GLOBAL PERSPECTIVE ON ROAD SAFETY ANDTECHNOLOGY

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**Background**

The Organization for Economic Cooperation and Development (OECD) represents the 30 wealthiest countries in the world. OECD maintains a Transport Research Program to examine issues that are of interest to the member countries. In 2000, they formed a an expert Group to examine road safety and technology. The expert group was composed of 37 members representing 20 Countries, 2 Automobile Manufacturers, and the European Council of Ministers of Transport. The members had a variety of backgrounds including Engineers (automotive, civil & electrical), Psychologists/Human Factors Experts, and ITS and Safety Specialists.

Road crashes exact a tremendous human and societal toll in OECD member countries. Each year, more than 125,000 people are killed in these crashes and millions more injured, many of them permanently. The cost of the road safety problem in the OECD amounts to 2 percent or more of gross domestic product (GDP). Clearly, this problem deserves and receives attention in the Member countries.

Recently, much attention has been paid to the development of intelligent transport systems (ITS) that can improve the safety and efficiency of road transport while improving user comfort and convenience. All OECD member countries have been involved in developing or deploying these technologies to some extent. As this process has moved forward, a great deal of information has been developed concerning the benefits that can be realised over time with the full deployment of ITS. Among other things, safety benefits have been measured or estimated for a wide variety of technologies. This paper summarises the current international perspective concerning the ability of ITS to address the road safety situation in the member countries as captured in the final report of the expert group.

In addition to ITS technologies that improve road safety, considerable development has also gone into advanced traveller information systems and convenience and entertainment systems. The global market for in-vehicle devices will exceed USD 40 billion by 2010. These technologies can have a considerable impact on road safety and are outlined in this paper.

**Deployment of new technologies - benefits**

Most OECD countries suffer from similar safety problems. In particular, run-off-the road, intersection and head-on crashes are the main crash types of concern in the OECD countries. As well, the countries share a common set of factors that contribute heavily to all of the crash types. Specifically, distraction, fatigue, alcohol, speed, and seat belt usage patterns all play a role in the crash scenarios of the countries. As a result, there is a generally common expectation among the countries that four types of technology (collision avoidance, driver status and performance, speed control, and automated enforcement) offer the greatest potential for lessening the number or severity of road crashes.

Specific types of collision avoidance systems under development include autonomous vehicle-based warning and control systems addressing frontal, rear end and roadway departure crashes. Vehicle-infrastructure cooperative systems have been demonstrated that warn drivers, by means of in-vehicle displays or automated road warning signs of potential intersection conflicts with other vehicles as well as pedestrians.

Driver status and performance systems are in development that can sense fatigue and distraction from the driving task, and provide a warning to the driver, based on analysing video images of the driver's eyes or control movements. Intelligent seat belt systems that adjust the response of seat belt and air bag systems according to the presence, posture and size of vehicle occupants are in production.

Speed governors have been commonplace on commercial vehicles for many years, but provide only one fixed limit. New technologies can provide speed control over a range of operating speeds and are adaptable to all vehicle types. Adaptive cruise control maintains a constant time headway between vehicles in traffic; intelligent speed adaptation can limit the vehicle speed in response to changing speed limits on different roadways. ACC is available on several production passenger cars and heavy trucks, while research on ISA is on-going.

Automated enforcement measures include the well-known "red light" cameras used to identify vehicles that violate traffic controls at intersections. Safety at railway crossings is receiving attention with the development of systems to warn drivers when action is needed to avoid collision with trains.

It is also recognized that safety problems specific to (or more serious among) heavy goods vehicles, including roll stability, braking performance and driver fatigue, present particular opportunities and challenges for new technology applications. Significant research on heavy truck ITS issues is underway.

These and other technologies are described in detail in the report[1] and evaluation results are included where these have been carried out. Based on the available data documented in the report, ITS safety technologies have the potential to dramatically impact road safety in OECD countries. Using only conservative estimates, the following outcomes are possible:

- ITS safety technologies can save as many as 47,000 lives per year in the OECD countries.

- ITS safety technologies can potentially reduce the total number of road crash injuries and fatalities by approximately 40 percent.

- The cost savings associated with the reduction in fatalities alone can conservatively be placed at over USD 73 billion per year.

- The savings related to a 40 percent reduction in injuries and fatalities would be approximately USD 194 billion annually.

The benefits outlined here and the resulting reduction in crashes, injuries and fatalities assumes these technologies are fully deployed in OECD countries. Thus, the benefits outlined here may not be realised for another 20 or 30 years. However, the mere indication that such

[1] OECD (2003) *Road Safety – Impact of New Technologies*, OECD, Paris. (To be published Fall 2003.)

benefits can be realised should spur the OECD governments to actively support and promote full deployment of as many of these safety technologies as possible.

## Deployment Challenges

These optimistic figures must be tempered, however, by the potential side effects or drawbacks that could result from implementation of new technologies that are not safety related. The primary concern with these technologies is that they may distract the driver from the driving task. Governments are urged to aggressively resist the unregulated proliferation of technologies that will further distract the driver or otherwise worsen road safety.

