



**Final Report
and
Recommendations of the
Implementation Road Map
Working Group**

18 October 2005

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LEGAL NOTICE

Legal notice by the European Communities, Information Society Directorate-General

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EXECUTIVE SUMMARY

The Road Map Working Group of the eSafety Forum commenced its activities in July 2003. The objectives of the Road Map Working Group were originally set by the steering group and further detailed at the first meeting of the Working Group on 18th of July 2003 by the working group members. The objectives were the following:

1. To identify the technical and economical potentials of the industry as well as the topics and time table for infrastructure improvements by the public sector with regard to eSafety systems capable of affecting road fatalities in Europe by 2010
2. To develop regularly reviewed road map which focuses technological steps and economic implication models for introduction of intelligent integrated road safety systems as well as the required improvements in road and information infrastructure

After a collection period for all available information and sources concerning eSafety relevant systems, a suitable structure was found in defining vehicle based systems as well as infrastructure based systems and combined solutions like eCall.

The evaluation of these different systems has reflected the following aspects:

- Accidents / fatalities to be affected
- % change in accidents expected
- other side effects / comfort functions
- cost of in-vehicle systems
- cost for infrastructure systems (investment / maintenance)
- cost for information infrastructure (investment / maintenance)
- year of technical readiness
- year of implementation readiness
- user acceptance and willingness to pay for
- year of implementation by regulation
- specific implementation issues
- estimation of cars equipped with at 2010 / 2020
- other actors involved for implementation

Not all questions could be appropriately answered but it was possible to create a table of generally prioritized systems which will have a reasonable impact of the number of fatalities and with a reasonable deployment for the timeframe which is on focus.

The priority vehicle based systems are :

ESP (Electronic Stability Program)
Blind spot monitoring
Adaptive head lights
Obstacle & collision warning
Lane departure warning

The priority infrastructure-related systems are:

eCall
Extended environmental information (Extended FCD)
RTTI (Real-time Travel and Traffic Information)
Dynamic traffic management
Local danger warning
Speed Alert

One key question is how to promote the deployment rate of these systems in future. There are also differences in feasibility between vehicle-based systems and more infrastructure / or mixed systems within the business case. Different incentives are likely to enhance the customer awareness for eSafety features. For each priority system, two market penetration forecasts were estimated, one based on “business as usual” conditions and the other based on incentives and other measures to promote the deployment of the system.

The potential safety effects of the systems were estimated based on research as well as expert assessments using German accident statistics and the European CARE accident data base.

The following recommendations were given for in-vehicle systems:

- a. The automobile industry, European Commission, the Member States and other stakeholders should enhance the customer awareness of the safety benefits of such systems in vehicles through well structured and harmonized European campaigns
- b. The Member States and insurance companies should give financial/fiscal incentives to customers to buy vehicles equipped with such systems. For this purpose, the discussion should start without further delay to clarify the possibility for incentives given by insurance companies or public agencies.
- c. All stakeholders should develop feasible sustainable business models for each application on the principle that those who benefit from the introduction in the form of reduced accident-related costs should share these benefits with those who have to carry the investments and costs. These should also cover nomadic devices.

The following recommendations were given for autonomous vehicle systems:

In order to increase and accelerate the market penetration of eSafety systems with highest safety benefits, such as ESP,

- d. EuroNCAP should incorporate such systems into their rating as soon as proven technology and safety benefit data becomes available, and the functionality of the systems can be adequately tested. ESP and Speed Limiter are on the list today.
- e. The European Commission and the Member States should consider regulatory actions (such as making a system mandatory equipment in new vehicles) only as a last option, when such action is judged as essential and beneficial for both industrial and public stakeholders. Socio-economic reasons and respecting the principle of subsidiarity are other important decision criteria. Voluntary solutions should be favoured.

- f. The Member States and the industry should follow the recommendations of the HMI (Human Machine Interaction) working group to ensure future user acceptance and a safe application and function of the systems during their whole life cycle
- g. The automobile industry, European Commission, the Member States and other stakeholders should continue R&D efforts to develop new technologies and solutions for in-vehicle safety systems as well as to evaluate the effects of *eSafety* system on safety, economy and employment.

The following recommendations are given for infrastructure-related systems:

In order to increase and accelerate the deployment of safety beneficial infrastructure-related *eSafety* systems,

- h. The Member States should ensure the deployment of socio-economically feasible systems and services according to their responsibility and in line with the requirements accepted on the European level.
- i. The European Commission should support the deployment of infrastructure-related systems on the TERN as well as other key parts of the road networks with the instruments at their disposal (e.g. TEN-T programme).
- j. The industry, European Commission and the Member States should together take actions to ensure that digital maps with the information required by the *eSafety* systems would be developed for all roads in the Member States.
- k. The European Commission and the Member States should agree on actions and instruments to increase the willingness of countries and regions to take on the role as “early adopters” for *eSafety* systems.
- l. The European Commission and the Member States should continue R&D efforts to develop new technologies and solutions for infrastructure-related safety systems as well as to evaluate the effects of such systems on safety and other socio-economic factors.
- m. Concerning eCall, the European Commission, the Member States and the industry should follow the recommendations of the eCall Driving Group.
- n. Concerning RTTI, the European Commission, the Member States and the industry should follow the recommendations of the RTTI Working Group.
- o. Concerning dynamic traffic management and local danger warnings, the road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with vehicle and telecommunications industry.
- p. Concerning speed alert, the European Commission and the other stakeholders should solve the currently open issues and utilise the implementation roadmap produced by the SpeedAlert project.

1 INTRODUCTION

eSafety is a joint industry-public sector initiative aiming to reduce the number of accidents by using new intelligent vehicle safety systems and related infrastructure utilising ICT. The *eSafety* Forum established in 2003 is a joint platform of the road safety stakeholders promoting the implementation of the recommendations of the *eSafety* Working Group on Road Safety. The Forum has created several Working Groups focusing on priority topics in the action plan. One of these is the Implementation Road Map Working Group (WG), which started its work in July 2003 and had a target for finishing its work by mid-2005, e.g. within approximately 24 months.

The Implementation Road Map WG was given the task of investigating how to promote the roll-out and deployment of vehicle- and infrastructure-based as well as co-operative systems in order to contribute to the overall goals of reducing road accident fatalities by 50% systems by 2010. The inclusion of both vehicle- and infrastructure-based systems caused special problems as there are the strong differences between both actors involved and the timelines for development and financial issues. Also the decision processes are quite different and especially problematic for truly co-operative systems. This meant that the WG had to involve actors from wide range of domains. Especially the car manufacturers and road authorities would have to be well represented. In addition to this, the WG needed members from user or customer related organizations, implementation road map experts, vehicle inspection, OEM industry etc. A close link was established to the Telematics Sub-Group of the Conference of European Directors of Road (CEDR). The chairing of the WG was also arranged in a manner reflecting the orientation of both the road authority and the vehicle industry.

It became also at an early stage quite clear that within the time frame and funding available, no highly sophisticated evaluation could be carried out for the key questions. Having in mind a close correlation to other working groups under the umbrella of the *eSafety* Forum, especially the output from Accident Causation, eCall, RTTI and Heavy Duty Vehicles WGs, at least one Implementation Road Map WG member was a member or at least had close links to the other *eSafety* Forum WGs.

2 OBJECTIVES

The Road Map Working Group of the *eSafety* Forum commenced its activities in July 2003. The objectives of the Road Map Working Group were originally set by the steering group and further detailed at the first meeting of the Working Group on 18th of July 2003 by the working group members. The objectives were the following:

1. To identify the technical and economical potentials of the industry and issues of existing and new systems as well as the topics and time table for infrastructure improvements by the public sector with regard to *eSafety* systems capable of affecting road fatalities in Europe by 2010
2. To develop regularly reviewed road map which focuses technological steps and economic implication models for introduction of intelligent integrated road safety systems as well as the required improvements in road and information infrastructure

3 APPROACH

The agreed generally approach was defined as follows:

A Survey of existing and feasible upcoming *e*Safety systems and available data sources

B Qualified ranking for identification of priority systems:

Relevant factors are: availability and capability
 estimated impact on road safety
 generally user intentions
 cost / efficiency business models /cases

C Evaluation of findings and best / worst case figures under certain circumstances

D Implementation issues

E Recommendations for actions to promote roll-out and deployment of priority systems

F Method for regular updating of the implementation road map

The results of the activities of the Working Group are described in this report.

4 IDENTIFICATION OF RELEVANT SYSTEMS

The Working Group dealt with a number of systems, which were first classified according to the timing of their operation with regard to the accident or crash: 1) normal driving, 2) danger phase, 3) crash unavoidable, 4) in-crash, and 5) post-crash. The primary systems (1 and 2) reduce accident risk whereas the secondary ones reduce the consequences of accidents. The functions can be autonomous, co-operative or infrastructure based and hence, also the following classification was tried: 1) Vehicle autonomous systems, 2) Vehicle autonomous systems with network potential, 3) Aggregate information in the vehicle with vehicle to vehicle or vehicle to infrastructure/infrastructure to vehicle (v2v or v2i/i2v) communication, and 4) Functions with support/communication from/to infrastructure.

After clarification of tasks and available options, it was possible to identify the relevant systems. It should be pointed out that the WG only included systems, where the market introduction would be possible in the very near future i.e. by 2010. A number of systems are still under research and hence, out of the time frame of this report. The list of systems needs to be adapted when emerging technologies appear on the market. The systems were first classed according to the following categories:

- A vehicle based autonomous systems
- B systems which are infrastructure & vehicle based
- C infrastructure based systems

Also systems, which are already or will, according to the working group's judgement, certainly be in the next generation of vehicles such as ABS were also left out.

Later, these were reclassified into two categories of vehicle based (A) and infrastructure related systems (B and C). The systems are described in Table 1.

Table 1. Description of vehicle based eSafety systems.

Adaptive Brake Lights	Triggered by the strengths of brake activation the rear brake lights are illuminated in different kinds to indicate emergency braking manoeuvres to the following vehicles
Adaptive Head Lights	The system consists of electromechanical controlled headlights to ensure optimum illumination of the lane in bends. The headlight is directed into the bend as soon as the vehicle begins cornering. A reduction of the glare to the upcoming vehicles is possible. Vehicle speed, yaw-rate and steering wheel angle can be used as input data for the controller of the system.
Alcohol (inter)lock	The system checks the alcohol intoxication of the driver (breath test) when starting the vehicle and prevents the start of the vehicle when driver is intoxicated. During driving, the system also checks intoxication at specific intervals and takes preventive actions with pre-warning.
Automatic Headlight Activation	When activated, the system switches on the headlights automatically when major environmental conditions for the use of head lights are present. The system detects the darkness and the light conditions in the environment.
Blind spot monitoring	At both sides of a vehicle normally there are some blind spots, if using a mirror for back ward view. Different systems can either provide better vision into the blind spot area or supplemental information regarding an obstacle being there, e.g. by warning signals. Wide angle side mirrors reduce the blind spot area. If the mirrors are heated, the vision in bad weather conditions is optimised further on. Camera techniques with image processing or radar sensors can give addition information about the situation in the blind spot. An adequate HMI solution is generally a prerequisite for an effective system.
Driver Condition Monitoring	The system monitors the condition of the driver. Discussed parameters today are drowsiness, distraction, and inattention.
Dynamic control systems (ESP etc)	Active Front Steering: The AFS allows - electronically controlled - a variable steering transmission and steering force support. Two different inputs overlap, the steering angle from the steering wheel and a correction angle given by a controller through a special gearbox. Electronic Stability Program ESP: Stabilises the vehicle under all driving conditions and driving situations within the physical limits. Helps to stabilise the vehicle and prevent skidding when cornering or driving off through active brake intervention on one or more wheels and intelligent engine torque management. Active Body Control ABC: Active damping and suspension system minimising car body roll and pitch motion, adjusting ground clearance according to speed, allowing for a two stage ride height including load-independent all-round self-levelling.
Lane Departure Warning	Warning given to the driver in order to avoid leaving the lane unintentionally. Video image processing is the most important technology.
Lane Keeping Assistant	Active lane-keeping support through additional and perceptible force e.g. in the steering wheel.
Obstacle& Collision Warning	System detects obstacles and gives warnings when collision is imminent. Current solutions with limited performance are a separate feature of Adaptive Cruise Control systems which use information obtained from radar sensors to give visual and acoustic warnings. Future systems will use long range/near range radar sensors or LIDAR and video image processing.
Runflat Indicator / Tire Pressure Monitoring System	In case of an air loss in a tire the systems gives a warning to the driver. With the runflat indicator the system detects the different rotation speed of the tire which is under-inflated. In case of a tire pressure monitoring system the air pressure in each tire is directly measured and displayed if necessary.
Vision enhancement	Assistance function with camera techniques like infra-red which enhances the perception of pedestrians and other relevant objects at night or in otherwise bad vision conditions

Table 2. Description of infrastructure related eSafety systems.

eCall	The emergency-call gives precise coordinates of the location of an accident to the emergency services which are responsible for the help. The service is a multi-stakeholder function of public organisations, telecom companies and service providers and car manufacturers.
Event data recorder	On-board EDR collect certain vehicle parameters to be stored in case of an accident. Those data, before, during and after the event, can be used for scientific, technical and legal purposes. Driver awareness of such a system might reduce the number and severity of drivers' crashes.
Extended environmental information	Data from different sources of the vehicle e.g. switched on lights, windscreen wipers on, fog lights on, information from ABS, stability control systems can be used to create useful information about the environmental situation where the vehicle is driving. They are called extended floating car data, which can - after filtering - provide information about potentially dangerous situations at certain locations. These data are handled like floating car data (□ high quality congestion- / traffic information)
High quality Congestion/Traffic Information / RTTI (Real Time Travel and Traffic Information)	This is information to the driver about the traffic (congestion) and weather conditions for choosing the most effective route or for preparing to cope with the foreseeable situation ahead on the route. Important is the actuality of the information about the traffic situation to maintain the credibility of the function. The information is transmitted to in-vehicle and nomadic devices. Short-term forecasting is essential for these systems. Information can be personalised.
Infrastructure Based Warning Systems / Local Danger Warning	Warning systems about dangerous locations or situations do not necessarily have to rely on vehicle based technology. There are solutions which are only based on the infrastructure to warn the drivers. Spot-wise warning can be given via variable message signs, flashing or electronic beacons, radar based excessive speed information.
Inter vehicle hazard warning	To transmit warnings about hazards and extended data to other vehicles in the vicinity, the function uses technologies of wireless local area networks between cars. Vehicle can be used as sender, receiver and relay stations for that information. Other technologies using communication infrastructure can provide local hazard warnings with the help of extended floating car data too.
Speed Alert	The system alerts the driver with audio, visual and/or haptic feedback when the speed exceeds a limit set by the driver or the legal fixed speed limit. The speed limit information is either received from transponders in speed limit signs or from a digital road map, requiring reliable positioning information.
Traffic sign recognition and alert	The function uses camera technologies and image processing to perceive the traffic-signs and give an alert about the content of the sign to the driver. The HMI is an important aspect for the information process.
Dynamic traffic management	Influencing traffic flow by influencing speeds, lane use, route choice, merging operations by employing variable message signs (VMS) in order to improve safety and network utilisation. Applications include also e.g. ramp control, access control, tunnel control and closure. Three categories of VMS are identified: 'regulatory messages', 'danger warning messages' and 'informative messages'. Uses for motorway links, for network situations and for rerouting are also recognised as functionally separate domains.

The systems are based on a number of technologies as illustrated in Table 3. It is evident that several systems utilise and/or require the same technologies. Hence, it is cost-effective to develop and provide system and application packages, the price of which would be substantially lower than for getting each system or application separately. For this reason, several European projects are investigating the feasibility of generic open application platforms or On-Board Units (OBU) enabling many applications at the same time. These projects include GST (Global System for Telematics), SpeedAlert and eNlink.

Table 3. Technology prerequisites for the eSafety systems. Green colour means that technologies are alternatives.

	Long Range Radar/LIDAR	Camera	Short range radar	Vehicle 2, Vehicle communication	Other vehicle/driver data	Airbag/CPU	Wheel speed sensors	Steering Sensor	GPS	GSM	Digital Map	PSAP	DAB/TMC	VMS	Traffic detection	Road weather detection	Incident detection
ESP					yaw rate, deceleration, brake actuation		X	X									
Blind Spot Monitoring		X	X		turn indicator signal		X	X									
Vision Enhancement		X (+ IR)					X										
Lane Keeping Assistance		X					X	X									
Lane Departure warning		X					X	X									
Driver Monitoring		X			eye movements, ...		X										
Speed Alert							X		X		X						
Local Danger Warning				X	X				X	X	X				X	X	X
eCall					X	X			X	X		X					
Adaptive Headlights					turn indicator signal		X	X									
Obstacle Collision Warning	X	X	X	X	X		X	X									
Run Flat Indicator							X										
Tire Pressure Monitoring					tire pressure sensors												
Autom. Headlight activation					light conditions												
Event Data recorder					driver input data, status of safety/assistance systems, deceleration	X	X	X									
Adaptive Brake Lights					deceleration		X										
Extended Environmental Information				X	X				X	X	X		X				
Dynamic Traffic Management				X					X	X	X		X	X	X	X	X
Infrastructure based Warning System														X	X	X	X
Intervehicle hazard warning				X													
High Quality Congestion/Traffic Information / RTTI									X	X	X	X	X		X	X	X

The following aspects were considered for each system:

- Accidents / fatalities to be affected
- % change in accidents expected
- other side effects / comfort functions
- cost of in – vehicle systems
- cost for infrastructure systems (investments / maintenance)
- cost for information infrastructure (investment / maintenance)
- year of technical readiness
- year of implementation readiness
- user acceptance and willingness to pay for
- year of implementation by regulation
- specific implementation issues
- estimation of cars equipped with at 2010 / 2020
- other actors involved for implementation

It was found out that all of questions raised were not likely to be answered within the work of the group. The competition situation does not allow industrial players to unveil sensitive information before the market implementation of new functions and features. Some other questions are only to be answered by dedicated studies and sophisticated research programs. Hence, not all fields in the table could be filled with appropriate data. But a more suitable option was found for getting an idea of the ongoing process of market deployment of those systems by looking at the systems in a more general way.

5 ASSESSMENT OF SAFETY IMPACTS

Individual members of the Working Group collected information about the safety impacts of ITS systems from various sources. Information of the safety impacts of *e*Safety systems was gathered from literature by VTT. In addition, DEKRA and ADAC produced some assessments of the impacts of *e*Safety systems on the basis of German accident causation data and Swedish researchers also produced such an overview on the basis of Swedish accident causation data. The results of these overviews are presented in Annex 1.

Furthermore, a data analysis of the European CARE accident data base was initiated to identify the accident patterns also on the European level, in addition to the afore-mentioned data from Germany and Sweden.

A comprehensive overview of the safety impacts of *e*Safety systems is expected to be produced by 2007 as a result of the European Commission's 6th Framework R&D Programme.

In order to facilitate more qualified assessments of the safety potential of *e*Safety systems, the European data bases for accidents have to be improved according to the recommendation of the Accident Causation Data Working Group.

6 PRIORITY SYSTEMS

After a ranking based on safety impacts, availability and possible market deployment, the Working Group selected a number of systems as priority systems. The priority systems are systems, which are expected to be able to reduce road fatalities in Europe already in the short- and medium-term. The priority systems are the following:

Vehicle-based systems

- ESP (Electronic Stability Programme)
- Blind spot monitoring
- Adaptive head lights
- Obstacle and collision warning
- Lane departure warning

Infrastructure-related / based systems

- eCall
- Extended environmental information / Extended Floating Car Data
- RTTI (Real Time Traffic and Travel Information)
- Dynamic traffic management (VMS)
- Local danger warning
- Speed Alert

A summary of the expected safety benefits of the priority systems according to research results is given in Table 4.

Table 4. Expected safety benefits of the priority systems based on research results and expert assessments. More details can be found in Annex 1.

Priority systems	Accident type especially affected	Local results in specific conditions for effects on all accidents for vehicles or roads equipped based on research incorporating accident analysis
ESP	single accidents, loss of control, accidents on wet and slippery roads	injury crashes -10 to -25% all fatal crashes -15 to -40% all fatalities -15 to -20%
Blind spot monitoring	side collisions	-
Adaptive head lights	accidents with pedestrians and cyclists on unlit roads	-
Obstacle & collision warning	rear-end accidents	-
Lane departure warning	head-on or run-off-road, side collisions	-
eCall		all fatalities -2 to -15% severe injuries -3 to -15%
Extended environmental information	accidents in adverse environmental conditions	-
RTTI	accidents in adverse conditions, pile-ups	-
Dynamic traffic mgmt (VMS)	accidents in adverse conditions, pile-ups	all injury crashes -5 to -20% all fatal crashes -10 to -25%
Local danger warning	accidents in adverse conditions, pile-ups	all injury crashes -1 to -5%
Speed Alert	accidents caused by exceeding speed limits	all injury crashes in an urban area -20% *

* Swedish study (Biding & Lind 2002)

The Working Group produced so-called simplified road maps describing the market penetration or deployment speeds for two cases: 1) Business as usual and 2) Incentives and EU support. The first case means the current situation with no extra measures to accelerate the roll-out of eSafety systems. In the second case, tax incentives, enhanced customer awareness programs, insurance companies incentives for eSafety Systems, and EU support actions for deployment (e.g. TEN-T support) have been carried out, and standardisation has reduced the prices.

