SUPREME

SUMMARY AND PUBLICATION OF BEST PRACTICES IN ROAD SAFETY IN THE MEMBER STATES

THEMATIC REPORT:

VEHICLES

THE FINAL REPORT OF SUPREME CONSISTS OF 14 PARTS:

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PART C	BEST PRACTICES IN ROAD SAFETY HANDBOOK FOR MEASURES AT THE NATIONAL LEVEL
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KfV Kuratorium für Verkehrssicherheit

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ÖRK Austrian Red Cross	AT	SWOV Institute for Road Safety Research	NL
IBSR-BIVV Institut Belge Pour La Sécurité Routière	BE	TNO Business Unit Mobility & Logistics	NL
CDV Transport Research Centre	CZ	DHV Group	NL
DTF Danish Transport Research Institute	DK	TØI Institute of Transport Economics	NO
DVR Deutscher Verkehrssicherheitsrat e.V.	DE	IBDIM Road and Bridge Research Institute	PL
CERTH/HIT Hellenic Institute of Transport	EL	PRP Prevenção Rodoviária Portuguesa	PT
FITSA Foundation Technological Institute for Automobile Safety	ES	SPV Slovene Road Safety Council	SI
INRETS Institut National de Recherche sur les Transports et leur Sécurité	FR	VÚD Transport Research Institute Inc.	SK
NRA National Roads Authority	IE	bfu Schweizerische Beratungsstelle für Unfallverhütung	CH
SIPSiVi Italian Society of Road Safety Psychology	IT	VTT Technical Research Centre of Finland	FI
ETEK Cyprus Scientific and Technical Chamber	CY	VTI Swedish National Road and Transport Research Institute	SE
Celu satiksmes izpete, SIA (Road Traffic Research Ltd)	LV	TRL Limited	UK
TRRI Transport and Road Research Institute	LT	CIECA Commission Internationale des Examens de Conduite Automobile	INT
KTI Institute for Transport Sciences	HU	ETSC European Transport Safety Council	INT
WHO Europe World Health Organization - Regional Office for Europe			

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Introduction

1 The SUPREME project

The objective of the SUPREME project is to collect, analyse, summarise and publish best practices in road safety in the Member States of the European Union as well as in Switzerland and Norway, with a view to implementation in as many partner states as possible. By making the study results available to a broad target audience across Europe – and thereby encouraging the take-up of successful strategies – the project wants to contribute to reaching the 50% reduction target of road fatalities, which the European Commission set in its White Paper "European transport policy for 2010: time to decide" (2001).

Analysis, synthesis and further selection of collected data were carried out along nine categories of measures and covers all areas of road safety work.

1. Education & Campaigns
2. Driver Education, Training & Licensing
3. Rehabilitation and Re-Licensing
4. Vehicles (incl. ITS)
5. Infrastructure (incl. ITS)
6. Enforcement
7. Statistics & In-depth Analysis
8. Institutional Organisation of Road Safety
9. Post Accident Care

In order to avoid overlapping between these categories, a detailed list of subcategories and – in some cases including even sub-subcategories - has been provided.

Accordingly, nine "Thematic Reports" (of which one is the volume in front of you) shall give a detailed description of best available practices for each of these categories, featuring basic characteristics such as target groups, quantitative and qualitative goals, key issues, duration of implementation and effects, coverage, costs, actors involved, implementation procedures as well as **key success factors** and potential **implementation barriers** in other countries or at the European level.

The crucial task of the project lies within the sound **identification of best practice** from the vast amount of available measures. In order to facilitate this process, a set of tools for collection, classification, selection and ranking of measures has been developed, along with guidelines for the assessment process at country level. As the common basis of all further activities, a list of eight best practice criteria was developed and transferred into a questionnaire. While the major part of this questionnaire consisted of a common set of core elements, some questions also addressed key features for each category.

On this basis, the SUPREME network of "Country Experts" has provided information from various stakeholders in cooperation with the respective Analysis Group members. Although 227 questionnaires have been completed, not all subcategories of road safety measures have been addressed. So this is the first step of data collection.

As an additional step, a list of road safety measures that had not been covered by questionnaires but were considered potential best practices by the SUPREME consortium, was compiled. Additional information was gathered from available scientific literature and earlier European projects. This extended list of potential best practices was the starting point for the second step of selection and analysis within each of the nine Thematic Reports.

Further SUPREME activities

Based upon these findings, 27 country surveys will be produced. The current status of implementation of best practice measures as well as implementation barriers shall be addressed and necessary steps shall be outlined.

Further, two separate handbooks will be provided, one for the European level (European institutions, international organisations, global industries) and one for the Country level (Ministries, regions, local level: stakeholders, policy makers, practitioners and the interested public).

For more information about the SUPREME project and latest results, please visit the SUPREME website, which is http://ec.europa.eu/transport/supreme/index_en.htm.

2 Focus of this thematic report

Traffic accidents are the final result of a series of events, leading to a situation which makes a crash inevitable. Traditionally traffic safety policies are geared towards an approach focussing on taking away major causes of specific accidents (accident prevention). Although the above approach is very successful, it was realized that more is needed to bring down the number of casualties and injuries. Therefore a second approach was developed focussing at a further reduction of the impacts of a crash (accident impact mitigation). This dual approach allowed us to bring down the number of traffic casualties and injuries considerably, this despite a significant increase of the traffic volumes on the road.

In the early nineties of the former century it was realised that a further reduction of traffic unsafety would ask for additional measures. Programs like 'Sustainable Safety' (The Netherlands) and 'Vision Zero' (Sweden) are the result of this rethinking of the traffic safety situation. Characteristic for this new approach are:

- road infrastructure is adapted to the limited (driving) capabilities of the traveller
- vehicles are equipped with devices that support and simplify the various tasks of the traveller and that at the same time protect the vulnerable traveller against injuries
- travellers are sufficiently and adequately trained and informed.

The safety principles that form part of this approach are:

- try to avoid unintentional use of the infrastructure; use is in accordance with function of road;
- try to avoid (vehicle) interactions with significant differences in mass, speed and direction;
- try to avoid insecure behaviour of the traveller: encourage predictive travel behaviour.

This report focuses on vehicle measures, which can help achieve all of the objectives listed above.

Vehicles and traffic safety

Vehicles can play a significant role in further improving traffic safety. Changes in legislation, vehicle construction and vehicle equipment are interesting measures as they generate an enduring (sustainable) effect. Speed management is another interesting measure, as on the one hand high speeds increase the probability of being involved in an accident, and on the other hand high speeds generate a more serious impact. Unfortunately speed management and enforcement are not particularly popular amongst car users. Therefore it is important to apply speed restrictions only on those road sections that really matter. Furthermore vehicles need to be designed and equipped is such a way that the "man-vehicle-road" system can function in an optimal way from the perspective of safety. This means that vehicles are designed is such a way that they do not only protect passengers in the vehicle itself, but also passengers in other vehicles. It is also important that vehicles are designed and equipped in such a way that drivers exhibit the desired behaviour without the need for enforcement. Also the collaboration, coordination and communication between the vehicle and the road infrastructure are important and, finally, vehicles need to be designed and equipped is such a way that the safety of vulnerable road users is safeguarded.

Intelligent transport systems and in-car technology

In the SUPREME project, the focus is on measures that have already 'proved their worth' – i.e. measures that have been evaluated and have shown to have a substantial effect. However, new technology in the vehicles and communication technology will be instrumental in the next step in improving road traffic safety, and this section has been included to describe the direction that vehicle measures are expected to take in the future. Several developments will contribute to improved traffic safety in the next 10-15 years (Rijkswaterstaat, 2003):

- Communication and communication technology will play a dominating role (road-vehicle-road and vehicle- vehicle);
- Traffic management will be smart and integrated, both 'horizontally' (regions, cities) and 'vertically' (main and underlying road network);
- Information from traffic management will go directly to the vehicle and/or the driver (the development of road-side systems will slow down);
- Vehicles will provide information with regard to traffic and local conditions ('floating car data');

- The first forms of information exchange between vehicles in 'local clusters' (vehicle to vehicle communication, longitudinally in a traffic flow and at intersections) will appear;
- Vehicles will sense the world around them (360 degrees, day and night);
- Autonomous driver support systems will be introduced, such as Adaptive Cruise Control (ACC), Lane Departure Warning Assistant (LDWA), 'co-pilot', etc.;
- Direct intervention in the vehicle's behaviour will only occur on a voluntary basis, with systems such as Intelligent Speed Adaptation (ISA), External Speed Assistant (ESA), etc.
- Pre-crash sensing applications will be available to improve the protection of vehicle occupants.

After 2015, co-operative road-vehicle systems will become more important, and there will be more intervening systems. It will become possible to warn drivers of potential dangers earlier, so they (or the vehicle) can take action, and when an accident cannot be avoided, the severity might be reduced.