### *Funding*

Attaining the benefits suggested in the report is possible, but several challenges remain before these benefits are fully realised. The most basic of these challenges is financial: the high cost of new safety systems being the primary constraint. This creates a barrier to implementation in that it prevents most consumers from purchasing the new technology. This can be overcome in time by market forces if the technologies truly provide a quantifiable benefit to the consumer and if the prices decline as a result of increased production and further technological development.

Many countries already lack budgets for fundamental safety technology investments, much less budgets for newer, untried technologies. This can lead to a lack of political will to fully pursue technologies that can make a difference. Though there are efforts in countries to overcome these challenges, more promotion and outreach is called for.

### *Evaluation*

As with any new technology or approach, there may be unknown risks or disbenefits associated with their use. Many technologies introduced in the past (*e.g.* airbags or seat belts) made a difference early even though they had technical drawbacks that led to some problems. As more knowledge was gained, adaptation of the technology occurred and the safety record improved even further. Sometimes this knowledge was gained reactively – *i.e.* from complaints or negative reports from safety agencies – rather than proactively – *i.e.* creating an evaluation plan and carrying it out over a long period of time. Clearly, the latter approach is preferred. It is therefore essential to plan and maintain a focussed ongoing evaluation program to monitor the continuing performance of ITS safety technologies.

### *Driver training and licensing*

One of the large deployment challenges revolves around responsibility. The primary responsibility for ensuring that safety benefits are attained or that systems are used properly resides with the driver. From this standpoint driver training is considered vital to ensure that drivers are not overwhelmed by systems, are aware of the capabilities and limitations of systems and are assured of the role that they play in managing the technology. This may be particularly important because the impact of driver behaviour could become more rather than less important in future traffic scenarios with technology.

Driver training should lead to appropriate licensing. Greater consideration needs to be given to driver license testing to ensure that a person is capable of managing a vehicle as well as the information they will potentially receive. With most OECD countries facing a significant increase in the older driver population, tailored training may be useful to help unlearn some habits and to better learn new habits. This type of training is good for all drivers who have been driving some time. Younger drivers may also experience special challenges with new technologies. In both of these cases, one aspect of the technology is to ensure that the systems are understandable and simple to use.

***Liability issues***

Problems regarding product liability are likely to occur with assistance systems that cannot be overruled by the driver or which intervene beyond human performance limits (*e.g.* anti-collision systems). There are two possible alternatives to dealing with this issue. The first is to allow uncontrolled deployment of new technology trusting to product liability controls to ensure products, primarily produced by manufacturers to sell vehicles, are safe. Another alternative is to try to influence deployment, promote technology that promises improved road safety, minimise the effects of inappropriate technology, and educate the driver to take full advantage of the existence of affordable electronics.

The former approach risks certain technologies will never be developed, despite enormous potential safety benefits. Manufacturers may consider that certain systems will make their products less attractive and may, therefore, quote legal and product liability obstacles to the introduction of such systems even when they do not exist. The latter approach runs the risk of stifling invention by introducing inflexible regulation based on insufficient proof. The challenge is, therefore, for liability issues to be overcome by finding a balance between the two alternatives such that manufacturers pursue invention and other promising technologies are promoted and deployed.

***Infrastructure issues***

Another deployment challenge is the need to introduce a robust infrastructure, enabling architectural and standards platforms. Robust infrastructure, for example, accommodates older vehicles, interfaces with existing infrastructure, requires minor training, is fault tolerant, and fails in a safe manner. In the first instance, this challenge centres on making appropriate architectural decisions that take account of and facilitate introduction and integration of ITS safety technologies. Most countries have approaches in place for establishing ITS architectures. Explicit attention and information on safety-related ITS needs to be incorporated into architectures to ensure that deployment is facilitated. As with any ITS technology, standardisation is also essential to successful deployment and use of safety technologies. Standardisation can aid in both the broadest and quickest penetration of the vehicle fleet and road system by ITS safety technologies. It can also contribute to global efficiencies in production – vehicles, etcetera – of either complete or component products that are essential for ITS safety deployment. Without such standardisation, there are many questions related to assurance that systems will behave as expected when they are needed most. Again, explicit attention to safety and the unique issues presented by safety technologies in the development of standards is called for.

Another infrastructure related issue that could be a core element of effective deployment of ITS safety technologies is digital maps of highway networks and location-identifying infrastructure. Digital maps and the infrastructure will form the core of many ITS safety applications and the current quality of these maps, where they exist, is insufficient for effective safety applications. The lack of quality maps and the location-identification environment is a major obstacle to deployment. Country-wide and regional efforts to develop consistent digital maps are strongly supported. These should form a basis and impetus for rapid development and deployment of certain safety technologies.