The level of market penetration or deployment was estimated in the following categories:

- Very high 80 up to 100 %
- High 50 up to 80 %
- Medium 20 up to 50 %
- Low 5 up to 20 %
- Very low 0 up to 5 %

The estimates of the level of market penetration for priority vehicle-based systems are given in Table 5.

Table 5. Estimates of new car market penetration of priority vehicle-based systems in the “business as usual” and “implementation support” scenarios.

Business as usual	% new cars equipped		
	2005	2010	2020
ESP	medium	high	high
Blind spot monitoring	very low	low	high
Adaptive head lights	very low	medium	high
Obstacle & collision warning	very low	low	medium
Lane departure warning	very low	low	medium
Implementation support	% new cars equipped		
	2005	2010	2020
ESP	medium	high	very high
Blind spot monitoring	very low	medium	high
Adaptive head lights	very low	medium	high
Obstacle & coll.warning	very low	medium	high
Lane departure warning	very low	medium	high

The market penetration varies a lot between different car segments, being highest in the top-end models and lowest for smallest cars, for which the price of any system forms a much larger proportion of the car price than for larger cars. The market penetration also varies between countries

The estimates of the level of market penetration for priority infrastructure-related systems are given in Table 6 for cars and in Table 7 for the road network. It should be noted that the only reason for giving the estimates for the TERN is that currently European data on current and planned deployment only exists for the TERN. It is likely that the estimates correspond well to the situation on other major roads as well. More detailed information on the level of system deployment on the TERN is given in Annex 2.

Concerning the network equipped (Table 7), it should be noted that the most problematic and important parts are equipped first.

Table 6. Estimates of new car market penetration of priority infrastructure-related systems in the “business as usual” and “implementation support” scenarios.

Business as usual	% new cars equipped		
	2005	2010	2020
eCall*	very low	very low	medium
Extended environmental info*	very low	low	medium
RTTI*	Low	medium	high
Dynamic traffic mgmt (VMS)	not applicable	not applicable	not applicable
Local danger warning	not applicable	not applicable	not applicable
Speed Alert	very low	low	medium
Implementation support	% new cars equipped		
	2005	2010	2020
eCall*	very low	high	very high
Extended environmental info*	very low	medium	high
RTTI*	Low	medium	high
Dynamic TM (VMS)	not applicable	not applicable	not applicable
Local danger warning	not applicable	not applicable	not applicable
Speed Alert	very low	medium	high

*Note that the estimates do not take into account nomadic systems for functions like RTTI, Local danger warning, eCall, etc. This means that the number of cars equipped is probably underrated.

Table 7. Estimates of TERN deployment of priority infrastructure-related systems in the “business as usual” and “implementation support” scenarios.

Business as usual	% of network equipped		
	2005	2010	2020
eCall	very low	very low	medium
Extended environmental info	very low	low	medium
RTTI 1)	Low	medium	high
Dynamic traffic mgmt 2)	low	low	medium
Local danger warning 2)	low	low	medium
Speed Alert	very low	low	medium
Implementation support	% of network equipped		
	2005	2010	2020
eCall	very low	high	very high
Extended environmental info	very low	medium	high
RTTI 1)	Low	high	very high
Dynamic traffic mgmt 2)	low	medium	high
Local danger warning 2)	low	medium	very high
Speed Alert	very low	medium	high

1) % of network with sufficiently good quality RTTI

2) applies only to the problematic part of the network (probably around 20-30% of the network)

TERN: Trans European Road Network

The figures shown above apply to the fitment of new vehicles. A study of vehicle fleet compositions in numerous European countries revealed that the average age of vehicles is somewhere between seven and more than ten years. This means that a number of vehicles which will be on the roads in the year of 2010 are already in operation today. Only some systems with considerable impacts on safety are on the market today; especially Anti-Lock Braking Systems (ABS) and Electronic Stability Program (ESP). Others, such as adaptive

cruise control systems, are currently only being deployed in the high-end sector of new vehicles.

Today, possible market penetration of new systems can only be calculated on the basis of rough assumptions. Simulations with different vehicle fleets and assumed equipment rates starting with low figures and assuming increasing equipment rates in the oncoming years led to the result that by 2010 only minor parts of vehicle fleets will be equipped with safety relevant ITS-systems. The SEISS study¹ estimated that in 10 years ca. 29% of the whole vehicle fleet of the 25 member states would be equipped with a system becoming standard equipment now. It should be noted that these estimates correspond to the “business as usual” case and do not take into account the impact of government or insurance incentives, campaigns and other positive influences for better customer awareness for eSafety systems.

7 IMPLEMENTATION ISSUES

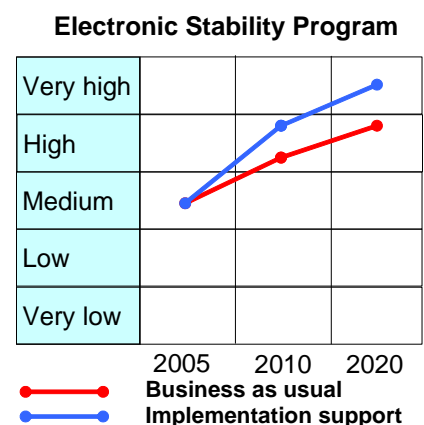
The implementation issues relevant for each priority systems were identified and reported applying a common template with the following headings:

- System description
- Technology availability
- Road and information infrastructure need and availability
- Organisation requirements
- Regulatory requirements / barriers
- Business case / customer awareness and acceptance
- Key success factors
- Feasible deployment strategies

These implementation issue summaries are presented in Annex 3, and the main issues are discussed below.

7.1 ESP

The general key success factor for ESP (Electronic Stability Program) is an increase of consumer awareness in a cost sensitive market segment. Studies on this topic have found that customers are becoming more interested in eSafety products than years ago, but there is almost a huge potential open especially in the lower car segment. Building up a EuroNCAP system for ESP systems is a significant option for enhanced consumer awareness. Government and insurance incentives would accelerate the deployment even more.



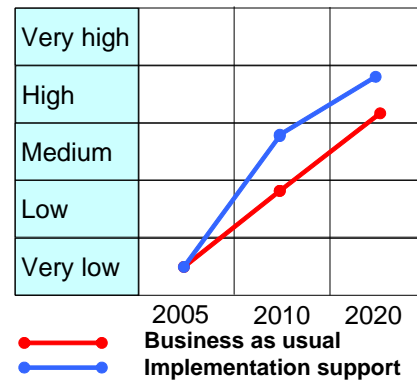
¹ Abele, J., Kerlen, C., Krueger, S., Baum, H., Geißler, T., Grawenhoff, S., Schneider, J. & Schulz, W.H. (2004). Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles. SEiSS. VDI/VDE Innovation + Technik GmbH and Institute for Transport Economics at the University of Cologne.

7.2 Blind Spot Monitoring

A first system based on video imaging is already available in 2005 integrated with other applications combining comfort and safety. A key element of future systems is the short range radar using 24 GHz, which are now regulated till the year 2013. After this period new 79 GHz based systems will be available for a reasonable pricing and substitute the 24GHz technology.

Consumers will pay for this application only if there is also an added value or a comfort function like parking assistance.

Blind Spot Monitoring

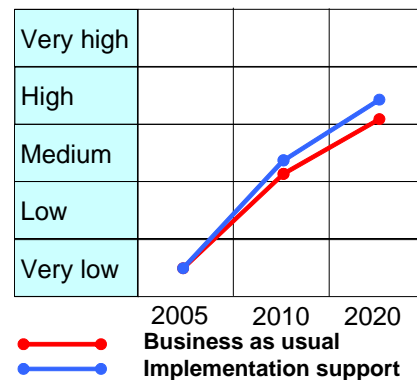


7.3 Adaptive Head Lights

The system is available as an option in several European models. The total market for adaptive head lights is growing fast. Better head lights can directly be experienced by the drivers. The effects for road safety are probably acknowledged by the consumers.

Customer awareness and willingness to bear the additional cost entailed is improving. In Europe, manufacturers predict that 10% of cars produced in 2007 will feature AFS (Advanced Front light System). Experts estimate 50% of all accidents which occur on night time are affected also by insufficient visibility or lighting. Hence, a reasonable potential is given to reduce fatalities with the AFS technology.

Adaptive Headlights

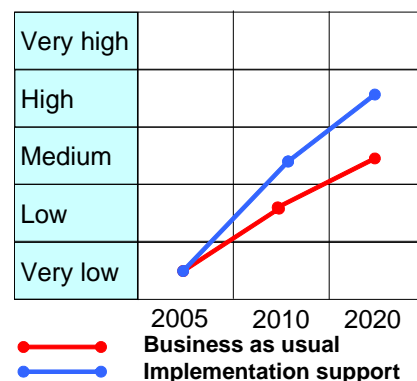


7.4 Lane Departure Warning Systems

For commercial vehicles, systems have been available as extra fitment for several years. For passenger vehicles with the model year 2005, some models are available with such a function.

As with all of the driver assistance systems, the user should be well aware of the capabilities of the system. Very often users have high expectations which can not be fulfilled by the system yet.

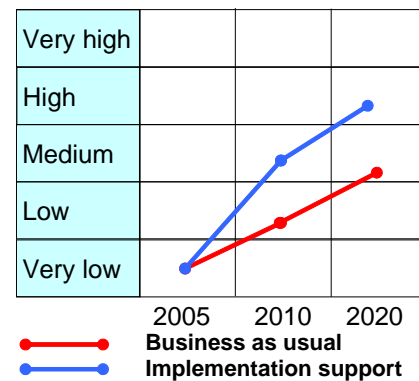
Lane Departure Warning



7.5 Obstacle and collision warning

In line with other innovations, a combination of different sensors and applications can lead to an efficient *eSafety* function. Existing functions like ABS, ESP and other devices are able to be connected and can generate more safety functions. It is likely to have first systems with warning functions on the market just within this year. Customer awareness again will decide about the market deployment, but the added comfort functions will make it easier for manufacturer to sell such systems. Short/long range radar systems as well as video image processing are the technologies used at least until 2010.

Obstacle and collision warning



7.6 Common issues for vehicle-based systems

Having in mind a market driven solution without a mandatory regulation, customer awareness is a key factor for the deployment of those *eSafety* systems. The additional cost of safety systems compared with other comfort systems is also a major aspect. Business cases for OEM, supplier and also dealer and vehicle owner have to be positive.

According to Züricher Versicherungsgruppe, the costs of accidents which can be affected by *eSafety* systems is about 15 billion € each year in Germany. For the EU15 countries the total cost of accidents is estimated to be ca. 160 billion € / year. The costs for advanced surrounding perception are estimated to be up to 6 000 € for each car. According to some statements, the costs for ADAS systems will be reduced to around 3 200 € per vehicle in 2010. Over all, the business case has to be positive. One of the major issues in cost discussions is in some cases the unbalanced allocation of costs and benefits for the involved parties. Most of the business cases are positive for the society but not in all cases for the user or vehicle manufacturer. It is essential to develop a well balanced model in order to accelerate the roll-out of the systems.

A detailed European accident database, which will enable the evaluation of the possible impact of different *eSafety* systems better than today, would make decisions in this field much easier.

Internationally accepted consumer information by EURO NCAP about ESP and other active safety systems would increase the awareness of customer positively.

Incentives given by Governmental departments or / and insurance companies will also be necessary for an increasing number of *eSafety* systems on the fleet.

For most *eSafety* related functions on vehicles, an updated European Statement of Principles (ESoP) for HMI (Human machine interaction) seems beneficial. As recommended by the working group on HMI, the updated ESoP should especially contain more precise advice on:

- Compliance with ISO standards, rules and directions
- System installation
- System information
- Nomadic devices
- Service provider/Fleet manager/Owner and Employers

Safe use of those systems over the full lifecycle of the vehicle is essential, without manipulation on certain functions like enabling TV and video games for the driver while driving.

All systems have a considerable potential to save lives. A precondition for acceptance is to assure the required robustness, which leads to the "limitation" that these systems will not intervene in all theoretical feasible critical situations. Open legal issues (e.g. the issue of driver responsibility with automatically activated systems) must be solved taking into account all current regulations such as the Vienna convention.

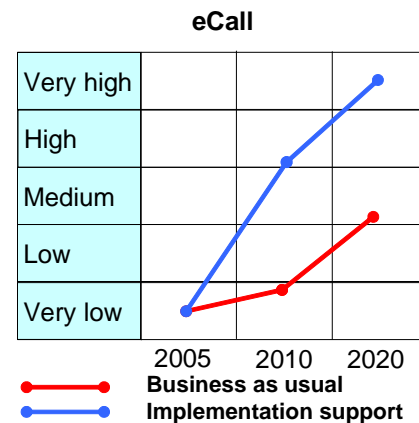
7.7 eCall

One of the most complex systems is eCall as it involves all the stakeholders of the complete rescue chain. The eCall Driving Group (ECDG) has developed a comprehensive roadmap for integrating the eCall functionality in each new (type approved) vehicle from a certain point in time onwards, depending on the progress made from now on. The complexity of the implementation is given through the different institutional arrangements required in each Member State due to differences in delegation of responsibilities for managing emergency situations. There are also differences with the technological equipment available at today's PSAPs (Public Service Answering Points) and their capability to manage eCall data. Furthermore emergency services across Europe are not unique as they have grown organically over decades.

For European technical interoperability, a common system architecture with standardized interfaces and protocols is recommended to create necessary economies of scale and allow efficient crossborder services. A European roll out should, therefore, start with the major European markets and the "Early Adopters", should be sufficiently tested and the infrastructure should be available in all countries according to the implementation plan.

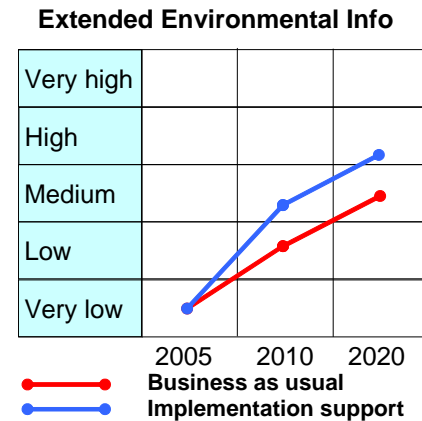
The ECDG identified an annual saving potential of up to 25 bn Euro in the health and social cost area, which more than covers the cost of in-vehicle equipment and infrastructure upgrades. In so far the business case is principally clear, the problem, however, is how, when and by whom will the cost be financed. This requires a political solution.

Low interest of drivers and customers results from low awareness of the benefits of a standard in-vehicle eCall and the general overestimated imagination that the own risk is rather low. Furthermore, professional cost-free emergency services exist today resulting in the view that in-vehicle emergency systems should also provide a service free of charge to the driver.



7.8 Extended environmental information

The main problems of extended Floating Car Data (FCD) are related to institutional and legal issues. Use of the system requires centres, which receive and fuse the data from various sources and prepare the actual and precise information of local hazards, traffic and road conditions (slippery roads, fog etc.). There should also be an organisation defining standards for the in-car equipment and an organisation to take care of the overall maintenance of the system. The same organisation could also be responsible for the further development of floating car data system. An organisation is also needed to deploy and maintain local transmitters and/or receivers to collect/distribute FCD and local information as well as to maintain the real-time data pool. In most cases a public service actor needs to be involved e.g. via a Public-Private-Partnership (PPP).



In order to avoid the development of further proprietary systems, it is necessary to set up standardization committees in early development stages. The ISO International Organisation for Standardisation in its Working Group TC 204/Subworking Group SWG 16.3 for vehicle probe data for wide area communication is already working. Their new work item proposal contains “Architecture, Basic Data Framework and Core Data Elements”.

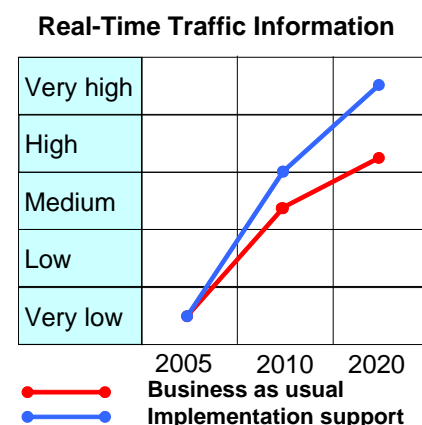
Legal issues to be solved include data protection and privacy issues concerning individual vehicles as well as issues related to the ownership of the data collected.

Intelligent message management and feedback channels minimise data transmission costs and ensure validity of real-time data. A working business model can probably be built upon payments from road operators and authorities for the data for their traffic management purposes and providers of real-time services (such as prediction of travel times) offered to the public.

The real-time status of the road network can be assessed with reasonable accuracy with about 5-10 % of cars equipped with in-car equipment used to collect FCD. This requirement is easier to meet when the geographic area is limited. Before the large-scale deployment the technological solutions for data collection and fusion as well as business models should be tested in practise.

7.9 RTTI

The provision of real-time travel and traffic information of inter-urban and metropolitan traffic to the majority drivers on those networks in Europe requires a number of actions. One of these is that the road administrations and ministries as well as the private operators in the member states of the EU should extend the introduction, the use and the application of the existing techniques such as RDS/TMC. The main issues as identified by the RTTI working group are the limited availability of traffic information content



especially in urban areas, difficulties in defining the roles of the public and private sectors, the cost of broadcasting, the limited data rate in FM radio, and the economic difficulties with business models.

The member states should

- agree at their national level on a strategy and time schedule for the implementation of RTTI services, starting from RDS/TMC, covering as good as possible both interurban and urban areas
- support the TMC-Forum to push the safety-related services features of TMC, building on the already existing and standardized European format for the data, messaging and transmission standards,
- take steps to ensure roaming and interoperability across the RTTI services in all of the EU member states,
- require the authorities to make available existing public data for the provision of RTTI services and to establish additional collection of RTTI when necessary,
- agree, on the basis of the national RTTI strategies and the Commission Recommendation on RTTI services, with the private service providers on the minimum extent of the public (free of charge) services and the conditions for the commercial services, and establish public-private partnerships if necessary,
- ensure the correct implementation for the standards by the service providers,
- publish, following the guidance of the Commission RTTI recommendation, clear guidelines for the private sector concerning the conditions for establishing private data collection networks for commercial purposes,
- require broadcasters, especially those operating under public licence, to carry the RDS/TMC traffic information on their FM services for public or private providers so that a minimum of 80% of journey drivers has access to a relevant service by the year 2010 or earlier,
- require authorities to ensure through the appropriate standardisation and regulation bodies that frequency spectrum and broadcast capacity will be made available for the more advanced digital broadcast services such as DAB, DRM, DVB-T and eventually satellite-DAB,
- support the development of more advanced services which are possible by 3G Mobile Communications, DAB, DVB-T and satellite broadcasting, WLANs and others.

The customer's awareness and interest in the RTTI-service can be augmented with more and more actual and correct traffic information, not only warning for traffic problems but giving information of the end – or even the expected time for end - of a traffic problem, extension to inner-urban traffic information, eventually extra features such as expected travel times and reasonable costs. In order to accelerate the deployment of RTTI services, the authorities should provide existing RTTI data to the operators and broadcasters, and give support and allowances for private data collection and service provision – especially when public organisations and communities show little or no interest to provide an adequate RTTI service.

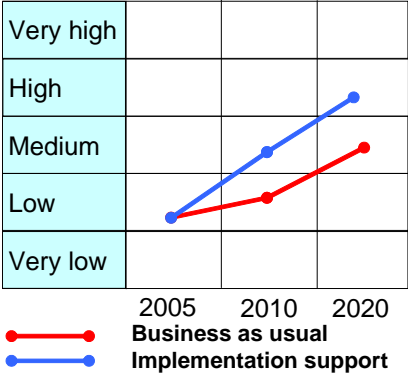
7.10 Dynamic traffic management

The technical implementation issues related to dynamic traffic management systems using Variable Message Signs (VMS) are mainly related to the need for some pictograms such as road closure, lane closure and tunnel closure as well as communication and sensing issues in the use of vehicles as mobile sensors in provision of information required by traffic management. The use of data from in-vehicle systems to improve the quality of the

monitoring systems will require new organisation-related solutions. European harmonisation has taken place and should be continued within the scope of the TEN-T programme of the European Commission. TEN-T programme support is also important for acceleration of the deployment of the dynamic traffic management systems on the TERN.

There are considerable costs involved in the implementation of dynamic systems. A key success factor is to maintain and improve the effectiveness of the systems while keeping costs at a reasonable level. The former is ensured by high quality of the systems and high user acceptance enabled by the efficient and understandable control of the VMS and supported by the harmonised deployment of them on the European level. The latter is supported by the increasing use of mobile, in-vehicle based systems for producing the necessary traffic and environmental information required.

Dynamic Traffic Management

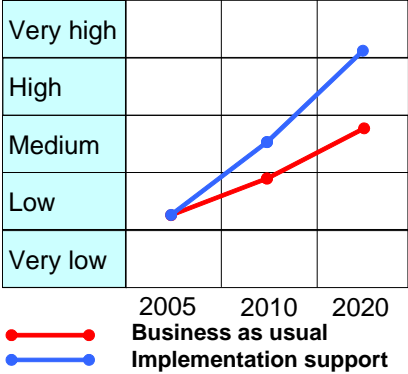


The road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with the vehicle and telecommunications industry and other involved parties, possibly on the basis of new PPP models. In the development the central organisations CEDR (Conference of European Directors of Road) and ASECAP (= European Association of toll road operators) play an important role

7.11 Local danger warnings

The technical implementation issues related to local danger warnings using Variable Message Signs (VMS) are mainly related to need for some pictograms such as fog, rain, snow, unauthorised person on road, on-coming vehicle as well as communication and sensing issues in the use of vehicles as mobile sensors in provision of hazard information.