Chapter 2 describes several of the research projects being carried out in this area. Many of the autonomous in-car systems (such as ACC) and the future co-operative road-vehicle systems aim at improving safety, although throughput, the environment and comfort are also important aspects.

Reference:

Rijkswaterstaat (2003), "Optiedocument Duurzaam Veilig Voertuig", Rotterdam, Rijkswaterstaat – Transport Research Centre of the Ministry of Transport, 1 November 2003.

Overview of vehicle measures

The different EU framework programmes contain a large number of projects to improve road safety using vehicle measures. Some research projects summarised available safety measures in vehicles, whereas other projects researched specific measures to improve safety.

In the first paragraph a selection of projects that describe measures selected for inclusion in the vehicle measures category is given. The information is based on the project's reports and websites available.

In the second paragraph the input of the countries is described. An analysis is made of the coverage of vehicle measures by the questionnaires.

3 EU-Studies targeting best practice Vehicles

3.1 Vehicle-related road safety programmes

ROSEBUD

The ROSEBUD (Road Safety and Environmental Benefit-Cost and Cost-Effectiveness Analysis for Use in Decision-making) project produced a handbook with examples of assessed road safety measures. This study can be seen as a predecessor of the Supreme project with a short description of many possible measures. It aimed at more precise and easily manageable tools for efficiency assessment, with the aim of using the available, always limited resources for traffic safety improvement efficiently, rescuing as many human lives and avoiding as many accident injuries and property damages as possible.

The result of the evaluation was obtained by comparing costs with benefits. Economic evaluation of road safety measures using cost-benefit analysis is based on the costs incurred as a result of road accidents. Avoiding such costs represents the economic benefit of road safety measures. The benefit-cost ratio represents the economic advantage of the safety measures.

The handbook is dedicated to political decision makers and the general public. It gives successful and efficient road safety measures to improve road safety in Europe.

This project finished in 2006.

Website: http://partnet.vtt.fi/rosebud/

DRL

The DRL (Daytime Running Lights) project assessed several effects of DRL. It had the following objectives:

- To assess the effectiveness of the currently legislated requirements for the use of DRL in the EU and elsewhere, and how that legislation has been implemented in these countries.
- To assess the various evaluations and make specific cost-effectiveness recommendations for the introduction of DRLs, taking into account the various positive and possible negative road safety impacts (casualty reduction ranges for various types of road users) and environmental impacts (increased fuel consumption and CO2 production).
- To investigate possible negative environmental impacts of the use of DRLs relative to other in-vehicle electrical equipment, such as air conditioners, etc.
- To collate the work done under the three bullets above, and produce various implementation strategies for DRLs in the EU, as well as further specific recommendations for implementation maximising the positive effects, while minimising the negative effects.

The project was finished in 2004. The results of the project were that all the designed policy options for DRL had a positive B/C-ration. The preferable option for DRL implementation is the technical measure of automatic dedicated DRL for new cars, combined with a behavioural measure requiring the mandatory use of low beams for existing cars. This option had the highest accident reduction, the lowest increase in pollution and the fairest distribution of road safety effects over the various categories of road users.

The best implementation scenario was to start mandatory DRL between autumn and winter and to use a large publicity campaign.

Website: http://ec.europa.eu/transport/roadsafety/publications/projectfiles/drl_en.htm

FRICTI@N

The objective of the FRICTI@N project is to create an on-board system for estimating friction and road slipperiness to enhance the performance of integrated and cooperative safety systems like vehicle-to-vehicle communication, and driver information. Moreover, applications that can benefit from precise information on road slipperiness are driving safety control systems such as Slip Control Systems, Emergency Braking System, Electronic Stability Program, Adaptive Cruise Control and Rollover Avoidance.

A single sensor approach is not considered as successful in determining road friction with a sufficient accuracy to improve vehicle control. The project will not develop new sensors, but uses existing ones in a novel way. The aim is to find a solution for real-time estimation of the tyre-road friction using a sensor cluster in a moving vehicle. Consequently, three kinds of sensors will be used: (1.) existing in-vehicle sensors for vehicle dynamics, (2.) environmental sensors, and (3.) tyre-based sensors. Today, the signals from these sensors are used separately for vehicle safety systems without combining them.

The project has two characteristics: in developing a new system to enhance driver assistance, and in providing a system for different applications and for on-going projects in preventive safety and up-coming cooperative systems. The innovative idea is to feed the signals into a FRICTI@N-Estimation-Observer to estimate the tyre-road friction by using on-line mathematical methods.

The project started in 2006 and will be finished at the end of 2008.

Website: http://friction.vtt.fi/

PROSPER

The Council resolution of June 2000 explicitly identified advanced assisted driving technology and technology relating to speed limitation devices as important measures for further investigation. Introduction of road speed management based on information technology (i.e. ISA - Intelligent Speed Adaptation) requires international co-operation to overcome technical, legal and policy barriers. This is why the PROSPER project (Project for Research On Speed adaptation Policies on European Roads) was started.

The project researched the cost effectiveness of ISA road speed management methods in relation to traditional methods, and a thorough analysis of the reaction of road users to ISA, and of possible and suitable implementation strategies for different road speed management methods was carried out. The results were tailored to each group of stakeholders in road speed management, taking into account the specific information needs of each group. The results of the project indicate (and confirmed findings from earlier field trials) that all ISA systems have an effect (better road safety, without increased travel times), but the effect is greater for intervening than for informative systems. Another conclusion was that ISA and physical measures to reduce road speed are complementary rather than competing methods.

The results can help the development and implementation of national and European road transport safety policies, particularly in the short term.

The project started in 2003 and will end in 2006.

Website: http://www.prosper-eu.nl

SPEEDALERT

In SpeedAlert, research was conducted on in-vehicle speed management, in parallel to the above mentioned PROSPER project,.

The overall objective of the SpeedAlert initiative was to support the implementation of in-vehicle speed alert applications that can contribute to improved road safety. The project resulted in:

- a speed limit classification (harmonisation is recommended) and identification of actors involved in speed limit management in Europe;

- system and service requirements for speed alert applications;
- a functional architecture with the required technical components for the following areas: provision of speed limit data, communication infrastructure and in-vehicle equipment;
- a harmonised definition of SpeedAlert concepts;
- requirements for standardisation to support and enable the future deployment of speed alert applications.

The project has co-operated with related activities and for a, and made use of an extensive consultation group. The project started in 2004 and finished in 2005.

Website: http://www.speedalert.org/

ALCOLOCK

This project concerned the introduction of an in-vehicle device that registers the amount of alcohol of the driver. The general objective of the project was to contribute to a reduction of the number of victims on European roads by preparing and facilitating legal implementation of alcolocks in the European Union through research on the psychological, sociological, behavioral and practical impact on drivers whose vehicles are equipped with an alcolock.

The duration of the project was from 2004 until 2006. The results were technical requirements for an alcolock and the design of a field trial with alcolocks in cars for defined high-risk target groups.

Website: http://ec.europa.eu/transport/roadsafety/publications/projectfiles/alcolock_en.htm

PROMISING

The PROMISING project aimed at developing measures that reduce the risk of injury to vulnerable and young road users as much as possible in a non-restrictive way. That is to say that safety and mobility must be improved together; the improvement of safety should not lead to reduced mobility. In the current situation in Europe, the mobility needs of vulnerable road users hardly receive any priority in traffic and transport planning. As a consequence, safety policies often have a curative approach, which restricts the mobility of these vulnerable road users. PROMISING focused on four groups of such vulnerable road users: pedestrians, cyclists, motorised two-wheelers (i.e. motorcyclists and moped riders) and young car drivers.

PROMISING started in 1998 and finished in 2001. It resulted in a list of 10 most important measures for vulnerable road users.

Website:

http://ec.europa.eu/transport/roadsafety/publications/projectfiles/promising_en.htm

EuroNCAP

EuroNCAP (European New Car Assessment Programme) is not a European framework research program, but the Programme is mentioned here because of its possible influence on road safety. EuroNCAP provides motoring consumers with a realistic and independent assessment of the safety performance of some of the most popular cars sold in Europe.

It was established in 1997 and is now backed by five European Governments, the European Commission and motoring and consumer organisations in every EU country.

Website: http://www.euroncap.com/

IMMORTAL

IMMORTAL (**I**mpaired **M**otorists, **M**ethods **o**f **R**oadside **T**esting and **A**ssessment for **L**icensing) is a special EU research programme dealing with the accident risk associated with different forms of driver impairment. The project aims to investigate the influence of chronic and acute impairment in order to make a more accurate risk assessment, to recommend criteria for high risk categories, and to provide key information to support EU Policy on licensing and roadside testing.