*Training of safety professionals and outreach*

There is a specific need to provide training to ITS and safety professionals in the OECD member countries. Such training should raise awareness of the possibilities of technology to address road safety and generate cross-speciality understanding (*i.e.* road safety professionals understanding ITS and vice versa). In addition, training would stimulate increased co-operation and, ultimately, accelerate the acceptance of ITS and the adoption of specific, available ITS technologies as workable countermeasures for safety. Some examples exist of this type of training and international co-operation and information sharing is encouraged.

One aspect of this issue is to understand the role of manufacturers and ultimately, their responsibilities. A mutual understanding between manufacturers and public officials on which technologies are most likely to serve the interests of road safety will ensure arguments related to liability and risk can be addressed early, appropriate architectures and standards can be created and technologies will be rapidly developed and deployed. Training that targets the private sector and facilitates dialogue on issues of relevance to both the public and private sectors is recommended.

*Research and development*

A critical aspect of successful deployment is a commitment to carry out targeted research and development. This includes developing outreach programs to communicate information on technologies and their benefits and better understand how to make systems simple and understandable. Other areas for research and development include human factors issues, various individual technologies, legal issues and ongoing technology evaluations. Another critical issue for research and development is related to data. Specifically, better knowledge and understanding about safety data and evaluation would be desirable because it can lead to the development of technologies that better target specific crash causes. As well, a focus on better storage and use of archival data generated by ITS technologies could lead to overall better safety systems and countermeasures.

## What Governments Can Do

It is often stated that the best thing for technological development is to reduce or eliminate the government's role as it will have the negative consequence of stifling development. However, private companies are developing and promoting the use of such things as fax machines, internet access, games and video/entertainment systems for use in vehicles. These developments are taking place without governmental links and pose a real risk of increasing driver distraction and task load. The ultimate effect on road safety, though not certain, is predictable. The introduction of non-safety ITS systems can pose a similar risk if the systems are not designed with the safety of the driver in mind. In both cases, the introduction of after-market technologies or products poses the greatest challenge.

The natural role of Government in preserving and protecting the safety of road transport operations leads to a certain conclusion that a "do nothing" posture by Governments in the face of technological development and deployment is not appropriate. The following tactics are suggested:

1. Development and use of safety performance indicators for ITS and other technologies for use in vehicles. The report provides a starting point for the types of indicators that could be used and the rational for such indicators. The use of indicators will also support the

recommendation by the group for governments to stress ongoing evaluation of technologies and their deployment from a safety standpoint.

2. The introduction of new technologies should be managed by ensuring they are part of national safety plans and strategies. Such an approach assures a high level of government commitment to the safety focus and stresses the importance of the technologies in question. Managing the introduction of technologies requires standardised processes to achieve the full safety benefits inherent in the technologies. Achieving these results would mean that development takes place in a highly focussed way that targets the most important technologies first. These processes will also encourage co-operation and communication across non-traditional lines in the road transport agencies, among ITS specialists, safety specialists, maintenance offices and others who will have new responsibilities and require new skills for successful deployment.

3. Basic infrastructure needs to be provided by governments to ensure the most rapid and successful deployment of ITS safety technologies. One example of this is digital highway system maps and the location-identifying infrastructure that can motivate the development and deployment of safety technologies. Other examples might be any roadside hardware or technology that would eventually be needed for vehicle/infrastructure co-operative systems. The presence of such hardware can in itself be a motivation for technological innovation and deployment.

4. Governments should encourage and fund targeted research and development on specific safety technologies, particularly where the private sector is not involved.

5. Governments should be involved to ensure new products have real safety benefits and are not unsafe. Whether such involvement comes in the form of standards setting, product testing, research or otherwise, is less important at this stage then the acknowledgement of the role and a commitment to fill that role. For instance, human-machine interface issues are real vis-à-vis distraction and call very strongly for government involvement.[2] Governments should therefore note the statements of principles referenced in the report and endorse or support their adoption. Another example from the report is the emphasis that should be placed on ensuring that ITS safety systems fail logically so that the driver is aware of the failure and can take appropriate action without relying on the technology.

6. Governments should be setting priorities for the deployment of infrastructure-related technologies that will facilitate more rapid technological development and deployment by the private sector and other independent sources.

7. Government should take the lead in outreach and education for communities and decision-makers to ensure that the public, governmental leaders and elected officials will fully support ITS safety deployments.

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[2] A comprehensive description of concerns surrounding HMI issues with ITS systems is contained in Transport Canada's current discussion document, *Strategies for Reducing Driver Distraction from In-Vehicle Telematics Devices,* TP 14133, June 2003, available at http://www.tc.gc.ca/roadsafety/tp/tp14133/en/menu.htm.

8. Governments should lead the effort for ongoing international co-operation in the development and dissemination of architectures and standards that will lead to regional harmonisation as needed or global harmonisation when called for.

## A Framework for Action

The recommendations captured in the OECD report form a framework within which governments can begin to examine the possibilities and directions for ITS technologies to be developed and deployed for safety. This information should be used to augment existing national safety action plans in individual countries and to spur the development of new actions and plans by individual countries or across international borders. Ultimately, these actions will drive further development and deployment and assist all countries in achieving our common aim, namely, to save lives.