Local danger warnings

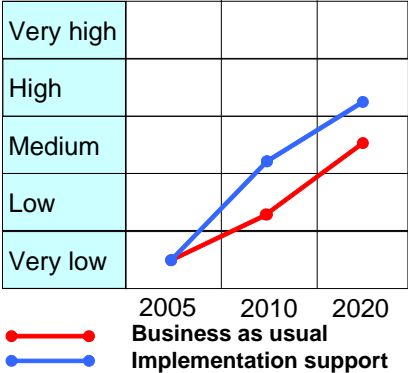


The same issues and solutions for harmonisation, costs, need for TEN-T programme involvement and common European strategy as with dynamic traffic management systems also apply to local danger warnings. The co-operation with the vehicle and telecommunication industry are, however, even more central with local danger warning systems due to the presentation of warnings via in-vehicle systems and the need for quick transmission of hazard warnings.

7.12 Speed alert

A number of open questions exist related to speed alert such as voluntary or mandatory equipment of vehicles, type of speed limits, road categories or road sections to be included, types of vehicles to be equipped and categories of road users to use speed alert. Suitable solutions need to be achieved on e.g. how to convey speed limit modifications to the data bases of on board units (OBUs), e.g. electronic Map on CD-ROMS, local short range communication, wide range

Speed Alert



communication (DAB). The basic information infrastructure required by the system, i.e. up-to-date fixed speed limit information in digital road map, needs to be made available in Europe, but is currently only available for all roads in Norway, Finland and Sweden, and limited to motorways and main roads for a large part of Europe. The fixed speed limit information should be complemented with dynamic and temporary speed limit information. The institutional and legal issues related to data quality requirements, questions of responsibility, liability, updating, timing of the updating, legal relevance of speed alert systems and speed limit signs as well as their possible contradictions and necessary business cases are among issues, which need to be solved.

The demand for speed alert is expected to increase among authorities and transport operators due to safety concerns and among drivers due to increased automated enforcement of legal speed limits. The large-scale implementation in the short-term will depend on European and national regulations aiming at mandatory or voluntary deployment of the system. European and national decision making will, however, require that the open questions will be settled. The most urgent factor is the need for an accurate, up-to-date speed limit database that is readily accessible to all potential service providers.

The SpeedAlert project developed the European wide deployment strategy for voluntary in-vehicle speed alert systems by establishing a common classification of speed limits in Europe, defining the system and service requirements of in-vehicle speed alert system, defining the functional architecture of speed alert, harmonising the definition of speed alert concepts and identifying the requirements for standardisation. The project defined recommendations and an associated deployment roadmap for a successful European-wide implementation.

It is quite likely, that deployment has to build on voluntary systems. In a longer perspective mandatory systems could be deployed for certain customer groups, such as learning drivers, frequently caught speeders, drivers wishing for insurance bonus etc., if this is regarded as feasible and beneficial.

7.13 Systems for heavy duty vehicles

Because of special implementation issues, different system solutions and also different accident analysis, the working group for Heavy Duty Vehicles was established. This working group identified the following priority systems, after ranking and evaluation of effectiveness, costs, availability and customer acceptance:

1. Tire Improvement
2. Emergency Braking Systems
3. Emergency Braking System incl. Stationary obstacles
4. Emergency Braking Systems incl. Upcoming traffic
5. Vulnerable Road User Protection System
6. Extended Flexible Under run Protection Systems
7. Inter Vehicle communication
8. Intersection Assistance (infrastructure based)
9. Interactive Driver Training

More detailed results can be found in the final report of the Heavy Duty Vehicles working group.

8 UPDATING OF IMPLEMENTATION ROAD MAP

The Implementation Road Map Working Group has produced a first version of the simplified Road Map for the implementation and roll-out of *e*Safety systems. The Implementation Road Map working group has adopted a pragmatic approach and concentrated not only on such systems, which will be available in new cars in the market at the latest by 2010, because the major impact of these new systems will occur in 2008 and later, so the timeframe up to 2015 and 2020 is also very important.

The working group has analysed all possible systems according to their safety effectiveness and implementation maturity among other things, and selected priority systems to be promoted for larger scale roll-out and implementation.

It is, however, desirable to continue to update the Road Map due to several reasons such as:

- advances in technology enabling new and more inexpensive solutions
- advances in standardisation and harmonisation
- changes in transport policy and investment programs
- changes in industrial and manufacturing policies due to global competition and other reasons
- accumulated knowledge about the safety impacts of the systems

In order to be meaningful, the updating process has to involve all key stakeholders in the domain, i.e. the automobile industry (OEMs and other system manufacturers), road authorities, transport ministries, the European Commission, ERTICO, insurance companies, automobile clubs or other user representatives, as well as academia and research institutes.

We recommend that the following procedure is to be used in the updating of the road Map:

- 1) The present Implementation Road Map Working Group is the platform used for the updating, pending that the members are available to continue their participation
- 2) Preparatory work for the annual updating of the simplified road map is carried out by designated Working Group members responsible for monitoring the implementation issues concerning specific systems and/or parts of the *e*Safety matrix
- 3) The actual updating should be carried out annually in two meetings or rather workshops. In the first, each responsible person will present the needs for updates and these will be discussed with the aim of having a common view. After the first workshop, the proposal for an updated road map will be discussed within various actors' organisations and umbrella organisations such as (*e*Safety Office) ACEA, CEDR, FIA etc. At the second meeting, the updates are agreed upon on the basis of feedback received.
- 4) The updated version should preferably include information from other than European Automotive manufactures like U.S., Japanese and Korean. This requires an extension of the monitoring scope to other markets and the involvement of experts from such manufacturers.
- 5) The updated road map will be made public in such a manner that those utilising the road map will be informed about the update. This will be elaborated upon after the publication of the first road map.

9 CONCLUSIONS AND RECOMMENDATIONS

The whole challenge to fulfil the major road safety target for 2010, ie to reduce traffic fatalities by 50% cannot be solved by eSafety systems alone although a positive impact is possible and realistic. Equally though, driver education and law enforcement as well as infrastructure development will also have their own powerful impacts on fatalities. Especially for the new Member States, road safety targets and measures are getting very high priority.

The Implementation Road Map Working Group of the eSafety Forum focused their work on vehicle- and infrastructure-based eSafety systems. New eSafety systems are likely to come faster into the market than in the past. For instance, the 50% market penetration of ABS in Germany took about 20 years starting in 1978, whereas the same level of penetration was reached for ESP in just 10 years, starting in 1995. Based on already existing basic technologies and sensors, new functions can faster become standard equipment in new vehicles. Agreements on open application development platforms in vehicles can also increase the speed of eSafety system rollout.

The use of sensors for surrounding recognition like Radar, Lidar (Light Detection And Ranging), ultrasonic and video camera systems can enable warning systems (first step), enhance both active and passive safety systems (second step) and finally activate collision avoidance/mitigation actions like autonomous braking.

A combination with enhanced traffic and travel information (RTTI) based on TMC and DAB, digital maps and on-board GPS / Galileo (satellite positioning) services can lead to a comfortable and safe way of travelling. GPS based eCall systems can bring those basic technical features into the vehicles, and the sensor signals could also be shared for other use than eCall.

Technological development is on a high level, but there has to be a stronger customer demand, a higher awareness for safety functions and also a positive business case. Combining comfort functions with safety functions can lead to a high market demand.

Regulatory prerequisites mostly exist; just some conditions for type approving complex and safety related systems are still not defined. Concerns regarding product liability still need to be addressed in some cases.

The working group identified, after an assessment of the safety potential and implementation readiness of the various eSafety systems, eleven priority systems for the eSafety deployment up to 2010. To see the full effect of these new technologies on the road, however, the timeframe has to be expanded to 2020

In addition to the Implementation Road Map working group, other working groups have also investigated the implementation of eSafety systems. The RTTI and Heavy Duty Vehicles working groups and the eCall Driving Group have produced detailed recommendations and road maps for their respective implementations.

It is interesting to note that the list of priority systems as identified by the Implementation Road Map working group has its focus on autonomous in-vehicle systems on one hand and road infrastructure systems on the other hand. Co-operative (vehicle and infrastructure)

systems, on the other side, are still mostly in the development stage. The situation is partly due to the diverging fundamental objectives of private and public stakeholders

The descriptions of the implementation issues are much more detailed for the infrastructure related systems than for autonomous vehicle-based system. It is obvious that all solutions, which more or less need a PPP (Public-Private Partnership) arrangement between public authorities and private companies, are more complicated and also become very complex within the European context for standardisation and harmonisation. Setting up agreements between all Member States and a number of industrial consortia is time consuming and also affected by different national or single company interests. Vehicle-based systems have an advantage in this comparison; only the manufacturer and the customer have to agree on new systems (partly some homologation issues are to be solved).

Nevertheless, in order to reduce road fatalities in Europe, infrastructure-based, vehicle-based and co-operative solutions are required. Improvements in the infrastructure affect directly each vehicle/driver, which uses the roads, whereas the effects of improvements in the vehicles depend on the fleet penetration of these improvements.

The costs for the eSafety systems are not always allocated to all of those getting the benefits from the systems. In many cases, the society and insurance companies are getting a positive business case in the form of reduction of accidents, fatalities and their costs while only the user/customer has to pay for the systems. When both savings and cost are put in the same equation, a positive business model could be developed leading to positive business cases for each stakeholder group.

The systems investigated in the Implementation Road Map working group do not cover all technology solutions, affecting the safety of road traffic. For instance, nomadic devices have not been discussed in detail, except as alternative solutions to vehicle-based systems. Also systems, which are already or will, according to the working group's judgement, certainly be as a standard in the next generation of vehicles, such as e.g. ABS, were also left out.

The recommendations for the priority systems as identified in the Implementation Road Map working group are given below:

The following recommendations were given for in-vehicle systems:

- a. The automobile industry, European Commission, the Member States and other stakeholders should enhance the customer awareness of the safety benefits of such systems in vehicles through well structured and harmonized European campaigns
- b. The Member States and insurance companies should give financial/fiscal incentives to customers to buy vehicles equipped with such systems. For this purpose, the discussion should start without further delay to clarify the possibility for incentives given by insurance companies or public agencies.
- c. All stakeholders should develop feasible sustainable business models for each application on the principle that those who benefit from the introduction in the form of reduced accident-related costs should share these benefits with those who have to carry the investments and costs. These should also cover nomadic devices.

Recommendations for autonomous vehicle systems:

In order to increase and accelerate the market penetration of *e*Safety systems with highest safety benefits, such as ESP,

- d. EuroNCAP should incorporate such systems into their rating as soon as proven technology and safety benefit data becomes available, and the functionality of the systems can be adequately tested. ESP and Speed Limiter are on the list today.
- e. The European Commission and the Member States should consider regulatory actions (such as making a system mandatory equipment in new vehicles) only as a last option, when such action is judged as essential and beneficial for both industrial and public stakeholders. Socio-economic reasons and respecting the principle of subsidiarity are other important decision criteria. Voluntary solutions should be favoured.
- f. The Member States and the industry should follow the recommendations of the HMI (Human Machine Interaction) working group to ensure future user acceptance and a safe application and function of the systems during their whole life cycle
- g. The automobile industry, European Commission, the Member States and other stakeholders should continue R&D efforts to develop new technologies and solutions for in-vehicle safety systems as well as to evaluate the effects of *e*Safety system on safety, economy and employment.

Recommendations for infrastructure-related systems:

In order to increase and accelerate the deployment of safety beneficial infrastructure-related *e*Safety systems,

- h. The Member States should ensure the deployment of socio-economically feasible systems and services according to their responsibility and in line with the requirements accepted on the European level.
- i. The European Commission should support the deployment of infrastructure-related systems on the TERN as well as other key parts of the road networks with the instruments at their disposal (e.g. TEN-T programme)
- j. The industry, European Commission and the Member States should together take actions to ensure that digital maps with the information required by the *e*Safety systems would be developed for all roads in the Member States
- k. The European Commission and the Member States should agree on actions and instruments to increase the willingness of countries and regions to take on the role as “early adopters” for *e*Safety systems
- l. The European Commission and the Member States should continue R&D efforts to develop new technologies and solutions for infrastructure-related safety systems as well as to evaluate the effects of such systems on safety and other socio-economic factors

Concerning eCall,

- m. The European Commission, the Member States and the industry should follow the recommendations of the eCall Driving Group

Concerning RTTI,

- n. The European Commission, the Member States and the industry should follow the recommendations of the RTTI Working Group

Concerning dynamic traffic management and local danger warnings,

- o. The road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with vehicle and telecommunications industry.

Concerning speed alert,

- p. Concerning speed alert, the European Commission and the other stakeholders should solve the currently open issues and utilise the implementation roadmap produced by the SpeedAlert project.



ANNEX 1: SAFETY EFFECT OVERVIEWS

Priority eSafety systems and safety

The following gives a summary of the research results on the safety impacts of the priority systems as recommended by the Implementation Road Map Working Group.

Electronic Stability Programme

A study of accidents in Sweden shows that there are positive effects of ESP or ESC (Electronic Stability Control) overall and in circumstances where the road has low friction. The overall effectiveness on all injury crashes except for rear end crashes was 16.7 +/- 9.3 %, while for serious and fatal crashes the effectiveness was 21.6 +/- 12.8%. The effectiveness for serious and fatal crashes on wet roads was 56.2 +/- 23.5 %. On roads covered with ice and snow, the corresponding effectiveness was 49.2 +/- 30.2 %. The estimates are based on the assumption that rear end crashes on dry road surfaces are not affected at all by ESC. (Lie et al 2005)

A study by DaimlerChrysler investigated the impacts of ESP with the help of German accident statistics. ESP was made available for Mercedes-Benz passenger cars starting in 1995. Between 1997 and 1999 the equipment level of Mercedes-Benz passenger cars with ESP increased rapidly up to 100%. The over-all-penetration of ESP for firstly registered passenger cars in Germany was 20% in 1999 compared to 100% for Mercedes-Benz (MB). The percentage of “loss of control accidents” decreased by about 30% for MB vehicles (accident years 2000/2001) whereas the percentage of the other vehicles is decreasing at a lower rate. Only about 10 percent of all accidents with MB cars were loss of control accidents, for the competitors the rate remained at a level of about 15 percent, which was also the level for MB before ESP became standard in all vehicles. The accident rate (accidents per newly registered vehicles) decreased by about 15% for Mercedes-Benz passenger cars, compared to a drop of 11% for the competitors. The percentage of accidents outside urban roads decreased for MB vehicles from about 35 % for model year 1996 down to about 30% for model years 2000 and 2001. No significant reduction was identified for the competitors. The percentage of accidents on icy roads dropped from about 5% for model years 1996 down to 2% for model year 2001. The reduction for the competitors is much lower. The percentage of fatal and injury crashes for MB dropped from about 13% for model year 1996 down to 11% for model years 1999 and 2000. No significant reduction was found for the competitors. (Breuer 2003)

A study from United States (Dang 2004) analysed crash data from 1997-2003 from 5 US-states by comparing specific make/models of passenger cars and SUVs with ESC (Electronic Stability Control) as standard equipment versus earlier versions of the same make/models, using multi-vehicle crash involvements as a control group. The study found that single vehicle crashes were reduced by 35 % in passenger cars and by 67 % in SUV crashes. The study also showed significant or borderline-significant reductions in the multi-vehicle crash rates per 100,000 vehicle years with ESC. As multi-vehicle crashes we used as the control group and it is possible that multi-vehicle crashes are being reduced by ESC, this actually means that the true effectiveness of ESC could even be higher than we estimated for single vehicle crashes. (Dang 2004)

Another U.S. study (Farmer 2004) compared crash involvement rates for otherwise identical vehicle models with and without ESC systems. ESC was found to affect single-vehicle crashes to a greater extent than multiple-vehicle crashes, and crashes with fatal injuries to a greater extent than less severe crashes. Based on all police-reported crashes in 7 states over 2 years, ESC reduced single-vehicle crash involvement risk by approximately 41 % and single-vehicle injury crash involvement risk by 41 %. This translates to an estimated 7 % reduction in overall crash involvement risk and a 9 % reduction in overall injury crash involvement risk. Based on all fatal crashes in the United States over 3 years, ESC was found to have reduced single-vehicle fatal crash involvement risk by 56 percent. This translates to an estimated 34 percent reduction in overall fatal crash involvement risk. (Farmer 2004)

A recent German overview (Langwieder 2005) has summarised all available scientific studies on the impacts of ESP. The overview states that independently of the examination methods and the selection criteria in the different international studies, all studies resulted in quite similar estimates of ESP efficiency. In Germany, 100 per cent equipment of all cars with ESP is estimated to reduce the number of accidents with car occupant injuries by about 7 -11 %. The reduction in the car occupant fatalities would be approximately 15 -20 % (Langwieder 2005).

Blind spot monitoring

Due to the early stage of deployment no scientific evaluation for blind spot monitoring systems is available, but given by accident situation analysis (see Annex) lane changing accidents are calculated with about 3.500 fatalities /major injuries each year. Such systems are since 2004 available on several new vehicles. It has to be monitored what deployment rate will occur.

Adaptive headlights

Rumar (1997) has studied the feasibility of a unified, adaptive vehicle illumination system, including direct and indirect illumination systems, systems for adverse weather and street lighting conditions and daytime running lights. The extent of road safety impact of such a system will rely on how drivers will adapt their behaviour to the increased visibility conditions. Drivers have been found to compensate for the improved vision by increasing their speeds as demonstrated, for example, by Kallberg (1991).

Obstacle & collision warning

Concerning obstacle warning systems, simulator studies indicate safety benefits (Yamada, 2002). Hoetink A. (2003)

Collision warnings systems are currently being developed as part of or complement to Adaptive Cruise Control (ACC) system. Also a system predicting driver's braking beforehand has been found as having safety potential as a collision warning system (Sakabe et al 2002). In a study compiling information from ACC systems it was found that the possibilities of current ACC systems in improving traffic safety and reducing congestion seem limited: although positive effects on driver safety and traffic safety were found, some negative effects are a cause for concern. Improving ACC systems with a Stop-and-Go functionality, and preferably also with collision warning or even collision avoidance capabilities, might improve traffic safety and at the same time reduce congestion (Hoetink 2003).

Wakasugi and Yamada (2000) show that with a Forward Vehicle Collision Warning System (FVCWS) the average reaction time from the warning output to braking is 0.73 s and 95% of the drivers can react in 1.0 s or less. The results indicate that the warning system compensates for a decline in driver perceptual ability caused by sleepiness.

Lane Departure Warning

According to Abele et al (2004), lane departure warning systems can prevent or reduce the severity of the accidents in which two vehicles collide frontally (head-on collision), accidents in which a vehicle leaves the road without colliding with another vehicle ("left roadway" accidents), and accidents in which two or more vehicles collide laterally (side-collision accidents). Abele et al (2004) concluded the following estimates of the impacts of lane departure warning systems:

- Head-on collisions: lane departure warning enables a driver to react, on average, 0.5 seconds earlier than he or she would without the system. This effects a collision reduction of 25 % for all relevant accidents. Furthermore, in 25 % of the accidents, a reduction in accident severity can be assumed.

- “Left roadway” accidents: Time gains of 0.5 seconds can also be assumed for this type of accident using a lane departure warning system. This translates into 25 % accident avoidance and 15 % accident severity reduction.
- Side-collision accidents: It is assumed that the aggregate time gain is composed of 0.5 s for the warning phase (lane departure warning and lane change assistant affect different accident causes and therefore the time gains are not combined) and 0.2 s for the assistance phase (lane change assistant with haptic feedback). The cumulated time gain is 0.7 s. This leads us to an expected 60 % reduction in the number of accidents and a 10 % reduction in accident severity.

A Dutch study on the impact of lane departure warning systems installed in heavy goods vehicles concluded that the system would decrease the number of accidents involving heavy goods vehicles by 10% (Korse 2003).

eCall

Considering the safety benefits the eCall system leads to a higher efficiency of the rescue chain. When medical care for critically (and severely) injured people is available at an earlier time after the accident, the death rate can be significantly lowered. This is known as the Golden Hour Principle of accident medicine. It expresses that in general, the earlier the medical help can reach the injured, the higher is the likelihood to avoid fatalities and long-term or permanent disability. One hour after the accident, the death rate of people with heart or respiratory failure or massive bleeding approaches 100 %. This is why the rapid reaction of rescue services is very important. (Abele et al 2004)

Recently, the E-Merge project approached the issue of decreasing rescue times and resulting safety benefits based on surveys conducted in different Western European countries. According to E-Merge and the eSafety Forum’s eCall Driving Group, 5 % to 15 % of road fatalities can be reduced to severe injuries and 10 % to 15 % of severe injuries can be reduced to slight injuries. For slight injuries, no positive effect of eCall was foreseen. (E-Merge 2004, eSafety 2004, Abele et al 2004). In Sweden, the full implementation of eCall has been estimated to reduce the number of road accident fatalities by 2-4 % and the number of severely injured by 3-5% (Lind et al 2003).

Extended environmental information (extended FCD)

The safety benefits from extended environmental information follow from the user services utilising the information collected. These effects are described in more detail under real-time traffic information, dynamic traffic management and local danger warnings.

Real-time traffic information

Real-time traffic information about problems and hazards on the road network to drivers before the trip and during the trip to in-vehicle receivers enable the drivers either to avoid the problem by e.g. changing their route or to be better prepared for the problem by increasing their awareness and alertness. Real-time information on slipperiness and other road weather related problems has been estimated to reduce the risk of injury accidents in adverse conditions by 8 % on main roads and 5 % on minor roads in Nordic conditions (Rämä et al 2003).