The IMMORTAL consortium comprised 10 partners from a range of European institutions with multi-disciplinary expertise.

A look back at the initially defined aims of IMMORTAL shows that:

- Concerning the prevalence of psychoactive drugs, there are indications by the IMMORTAL research that the proportion of drugged drivers has increased and that mixed consumption has become more frequent. By means of case control studies a more accurate risk assessment was made possible.
- Furthermore, prosecution of driving under influence (DUI) is urgently needed in case of alcohol especially for drivers with high blood alcohol contents (BAC), and drivers with combinations of drugs and alcohol and more than one drug.
- Legal framework for both prosecution and further research is important and still has to be established in some cases.
- Concerning illness and diseases, it became apparent that the degree of impairment not only differs depending on the medical condition, but also may clearly vary individually. Individual compensation abilities can be crucial factors in the context of assessing the fitness to drive. This result speaks for two things: (1) To measure the identified, especially risky medical conditions and (2) To assess individually to which extent driving fitness exists.
- For the assessment, both medical and psychological variables have turned out to be relevant.

- Regarding the intervention methods, frequent Random Breath Testing and Alcolocks are promising measures. A drug recognition method tested in the context of IMMORTAL still needs further improvement, also the saliva test devices seemed yet to be error-prone. Since it turned out that the combination of alcohol and drugs and the combined consumption of different drugs have increased, it is vital that, besides impairment by alcohol, also the impairment by drugs is recorded. This means that alongside Random breath test devices, also good screening instruments should be available to clarify the impairment by drugs.
- Concerning licensing procedures, consistent, reliable, and valid standards are sought after. Here, work can be continued on the basis of the findings of the odds ratios of medical conditions. Target group-specific proceeding is also recommended on the basis of the IMMORTAL results. Medical expertise turned out to be an important contact that on one hand should be informed about the specific effects of medicines on driving performance (see e.g. IMMORTAL research concerning cold medication, SSRI) and on the other hand has to relay this information to the patients.
- Concerning criteria for high risk categories, IMMORTAL yielded important starting points: For illegal drugs that are taken alone, and with the exception of heroin, zero-tolerance legislation would, however, seem to result in very high costs and hardly any road safety benefits.
- For most medicinal drugs, like antidepressants, benzodiazepines, codeine, barbiturates and even morphine, therapeutic levels may be adequate as legal limits, at least for the time being.

The above recommendations provide starting points for different areas: Licensing, legislation, and measures.

Website: http://www.immortal.or.at/

3.2 EU projects on Intelligent Transport Systems and Safety

Besides the EU projects related to the Best Practice Measures on Road Safety, there are also projects conducted on promising in-vehicles safety applications in the future. The next section summarises these EU projects.

PReVENT

The Integrated Project PReVENT aims to contribute to road safety by developing and demonstrating preventive safety applications and technologies.

PReVENT envisions the early availability of advanced, next generation preventive and active safety applications and enabling technologies and an accelerated deployment on European roads.

Preventive safety applications help drivers to avoid or mitigate an accident through the use of in-vehicle systems which sense the nature and significance of the danger, while taking the driver's state into account.

PReVENT consists of a number of subprojects in complementary function fields:

Safe Speed and Safe Following (subprojects: Saspence & Willwarn).
These functions help drivers keep or choose a speed or inter-vehicle distance, allowing them to safely cope with the road situation they will meet in the following seconds. The approach is mostly autonomous.

Lateral Support (subprojects: Safelane & Lateral safe).
This field deals with autonomous applications focusing on the lateral areas of a vehicle to help drivers keep their vehicle at the safest position in the lane, as well as warn them if the vehicle is about to run off the road.

Intersection Safety (subproject: Intersafe).
This function field covers the investigation of autonomous and cooperative approaches to safety applications dedicated at approaching or passing intersections.

Vulnerable Road Users and collision Mitigation (subprojects: Apalaci, Compose & UseRCams).
Collision mitigation and pre-crash protection systems focus on reduction of injuries and fatalities in case of unavoidable crashes (in particular during the last 2-3 seconds before the impact). Collision mitigation by braking significantly reduces kinetic energy of impact, thereby greatly reducing crash severity.

Cross-functional Activities (subprojects: Response 3, MAPS&ADAS, ProFusion & Insafes).
This additional cross-functional field covers methodologies, common architectures, liability issues, and technology or standardisation oriented activities safeguards a common approach.

PReVENT started in 2004 and will end in 2008.

Website: http://www.prevent-ip.org/

eIMPACT

eIMPACT assesses the socio-economic effects of Intelligent Vehicle Safety Systems (IVSS), their impact on traffic safety and efficiency. It addresses policy options and the views of the different stakeholders involved: users, OEMs, insurance companies, and society. With determining these effects, eIMPACT also provides an indication of the prospects for introducing IVSS.

eIMPACT started in 2006 and will end in 2007.

Website: http://www.eimpact.info/

AIDE

The AIDE IP generates knowledge and develops methodologies and human-machine interface technologies required for safe and efficient integration of ADAS, IVIS and nomad devices into the driving environment.

The objectives of AIDE are:

- to maximise the efficiency, and hence the safety benefits, of advanced driver assistance systems,
- to minimise the level of workload and distraction imposed by in-vehicle information systems and nomad devices and
- to enable the potential benefits of new in-vehicle technologies and nomad devices in terms of mobility and comfort.

AIDE started in 2004 and will end in 2008.

Website: http://www.aide-eu.org/

ADASE II

ADASE II is an EC IST funded thematic network that helps to introduce and implement active safety systems by harmonising and communicating active safety functions, identifying technological needs and focussing on essentials, and preparing architectures, roadmaps and standards. ADASE II activities aim at preparing the baseline and ground for these measures.

To achieve its objectives ADASE II aimed at covering a comprehensive range of activities. Its detailed objectives were:

- to facilitate the information exchange within the cluster of projects related to ADA systems and transport.
- to organise in-depth expert workshops on selected topics.
- It resulted in a state-of-the-art knowledge to generate corresponding road maps and guidance (see below).

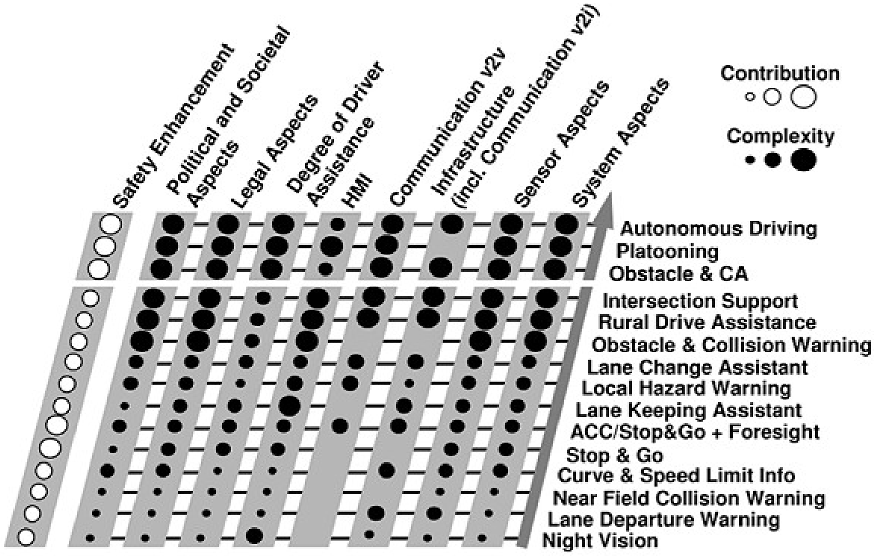


Figure: Road map Adase II

Website: http://www.adase2.net/

CarTALK

The European Project CarTALK 2000 focussed on new driver assistance systems which are based upon inter-vehicle communication. The main objectives were the development of co-operative driver assistance systems and the development of a self-organising ad-hoc radio network as a communication basis with the aim of preparing a future standard. As for the assistance system, the main issues were:

- assessment of today's and future applications for co-operative driver assistance systems,
- of software structures and algorithms, i.e. new fusion techniques,
- testing and demonstrating assistance functions in probe vehicles in real or reconstructed traffic scenarios.

To achieve a suitable communication system, algorithms for radio ad-hoc networks with extremely high dynamic network topologies were developed and prototypes were tested in probe vehicles. Apart from the technological goals, CarTALK 2000 actively addressed market introduction strategies including cost/ benefit analyses and legal aspects, and aimed at the standardisation to bring these systems to the European marketCarTALK 2000 started in 2001 as a three-year project.

Website: http://www.cartalk2000.net/

4 All data in the Vehicles category

4.1 Categorisation

Within the SUPREME project, measures for road safety are organised within several categories, subcategories and sub-subcategories. The category 'measures for vehicles' is category number 4. This category was divided into four subcategories. Each subcategory has a certain number of sub-subcategories.