Several studies have been carried out on the RDS-TMC (Radio Data System – Traffic Message Channel) service providing event information to drivers with specific RDS-TMC receivers. While there exists little explicit evidence of safety impacts, studies indicate that the service is affecting driver behaviour in the assumed direction. A study in UK showed that 45 % of drivers with an RDS-TMC receiver had changed route due to on-trip RDS-TMC messages at least once. On the basis of information received before the trip, 23 % of the drivers had changed their plans (Tarry & Pyne 2003).

Dynamic traffic management and local danger warnings

Incident warnings are provided by roadside VMS or beacons, and via radio and cellular information services. Studies usually show accident reductions on the IWS (Incident Warning System) equipped motorway sections. The whole range of the effect on the total number of injury accidents is from –35 per cent to + 9 per cent, where the largest reductions may include bias caused by the regression-to-the-mean effect. The effects are more beneficial on secondary accidents (Kulmala, Fránzen & Dryselius, 1995). According to Elvik et al. (1997), rear-end injury accidents have decreased as a result of queue warning systems on motorways whereas the number of rear-end accidents resulting in property damage only have increased. Japanese field tests (Makino 2004) of a local obstacle and congestion warning VMS system on a motorway indicated a 45% reduction in accidents after the VMS was installed, but the effect is probably biased due to the regression-to-the-mean effect.

Safety can be improved not only by just reacting swiftly to incidents but also by preventing them through harmonisation of the traffic flow. This can be accomplished by ramp control (or ramp metering), lane control, route diversion schemes, and in general traffic management. Safety is also expected to be improved as a result of replacement of manual toll collection with automatic tolling on motorways due to the elimination of traffic channelling at toll plazas as well as of the possible queues and unnecessary stops (Bandmann & Finsterer, 1997).

Lane control has little effect on injury accidents (Perrett & Stevens, 1996 and Elvik et al., 1997). Ramp control is considerably more beneficial to safety, the accident reduction on equipped motorways being up to 10 % as such, and more than 15 % as a part of an integrated motorway management system (Federal Highway Administration, 1997a; Perrett & Stevens, 1996).

Route diversion schemes are beneficial to safety only when the diversion does not increase exposure (driving distance) too much and does not divert traffic to roads with higher accident risk. Unfortunately, this is very seldom the case. The opposite case is shown by for example Lashermes and Zerguini (1997).

Route information and management systems employing VMS in Germany decreased the risk of road accidents by 15% and the risk of severe injury accidents by somewhat more, between 9 and 36 %. The impacts of the system depend on the quality of the traffic management system and the level of traffic volumes. On roads with high traffic volumes, the numbers of accidents were 22 – 64 % lower than before the implementation of the system. On roads with low or moderate volumes, the changes in accident numbers were statistically insignificant. (Siegener et al 2000)

Influencing vehicle speeds with the help of variable speed limits has been tried especially in connection with weather-related traffic management systems by lowering speed limits in adverse conditions. A variable speed limit system integrated with a fog warning system reduced the number of injury accidents on a German motorway by around 20 % (Balz & Zhu, 1994), and a variable speed limit system integrated with a slippery road warning system on a Finnish motorway by around 10 % (Rämä, 2001). Both studies reported significant reductions in mean speeds (3 to 9 km/h) in adverse weather conditions, and the latter also a significant decrease in speed variation. An accident study showed that weather-related speed control reduced injury accidents by 13 % in winter and 2 % in summer on sections, where the control system was automatic and of good quality. Manually operated systems, however, were estimated to result in increased accident risks (Rämä & Schirokoff 2004).

A Dutch fog warning system including a text warning (“fog”) and dynamic speed limit VMS signs on a motorway, reduced speeds in fog by 8 to 10 km/h, although in extremely dense fog, the system had an adverse effect on speed. This was due to the too high “lowest possible speed limit” display in the VMS (60 km/h). A more uniform speed behaviour was obtained due to the introduction of the system (Hogema, van der Horst & van Nifterick, 1996). Variable speed limits have also been applied by schools, resulting in a 20 per cent accident reduction (Elvik et al., 1997).

In addition to speed control, the high accident risks caused by adverse weather conditions can be decreased by providing information, warnings and support to road users, but also by combating weather problems with the help of winter maintenance. A Finnish study (Rämä et al., 1996) showed that slippery road warning VMS decreased mean speeds by around 1–2 km/h when the signs were lit. The system was also shown to affect the direction of attention to find cues showing potential hazards, and to make passing behaviour more careful indicating an even larger positive impact on safety than that due to lower speeds (Luoma, Rämä, Penttinen & Harjula, 1997).

The automatic fog-warning system on the M25 motorway in England displays the “Fog” legend on roadside matrix signals. The assessment of this system showed that the net mean vehicle speed reduction was around 3 km/h, when the signals were switched on as a result of the formation of fog (Cooper & Sawyer, 1993). Collision warning systems are probably beneficial to road safety in the fog (Saroldi, Bertolino & Sidoti, 1997).

Speed Alert

The largest study so far on Intelligent Speed Adaptation (ISA) systems have been carried out in Sweden (Biding & Lind 2002). These studies involved 5000 equipped vehicles driven by over 10000 drivers (from different age groups) in urban areas as well as an accident study. Speed alert was one of the systems studied. The studies found out that all ISA systems result in better road safety without increasing travel time, and that there were quite minor differences between the impacts of speed alert and those of other types of ISA. The estimate was that if everyone had ISA, there could be 20% fewer road injuries in urban areas.

Speed alert systems signalling with light and sound if the driver exceeds the speed limit are expected to reduce the number of injury accidents by ca. 10% and fatalities by ca. 18%. A voluntary system, where the driver can enable or disable control by the vehicle of the maximum speed has been estimated to affect safety in a similar fashion (Carsten & Fowkes 2000). Várhelyi (1997) has estimated that automatic speed limiting on rural roads would reduce the total number of injury accidents in Sweden by about 10%.

Speed alert and ISA can also be implemented as a dynamic version, where in addition to fixed speed limits the system applies temporary limitations to maximum speed due to congestion, fog, slippery road surfaces, major incidents, outside schools at drop-off or pick-up times, etc. Dynamic ISA in conditions of low friction would decrease the total number of injury accidents by ca. 12% and ISA in darkness by 12% (Várhelyi 1997). Carsten and Fowkes (2000) estimate that the dynamic version of the compulsory ISA reduces injury accidents by 36% and fatal accidents by 59%.

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Attempt to assess the impact of Telematics systems on the improvement of the accident situation

Basis: Data on German traffic accidents with injured persons and fatalities as of 2002; Total number of traffic accidents with injured persons: 362,000; total of fatalities hereof: 6.842. Source: Statistisches Bundesamt der Bundesrepublik Deutschland; delivered by ADAC.
The Results on accident reduction due to ESP of 25% (source: DaimlerChrysler) are applied to other technologies, if no more accurate estimation is possible

Assumption: at the envisaged point in time systems which need equipment in cars are penetrated by 70% in the car fleet.

Attention: The estimated accident reduction is a very rough guess due to lack of availability of secured data

Type of System	Comment	Assumed Accident reduction of this specific type of accident (%)	Assumed overall impact on reduction of traffic accidents
1. Systems which are independent of infrastructure facilities			
DCS = Dynamic Control Systems;	corresponds to ESP; this could influence the group of veer-off accidents. Number of veer-off accidents with personal injuries in Germany 2002: 60,000, some 30,000 (50%) of them due to speed (the remaining 50% by fatigue) Assumed effectiveness: 25%; estimated reduction: 25% x 70%	17.5%	1.5%
RFT = runflat indicator	Effects identical with 'Tire Pressure Monitoring System'. This can influence the accident cause of "Technical deficiencies, maintenance deficiencies/tyre set-up". Number of accidents with personal injuries caused by "tyre set-up": 1.500 Assumed effectiveness: 50%; estimated reduction: 50% x 70%	35%	0.15%
Vision Enhance-ment	Serves the improvement of obstacle identification at dark. A reduction can be achieved in the number of pedestrians in non-urban areas at dusk/dawn and dark. Number of pedestrians and cyclists with accidents at dusk/dawn and dark: 2.500 Assumed effectiveness: 25%; estimated reduction: 25% x 70%	17.5%	0.1%
AHL = Adaptive Head Lights	Turns with the steering while negotiating curves. May positively influence the number of cyclists and pedestrians with non-urban road accidents at night. Number of pedestrians and cyclists with accidents in non-urban areas at dusk/dawn and dark: 2.500. Assumed effectiveness: 25%; estimated reduction: 25% x 70%	17.5%	0.1%
AHA = Automatic Headlight Activation	Similarly unknown effects like driving with the headlights on. 'Italian' experiences of the effects are not yet available, however, major progress cannot be expected. Number of accidents with personal injuries caused by 'lighting (only cars)': some 100. Assumed effectiveness: 25%; estimated reduction: 25% x 70%	17.5%	0.03%
2. Systems forwarding warnings as networks			
Obstacle & Collision Warning	May help avoid accidents in longitudinal traffic. Number of accidents with personal injuries of the accident type 'accident in longitudinal traffic': Within urban areas: some 50,000, outside urban areas: some 40,000, i.e. some 90,000 accidents. Assumed effectiveness: 25%; estimated reduction: 25% x 70% x 70%	12.5%	3.1%
LDW = Local Danger Warning	To local dangers can lead to avoidance of accidents due to slippery roads, accidents by tyre hydroplaning or side wind and accidents on roads with low friction values. Yet, only accidents on slippery roads and caused by "side wind" are documented in the accident statistics. Number of accidents with personal injuries on slippery roads, road condition: slippery/slick lane or side wind: some 20,000, Assumed effectiveness: 25%; estimated reduction: 25% x 70% x 70%	12.5%	0.7%

Adaptive Brake Lights	May have a reducing effect on the accident type 'of collision with a preceding or waiting vehicle'. Out of the 40,000 non-urban accidents with personal injuries of the accident type 'collision with a preceding or waiting vehicle" 20,000 occur in 'moving traffic'. Assumed effectiveness: 25% for moving traffic and 15% for the others; estimated reduction: $50\% \times (25\% + 15\%) \times 70\%$	14%	1.5%
Extended environmental information	May call attention to the danger of accidents due to slippery roads and fog. Number of accidents with personal injuries due to slippery road conditions: slippery/slick lane or side wind: some 20,000 Assumed effectiveness: 25%	12.5%	0.7%
3. Traffic information from a data combination of vehicle-vehicle and vehicle-road, road-vehicle			
RTTI (High quality Congestion / Traffic Information Systems)	Can prevent collisions with rear-end of traffic jams on vision-obstructed routes. There are however no statistical values. Number of accidents with personal injuries of the accident type of "accidents with fewer than 2 parties involved" as rear-end collisions (consecutive accidents): some 6,000 accidents (30% out of 17,000 accidents) Assumed effectiveness: 25%; estimated reduction: $25\% \times 70\% \times 70\%$	12.5%	0.2%
Intervehicle hazard warning	May contribute to the avoidance of accidents due to slippery roads and fog. Number of accidents with personal injuries in slippery road conditions: slippery/slick lane or side wind: some 20,000, Assumed effectiveness: 25%; estimated reduction: $25\% \times 70\% \times 70\%$	12.5%	0.7%
4. Road-based infrastructure measures			
e-call	No contribution to accident avoidance, but more rapid assistance can arrive. Effects expected particularly with regard to accident consequences and severity. Effectiveness: Non-urban areas: average rescue times are 12 minutes for e-call rather than 21 minutes, i.e. they are shorter by 9 minutes or 43%. In urban areas: rescue times average 8 minutes for e-call rather than 14 minutes, i.e. they are shorter by 6 minutes or 43%. Source: Final report STORM 12/1995 (EU-Project 1993-1995 in the area of Stuttgart)	n/a Expected increase of the chance to survive of 12% in rural areas and 7% in urban areas	estimated reduction of total fatalities: 11%
Speed Alert	The effect depends on the road segments equipped with it. Speed Alert, however, is very well suited for taking the hazards out of black spots, i.e. the issue of a concrete warning against black spots will lead to the avoidance of black spots. Assumption: application on black spots only; those count for 5% of accidents with injured persons. Assumed effectiveness: 50%, on black spots only ($5\% \times 50\% \times 70\%$)	1.75%	1.75%
Dynamic Traffic Management	Produced a decline in accidents of some 30% on 2,000 km = 17% of German motorways are equipped with them. Assumed overall reduction 20%. Number of accidents with personal injuries on motorways: 25,000 Assumed average effectiveness: approximately 1.2% reduction per 1% equipped motorway	depends on number of accidents in a given section	
Infrastructure Based Warning Systems	Can reduce accidents in longitudinal traffic and side wind-related accidents. Number of accidents with personal injuries of the accident type 'accident in longitudinal traffic': In urban areas: some 50,000, outside urban areas: some 40,000 in total, i.e. some 90,000 accidents. Assumption: application on black spots only; those account for 5% of accidents with injured persons. Assumed effectiveness: 20%, on black spots only (5% of relevant accidents); estimated reduction: $90,000 \times 20\% \times 5\% \times 70\% = 630 = 0.7\%$	0.7%	0.17%







Lane Keeping Assistant and Lane Departure Warning	Can contribute to a reduction in veer-off accidents. Number of veer-off accidents with personal injuries in Germany 2002: 60,000 Assumed effectiveness: 25% estimated reduction: 25% x 70% = 17.5%	17.5%	2.9%
5. Autonomous vehicle systems			
Driver Condition Monitoring	It tracks fatigue, disturbances like distractions and lack of attention. Number of accidents with the accident cause of "fatigue": some 2,000, estimated number of unknown cases (50% of all accidents involving road veer-off) = some 30,000 accidents Assumed effectiveness: 50%; estimated reduction: 50% x 70%	35%	2.9%
Alcohol Interlock	as an indirect blood alcohol analysis prevents vehicle start, if BAC is excessive. Number of accidents involving at least one intoxicated person: some 23,000 Assumed effectiveness 25 % (50% technical tolerance, 50% bypassing); estimated reduction 25% x 70%	17.5%	1.1%
Traffic Sign Recognition and Alert	points out traffic signs and warns against violations. Number of accidents with the accident cause of 'non-compliance of priority-controlling traffic signs': some 47,000 Assumed effectiveness: 50%, on black spots only (5% of relevant accidents) 50% x 5% x 70%	1.75%	0.2%
Event Data Recorder or Black Box	is not directly suited for accident prevention. Knowing of the existence of this piece of equipment may have a disciplining influence on driver behaviour. Expect no significant influence on accident figures	n/a	n/a

Impact of e-Safety on car accidents



Database: Statistisches Bundesamt 1998/2003

Given crash data are approximated and based on 60,8%/57,07% of fatalities of car crashes on all traffic fatalities.

System	Accident Situation	Killed		% of fatalities		Assumption of efficiency	estimated reduction*	Penetration EU 2008**
Dynamic Control Systems	Loss of control accidents	1998	2003	1998	2003	25% efficiency	-1,5%	100%
Tire Pressure Monitoring						50% efficiency	-0,15%	100%
Lane Departure Warning	Leaving the track	1671	1344	approx. 35%	approx. 35%	25% efficiency	-2,9%	10-20%
						50% efficiency	-2,9%	-
	Frontal Crash	1106	839	approx. 23%	approx. 22%			
Collision Warning Emergency Brake System	Collision Accidents					25% efficiency	-3,1%	not available
						50% efficiency	-	50-60%
	Rear end collisions	299	267	approx. 6%	approx. 7%			
Adaptive Cruise Control ACC Stop&Go						25% efficiency	-	5-10%
	Side impact collisions	666	544	approx. 14%	approx. 14%			
Blindspot Monitoring								
	Obstacle collisions	30	18	approx. 1%	approx. 1%			
								
	Pedestrian collisions	635	439	approx. 13%	approx. 12%			
								
	Lane change accidents	87	89	approx. 2%	approx. 2%			
	Others	247	232	approx. 6%	approx. 7%			
		4741	3774		100%			







* ADAC-Study "Technology Impact Assessment"
Overall impact on reduction of traffic accidents

** Mercer-Study "Automobile Sicherheitstechnik"
Market penetration in upperclass cars

Impact of e-Safety on Car Accidents



Database: CARE-Database 1998 (I)/2001 (B)/2002 (GR, IR, LUX, NL, P, ES, S)/2003 (A, F, D)

Type of Accident	Accident Situation	Killed		% of Fatalities		Relevant Systems	Assumption of Efficiency*	Estimated Reduction*	Penetration EU 2008**
Loss of control Accidents		EU	D	EU	D	Dynamic Control Systems	25% efficiency	-1,5%	100%
	Single Vehicle Acc.	8053	1692	30,87%	31,83%	Tire Pressure Monitoring	50% efficiency	-0,15%	100%
		5374	1365	20,60%	25,68%	Lane Departure Warning	25% efficiency	-2,9%	10-20%
Collision Accidents						Collision Warning Emergency Brake System	25% efficiency	-3,1%	not available
	Rear/Chain Collisions	1872	357	7,18%	6,72%	Adaptive Cruise Control ACC Stop&Go	50% efficiency	-	50-60%
						Lane Change Assistant Blindspot Monitoring	25% efficiency	-	5-10%
	Lateral Collisions	5635	886	21,60%	16,67%				
									
Obstacle Collisions	139	1	0,54%	0,02%					
									
Pedestrian Collisions	2978	1014	11,42%	19,8%					
Others	Others	2034	-	7,78%	-				
		26086	5315		100%				

* ADAC-Study "Technology Impact Assessment"
Overall impact on reduction of traffic accidents

Assumption of Efficiency
ESP estimation of 25% (source: DaimlerChrysler)
If no more accurate estimation possible: Impacts are viewed for each system alone.
No dynamic effects due to combination of different systems are taken into consideration.

Estimated Reduction
Value is assumed to a penetration rate of 70% of the entire car fleet and refers up to the accident rate.

** Mercer-Study "Automobile Sicherheitstechnik"
Market penetration in upperclass cars

Comparing the different values for accident situations it is obvious that no bigger difference between those data bases exists. The Accident Causation Analysis WG, is promoting the development towards common and improved data bases for accidents analysis in Europe.

A major share of accidents with fatalities is accounted for by single vehicle accidents / loss of control accidents. Generally spoken, for this accident category the priority systems are likely to have a reasonable impact.

The existing figures on vehicles on the road in different European member states and the current vehicle fleet renewal rate in each MS indicate that the time needed to have a market penetration of more than 50% over all vehicle categories is more than 10 years for a system introduced in all vehicles today.

Remark: In Germany the average age of the vehicle fleet is 7.8 years. Ca. 3.2 million new registered vehicles/year leads to approximately 21 million new vehicles equipped with eSafety systems (ca. 50% of the fleet) after 8 years if all new vehicles are from this year on equipped with the systems. An open question is the fitment rate per vehicle; optional solutions, hence only driven by customer demand, are likely to have a slower gradient in deployment than standard fitment or mandatory regulations.

Safety benefits of selected ITS applications

Lind, G., Lindqvist, E. & Persson, S. 2003. Potentialen hos ITS att öka trafiksäkerheten på kort och lång sikt (The potential of ITS to increase safety in the short and long run). Stratega and Transek.

Assumptions

- Vehicle functions that not are introduced already today, need at least a couple of years before implementation in new cars
- It will take a number of years before the entire vehicle fleet will be renewed
- It will take a couple of years for planning, decision making and construction of Infrastructure measures
- The assessment for year 2015 is based on the assumption that vehicle measures influence 50 % of the total traffic volume and that infrastructure measures influence 70 % of total traffic volume (percent of vehicle-kilometres).

The assumptions above are relatively optimistic concerning the rapidity in implementation. The reason for the optimistic view is the objective to show the potential, not a forecast of the future development. If the traffic safety applications are viewed by all major players as a great opportunity, then it is reasonable to assume a corresponding big effort in resources from the Government, the Road Administration and from the Car industry.

The most efficient ITS applications in each problem area are presented in the table below based on Swedish accident data. The effect is put in brackets and stands for the estimated percentage of reduction of fatalities within each problem area. The biggest problem area – speeding – can be found in the first row of the table. After that different problem areas follow in the table in descending order according to the number of fatalities.

Problem area	Estimated potential	Preliminary potential 2015
Speed (200 fatalities)	Intelligent Speed Adaptation (20 %) Speed Camera Control (17%) Variable Speed Limits (5 %)	Speed Camera Control (12%) Intelligent Speed Adaptation (10 %) Variable Speed Limits (4 %)
Alcohol (160 fatalities)	Alcohol Interlock (18 %)	Alcohol Interlock (9 %)
Safety belt (160 fatalities)	Seat Belt Reminder (50 %)	Seat Belt Reminder (25 %)
Tiredness (100 fatalities)	Driver Condition Monitoring (4 %)	Driver Condition Monitoring (2 %)
Meeting (100 fatalities)	Emergency braking (40 %)	Emergency braking (20 %)
Pedestrian (70 fatalities)	Night vision (30 %) Pedestrian Reflectors (15 %)	Night vision (15 %) Pedestrian Reflectors (11 %)
Intersection (50 fatalities)	Speed Camera Control (12 %) Urban Drive Assistant (10 %)	Speed Camera Control (8 %) Urban Drive Assistant (5 %)
Road-holding (50 fatalities)	Lane Keeping Assistant / Lane Departure Warning (40 %) Lane Change Assistant (20 %) Emergency Braking (18 %)	Lane Keeping Assistant / Lane Departure Warning (20 %) Lane Change Assistant (10 %) Emergency Braking (9 %)
Road surface (50 fatalities)	Outside Temperature Warning (40 %) VMS (30 %)	VMS (21 %) Outside Temperature Warning (20 %)
Cycling (20 fatalities)	Night vision (15 %)	Night vision (8 %)
Distance-keeping (20 fatalities)	Urban drive assistant (20 %) ESP (15 %)	Urban drive assistant (10 %) ESP (8 %)
Rescue (20 fatalities)	eCall (40 %)	eCall (30 %)

The total potential and the potential up to year 2015 are presented in the table below.

Problem area	Fatalities %	Total potential % reduction	Potential in year 2015 % reduction
Speeding	20	7.6	4.0
Alcohol	16	4.4	1.1
Safety belt	16	8.8	3.0
Tiredness	10	1.5	0.2
Meeting	10	4.9	1.5
Pedestrian	7	4.0	1.9
Intersection	5	1.8	0.6
Road-holding	5	3.6	1.8
Road surface	5	3.2	1.6
Cycling	2	0.5	0.1
Distance-keeping	2	1.3	0.7
Rescue	2	0.8	0.5
Total	100	42.5	16.8

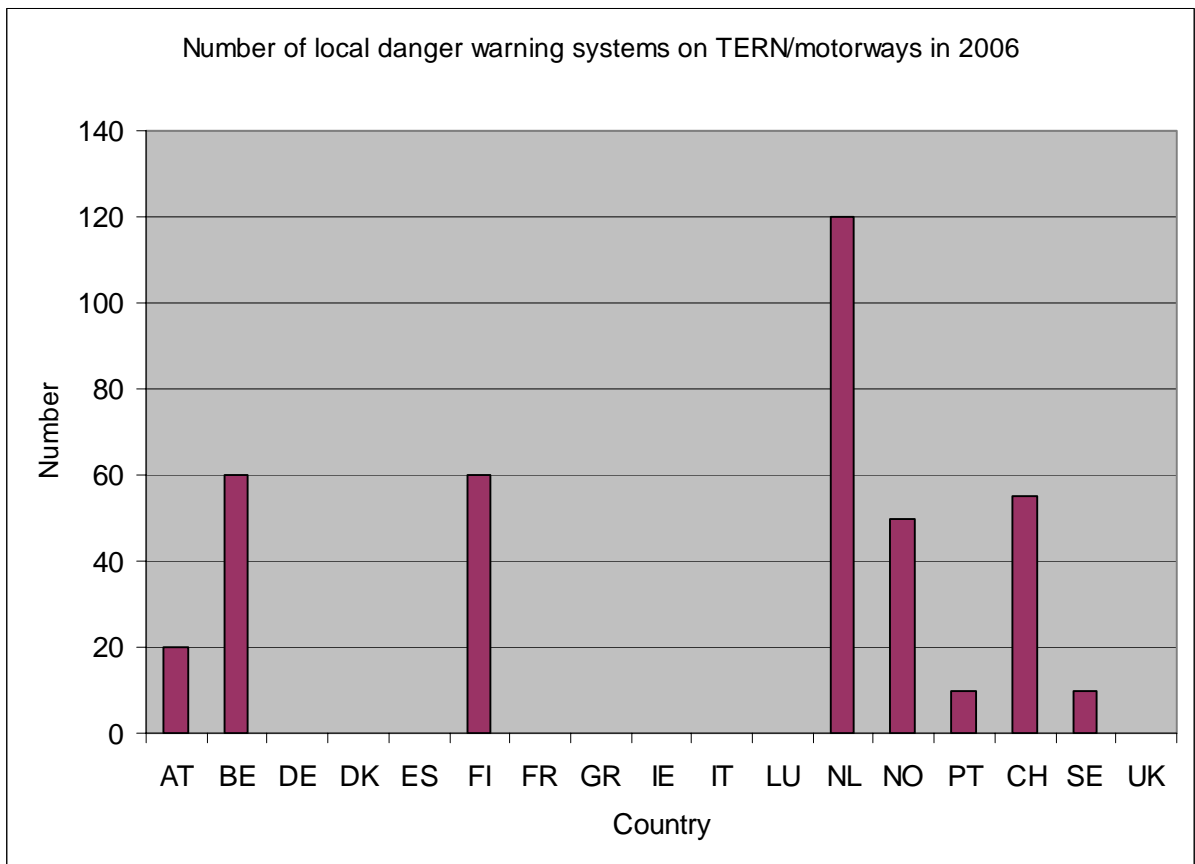
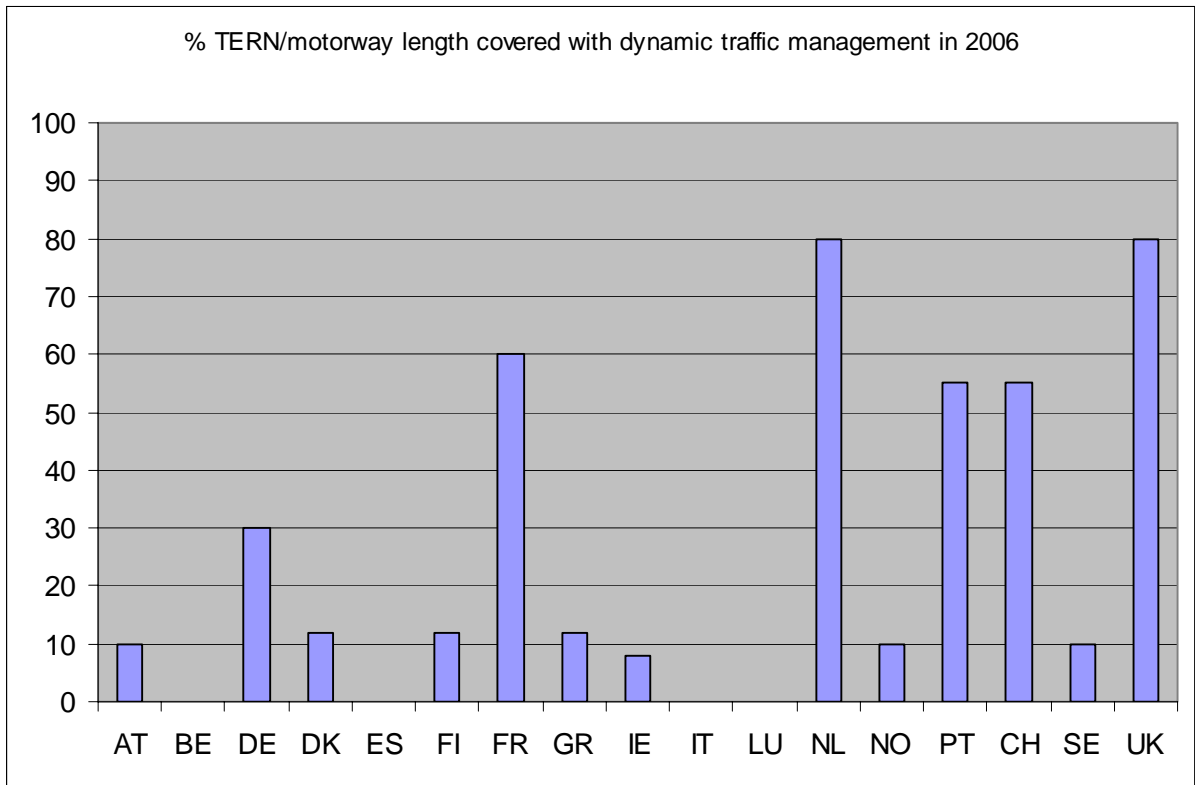
By summing up the effects on the number of fatalities in traffic of all applications in all problem areas, it is possible to get an idea of the total traffic safety potential of ITS. In this calculation, a factor of 0.75 has been used to reduce the total potential because of double-counting as different measures influence the same type of crashes.

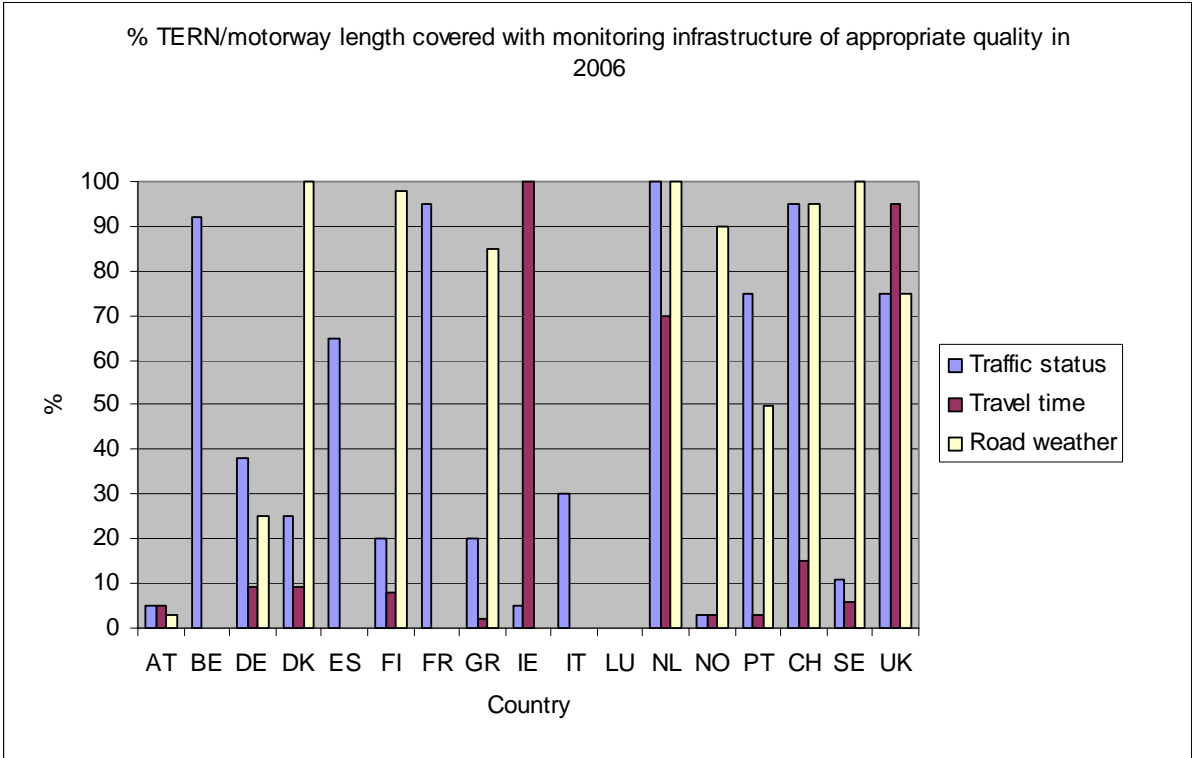
The table below shows the full safety potential with regard to fatalities by system type.

Safety application	Verified potential Percent	Predicted potential Percent	Full potential Percent
EXPOSURE			
Demand management	< 0.5%	< 0.5%	1%
Travel planning with ITS	< 0.5%	< 0.5%	0.5%
Route guidance	< 0.5%	< 0.5%	< 0.5%
Freight and fleet management	< 0.5%	< 0.5%	0.7%
Selection of road users	1%	3%	5%
ACTIVE SAFETY (risk)			
Speed adaptation	7%	11%	17%
Collision avoidance	< 0.5%	4%	4%
Local risk information	< 0.5%	2%	3%
Vision enhancement	< 0.5%	3%	8%
Lane keeping	< 0.5%	2%	2%
Driver and vehicle monitoring	< 0.5%	1%	3%
Policing and tutoring	3%	4%	7%
Incident management	< 0.5%	1%	3%
Flow control	< 0.5%	< 0.5%	< 0.5%
Urban traffic control	< 0.5%	< 0.5%	0.7%
Vulnerable road users	< 0.5%	0.8%	1%
PASSIVE SAFETY (consequences)			
Crash impact mitigation	< 0.5%	< 0.5%	1%
Occupant protection systems	4%	7%	10%
Pedestrian and cyclist protection	< 0.5%	< 0.5%	0.6%
Emergency notification	0.8%	0.8%	1%
TOTAL	17%	42%	69%



ANNEX 2: DEPLOYMENT OF ITS ON THE TERN IN MEMBER STATES







ANNEX 3: DESCRIPTIONS OF IMPLEMENTATION ISSUES FOR THE PRIORITY SYSTEMS

Implementation Issues for ESP (Electronic Stability Program)

A System description

ESP stabilises the vehicle and prevent skidding under all driving conditions and driving situation within the physical limits by active brake intervention on one ore more wheels and by intelligent engine torque management.

As soon as ESP identifies a critical driving situation it intervenes by applying specific brake pressure to one or more wheels, as required. If necessary, the engine torque is also adjusted automatically. In this way, ESP helps the driver stabilise the vehicle – although the extent to which it can do so is of course limited by the physical laws governing the dynamic behaviour of the vehicle.

A yaw-rate sensor and a lateral acceleration sensor continuously monitor the movement of the vehicle about its vertical axis and compare the actual value with the target value calculated on the basis of the driver's steering input and the vehicle speed. The moment the car deviates from this ideal line, ESP intervenes to counteract any incipient tendency to skid by applying a precisely metered braking force to one or more wheels. ESP systems combine the functions of ABS and TCS traction control and complement them with directional stability assistance.

B Technology Availability

ESP is in serial production since 10 years. During this time the cost have been reduced from 100% in 1995 to less than 25 % in 2005.

ESP is based on ABS, which is standard in 15 EU Countries thanks to the ACEA self-commitment.

That's why the additional cost on TOP of ABS are relatively low ((ABS plus Yaw Rate Sensor with lateral acceleration Sensor, Steering Angle Sensor (Standard in vehicles with Electronic Powered Steering EPS,), Pressure Sensor, enhanced ECU and enhanced hydraulic Unit)).

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

none

F Business Case / Customer Awareness and Acceptance

Market research result - End Customer Safety Study – (more than 5000 respondents (CATI)) See attachment Customer Awareness

Market Research Result out of Focus-Group discussion with End Customer:
New car buyers expect full safety standard in all available models.

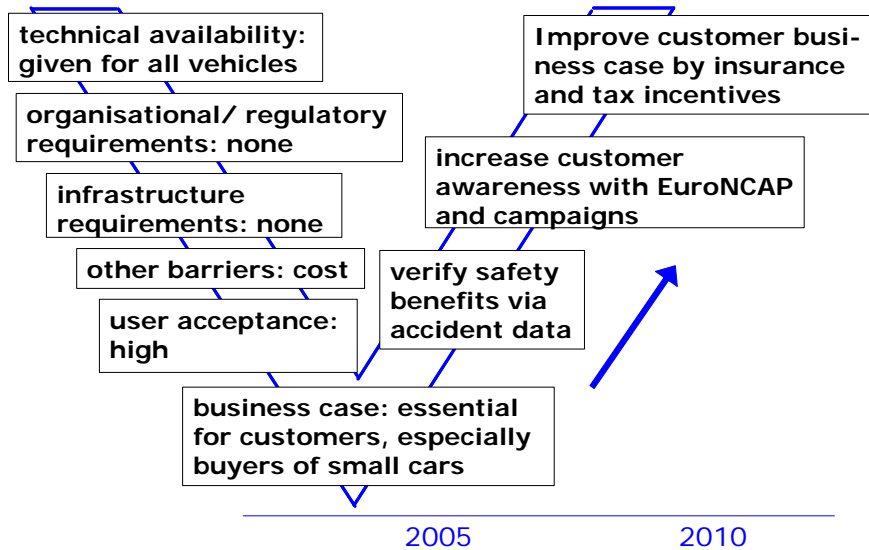
G Key Success Factors

Increased Consumer awareness especially in cost sensitive market segments

ESP with high potential to reduce accidents. ESP saves lives. Proved by studies about ESP-effectiveness. ESP is commodity and available in all car segments.

ESP is base for value added functions (safety and comfort) e.g. hill hold control, trailer logic, hill descent control, Brake assist...

H Feasible Deployment Strategies

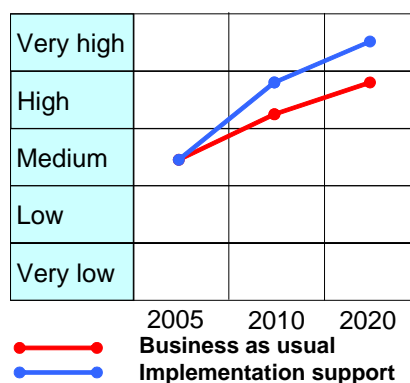


According to the V analysis of the implementation of ESP, the measures to be taken include the following:

- the benefits of ESP have been verified in many countries with accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- customer awareness needs to be increased by including and maintaining ESP in the EuroNCAP system, which requires that the identification and performance of various ESP systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of ESP, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of ESP.
- customer business case needs to be improved by tax and/or insurance incentives making it attractive to purchase ESP-equipped cars even in the small car segment

With the help of these measures, the market penetration of ESP in new cars in Europe is forecasted as the following up to 2020:

Electronic Stability Program



A crude estimate of the benefits of ESP installed after 2005 is given in the table below.

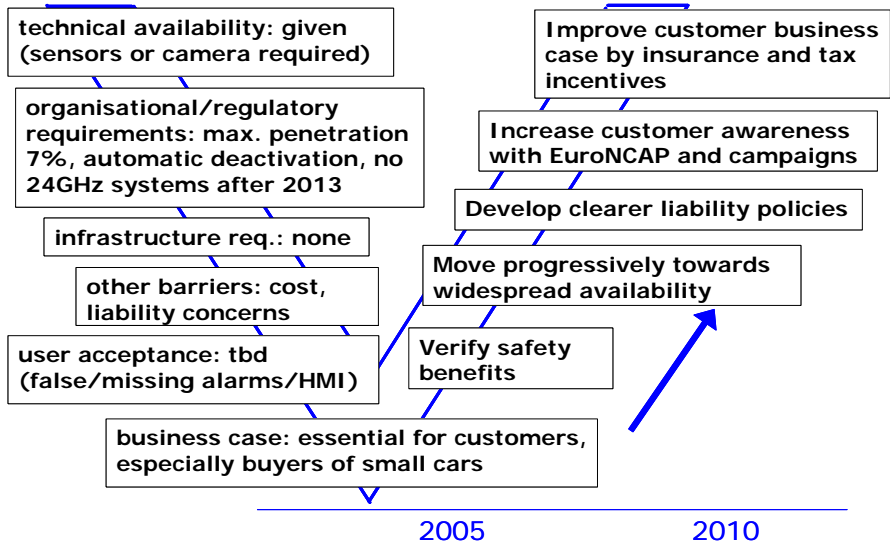
Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	850 – 1,150	1,150 – 1,550	2,000 – 2,650	2,700 – 3,550
2020	2,000 – 2,700	2,900 – 3,900	4,650 – 6,200	6,700 – 8,950

Assumptions:

- 1) market or fleet penetration in 2010/2020 for business as usual is 24.5/51.5 % and for implementation support case 30/73%. Fleet penetration of cars equipped with ESP already before 2006 is 9% in 2010 and 3.5% in 2020. The lower figure in 2020 is due to the fact that cars equipped with ESP before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of ESP is 15-20% on all road fatalities involving equipped cars..
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€.

Implementation Issues for Blind Spot Monitoring Systems

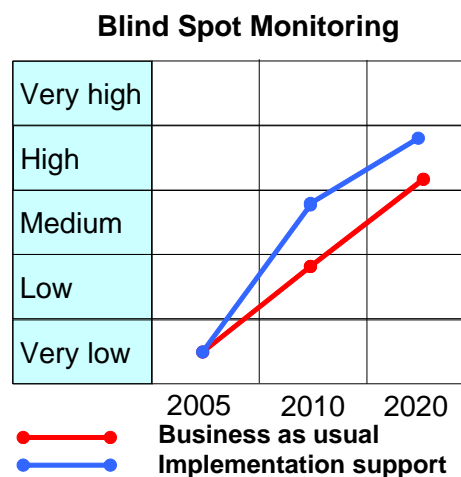
- A System description
Systems, which give information/warnings to the driver about relevant obstacles in the blind spot around the vehicle, when the driver intends to change the lane. Systems can use cameras or radar sensors to detect relevant objects.
- B Technology Availability
Available as an option in a few models since 2005 in production.
- C Road and Information Infrastructure Need and Availability
none
- D Organisation requirements
none
- E Regulatory Requirements / Barriers
For the systems based on 24 GHz short-range radar, the market penetration must not exceed 7%, automatic deactivation in exclusion zones and no new systems after 2013 due to risk of interference with other systems using the same frequency band. Liability problems need to be solved.
- F Business Case / Customer Awareness and Acceptance
- G Key Success Factors
Consumer information, customer awareness and willingness to bear additional cost, driver acceptance (false/missing alarms, HMI), liability.
- H Feasible Deployment Strategies



According to the V analysis of the implementation of blind spot monitoring, the measures to be taken include the following:

- The safety benefits of blind spot monitoring have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining blind spot monitoring in the EuroNCAP system, which requires that the identification and performance of various blind spot monitoring in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of blind spot monitoring, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of blind spot monitoring.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase blind spot monitoring - equipped cars

With the help of these measures, the market penetration of blind spot monitoring in new cars in Europe is forecasted as the following up to 2020:



As there is very little knowledge about the benefits of blind spot monitoring, the estimates for fatalities and costs saved through the deployment of these systems were not calculated.