The subcategories 4.1 (adaptations to vehicles, including driver support systems) and 4.2 (prevention of unsafe participation in traffic) comprise the following vehicles: passenger cars, vans and heavy vehicles/trucks. Subcategory 4.3 (other modes) comprises all other modes than the ones mentioned in 4.1 and 4.2. The final subcategory (4.4 – other measures) comprises all measures that do not fit the other subcategories.

When we speak about passive vehicle safety, we are referring to all measures that protect the occupants and other traffic participants against injuries caused by a crash. Active vehicle safety refers to all measures to prevent a crash.

Subcategory	Sub-subcategory	Measures
4.1 Adaptations to vehicles incl. Driver Support Systems Passenger cars, vans and trucks	4.1.1 Active Safety	Speed Alert (ISA), Electronic Stability Program, Reverse safety alert, Blind spot mirror, Rear view camera, Navigation systems
	4.1.2 Passive Safety	Under run protection, Seatbelt reminders
4.2 Prevention of unsafe participation in Traffic Passenger cars, vans and trucks	4.2.1 Vehicle inspections	Yearly inspections, Roadside inspections (belongs to category 'Enforcement')
		Maintenance programs
	4.2.2 Regulations	Daytime Running Lights, Winter Tyres, Hands free use of mobile phones; contour marking
		Enforcement of safe loading of trucks and vans
	4.2.3 Prevention of Drunk Driving	Alcohol Ignition Interlock
4.3 Other modes	4.3.1 Powered two-wheelers	ABS, Prevention of illegal adaptations to mopeds, helmet use, moped licensing
	4.3.2 Bicycles	Bicycle Side Reflection, Helmet use
	4.3.3 Pedestrians	Reflectors at night-time
	4.3.4Buses/Coaches	Seatbelts on coaches, rollover strength buses, ESP, contour marking
4.4 Other measures	4.4.1 EuroNCAP Crash test database	Website with test results
	4.4.2 Event data recorders	Black box

Table 1: Categorisation of vehicle measures

Received questionnaires

A total of 17 questionnaires from 9 European countries have been received, describing 11 different measures (see table 2).

Sub-subcategory	Respondent Country	Name of measure
4.1.1	Netherlands	Speed Alert (ISA)
4.1.1	Spain	Electronic Stability Program
4.1.1	Norway	Electronic Stability Program
4.1.2	Norway	Whiplash protection
4.2.1	Estonia	Yearly Inspections
4.2.1	Latvia	Yearly Inspections
4.2.1	Hungary	Yearly Inspections
4.2.2	Latvia	Daytime Running Lights
4.2.2	Norway	Daytime Running Lights
4.2.2	Hungary	Daytime Running Lights
4.2.2	Latvia	Winter Tires
4.2.3	Belgium	Alcohol Ignition Interlock
4.3.1	Austria	ABS on motorcycles
4.3.2	Austria	Bicycle helmet use
4.3.2	Netherlands	Bicycle Side Reflection
4.3.4	Denmark	ESP for Coaches
4.4.1	Norway	EuroNCAP

Table 2: Questionnaires received, category 4.

4.2 Which categories are covered?

The 16 questionnaires were divided over the different subcategories and sub-subcategories. All subcategories are covered. However, no measures have been received for one sub-subcategory, number 4.3.3 Pedestrians. An overview of the coverage of all subcategories and sub-subcategories is presented in table 3 (between brackets the number of questionnaires per measure is indicated).

Subcategory	Sub-subcategory	Measures
4.1 Adaptations to vehicles incl. Driver Support Systems	4.1.1 Active Safety	Speed alert/speed limiter (1)
		ESP (2)
	4.1.2 Passive Safety	Whiplash protection (1)
4.2 Prevention of unsafe participation in Traffic	4.2.1 Vehicle inspections	Yearly inspections (3)
	4.2.2 Regulations	Daytime Running Lights (3)
		Winter tires (1)
	4.2.3 Prevention of Drunk Driving	Alcohol lock (1)
4.3 Other modes	4.3.1 Powered two-wheelers	ABS on motorcycles (1)
	4.3.2 Bicycles	Side reflectors (1)
		Bicycle helmet use (1)
	4.3.4Coaches	ESP (1)
4.4 Other measures	4.4.1 EuroNCAP	EuroNCAP assessment (1)

Table 3: Measures covered.

Coverage of almost all sub-subcategories does not mean that all possible measures are mentioned. A large number of possible measures is not covered by the filled-in questionnaires. These missing measures were identified and are presented in table 4.

Subcategory	Sub-subcategory	Missing measures
4.1 Adaptations to vehicles incl. Driver Support Systems	4.1.1 Active Safety	Reverse safety alert,
		Blind spot mirror / camera,
		Rear view camera,
		Navigation systems
	4.1.2 Passive safety	Under run protection,
		Seatbelt reminders
4.2 Prevention of unsafe participation in Traffic	4.2.1 Vehicle inspections	Roadside inspections (belongs to category 'Enforcement')
		Maintenance programs
	4.2.2 Regulations	Hands free use of mobile phones
		Contour marking
		Enforcement of safe loading of trucks and vans
4.3 Other modes	4.3.1 Powered two-wheelers	Prevention of illegal adaptations to mopeds,
		Moped licensing
		Mandatory motorcycle helmet wearing
	4.3..3 Pedestrians	Reflectors at night-time
		Reflective garment
	4.3.4 Buses/coaches	Seatbelts on coaches,
		Rollover strength buses
4.4 Other measures	4.4.1 EuroNCAP Crash test database	Pedestrian friendly car fronts
	4.4.2 Event data recorders	Black box

Table 4: Missing measures.

Description of the selection process

The selection of the best practice measures is done in several steps. The first step was the decision of the country experts to select the measure and to fill out the questionnaire.

The second step was a further selection of all different measures along a list of criteria. The following criteria were used in this second selection step:

1. Impact of the measure on traffic safety: application of the measure causes a sustained reduction of road accidents and accident victims, mainly fatalities and serious injuries
2. Evaluation of the measure: the effects caused by the measure are evidence-based (evaluation study or studies are available) and/or
3. Evaluation of the measure: the effects caused by the measure are expected due to the identification of risk factors, which will be positively influenced by the measure
4. Transferability of the measure: the measure is transferable to other countries or regions
5. Benefit/Cost ratio of the measure: assessment of all benefits and costs caused by the introduction of the measure is available; benefit/cost ratio > 1
6. Acceptance of the measure: how well is the measure accepted by the various stakeholders (target group, society, politicians, police)
7. Sustainability of the measure: does the measure create a sustained (long term and positive) impact on traffic safety.

Not all criteria have the same weight in the selection procedure. The criteria 1- 3 are critical. The effects generated by a measure should be evidence based, i.e. supported by a scientific evaluation. This means that the introduction of the measure was accompanied by a before and after study and it also means that the introduction of the measure generated a positive impact on reducing traffic unsafety by either reducing the number of road accidents and road accident victims or by reducing the risk factors experienced by the various traffic participants.

If a measure doesn't comply with the criteria 1 – 3 the measure will not be recommended to be included in the list of best practices measures. Also, if information necessary for the judgement of the criteria 1 – 3 is lacking, the measure will not be incorporated in the list of best practice measures.

The criteria 4 – 7 are less critical. This means that if it is not known whether a measure does comply with one of these criteria, this doesn't mean that the measure will be rejected. However, if the introduction of the measure is evaluated and if the score of a measure for one of the criteria 4 – 7 is negative (score is based on correctly performed before-and-after study), than the measure will be rejected for incorporation in the list of best practice measures.

Furthermore the description of a measure along the complete list of selection criteria is only possible if the necessary information is available. The questionnaires but also other data sources will be used to retrieve all necessary information.

Table 5 comprises all potential best practice measures for vehicles. In table 5 it is also indicated which measure are described extensively (along the complete list of criteria) and which measures are described briefly (based on the information available).

Description measure	Respondent country	Description of measure
4.1.1 Speed Alert (ISA) is a system that aids the driver or rider in maintaining road speeds compliant with relevant local statutory speed limits.	Netherlands	Extensively
4.1.1 Blind spot mirrors and cameras reduce the blind spot of trucks, which make other road users better visible.	Netherlands	Briefly
4.1.2 Electronic stability control / program is an extension of antilock brake technology, which has speed sensors and independent braking for each wheel.	Norway / Spain	Extensively
4.1.2 Seatbelt reminder is a device that gives a warning whenever a seat is occupied, but the seat belt is not fastened	Netherlands	Extensively
4.2.2 Daytime Running Lights are mandatory on all motor vehicles driving in Norway, independent on time of day, light conditions, type of motor vehicle and location	Latvia Hungary Norway	Extensively
4.2.2 Contour marking can increase the perceptibility of the truck.	Netherlands	Briefly
4.2.3 Alcolock shuts down the start engine when the attempt to start the vehicle is not preceded by the performance of a negative breath test (trial under 40 Belgian drink driving offenders)	Belgium	Extensively
4.3.1 Mandatory bicycle helmet wearing reduces the number of head injuries among bicyclists	Austria	Briefly
4.3.1 ABS on motorcycles are a very effective countermeasure against driver misbehaviour in emergency situations	Austria	Extensively
4.3.2 Bicycle side reflection. Bicycles have to be equipped with reflection circles in both wheels	Netherlands	Extensively
4.3.3 Reflective garment to increase visibility	Netherlands	Extensively (see 4.3.2 Side reflectors on bicycles)
4.4.1 EuroNCAP provides consumers with independent information about a car's safety.	Norway	Extensively, including pedestrian friendly car fronts
4.4.2 Event data recorders can monitor the driving behaviour of the driver.	Netherlands	Extensively

Table 5: Potential best practice measures for vehicles.

In the next chapter these potential best practice measures will be described in more detail.

Description and analysis of best practice measures along the selection criteria

5 ISA

Description of the measure

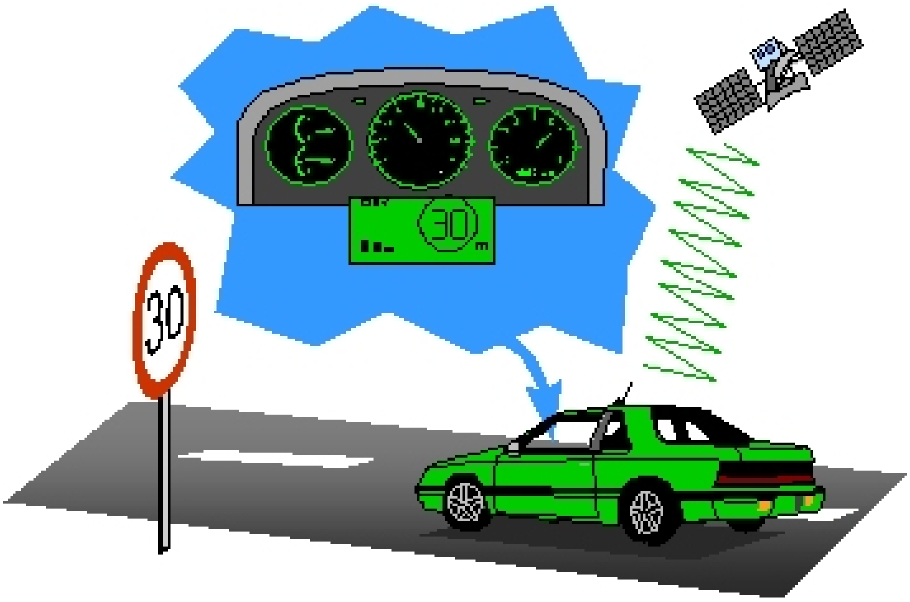
In the PROSPER-project recently carried out (PROSPER, 2006), Intelligent Speed Adaptation was defined as: An Intelligent Speed Adaptation (ISA) system is one that aids the driver or rider in maintaining road speeds compliant with relevant local statutory speed limits.

A Speed Alert System is an informative version of ISA; it is able to inform the driver of current speed limits and speeding.

Depending on the type of ISA / Speed Alert system and its Human Machine Interface (HMI), the system:

- advises the driver that he/she is exceeding the local speed limit;
- supports the driver in keeping the local speed limit (e.g. with a haptic accelerator pedal)
- keeps the driver from exceeding the local speed limit (e.g. with a dead throttle).

Trials with ISA have been carried out in ten European countries: Austria, Belgium, Denmark, Finland, France, Hungary, The Netherlands, Spain and Sweden (ETSC, 2006). So far, ISA has only been implemented on a larger scale (than a trial with a limited number of vehicles) in Sweden, where the work has been continued according to an action plan to increase the use of ISA .



(www.rws-avv.nl)

Definition of target group

The target group of ISA or SpeedAlert is: (professional) drivers or riders of motorised vehicles: passenger cars, powered two-wheelers, vans and trucks.

Size of road safety problem

ISA / Speed Alert systems aim to reduce accidents occurring because of driving at speeds that are too high. Excessive and inappropriate speeds are the cause of about a third of all fatal and serious accidents (EC, 2003). According to the SWOV traffic accidents database for the Netherlands (see www.swov.nl), 3.6% of the speeding accidents with passenger cars were fatal in 2003. 10% of the speeding accidents with passenger cars caused serious injuries in 2003.

Also according to the SWOV traffic accidents database, the division of speeding accidents over road types was as follows (for 2003):

- 5% took place on 30 km roads;
- 50% took place on 50 km roads;
- 19% took place on 80 km roads and
- 10% took place on 120 km roads.

Expected effects on safety

The system communicates the local speed limit to the driver or keeps the driver from exceeding the limit. This means that speeds are reduced, which is associated with fewer and/or less severe accidents – see e.g. (Elvik, 2004), (Carsten, 2006).

Additional effects are lower speed variance (also associated with improved traffic safety), homogenisation of traffic flows (at higher penetration rates), reduced risk for pedestrians, and better insight into the relationship between speed and risk for drivers.

Because of the change in driving behaviour of individual (equipped) vehicles and the whole vehicle flow, ISA / Speed Alert systems can also help to reduce fuel consumption and noise annoyance, and improve local air quality.

Evaluation of effects

Numerous evaluation studies have been carried out (in several countries), based on user experiences in the ISA trials and on micro-simulation. As ISA has only been implemented on a larger scale in Sweden, there are no data yet on actual accident reductions. However, the research carried out (of which the final report of PROSPER gives the most recent overview) indicates that ISA is a very effective measure. In the PROSPER project, accident reductions were calculated for six countries. Reductions in fatalities between 19.5-28.4%, depending on the country, were predicted in a market-driven scenario. Even higher reductions were predicted for an authority-driven scenario – between 26.3-50.2%. Benefits are generally larger on urban roads and are also larger if more intervening forms of ISA are applied (Carsten, 2006).

Costs and benefits

Costs of ISA include: the cost of the ISA equipment (fit to new vehicle or retrofit), and the costs of creating the digital map databases that form the basis of ISA, keeping these maps current, and the dissemination of the base maps and subsequent updates. The benefits are the reduced costs of accidents.

Benefit-cost ratios ranging from 2 .0 to 3.5 and 3.5 to 4.8 were calculated in the PROSPER project for the two scenarios: market-driven and authority-driven. The costs were based on the premise that by 2010, all new vehicles will come with a satellite navigation system (Carsten, 2006). Benefits in terms of a reduced need for police speed enforcement or reduced fuel consumption, emissions and noise were not included.

Public acceptance

Acceptance of ISA by test drivers is generally high, for the different types of ISA that have been trialled. The test drivers often want to keep the system after the trial (PROSPER, 2006). There are, however, some aspects to acceptance of ISA that need to be mentioned.

First of all, ISA / Speed Alert would be most effective if it was used by those users that are most likely to speed (e.g. young, inexperienced drivers, male lease car drivers). However, it is likely that the support for ISA is highest among drivers expressing strong support for traffic safety measures and also demonstrating this by being safe drivers even without ISA (PROSPER, 2006).

Secondly, the application of ISA requires relevant (and enforced) speed limits on the roads and an 'image' of ISA as a supportive function. If ISA (or the prevailing speed limit) is seen as an obstacle to normal driving, ISA will face an acceptance problem from the start (PROSPER, 2006).

Sustainable effects

In the research carried out in the PROSPER project, there were no signs of compensatory behaviour or complacency for the ISA systems studied. It can be expected though that drivers, as they become more experienced, will use the system according to their own preferences (i.e. drivers will still exceed the speed limit). Enforcement of speed limits could support the continuous use of ISA / Speed Alert systems and improve the compliance rate.

Transferable effects

Positive cost-benefit ratios have been found for ISA. The technology can work anywhere, but the system has not yet been made a priority. Why? ETSC (2006) lists some reasons for this:

- most automobile manufacturers have been sceptical towards ISA technologies;
- Most European governments have had little ambitions to implement ISA;
- European level action has been limited to financing research.

A number of criticisms of ISA have hindered widespread implementation. ETSC (2006) reviews ten 'myths' regarding ISA, showing that ISA (and Speed Alert) technologies can work reliably. However, a huge spontaneous demand is not expected (PROSPER, 2006), so an implementation strategy is needed to speed up the process of implementation of ISA in vehicles. A precondition is the provision of reliable, up-to-date speed limit maps, which should be organised by European, national and regional authorities. So far, only Sweden and Finland have established speed limit databases and the UK and the Netherlands are working on it.