Implementation Issues for Adaptive Head Lights

A System description

Adaptive Head Lights improve night-time driving safety on twisty roads: the headlamps follow the direction in which the driver is steering, thus extending the illumination range in the relevant areas. In this way it is possible to spot pedestrians, cyclists and animals much sooner. Conventional headlamps have a range of about 30 metres when entering a corner with a 190-metre centre-line radius. With the Active Light System however, this is extended by a further 25 metres. The Active Light System is based on bi-xenon headlamps with dynamic range adjustment. A microprocessor integrated in the vehicle's electronic data network controls the system on the basis of real-time information supplied by the steering angle and speed sensors. Other possible functions include bending lights.

B Technology Availability

Available as an option in several European models.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

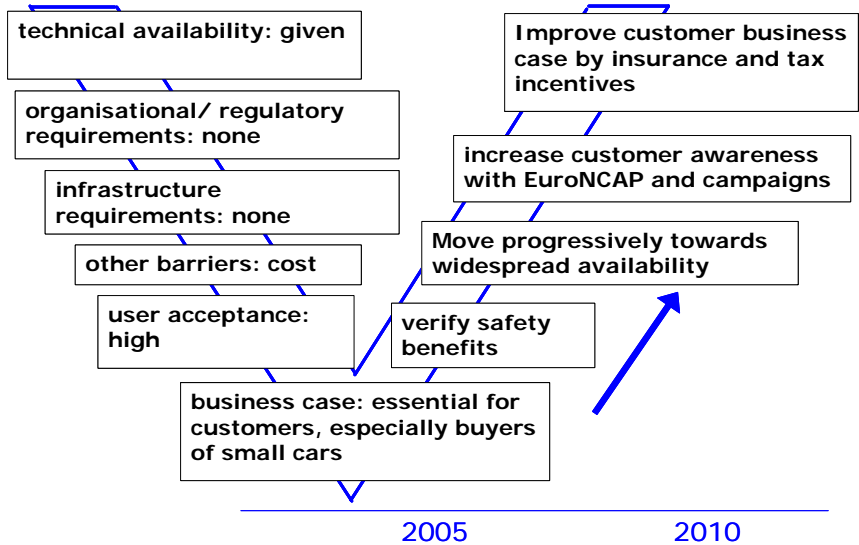
Liability problems need to be solved..

F Business Case / Customer Awareness and Acceptance

G Key Success Factors

Customer awareness and willingness to bear additional cost, liability.

H Feasible Deployment Strategies

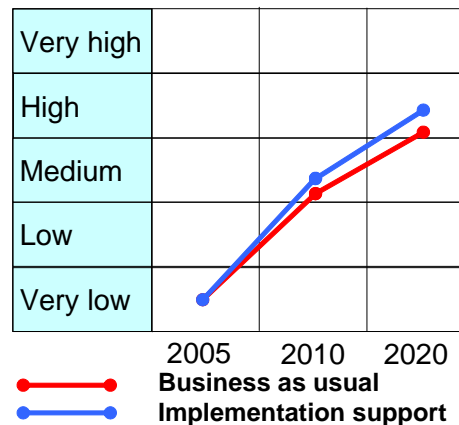


According to the V analysis of the implementation of adaptive head lights, the measures to be taken include the following:

- The safety benefits of adaptive head lights have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Customer awareness needs to be increased by including and maintaining adaptive head lights in the EuroNCAP system, which requires that the identification and performance of various adaptive head lights in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of adaptive head lights, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of adaptive head lights.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase adaptive head lights - equipped cars

With the help of these measures, the market penetration of adaptive head lights in new cars in Europe is forecasted as the following up to 2020:

Adaptive Headlights



As there is very little knowledge about the benefits of adaptive head lights, the estimates for fatalities and costs saved through the deployment of these systems were not calculated.

Implementation Issues for Obstacle and Collision Warning

A System description

Systems detect obstacles and give warnings when collision is imminent. Current solutions with limited performance are a separate feature of Adaptive Cruise Control systems which use information obtained from radar sensors to give visual and acoustic warnings. Future systems will optionally use near range radar sensors or LIDAR in addition to the long range radar. The evolution of the function has been the following: 1) ACC without braking capability, 2) ACC including braking capability but without taking care of fixed obstacles, 3) taking care of some category of fixed obstacles i.e. those with a big equivalent surface to detection.

B Technology Availability

Available as ACC feature as an option in several European models. Safety systems based on long range radar and additional near range radar sensors or LIDAR to be introduced in 2005.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

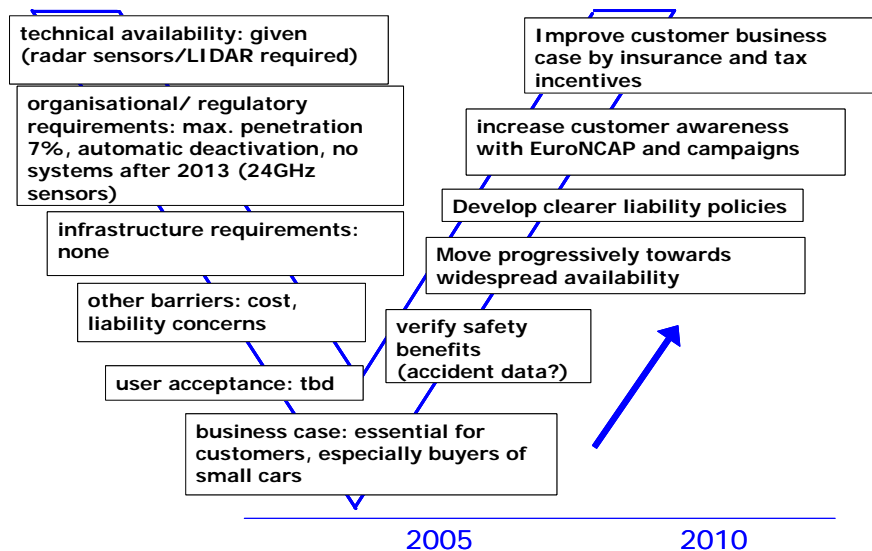
For the systems based on 24 GHz short-range radar, the market penetration must not exceed 7%, automatic deactivation in exclusion zones and no new systems after 2013 due to risk of interference with other systems using the same frequency band. Liability problems need to be solved.

F Business Case / Customer Awareness and Acceptance

G Key Success Factors

Consumer awareness, willingness to bear additional cost, liability.

H Feasible Deployment Strategies

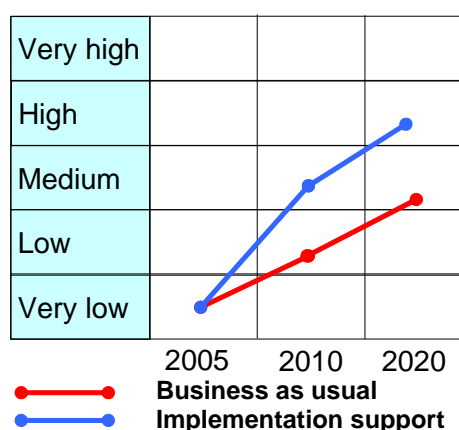


According to the V analysis of the implementation of obstacle and collision warning systems, the measures to be taken include the following:

- The safety benefits of obstacle and collision warning systems have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining obstacle and collision warning system in the EuroNCAP system, which requires that the identification and performance of various obstacle and collision warning systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of obstacle and collision warning, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of obstacle and collision warning.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase obstacle and collision warning system -equipped cars

With the help of these measures, the market penetration of obstacle and collision warning systems in new cars in Europe is forecasted as the following up to 2020:

Obstacle and collision warning



A crude estimate of the benefits of obstacle and collision warning systems installed after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	30 – 70	50 – 110	80 – 150	120 – 250
2020	150 – 300	300 – 550	300 – 650	650 – 1,250

Assumptions:

- 1) market or fleet penetration in 2010/2020 for business as usual is 3.6/17.5 % and for implementation support case 5.4/33.2%. Fleet penetration of cars equipped with obstacle and collision warning already before 2006 is 0.6% in 2010 and 0.3% in 2020. The lower figure in 2020 is due to the fact that cars equipped with obstacle and collision warning before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of obstacle and collision warning is 3-6% on all road fatalities involving equipped cars..
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€.

Implementation Issues for Lane Departure Warning Systems

A System description

Warning given to the driver in order to avoid leaving the lane unintentionally. Video image processing is the most important technology. Warnings can be acoustic/ visual/ haptic.

B Technology Availability

Systems have been available for commercial vehicles for several years, just recently introduced in some European and other passenger cars using video image processing technology. Systems are also under research and development

C Road and Information Infrastructure Need and Availability

Good (unambiguous) lane markings

D Organisation requirements

none

E Regulatory Requirements / Barriers

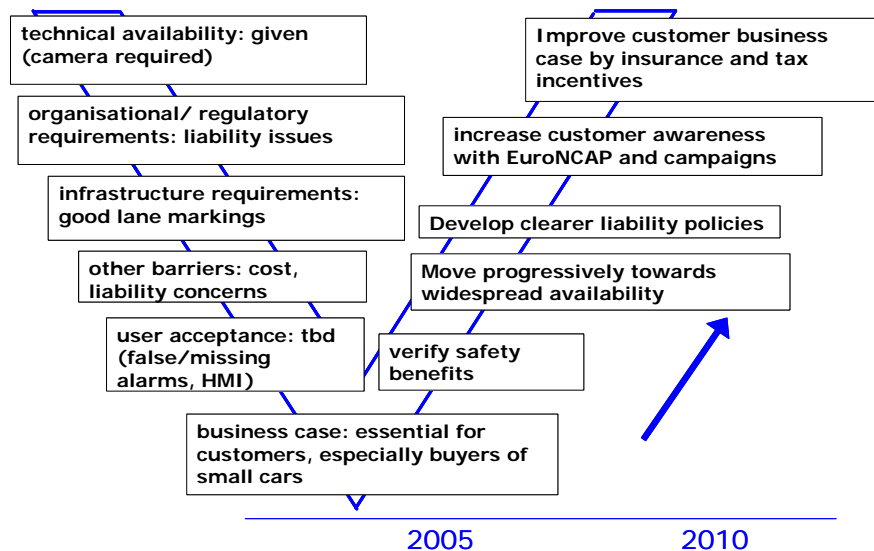
Liability problems need to be solved.

F Business Case / Customer Awareness and Acceptance

G Key Success Factors

Customer awareness, willingness to bear additional cost, driver acceptance (false/missing alarms, HMI), liability

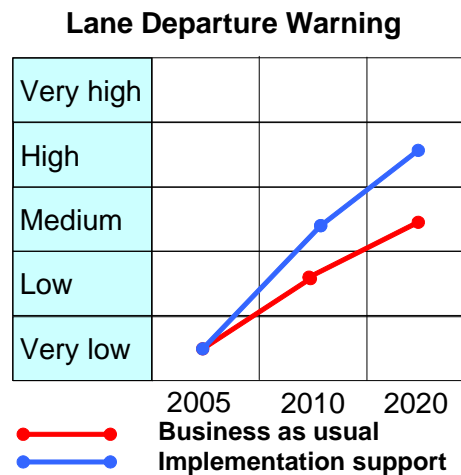
H Feasible Deployment Strategies



According to the V analysis of the implementation of lane departure warning systems, the measures to be taken include the following:

- The safety benefits of lane departure warning systems have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining lane departure warning system in the EuroNCAP system, which requires that the identification and performance of various lane departure warning systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of lane departure warning, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of lane departure warning.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase lane departure warning system -equipped cars

With the help of these measures, the market penetration of lane departure warning systems in new cars in Europe is forecasted as the following up to 2020:



A crude estimate of the benefits of lane departure warning systems installed after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	40 – 130	60 – 200	90 – 300	140 – 450
2020	170 – 550	300 – 1,000	400 – 1,250	700 – 2,300

Assumptions:

- 1) market or fleet penetration in 2010/2020 for business as usual is 4.1/19.9 % and for implementation support case 5.9/36.3%. Fleet penetration of cars equipped with lane departure warning already before 2006 is 0.6% in 2010 and 0.2% in 2020. The lower figure in 2020 is due to the fact that cars equipped with lane departure warning before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of lane departure warning is 3-10% on all road fatalities involving equipped cars..
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€.

Implementation Issues for eCall

A System description

eCall is targeted by the European Commission to become a harmonized European emergency service, which is based on precise satellite positioning and additional information of vehicles involved in a severe accident (vehicle identification, time of incident, eCall qualifier, identification of service provider as described in a minimum set of data or MSD). Severity will be defined from a personal injury point of view. The generated information will then be sent to a Public Service Answering Point (PSAP) or another type of certified first level emergency centre via a mobile phone connection. It is the intention that the eCall is triggered off by dialling the European emergency number 112 either automatically (deployment of airbag or crash sensors) or manually (press of a dedicated button). When a voice connection to the next PSAP is set up, accident and vehicle related data (MSD) are transferred through GSM/GPRS communication, using the same channel. In a second phase, it might be possible that when the customer has a contract with a private emergency service provider, additional information (full set of data) could be sent to this service provider. As the contractual optional connection to a private service provider is flagged on the operator screen at the PSAP the operator might pull down these additional information via the Internet. A possible valuable service might be language/translation service in case the accident happens in a different country and the accident victim has no knowledge of the local language. The PSAP, the emergency centre or service provider has to be able to receive and process the voice call and data set. The information is then sent to the local emergency authorities in order to dispatch the necessary emergency vehicles. The service should work in principle all over Europe.

B Technology Availability

Vehicle integrated GSM/GPRS communications	only available in part of the vehicle park, but the percentage is slowly increasing
Roaming to overcome language difficulties	conference call via private service provider or local language. Only very large PSAPs able to serve many languages
Low cost in-vehicle communication system	not available yet in Europe to create volume market
Emergency call routing all over Europe	European call and SMS routing through private network only. Not available in all member states. No public crossover systems exist
PSAP receiving technology	theoretically available, however, implementation depending on E-112 roll-out
Vehicle sensors	Airbag deployment and crash sensors used in existing applications.

C Road and Information Infrastructure Need and Availability

GPS Information	available in small part of the fleet; in most HGVs (Heavy Goods Vehicles)
Road infrastructure	not necessary but traffic accident information could be displayed on variable message signs to avoid rear-end collisions
GSM Communication Technology all over Europe	future of GSM in Europe unclear
Receiving technology in PSAP's and others	theoretically available, implementation depending on E-112 roll-out map

D Organisation requirements

Collaboration with and between all EU Member States (EU-25) and other key stakeholders of the emergency value chain in Europe

All stakeholder representatives have to get involved in detailed discussions to work out necessary plans and solve open questions, in particular solve the commercial aspects, regulatory and data protection issues

Development of and agreement on a business plan before starting the system development and implementation

Development of and agreement on an implementation (roll-out) plan before starting the system development and implementation

Receiving PSAP infrastructure needs to be specified, tested and in place

eCall system architecture, standards, protocols and interfaces need to be agreed in advance before volume production and service can start. Simultaneously the necessary receiving infrastructure needs to be prepared.

Vehicle model cycles and starting dates for vehicle production must be considered, taking into account vehicle type-approval.

Matching of voice calls and data sets (technology).

Roaming requirements must be solved.

E Regulatory Requirements / Barriers

Data protection and privacy issues have been solved but liability issues still open. Legislation not harmonized across Europe.

F Business Case / Customer Awareness and Acceptance

The interest of drivers and customers to pay for emergency call activities is rather low. As long as the customer is not made aware about the benefits of a harmonized European emergency call service he/she is reluctant to pay for this service. The current situation of different state of deployment of rescue services and gaps in rescue chains in different European countries is making it difficult to find common solutions.

Today there is no business model discussed and accepted among the different stakeholders. The ECDG (eCall Driving Group) has identified significant savings in the health and social cost side outnumbering the investment needs in in-vehicle systems and infrastructure. Models of tax and financial incentives have been presented and discussed. So far no agreement is reached.

G Key Success Factors

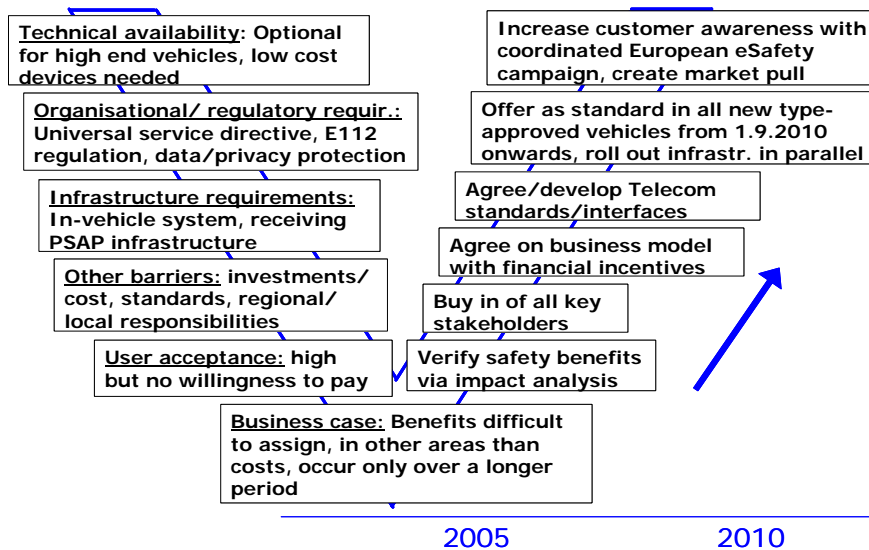
The commitment of the larger EU member states, where the major traffic volume takes place, is key.

Availability of suitable technologies in the Member States and in the vehicles

Availability of an accepted business model by all involved stakeholders (financially, technically and organizationally) leading to positive business cases

Availability of an accepted implementation plan by all involved stakeholders (financially, technically and organizationally)

H Feasible Deployment Strategies

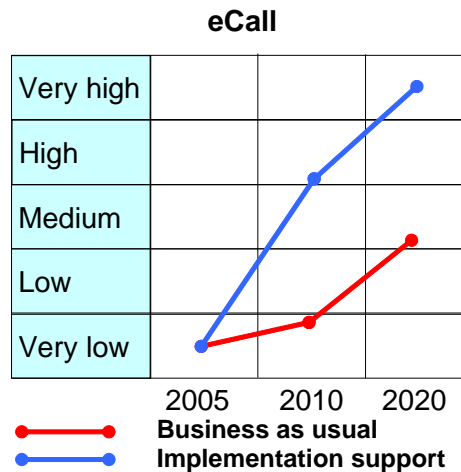


According to the V analysis of the implementation of eCall and the roadmap produced by the eCall Driving Group, the measures or the roadmap to be taken include the following, taking into account the rollout plan delay due to the missed deadline for MoU signatures by June 2005:

- Verify the safety impact of eCall in European conditions with actual European accident data
- Form “eCallNet” consortium and establish financial support for it
- MoU (Memorandum of Understanding) signatures from all key stakeholders of the eCall service chain including the member states – December 2005 (EC)
- Commission to adopt 2nd eSafety communication with actions for the member states and industry – September 2005 (EC)
- eCall Business Model prepared for decision taking by key stakeholders including insurances – June 2006 (All)
- ETSI standardization and eCall interface – June 2006 (ETSI)
- Implementation and rollout plan prepared for decision taking – June 2006 (All)
- Finalize in-vehicle eCall system architecture and start system development – December 2006 (ACEA)
- Rollout of infrastructure in key member states – December 2007 (MS)

- Full-scale field test by “early adopter” member states – until Dec 2008 (EC/MS)
- Finalize infrastructure in all other Member States and staggered introduction of eCall as standard option – Sept 2010 (MS, ACEA)
- Promote customer awareness by campaigns and attempt to improve business case by incentives

With the help of these measures, the market penetration of eCall in new cars in Europe is forecasted as the following up to 2020:



A crude estimate of the benefits of eCall installed after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	10 – 80	30 – 350	10 – 130	60 – 600
2020	30 – 350	150 – 1,600	50 – 550	250 – 2,700

Assumptions:

- 1) Market or fleet penetration in 2010/2020 for business as usual is 2.4/11.2 % and for implementation support case 9.3/52.3%. Fleet penetration of cars equipped with eCall already before 2006 is 0.6% in 2010 and 0.3% in 2020. The lower figure in 2020 is due to the fact that cars equipped with eCall before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of eCall is 1-11% on all road fatalities involving equipped cars, and similar for severe injuries.
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also severe injuries in all accidents, 1.7 M€.

Implementation Issues for Extended Environmental Information

A System description

The idea of Floating Car Data (FCD) is to monitor individual vehicles to gather data concerning the traffic situation on the whole road network. The in-vehicle equipment records the location of the car, speed and possibly other information such as acceleration or deceleration, and sends the recorded information to the central system or to other cars. The central collected data can be used as content for different applications and services. Floating car data can also be implemented as a decentralised system as in the German FleetNet project.

B Technology Availability

The technology needed to implement FCD systems exists. There have been several implementations with varying features. Trials have been carried out and actual FCD deployments exist in Europe (e.g. France, Germany and UK), USA and Japan. Technological solutions such as the wireless communication and location systems used vary from one case to the other. In addition to speed and location, many other kinds of information can be collected. First FCD systems transmitted travel times and locations out of range-outs or time-outs. Enhanced methods compare the onboard travel times with expected travel times to transmit only travel times which exceed a certain threshold value. Different kind of sensors can be mounted in the car and the results of measurements transferred. In modern vehicles numerous control devices and subsystems generates data which can be used by intelligent algorithms to detect traffic situation and safety relevant events and situations (Extended Floating Car Data – XFCD). For example, the operation of ABS brakes can be used to detect slippery road conditions.