Also, awareness of ISA / Speed Alert has to be created. Authorities and organisations (e.g. fleet owners) can act as forerunners by implementing ISA in their vehicle fleets. Last but not least, harmonisation activities are needed on the international level.

References

Carsten, O., F. Tate & R. Liu (2006), "D4.3 External Deliverable", Project for Research On Speed adaptation Policies on European Roads, Project no. GRD2-2000-30217, May 2006.

EC (2003), " European road safety action programme", Communication from the Commission, Luxembourg, Office for Official Publications of the European Commission, COM (2003) 311 final, 2003.

ETSC (2006), "Intelligent Speed Assistance – Myths and Reality", ESTC position on ISA, European Transport Safety Council, 2006.

Elvik, R., P. Christensen, A. Amundsen (2004), "Speed and road accidents, an evaluation of the Power Model", TOI report 740/2004, Oslo, December 2004.

PROSPER (2006), PROSPER Final report, Project for Research On Speed adaptation Policies on European Roads, Project no. GRD2-2000-30217, May 2006.

SWOV traffic accident database on the SWOV website, at www.swov.nl.

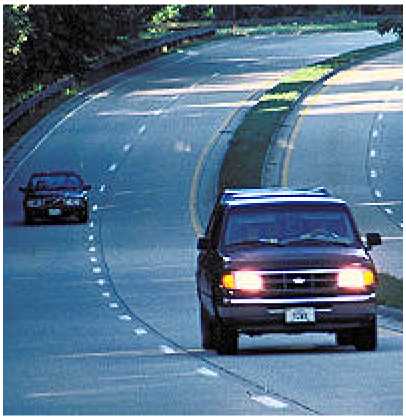
6 DRL

Description of the measure

Daytime Running Lights is a legal obligation for all motor vehicles to drive with low beam headlights on or with special DRL lamps during the whole year, independent of time of day, light conditions and location. In some countries the vehicles should be equipped with automatic lightning of running lights.

DRL aim at reducing daytime-accidents that involve more than one participant and at least one motor vehicle. DRL increase visibility and improve distance and speed perception of motor vehicles especially under different light conditions. It improves the possibilities for other road users to perceive motor vehicles and to adjust their own behaviour.

14 EU member states have mandatory rules on the use of DRL so far, with different requirements, and some member states recommend the use of DRL.


(www.securtyworld.com)

Definition of target group

The target group is drivers and owners of motor vehicles (Pokorny, 2006).

Size of road safety problem

The size of the road safety problem was calculated in different studies across Europe. They showed that around one out of three accidents are multi-party daytime accidents.

Expected effects on safety

It is expected that this measure can make a significant contribution to reaching the target of 50% reduction in road traffic fatalities in the EU in 2010 compared to 2001. With a general introduction of DRL, it is estimated that between 1200 and 2000 lives could be saved per year in the European Union. DRL has its strongest potential in multi-vehicle accidents with cars and in accidents involving cars and bicyclists (EU, 2006).

It is probable that better and earlier recognition of traffic partners due to DRL could lead to earlier manoeuvres to avoid the collision or to decrease the severity of the accident.

Evaluation of effects

Several meta-analyses have investigated the effects of DRL on accidents (Elvik et al. (2003), Elvik & Vaa (2004), Koornstra, M. et al. (1997)). The results show consistently that mandatory DRL reduce the number of daytime multipart accidents with motor vehicles by between 5% and 15%. The effects are larger for fatalities than for other personal injury accidents, and larger for personal injury accidents than for property damage only accidents. This is explained in terms of lower impact speeds in collisions (due to earlier detection of collision objects).Types of personal injury accidents that were significantly reduced are: collisions between pedestrian and car (-6%), collisions between cyclist and car (-10%), front- and side collisions between motor vehicles (-8%). Only one study was found that evaluated the effects of DRL for motorcyclists and that could be included in the analysis.

Multi-party daytime accidents were reduced by 32%.The results of the meta-analyses are very robust for cars, they are independent of publication bias, quality of studies and size of the studies. The result for DRL for motorcycles is more uncertain. Results of different types of DRL (ordinary or reduced intensity low beam headlights or dedicated DRL) show that ordinary headlights and dedicated DRL seem to be equally effective, while reduced intensity headlights are likely to be somewhat less effective.

Costs and benefits

The costs associated with DRL are mainly costs for extra fuel use and ecological costs due to the extra fuel use. For small vehicles the fuel use will increase by 1.6%, for heavy vehicles this is 0.7%. The benefits are the reduced number of accidents (Elvik et al., 2003).

Several benefit-cost ratios are calculated in different studies. All analyses yield benefit-cost ratios ranging between 1.2 and 7.7 (Rosebud, 2006). The results depend mainly on the implementation scenario. Behavioural measures (obligatory to switch the light on) are most cost effective, technical measures (light obligatory for vehicle) are least cost effective.

The EU study Daytime Running Lights (2006) stated that taking into account the negative effect on fuel consumption and CO_2 emissions, the benefits of a legal obligation to use dipped headlights on existing vehicles and to equip new vehicles with automatic dedicated DRL outweigh the costs by the factor 1 tot 2.

Public acceptance

The public acceptance in the countries where DRL is mandatory is high. Opposition against DRL greatly subsided after introduction.

In some countries where this measure has not yet been introduced opposition against DRL can arise from hypotheses of adverse effects on several types of accidents (pedestrian), cyclists and motorcyclist, and rear-end collisions).

Sustainable effects

The different studies do not indicate diminishing effects for DRL over time. When cars have to be equipped with automatic lighting of running lights it will be active and working properly throughout the lifetime of the vehicle.

Transferable effects

The measure is transferable to other countries in Europe. At this moment DRL is mostly mandatory in countries in the Northern part of Europe where difficult light conditions at daytime are more frequent than in other parts of Europe. That is why the effects are expected to be larger in countries further away from the equator.

References

EU (2006), Saving lives with Daytime Running Lights (DRL).

Pokorny (2006), Day time running lights in the Czech Republic.

Pokorny (2006), Day time running lights in the Austria.

Elvik, R. & Vaa, T. (2004). The handbook of road safety measures. Amsterdam: Elsevier.

Elvik, R., Christensen, P. & Olsen, S.F. (2003). Daytime running lights. A systematic review of effects on road safety. TØI-report 688/2003. Oslo: Institute of Transport Economics.

Koornstra, M., Bijleveld, F. & Hagenzieker, M. (1997). The safety effects of daytime running lights. SWOV-report R-97-36.

Rosebud (2006), Examples of assessed road safety measures – a short handbook – EU.

7 Electronic Stability Control (ESC)

Description of the measure

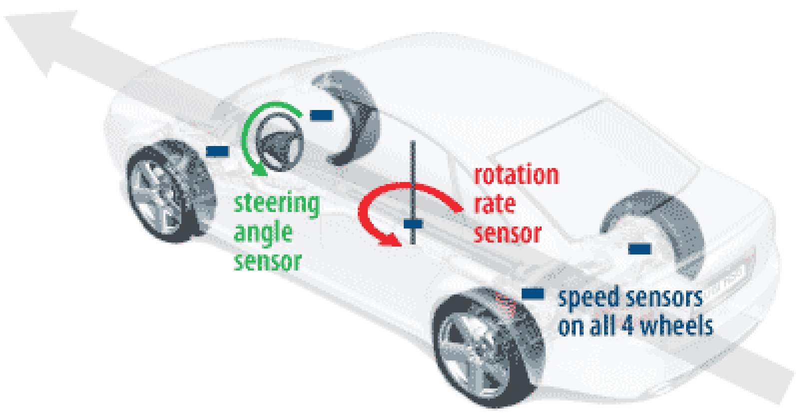
Electronic Stability Control (ESC) is an active safety system for motor vehicles (passenger cars, goods vehicles, buses/coaches). It is an extension of antilock brake technology, which has speed sensors and independent braking for each wheel. It aims to stabilise the vehicle and prevent skidding under all driving conditions and situations, within physical limits. It does so by identifying a critical driving situation and applying specific brake pressure on one or more wheels, as required. If necessary, the engine torque is also adjusted automatically [eSafety effects database, 2006][Dang, 2004][Lie, 2005].

There is a large number of ESC systems. They have in common that they help the driver stabilise the vehicle, and help prevent skidding in cases of over steering or under steering. The system's sensors monitor the speed of each wheel, the steering wheel angle, and the overall yaw rate and lateral acceleration of the vehicle. Data from the sensors are used to compare a driver's intended course with the actual movement to detect when a driver is about to lose control of the vehicle. The system then intervenes and helps the driver to stay on course.

ESC has been on the market since 1995 and is currently standard equipment in many cars of the middle and upper price classes, but not yet in smaller cars. In Denmark, ESC is mandatory on new coaches (of class M3 – tourist coaches heavier than 12 tonnes) (see:

http://ec.europa.eu/transport/road/roadsafety/profiles/pdf/countryprofile_dk_en.pdf).

N.B. ESC is part of the EuroNCAP evaluation.



(www.iihs.com)

Furthermore it is interesting to note that ACEA, the European Automobile Manufacturers Association, has expressed its commitment to deliberately take the initiative of implementing measures going beyond the regulatory requirements in force, namely: To continue to equip progressively integral/single build coaches defined as M3 class III vehicles with electronically controlled stabilising systems, taking into account the main purpose of the product, its distinctive characteristics and general capacities, resulting in all of new vehicles types to be equipped accordingly by 01.01.09 at the latest and all new vehicles by 01.01.10 at the latest;

http://www.paueducation.com/charter/index.php?page=doc&doc_id=896&doclng=8&menuzone=6

Definition of target group

The target group for ESP is all (four-wheeled) motor vehicles: passer cars, trucks, buses/coaches.

Size of road safety problem

The accidents that ESC is expected to help prevent or mitigate are accidents involving loss of control, e.g. those caused by too high speeds in curves, in accident avoidance manoeuvres, or on slippery roads. These accidents are mostly single vehicle accidents (road departure, roll-over) or front collisions with oncoming traffic. Accidents are likely to be side collisions, due to the rotation of vehicles.

The absolute numbers and shares of accidents which ESC might help prevent or mitigate differ per country. For instance, ESC will be particularly effective in countries with frequent poor weather conditions.

Expected effects on safety

ESC reduces the probability of loss of control (e.g. in curves, curves, in accident avoidance manoeuvres, or on slippery roads), and it can help reduce the severity of accidents that do still occur. ESC has a high potential in saving lives and preventing or mitigating injuries (more than any other safety system, except for the use of a seatbelt) (Lie et al., 2005).

Accidents which involve loss of control caused by excessive speed, alcohol or drowsiness are not expected to be affected by ESC. It is not known whether or not ESC affects driving style (especially speed) and risk-taking behaviour in general. The effect is likely to be small as not many drivers know what ESC is and how it works. For drivers who are familiar with the function of ESC both more careful behaviour and more risk-taking behaviour are imaginable.

Evaluation of effects

Numerous effect studies have been carried out, with varying but always positive findings. Notably, the reductions in fatal accidents are larger than for other injury accidents. The eSafety effects database summarises several studies as follows: ESC is estimated to reduce the number of injury accidents by about 7-11%. The reduction in the car occupant fatalities is estimated to be approximately 15-20%. The system affects especially accidents on slippery road surfaces and in general, loss of control accidents. Lie (2005) reports an effectiveness of over 25% for crashes where car occupants were severely injured or killed, in Sweden. For more ESC sensitive crashes, such as single/oncoming/overtaking crashes on wet or icy roads, the reduction found was in the order of 50%. In Great Britain, an analysis of national accident data showed that cars equipped with ESC are involved in 3% fewer crashes overall compared to unequipped cars (Thomas, 2006). There, also, ESC was found to be most effective under poor road surface conditions (effectiveness of 25%). In the USA, a reduction rate of 32% of the risk of fatal multiple-vehicle crashes was found. The reduction of the risk of single-vehicle crashes was more than 40% (of fatal ones: 56%) (Insurance Institute for Highway Safety, 2006).

Some cost-benefit analyses have been carried out. A Norwegian benefit-cost analysis showed that if ESC is made obligatory for all vehicles (i.e. all vehicles have to be equipped with ESC), the costs would exceed the benefits by 57% (benefit cost-ratio = 0.43). However, if ESC is not made obligatory for all vehicles at once but if it is becoming standard equipment in new cars, the benefits would exceed the costs by more than 400% (benefit cost-ratio = 4.20). Another example is (Paine, 2005), which found a benefit cost ratio of 0.51, assuming that ESC can prevent 50% of loss-of-control accidents and that an ESC units costs $1,000. This appears, however, to be a reasonable ratio, if compared to other safety systems. In addition, the prices of ESC, which vary greatly at the moment (e.g. depending on whether it is offered as part of a package or not), will probably decrease over time - according the NHTSA's proposed regulation, the average cost is estimated to be $111 per vehicle on vehicles that already include ABS brakes.

Public acceptance

There is generally a high acceptance for safe cars, and for safety systems such as ESC. However, the still high purchase price may hinder the acceptance of ESC in the smaller vehicles market. Additional policy making (to convince consumers to buy and the automotive industry to market cars with ESC) is recommended by several of the studies (e.g. Lie et al., 2005). In Sweden, for instance, a firm recommendation to buy ESC-equipped vehicles in 2003 resulted in a strong increase in the fitment rate of new vehicles. Regulation is also a possibility. So far, ESC has only been made mandatory in Denmark, for coaches (M3 class). Also, on September 14, 2006, The National Highway Traffic Safety Administration (USA) announced its plan to establish a new Federal motor vehicle safety standard to require ESC on passenger cars, multipurpose vehicles, trucks and buses with gross vehicle rating of 4,536 kg or less.

Sustainable effects

Sustainability is not an issue if it is assumed that ESC will be active and working properly throughout the lifetime of the vehicle.

Transferable effects

In principle, there are no problems with transferability. ESC is a global measure; the system is available in cars from many different manufacturers. However, some encouragement may be needed to raise the penetration rate in smaller (and cheaper) cars and in buses/coaches.

References:

Dang, J. N. (2004), "Preliminary results analyzing the effectiveness of electronic stability control", Evaluation note, National Highway Traffic Safety Administration, US Department of Transportation, DOT HS 809 790, September 2004.

Elvik, R. & T. Vaa (2004), "Handbook of road safety measures", Amsterdam, Elsevier, 2004.

eSafety effects database, available at http://www.esafety-effects-database.org/application_13.html (website consulted on November 6, 2006).

Insurance Institute for Highway Safety (2006), "Electronic Stability Control could prevent nearly one-third of all fatal crashes and reduce rollover risk by as much as 80%", Update on Electronic Stability Control. Insurance Institute for Highway Safety, Status Report, Vol. 41, No. 5 and News Release, June 13, 2006.

Lie, A, C. Tingvall, M. Krafft & A. Kullgren (2005), „The effectiveness of ESC (Electronic Stability Control) in reducing real life crashes and injuries", 19th International Technical Conference on the Enhanced Safety of Vehicles Conference (ESV), June 2005.

Paine, M. (2005), "Electronic Stability Control: Review of Research and Regulations", Vehicle Design and Research Pty Limited for Roads and Traffic Authority of NSW, June 2005.

Thomas, P. (2006), "The accident reduction effectiveness of ESC equipped cars in Great Britain", in: Proceedings of the 13th ITS World Congress and Exhibition, London, UK, 8-12 October 2006.

Website of the National Highway Traffic Safety Administration at http://www.nhtsa.dot.gov/ (website consulted on November 6, 2006).

Website of the European Commission on road safety at http://ec.europa.eu/transport/roadsafety/road_safety_observatory/profiles_en.htm (website consulted on November 8, 2006).

8 Alcohol Ignition Interlock (Alcolock)

Description of the measure

An alcohol ignition interlock or ‘alcolock’ is an electronic device that prevents a vehicle from being started if the driver has drunk too much. Actually the device shuts down the start engine of a vehicle when the attempt to start the vehicle is not preceded by the performance of a negative breath test. A “breath alcohol ignition interlock device” (BAIID), is fitted to a car’s ignition to stop a driver from starting it if he’s over the drink-driving limit. The device is seen as a way to stop people who have been convicted of driving under the influence from offending again. Trials have been taking place in recent years in the US, Australia, Canada, and Sweden, though not always under this name. The European Union has been conducting studies to see if it ought to be adopted throughout the EU and as a follow-up to this investigation a trial is to take place in two areas of the UK shortly. Supporters of the scheme argue that it helps to prevent repeat offences. Alcolocks prevent drink-driving, and hence all accidents which are caused or co-determined by drink-driving

From 2004 to 2006 a pilot trial has been conducted with 40 Belgian drink-driving offenders and alcohol dependent patients, in the framework of a cross-national European qualitative field trial on alcolocks.

Inspired by the large-scale application of alcolocks in North America, this pilot project examined the feasibility of Alcolock applications in several European countries. The main objective of the project was to analyse the practical, psychological, behavioural and social impact of alcolocks. The field trials were funded by the European Commission and coordinated by the Belgian Road Safety Institute.

Source: BIVV

Definition of target group

The target group consists of drink-driving offenders (people who have been convicted of driving under the influence) and alcohol dependent patients.