C Road and Information Infrastructure Need and Availability

In case of floating car data no roadside equipment is needed. Satellite location systems and means of communication between cars and central system exist. Usually, the location data is produced by a GPS receiver. In future, the corresponding European system called GALILEO together with GPS offers complementary added value compared with either on their own. GPRS, GSM, UMTS, WLAN can be used for wireless communication. At present, GPRS is widely available and offers packet switched data connection which is cheaper to use than circuit switched GSM data. Methods for the data fusion of the data from different sources (stationary detectors, floating cars, manual reports) are needed and are already used for travel time and traffic status FCD by e.g. ITIS in the UK. The system also requires centres, which receive the various data and where very actual and precise information of local hazards, traffic and road conditions (slippery roads, fog etc.) will be prepared.

D Organisation requirements

The floating car data are collected from individual cars. At least, there should be an organisation which defines standards for the in-car equipment and an organisation to take care of the overall maintenance of the system. The same organisation could also be responsible for the further development of floating car data system. An organisation is also needed to deploy and maintain local transmitters and/or receivers to collect/distribute FCD and local information as well as to maintain the real-time

data pool. It is likely that in most cases a public service actor needs to be involved e.g. via a Public-Private-Partnership (PPP).

In order to avoid the development of further proprietary systems, it is necessary to set up standardization committees in early development stages. The ISO International Organisation for Standardisation in its Working Group TC 204/Subworking Group SWG 16.3 for vehicle probe data for wide area communication is already working. Their new work item proposal contains “Architecture, Basic Data Framework and Core Data Elements”

E Regulatory Requirements / Barriers

Data protection and privacy issues should be dealt with when the system gathers data on the movement of individual vehicles. Questions related to the ownership of the data collected must be answered before starting the implementation.

F Business Case / Customer awareness and Acceptance

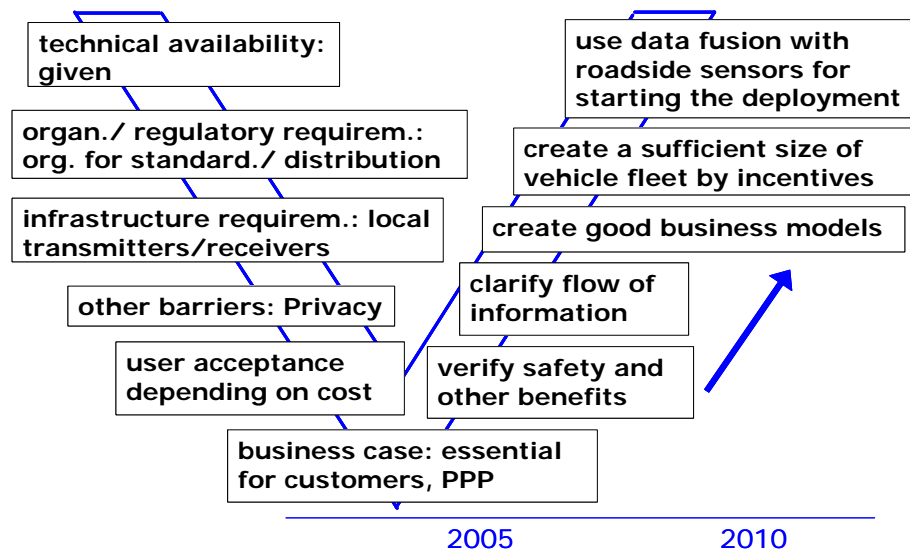
Monitoring traffic with conventional roadside equipment is costly. FCD could be one way to produce real-time data for traffic control purposes. A part of the cost could be paid by the authorities paying for the data while the other part can be recovered by the value of real-time services (such as prediction of travel times) offered to the public. In addition, the business model chosen should be feasible with the technology used. New generation of extended floating cars will transmit only data which are relevant to know in the centre: e.g. detected slippery conditions on the road, congested traffic with precise located congestion fronts and weather related visibility obstructions (fog, snowfall). To avoid unnecessary repetition of in-vehicle message feedback-channel-referencing has to be implemented. Every message sent over the air (digital audio broadcast-DAB, traffic message channel-TMC) into the vehicles contains what the centre already knows and does not need to get informed. An intelligent message management in the vehicles with feedback channel referencing will keep the number of send messages explicitly low. Special attention needs to be given to deletion of outdated messages.

G Key Success Factors

One of the most crucial issues is, who will pay the costs and why. There should be a valid business model or a way to share the costs between different parties concerned e.g. in a PPP. Data protection and privacy issues should be taken account when designing the system to minimize the potential for abuse the data collected and to ensure the user acceptance.

Important is to send all Floating Car Data of a geographical area into one single data pool in order to get the highest quality of content for the services. It doesn't make sense to have numbers of data pools, each with some data.

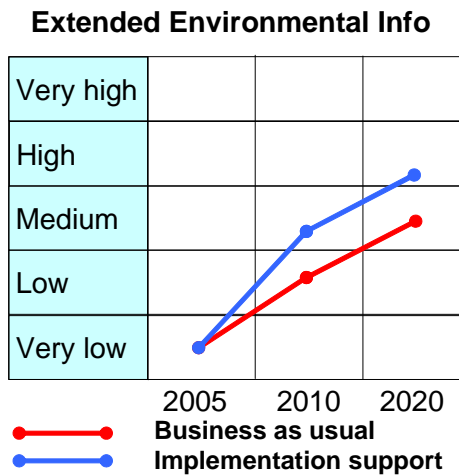
H Feasible Deployment Strategies



According to the V analysis, the measures to be taken include the following:

- Verify the safety and other benefits as well as the benefit/cost ratios in different conditions and test the technical performance of the system in large scale demonstrators
- Clarify the flow of information between the vehicles and the FCD servers as well as between FCD servers and traffic information or management centres (both public and private) while maintaining privacy of equipped vehicles
- Develop good business models for European conditions in the context of large demonstrators so that all stakeholders including the drivers have a sufficient business case
- Create a sufficient size of vehicle fleet, usually 5-10% of vehicles on a network is sufficient. In order to quickly reach the required critical mass, the deployment is perhaps best to do one area at a time
- Improve and maintain data quality by co-operating and carrying out data fusion with the owners of roadside monitoring infrastructure

With the help of these measures, the market penetration of extended FCD in new cars in Europe is forecasted as the following up to 2020:



As Extended Floating Car Data will not reduce accidents directly but indirectly via the use of the information produced in a number of other services such as RTTI or local danger warnings, no estimate of the safety impact is calculated. Most benefits are expected to be caused by the fact that extended FCD will improve the quality of the RTTI services and local danger warning systems and thereby increase their user acceptance and effectiveness.

Implementation Issues for RTTI

A System description

“Real-time Traffic and Travel Information” includes all information which is relevant to organize and to optimize traffic flow and which can give advice to the mobile user, usually the driver, and to contribute to road safety and efficiency. The *eSafety* goal is to provide the majority of drivers with actual intra-urban traffic information and to get adequate urban traffic information in 50% of all major metropolitan areas in the EU.

RTTI contains

- * the collection of relevant traffic data,
- * the interpretation of that information and prepare it for further use and distribution,
- * the application of that information to operate infrastructural installations such as traffic lights or moving traffic signals,
- * the wireless transmission of the RTTI to the mobile user by public or private broadcast and/or two-way systems such as GSM, GPRS, UMTS, WLAN, Satellite transmission.

B Technology Availability

Beside verbal radio announcements which interrupt the regular audio program, the most commonly used service is RDS/TMC, which is in operation in quite some European countries, already. It offers digitally coded traffic information which can then be electronically selected and interpreted. Very often this is then used to adjust the routing of electronic navigation systems in vehicles to the actual traffic situation (- > “dynamic navigation”). RDS/TMC has a significant user base – about 3 million users - and is growing currently by about 1 million users p.a. A growing number of terminals such as in-car navigation sets, PDAs and mobile radios with built-in navigation capability are on the market.

In many European countries, RDS-TMC services are available free of charge for the users. The highest penetration can be seen in Germany, where RDS-TMC messages are transmitted by 10 public broadcasters and 8 private broadcasters within 53 regional or local programs. This means, that full coverage in Germany has been reached and RDS-TMC messages can be received at any place from several programs. During the last years in some countries commercial services have taken up – mainly in France and the UK. These private companies normally operate their own data collection system, but use public data, too, where available. RDS/TMC services are already installed in some of the new Member Countries of the EU, too.

C Road and Information Infrastructure Need and Availability

The systems require monitoring systems of sufficient quality in order to serve the user and have a positive effect on safety and efficiency. The proliferation of RTTI services into further European countries and/or the extension of services in the countries already equipped is however sometimes hindered by a number of factors, such as

- * limited availability of traffic information content,
- * difficulties in defining the roles of the public and private sectors,
- * cost of broadcasting,
- * limited data rate in FM radio,
- * and economic difficulties with business models.

The RTTI Working Group group has analysed some of the issues mentioned as being caused by

- the limited capacity in FM which may be removed by using DigitalRadio (DAB)
- the lack of data in most urban areas
- and the lack of some push for starting-up in some European countries.

The RTTI Working Group has proposed to the eSafety Forum that all EU-countries should agree or should be advised to enable and to extend the installation of the chain of information needed to establish RTTI services, so to have about 80% of all journeys served with adequate, standardized services by the year 2010.

D Organisation requirements

To reach the target mentioned above, the RTTI WG has recommended to the Member States

- * agree at their national level on a strategy and time schedule for the implementation of RTTI services, starting from RDS/TMC, covering as good as possible both interurban and urban areas
- * support the TMC Forum to push the safety-related services features of TMC, building on the already existing and standardized European format for the data, messaging and transmission standards,
- * take steps to ensure roaming and interoperability across the RTTI services in all of the EU,
- * require the authorities to make available existing public data for the provision of RTTI services and to establish additional collection of RTTI when necessary,
- * agree, on the basis of the national RTTI strategies and the Commission Recommendation on TTI services, with the private service providers on the extent of the public (free of charge) services and the conditions for the commercial services, and establish public-private partnerships if necessary,
- * ensure the correct implementation for the standards by the service providers,
- * publish, following the guidance of the Commission RTTI recommendation clear guidelines for the private sector the conditions for establishing private data collection networks for commercial purposes,
- * require broadcasters, especially those operating under public licence, to carry the RDS/TMC traffic information on their FM services for public or private providers so that a minimum of 80% of journey drivers has access to a relevant service by the year 2010 or earlier,
- * require authorities to ensure through the appropriate standardisation and regulation bodies that frequency spectrum and broadcast capacity will be made available for the more advanced digital broadcast services such as DAB, DRM, DVB-T and eventually satellite-DAB,
- * support the development of more advanced services which are possible by 3G Mobile Communications, DAB, DVB-T and satellite broadcasting, WLANs and others.

E Regulatory Requirements / Barriers

See D and the proposals made there to get the necessary regulatory requirements installed and the existing barriers removed.

F Business Case / Customer Awareness and Acceptance

In many European countries, RTTI is run in coordination between the authorities or operators of the main roads, the public and private broadcasters and some automobile clubs. The cost of the RTTI services are then covered by these groups, and no extra charge has to be born by the users. They deliver the traffic information normally free of charge to the broadcasters. These distribute that part of the information to their audience which they feel will be relevant to the road users. Very often they add some more and extra information which they may get from other sources such as the automobile clubs, from local police or organisations.

In case of private broadcasters and Public Private Partnerships some other business cases are applied. The most common one is: Encryption of the TMC-service and a once-per-life down-payment for the car-radio installed into the vehicle.

The existing RTTI-service via RDS/TMC is widely accepted – especially when the service is free of an extra monthly or annual charge. In countries with that service about all navigation systems installed by the car manufacturers have the RDS/TMC-feature installed, already. Due to this the strong expansion by about 1 million customers p.a. in the Member Countries of the European Union is understandable.

The next step expected by the users is a more detailed digital information on the urban traffic situation and so to allow a dynamic navigation in towns.

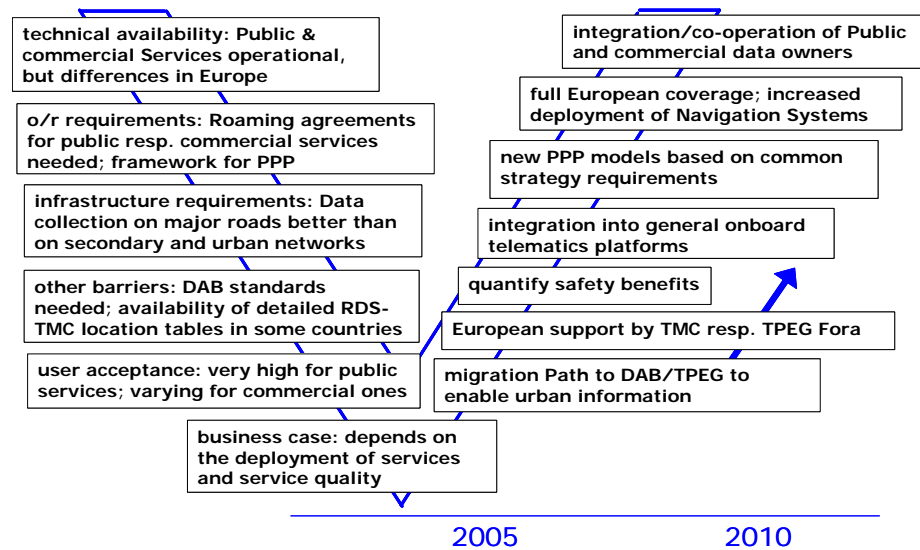
G Key Success Factors

There are many factors for success, the two most important ones may be:

- a. Customer's awareness and interest in the RTTI-service, augmented with:
 - * more and more actual and correct traffic information
 - * not only warning for traffic problems but giving information of the end – or even the expected time for end - of a traffic problem
 - * extension to inner-urban traffic information
 - * eventually extra features such as expected travel times
 - * reasonable costs

- b. enabling of the installation of RTTI-services by the authorities,
 - * providing existing RTTI-data to the operators and broadcasters,
 - *and giving support and allowances for private installations – mainly then, when public organisations and communities show no or only small interest to install an adequate RTTI service.

H Feasible Deployment Strategies

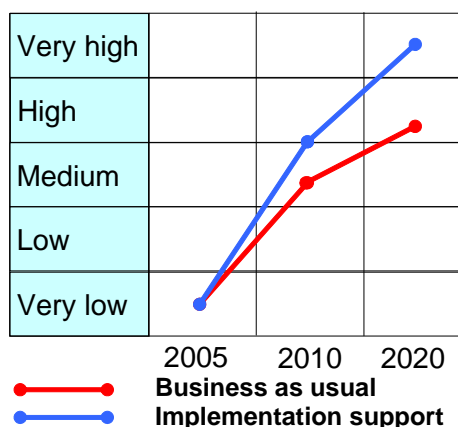


According to the V analysis of the implementation of RTTI, the important measures to be taken include the following:

- All stakeholders to follow the migration path from RDS/TMC to DAB/TPEG (Digital Audio Broadcasting/Transport Protocol Expert Group) so that also urban information can be included in the European services.
- European Commission to provide their support to the member states' and other stakeholders' co-operation for a, i.e. the TMC forum and the TPEG forum.
- The benefits of RTTI are acknowledged but the safety benefits need to be quantified with empirical studies.
- The industry and other stakeholders should provide the integration of RTTI into the general onboard telematics platforms in the vehicles.
- The member states, services providers, broadcasters and other stakeholders should develop common strategies and business models to facilitate efficient PPP models for RTTI service provision.
- In order to achieve full European coverage and to accelerate market penetration, the penetration of navigation systems equipped with RTTI should be promoted via campaigns and incentives.
- In order to improve data quality and thereby user acceptance and demand, the co-operation and data sharing between public and private owners of real-time transport related data should be improved.

With the help of these measures, the market penetration of RTTI in new cars in Europe is forecasted as the following up to 2020:

Real-Time Traffic Information



A crude estimate of the benefits of RTTI systems installed in cars after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	4 – 20	7 – 35	40 – 200	60 – 300
2020	20 – 90	30 – 150	150 – 800	250 – 1,300

Assumptions:

- 1) market or fleet penetration in 2010/2020 for business as usual is 7.4/33.1 % and for implementation support case 10.7/52.9%. Fleet penetration of cars equipped with RTTI already before 2006 is 1.5% in 2010 and 0.6% in 2020. The lower figure in 2020 is due to the fact that cars equipped with RTTI before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of RTTI is estimated at 0.2-1% on all road fatalities involving equipped cars..
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€. In addition, the efficiency, comfort and other benefits of RTTI are estimated to be two times as high as the safety benefits when expressed in cost terms.

A more detailed set of recommendations and roadmap is to be found in the final report of the RTTI Working Group of the eSafety Forum.

Implementation Issues for Dynamic Traffic Management and Local Danger Warnings

A System description

Dynamic traffic management systems and local danger warnings are used to increase the safety and flow of traffic in cases of disturbance caused by incidents, congestion and adverse weather. The systems are operated automatically, semi-automatically or manually from traffic control centres based on fixed monitoring systems or mobile sensors (FCD etc.) on location. The systems employ Variable Message Signs or VMS to give the information to the drivers. Three categories of VMS exist based on the types of messages given: 'regulatory messages', 'danger warning messages' and 'informative messages'. The dynamic traffic management systems usually use regulatory messages, sometimes accompanied by danger warning and informative messages, and local warning systems use danger warning messages.

B Technology Availability

The technologies needed to implement the systems exist. The VMS signs vary from single matrix devices which can display just one sign/symbol (in on/off mode) via line matrix displays which can display any text or which can display a varying combination of pictograms and text to graphical panels which can display anything. Also combinations of signs/symbols and texts are in use (Multi-purpose VMS). Various technologies are used in the signs, e.g. fiber optics, leds, prisms. The telecommunications between the VMS, monitoring systems and traffic control centres utilise various wire and wireless technologies. The traffic or environmental monitoring systems required by the systems are primarily based on fixed road infrastructure based monitoring stations utilising e.g. inductive loops, microwave detectors, video detectors, infrared detectors, etc. Specific systems are used for monitoring weather conditions.

There are situations for which no pictogram or no satisfactory pictogram exists. New or adequate pictograms may be needed for the following regulatory pictograms: 1) Switch off the engine if congestion persists, 2) Switch on hazard warning lights and 3) Vehicle broken down; Danger warning pictograms: 1) Unauthorised person(s) on the road, 2) On-coming vehicle and 3) Weather conditions such as fog, rain, snow; Informative pictograms: 1) Road closure, 2) Lane closure and 3) Tunnel closure. Major technical issues relate to the future developments in technology and vehicle equipments enabling the use of cars and other motor vehicles as mobile sensors. This means that we need to solve the in-vehicle sensing issues as well as the communication issues, which mainly relate to vehicle-to-infrastructure and roadside-to-control centre communications, but also vehicle-to-vehicle communications. In-vehicle technologies for producing monitoring information required by the systems exist (travel time and traffic status, accidents) or are under development (road surface friction, incidents, pedestrian and animal detection).

C Road and Information Infrastructure Need and Availability

The systems require monitoring systems of sufficient quality. The high quality of the monitoring information input is essential to the high quality operation of the dynamic traffic management and local warning systems, which in turn is directly linked to the effectiveness of the systems. The type and quality of the monitoring system are dependent on the aim of the traffic management and local warning system as listed below.

- Speed management /speed harmonisation (traffic-related): Cross-section traffic parameters (traffic flow by vehicle class; spot speed – average and standard deviation; occupancy) and/or queue length and/or camera output
- Speed management (weather-related): Cross-section road weather information (temperature - air, road, ground, dew point; precipitation; visibility; wind - speed, direction, gusts) and cross-section or continuous road surface condition information (water/snow existence; black ice existence; friction); additionally camera output
- Ramp control/metering: Cross-section traffic parameters and queue length on motorway and ramp
- Network traffic control: From main parts of network cross-section traffic parameters and/or link travel times and/or queue lengths; camera output
- Lane control: cross-section traffic parameters lane by lane; camera output (geographical position of stationary objects , e.g. vehicles); automatic incident detection
- Tunnel control: cross-section traffic parameters; queue length, camera output; automatic incident detection; automatic fire detection, stopped vehicle detection
- Bridge control: cross-section road weather information (especially wind - speed, direction, gusts and black ice); cross-section traffic parameters
- Incident warning: Output from Automatic Incident Detection (AID) systems or cross-section traffic parameters; queue length; camera output;
- Local warnings (school children): Output from pedestrian detection system, or manual or clock-based trigger system
- Local warnings (large animals): Output from animal detection system
- Local warnings (slipperiness): Cross section road surface information
- Local warnings (queue): Cross-section traffic parameters; queue length; camera output

D Organisation requirements

The systems are currently usually fully operated by traffic control centres under the jurisdiction of the road operator/authority or the police.

The use of data from in-vehicle systems to improve the quality of the monitoring systems will require new organisation-related solutions.

E Regulatory Requirements / Barriers

Both regulatory rules and warning messages shall be indicated on VMS's with symbols as prescribed by the Vienna Convention (1968), and texts shall be minimised. Supplementary brief texts according to the Vienna Convention can be used. This could also be extended to informative and advisory messages on VMS's. This is especially recommended where these messages along the Trans European Road Network (TERN) are meant for all drivers, thus including a growing percentage of foreign drivers, avoiding language confusion. (CEDR 2003).

The current representation of regulatory rules on the European VMS's almost completely conforms the signs of the Vienna Convention. This seems to be rather evident as they have the same legal status/value everywhere in Europe. Regarding danger warnings, the different approaches of the European states already appear, ranging from warning signs conform the Vienna Convention to entirely textual descriptions which may vary per region. The differences between the European states are most apparent with informative signs. Where the Vienna Convention gives some

recommendations for informative signs like (non-variable) directional signs, it does not contain prescriptions nor recommendations for pure textual messages on VMS's. This lack probably is the cause of the variety of the national and local guidelines which describe these panels in more detail. Besides the fact that each county/region currently uses its own language, they also apply different national and even local approaches to the use of VMS. The common practice of VMS in the CEDR member states shows a mixture of different languages and, in some cases, 'invented' pictograms which are not being used all over Europe or which are an interpretation of the Vienna Convention.

The most harmonised areas are the colours and the use of symbols and pictograms in regulatory and danger warning message signs. In some cases the harmonisation is based on practices and the development should be followed and kept consistent. Examples of already harmonised objects are light emitting (e.g. LED or fibre optic) signs with inverted colours in speed limit systems and in danger warning signs on main roads; a red circle indicating a mandatory speed limit; avoidance of text messages in lane control; small amount of information; no unnecessary information; pictograms instead of text messages and, combined messages; no flashing warning signs; and approval procedures for new pictograms.

The accident pictogram (suggested by FIVE) should be confirmed at national level if an overall consensus will be reached (e.g. on UNECE-level). An alternative is to show the consequences of the accident i.e. to just show the congestion pictogram. The current definitions for the maximal length of text messages are not equal, except for the definition for number of lines, and they should be made more uniform. If a text message is shown, it should be as short as possible and have minimal amount of the words. Internationally understood expressions or symbols (e.g. ←, →, ↑, ↓, <, >, +, -, =) should be preferred.

The liability issue has delayed the deployment of VMS in some cases. The problem is due to cases where a danger warning message is not displayed, although the danger (about which the system should warn) is present at the location, and the driver interprets the absence of warning as an indication of no danger and then is involved in an accident or a near-accident due to the danger event. Liability is very much connected to the reliability of the system and its control algorithms and monitoring infrastructure. The final responsibility lies in any case with the driver.

For all deployments the reliability of the systems is important. Information on the qualities of VMS is occasional or does not even exist, but the quality should be controlled. Siting criteria should be specified in national guidelines. There is a substantial variation in the control principles both nationally and between countries. A more harmonised use of variable warning signs would be beneficial to the drivers. For this purpose the documented principles should be collected for the common use and analysis.

In long term, the differences in the use of pictograms should be minimised. For text messages, the approval procedures should be developed. The existing message prioritisation practices should be discussed and evaluated.

F Business Case / Customer Awareness and Acceptance

Road users find the systems useful, and usually comply well with the regulatory messages and danger warning messages. For these reasons, the systems have been also found to be very effective for reducing the risk of accidents and their consequences. The systems are, however, quite costly to implement. The systems are usually only installed if the expected benefit-to-cost ratio is high enough.

G Key Success Factors

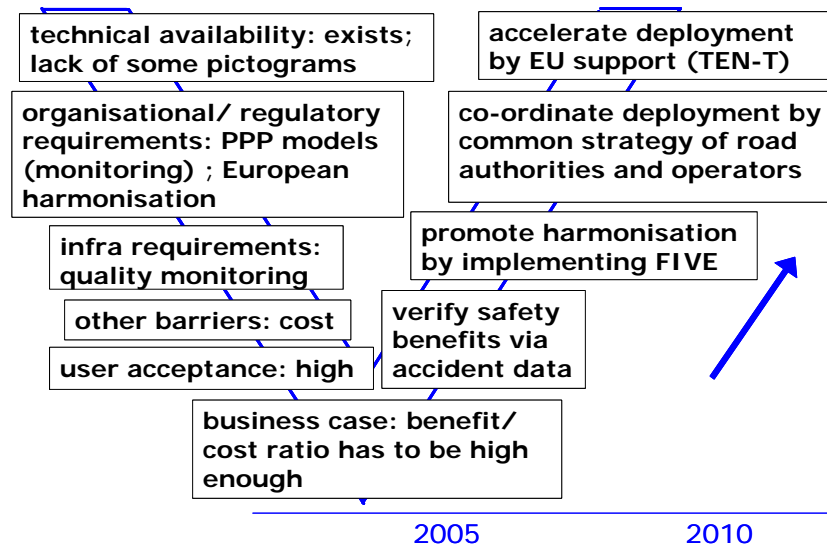
There are considerable costs involved in the implementation of VMS systems. The extent of the costs are naturally linked to the location, the objectives of the system, the VMS signs, control system, monitoring infrastructure required, communication systems etc. The costs of route and network control systems on motorways are in the range of 0.15-0.2 M€/motorway-km, and of a line control (speed management) system on a motorway can be estimated to be in the range of 0.05-0.1 M€/motorway-km and the investment cost for one VMS in a larger system to be 15 000 – 30 000 €. The annual maintenance and operation of the systems can be 5...10% of the investment costs.

For most road authorities, the decision to implement the system will be based on the benefits of the system in comparison to its costs. The main benefits of the systems come from improved safety and efficiency. Evidence exists of an accident reduction of 25% from motorway traffic management systems, a 13% reduction in wintertime injury accidents due to dynamic weather related speed management systems. The benefit/cost ratio of the system will depend much on the location, accident situation and traffic volumes, e.g. the benefit/cost ratio for a motorway control system on a motorway with average daily traffic volume of 95 000 vehicles was estimated as 5.6. Concerning local danger warnings, studies indicate injury accident reductions of 5-15%.

A key success factor is to maintain and improve the effectiveness of the systems while keeping costs at a reasonable level. The former is ensured by high quality of the systems and high user acceptance enabled by the efficient and understandable control of the VMS and supported by the harmonised deployment of them on the European level. The latter is supported by the increasing use of mobile, in-vehicle based systems for producing the necessary monitoring information required.

H Feasible Deployment Strategies

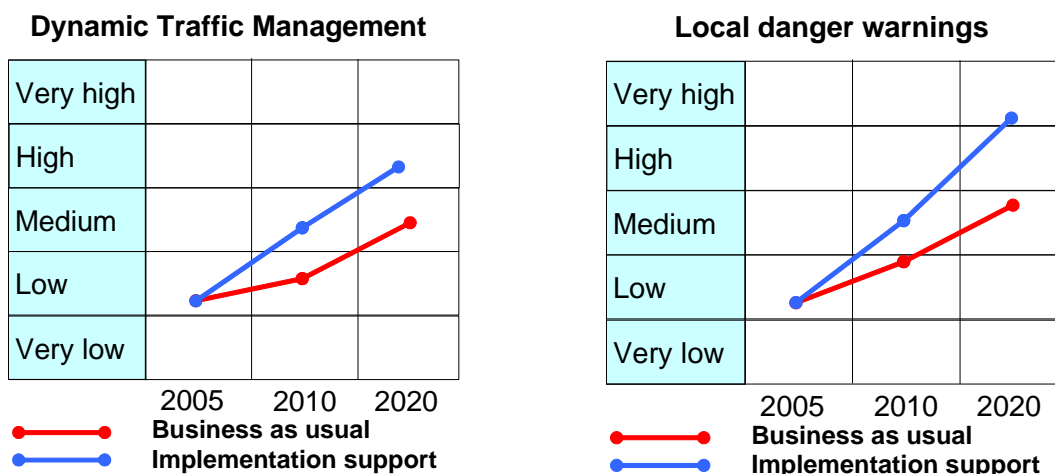
CEDR (Conference of European Directors of Road) has worked for many years toward the implementation of harmonised VMS based traffic management and danger warning systems in Europe. The last efforts have been the FIVE action as well as the VMS Platform funded by the UK but terminated in the spring of 2004. A successful implementation of the harmonisation of VMS around Europe - and setting up a Platform to coordinate that work - depends first and for all on the willingness of the NRA's to implement the FIVE Framework. A CEDR Sub-Group on Telematics has been asked to present a TERN deployment strategy for VMS (Implement FIVE) and to seek a structure to implement this strategy.



According to the V analysis of the implementation of dynamic traffic management as well as mainly infrastructure based local danger warnings, the measures to be taken include the following:

- The safety benefits of all new types of systems need to be verified with actual accident data in controlled before and after studies.
- The implementation of the FIVE framework should be ensured by the European road authorities and operators in order to achieve the harmonisation according to user needs and requirements.
- A common European strategy for deploying and operating dynamic traffic management, local danger warning and also other infrastructure-related eSafety systems should be developed and maintained by the road authorities and operators together with the other stakeholders
- The European Commission should continue to provide their funding support to the deployment of these systems within the context of the TEN-T programme and also with other instruments to ensure the deployments on the critical road sections outside the TERN.

With the help of these measures, the market penetration of these systems for problematic parts of the European road network is forecasted as the following up to 2020 for :



A crude estimate of the benefits of dynamic traffic management on road sections equipped after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	50	150	200	550
2020	200	400	750	1,350

Assumptions:

- 1) Coverage of dynamic traffic management is in 2010/2020 for business as usual is 14/27 % and for implementation support case 35/57%. The coverage before 2006 was 7%.
- 2) Effect of dynamic traffic management is estimated as a reduction of 20% on all road fatalities and other injuries.
- 3) Length of the problematic road network is 70,000 km with average daily traffic of 30,000 vehicles and average fatality rate of 5 fatalities against billion vehicle kilometres.
- 4) The effect of growth of traffic up to 2020 on fatalities is fully compensated by expected decrease of fatality rate due to various safety measures deployed during the years up to 2020.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€. In addition, the efficiency, comfort and other benefits of dynamic traffic management are estimated to be half of the safety benefits when expressed in cost terms.

A crude estimate of the benefits of local danger warning systems on road sections equipped after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	2	4	4	8
2020	5	9	12	21

Assumptions:

- 1) The number of local danger warning systems is in 2010/2020 for business as usual is 1,500/2,500 and for implementation support case 2100/3,700. The number before 2006 was 1,000.
- 2) Effect of local danger warnings is estimated as a reduction of 20% on all road fatalities and other injuries.
- 3) Length of the impact area of each system is 3 km with average daily traffic of 30,000 vehicles and average fatality rate of 10 fatalities against billion vehicle kilometres.
- 4) The effect of growth of traffic up to 2020 on fatalities is fully compensated by expected decrease of fatality rate due to various safety measures deployed during the years up to 2020.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€. In addition, the efficiency, comfort and other benefits of dynamic traffic management are estimated to be half of the safety benefits when expressed in cost terms.

Implementation Issues for Speed Alert

A System description

The system alerts the driver with audio, visual and/or haptic feedback when the speed exceeds the locally valid legal speed limit. The speed limit information is either received from transponders in speed limit signs or from a digital road map, requiring reliable positioning information. Some open questions exist such as:

- Voluntary or mandatory equipment of vehicles
- Type of speed limits to be included: General regulations, local speed signs, temporary speed limits (e.g. “70” between 07.00 – 10.00h), dynamic speed limits depending on traffic and other conditions
- Road categories to be included: motorways, rural highways, urban roads
- General deployment for selected road categories or equipment of specific parts of road networks, such as accident black spots, tunnels, bridges
- Types of vehicles to be equipped: all vehicles, passenger cars, lorries, hazardous goods transports, buses,
- Categories of road users to use speed alert: all drivers, young/aged drivers, drivers under rehabilitation, commercial companies/drivers, other specific groups

B Technology Availability

The basic technology needed to implement speed alert systems exists. There have been several successful large-scale tests with varying speeding feedback solutions, and voluntary speed alert or limiter systems are on the market. However, suitable solutions need to be achieved on how to convey speed limit modifications to on board units (OBUs), e.g. electronic Map on CD-ROMS, local short range communication, wide range communication (DAB).

C Road and Information Infrastructure Need and Availability

The basic information infrastructure required by the system, i.e. up-to-date fixed speed limit information in digital road Map, is only partly available in Europe for all roads in Finland and Norway, and in the near future Sweden, and limited coverage (motorways and main roads) for a large part of Europe.

D Organisation requirements

There has to be an organisation responsible and liable for updating the speed limit data banks in regular time cycles, as soon as speed limits are changed, and for the actual update reporting procedures. The organisation responsible for conveying temporary and variable speed limit information is required, if they are included in the system.

E Regulatory Requirements / Barriers

In order to have a nation- or European-wide implementation of the system, the following aspects have to be solved: data quality requirements, questions of responsibility, liability, updating, timing of the updating, legal relevance of speed alert systems and speed limit signs as well as their possible contradictions.

F Business Case / Customer awareness and Acceptance

So far, there has not been substantial market (car buyer) demand for the system. The market demand for speed alert will probably be increasing in the future with the

expected increase of automated speed enforcement throughout the EU. The growing awareness for traffic safety issues among organisations and the use of speed alert as a tool to ensure delivery of safety quality-assured transport services for a company might also increase market demand. It is also obvious from the pilots that user acceptance for speed alert will increase with increasing familiarity with the system.

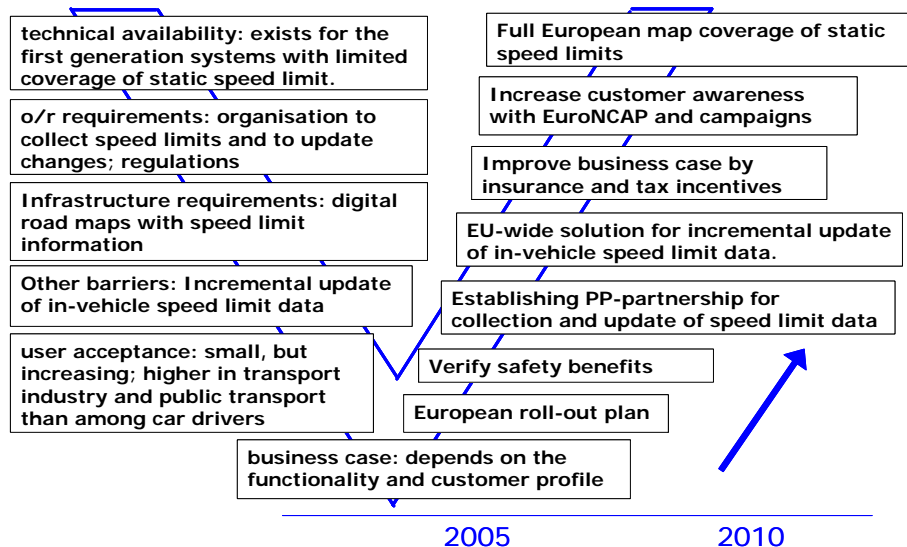
G Key Success Factors

Many road and other authorities are regarding speed alert as a key system for improving road safety, and the large-scale implementation in the short-term will depend on European and national regulations aiming at mandatory or voluntary deployment of the system. European and national decision making will, however, require that the open questions as listed above will be settled. The most urgent factor is the need for an accurate and up-to-date speed limit database that is readily accessible to all potential service providers.

H Feasible Deployment Strategies

Together with another EU project PROSPER, SpeedAlert has developed the European wide deployment strategy for informative and voluntary-based speed alert. The SpeedAlert project has established a common classification of speed limits in Europe, defined the system and service requirements of in-vehicle speed alert system, defined the functional architecture of speed alert, harmonised the definition of speed alert concepts and identified the requirements for standardisation. The project has built consensus with all key stakeholders leading to the definition of recommendations and associated deployment roadmap for successful European-wide implementation.

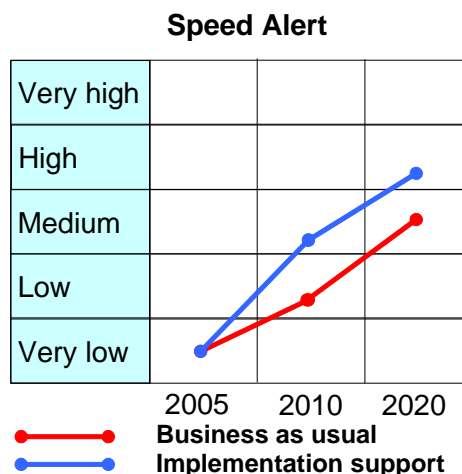
It is quite likely that deployment has to build on voluntary systems. In a longer perspective mandatory systems could be deployed for certain customer groups, such as learning drivers, frequently caught speeders, drivers wishing for insurance bonus etc.



The V model is also based on the work of the SpeedAlert project. According to the roadmap produced by the SpeedAlert project (www.speedalert.org), the following measures need to be taken to promote the deployment of informative and voluntary speed alert systems:

- In order to deploy an autonomous system for static speed limits with limited coverage and to reach a consensus by all stakeholders for speed alert deployment by 2006:
 - Establishment of European roll-out plan endorsed by public and private sectors
 - Assessment of technical and economical feasibility of speed limit data collection and maintenance at European level
 - Development of cost/benefit analysis and business case
 - Promotion of tax/insurance incentives to strengthen end-user interest in speed alert applications
- In order to deploy an enhanced autonomous system for static speed limits by 2009
 - Ensuring the European-wide procurement of speed limit data by progressively establishing appropriate public/private partnerships
 - Development of adapted procedures to optimise the speed limit data maintenance process by public authorities
 - Development of action plan to support market introduction of incremental map update solutions to enhance in-vehicle speed limit up-to-dateness
- In order to deploy a cooperative system for variable speed limits and to have speed alert applications as standard option in all new cars by 2015:
- Deployment of pan-European standardised infrastructure-vehicle communication service for provision of dynamic content
- Implementation of appropriate certification process of speed limit data to support exploitation by ADAS applications

With the help of these measures, the market penetration of speed alert in new cars in Europe is forecasted as the following up to 2020 for :



A crude estimate of the benefits of speed alert systems installed in cars after 2005 is given in the table below.

Year	Road fatalities in EU25		Accident and other costs saved (M€)	
	Business as usual	Implementation support	Business as usual	Implementation support
2010	20 – 220	30 – 350	50 – 500	70 – 850
2020	90 – 950	160 – 1,850	190 – 2,200	350 – 4,200

Assumptions:

- 1) market or fleet penetration in 2010/2020 for business as usual is 3.6/17.5 % and for implementation support case 7.5/33.2%. Fleet penetration of cars equipped with speed alert already before 2006 is 0.6% in 2010 and 0.2% in 2020. The lower figure in 2020 is due to the fact that cars equipped with speed alert before 2006 are by then more than 15 years old and thus many of them are already scrapped.
- 2) Effect of RTTI is estimated at 1.75-20% on all road fatalities involving equipped cars..
- 3) Expected number of fatalities without additional eSafety measures is 37,000 in 2010 and 28,000 in 2020 for EU25.
- 4) Average cost of a fatality saved is 1 M€, and when considering also less severe injuries in all accidents, 2.3 M€.



**ANNEX 4: TERMS OF REFERENCE FOR THE IMPLEMENTATION ROADS MAP
WORKING GROUP**

Implementation Road Map Working Group: Terms of Reference

Chairmen: Risto Kulmala, VTT and Hans Jürgen Mäurer, DEKRA

1. The context

The Road Map working group was one of the later established groups to provide a combined strategic approach for the *e*Safety Forum. The Forum is a joint platform for all road safety stakeholders to promote and monitor the implementation of the recommendations identified and presented to the High Level Group.

2. Constitution

The Road Map working group was established in July 2003, for a period of approximately two years.

The group is chaired by representatives from VTT and DEKRA, and it is open to any stakeholder with an interest and expertise to contribute to the work of the group.

The work is on a voluntary basis and does not commit group members to any particular view or course of action. Decisions and recommendation will be arrived at by consensus.

3. Objectives and Scope

The Road Map working group has decided to focus on

- Global Matrix of *e*Safety Systems
- Technical availability
- HLG recommendations.

The working group has members from industry, national authorities, research institutions, the Commission and user groups. It aims to reach consensus amongst these stakeholders on the critical questions.

The group aims to reach specific detailed recommendations on the implementation steps within a two year period.

The group cannot undertake the detailed research and analytical work necessary but it will monitor progress in the development / fulfilment of Road Map at a EU level.

4. Reporting

The Road Map group reported progress of its initial work at the first *e*Safety Forum plenary meeting and will continue to report progress at future *e*Safety Forum and Steering Group meetings.

Members of the working group will also report to other meetings deemed as relevant for the group.



**ANNEX 5: MEMBERS OF THE IMPLEMENTATION
ROAD MAP WORKING GROUP**

Implementation Road Map WG - List of members

Name	Organisation
Hans-Jürgen Mäurer	DEKRA
Risto Kulmala	VTT
Franck Batocchi	PSA
Didier Wautier	Renault
Giorgio Audisio	Fiat
Alessandro Coda	Fiat Auto
Lars Lind / Mats Rosenquist	Ford/Volvo
Jörg Breuer	Daimler-Chrysler
Jürgen Trost	Daimler-Chrysler
Wolfgang A. Reinhardt	ACEA
Arnold van Zyl	ACEA
Bernhard Labudek	ADAC
Joachim Scholten	BMW
Roland Niggstich	BMVBW
Adam McCarthy	AIT + FIA
Fritz Bolte	BAST
Gerard Gastaut / Patrick Mallejacq	France
Cathy Jenkins	UK DfT
Juhani Jääskeläinen	EC DG-INFSO
Ghassan Freij / Paul Kompfner	ERTICO
Brian Knibb	KGP
Vera Siegler / Agnes Lindenbach	Topolisz
Martin Rowell	NavTech
Erich Bittner	Bosch
Eva Boethius/Bengt Hallström	SRA