Worldwide: It is estimated that there are currently about 70.000 interlocks in use throughout North America (Beirness et al, 2004). In Sweden 1,500 Volvo trucks have been fitted with the Alcolock (*The Times*, 4 May 2003).

Size of road safety problem

In Norway (1993) it was found that 62.9% of the drivers injured or killed in an accident had alcohol, in Spain (1992-1995) this percentage was 51.2 and in Belgium (1995-1996) this was 27% (source: ROSITA 2006,).

In the U.S.A. in 1998, 15,935 people were killed in alcohol-related traffic crashes, an average of one every 33 minutes. These deaths constituted approximately 38.4% of the total of 41,471 traffic fatalities. (NHTSA, 1999).

In Europe: Alcohol is one of the major contributory factors in road traffic accidents, in particular in accidents with severe consequences. In EU countries, alcohol is a contributory factor in around 20 percent of the serious and fatal injury accidents (European Transport Safety Council, 1995).. In Belgium, according to the official statistics of 2001 (IBSR, s.d.), 8.4% (4002) of all Belgian injury accidents were alcohol-related, whereas 10.0% (870) of all accidents with dead and seriously injured persons were alcohol-related. 7.7% (723) of all car drivers who got involved in an accident with at least 1 dead or seriously injured road user, were under the influence of alcohol (BIVV, 2001). 28% of the drivers who entered the emergency room after an injury accident had blood alcohol levels above the legal limit (source: the Belgian Toxicology and Trauma Study)

In the Immortal project (Vlakveld et al., 2005), preliminary results of an epidemiological study in The Netherlands are shown. The results show an accident ratio of 6.7 for drivers with a BAC between .5 and .8 g/l, of 12 for drivers with BAC between .8 and 1.3 g/l, and of 60 for drivers with a BAC above 1.3 g/l. The authors also state that it makes sense to develop effective countermeasures for drivers with BAC > 0.5 g/l. The percentage of drivers who were found to have a blood alcohol concentration at or above the legal limit of 0.5 g/l during weekend nights (7.68%) is significantly higher than all other time spans. The percentages for the remaining time spans do not differ significantly (weekdays: 1.76%; weekday nights: 2.99%; weekend days: 2.98%).

Expected effects on safety

An Alcolock should reduce recidivism when it has been installed in a car. It is not possible to drive when the driver has drunk alcohol. The effects on accidents involving drivers under the influence of alcohol depend on the proportion of drivers having an Alcolock in their cars. It was estimated that alcolocks lead to 40-95% reductions in the rate of repeat driving under the influence (DUI) offenses of convicted DUI offenders (ICADTS, 2001).

In the Immortal project, the traffic safety effects of introducing alcolocks for 2 types of drivers were estimated . The traffic safety effect of an alcohol lock for drivers with a BAC higher than 1.3 g/l was estimated to generate a reduction of 33 traffic fatalities (272 fatalities * 25% of getting caught * 49% less recidivist risk). The traffic safety effect of an alcohol lock for drivers caught twice with a BAC between 0.5 and 1.3 g/l was estimated to generate a reduction of 2 traffic fatalities (54 fatalities * 6.25% of getting caught twice * 49% less recidivist risk).

Evaluation of effects

In a literature study of the UK Department of Transport (2004) the following results were mentioned: the results of the evaluations show a recidivism reduction of about 28-65% in the period where the Alcolock is installed compared with the control groups who were not using the alcolock.

Coben J. H., Larkin, G. L. (1999) also conducted a literature study on Alcolocks. They found in five of six studies that Alcolocks were effective in reducing DUI recidivism while the Alcolock was installed in the car. In the five studies demonstrating a significant effect, participants in the Alcolock programs were 15%–69% less likely than members of the control group to be re-arrested for DUI. The only reported randomized, controlled trial demonstrated a 65% reduction in re-arrests for DUI in the Alcolock group, compared with the control group.

Costs and benefits

It is hard to estimate all the costs of implementing an Alcolock program. In the Immortal cost-benefit analysis (Vlakveld et al., 2005) estimations are made for implementing alcolocks for drivers caught twice with a BAC between .5 and 1.3 and for drivers caught with a BAC above 1.3 g/l.

Regarding the situation in The Netherlands they report (Vlakveld et al.,2005) "In the Netherlands some 1.5 million roadside breath test were performed in 2003. This means that in general one in seven car drivers is tested each year. However drunk drivers have a higher chance of getting caught since they drive more at night (when most road side tests are carried out), they are more involved in accidents, and have a noticeable driving pattern. We therefore assume that the chance of getting caught while having been drinking is 25%. This means that each year around 12,000 offenders with a BAC higher than 1.3 are caught (25% of 48,000 drivers) and 5,950 drivers are caught twice with a BAC between 0.5 and 1.3 (25% of 25% of 95,145 drivers), leading to a total of 17,950 participants each year. For each participant there are introduction costs of € 420 (application, medical examination, administration and installation costs). After implementation, the annual costs consist of rent of the alcohol lock (€ 1344) and costs for four medical examinations per year (€ 672).

After the installation period of two years, there are costs related to the dismantling of the alcohol lock (€ 112) (Bax et al, 2001). In total the costs per participant amount to € 4,564 for a two-year programme, leading to total costs of € 41 million per year for all offenders.

Situation in The Czech Republic (Vlakveld et al., 2005) "The costs related to the implementation of the alcohol lock are based on the average costs (Bax et al, 2001). These costs are adjusted by using the wage factor between the Netherlands and the Czech Republic [International Labour Organisation]. This leads to the following costs per alcohol lock: introduction costs € 104 ; rent of alcohol lock € 332 per year; costs medical tests € 166 per year; removing costs € 28 These costs are related to 7,500 offenders of a BAC higher than 1.3 g/l and 2,375 offenders getting caught twice with a BAC between 0.5 and 1.3 g/l. The total annual costs are thus € 5.6 million per year.

Situation in Norway (Vlakveld et al., 2005) "If the same costs per participant are applied as for the Netherlands for the various segments of an alcohol lock programme (see Paragraph 8.3.2), the total costs for all participants transferred to the Norwegian price level are: introduction € 1,18 million; rent € 3,78 million; medical examination € 1,89 million; dismantling € 0,31 million The total annual costs are thus € 7.2 million per year.

Situation in Spain (Vlakveld et al., 2005): "Without basic input it has been chosen to apply an average of Dutch and Czech costs, mirroring that the price/wage level of Spain is between that of these two countries. This leads to the following cost estimates per alcohol lock per participant: introduction costs € 262; rent of alcohol lock € 838 per year; costs medical tests € 419 per year; removing costs € 70 Since the project horizon is only two years we may skip discounting and just find annual costs. As there are 26,674+6,630=33,304 participants this yields an estimate of nearly € 99 million per year."

Using cost-benefit analysis an estimation is made of the financial benefits of the particular Alcolock implementation studied for 4 countries:

For the Netherlands, the reduction of 35 traffic fatalities annually is valued at 4.8 million per death, leading to a benefit of 168 million Euros. Benefit/cost ratio = 4.1

For the Czech Republic, the 8 fatalities prevented are counted at 1.1 million Euro/death, leading to estimated benefits of 9 million Euro/year. Benefit/cost ratio = 1.6

For Norway, the benefits are calculated as 5.5 deaths less per year a rato de 5.9 million Euro per death, or at 32.5 million Euro / year. Benefit/cost ratio = 4.5

For Spain, the reduction with 86.5 deaths/year at 800.000 Euro per death, would imply benefits of 69 million Euro/year. Benefit/cost ratio = 0.7

Public acceptance

Acceptance studies show a discrepancy between the public acceptance of the measure and the fact that only a minority of the convicted offenders take part in BAIID programmes (Bax et al, 2001). Possible explanations for this discrepancy are the perceived disadvantages e.g. costs, embarrassment, reluctance, etc. of using a BAIID. Some suggestions to increase the attractiveness of using a BAIID are:

- reduction of the participation costs; preferably costs of using a BAIID should be in line with the costs of alternative sanctions
- improving the attractiveness of the programme by making conditions more transparent and easy to understand
- improving the accessibility to service points for training, medical checks, etc.
- better promotion of the measure by means of information campaigns; a positive approach, pinpointing at the gains for the participant, is recommended
- monitoring of the individual developments of the participant while taking part in the programme; programme allows for adaptations and accompanying educational/psychological measures.

Sustainable effects

Large scale quantitative research on alcohol ignition interlocks in use has shown that alcolocks are 40 to 95 percent more effective in preventing drink driving recidivism than traditional measures such as license withdrawal or fines. Since drink driving, and especially drink driving by recidivating offenders, is a proven risk factor, the Alcolock may have a beneficial impact on the number of traffic casualties due to drink driving. In Europe, the measure is currently only tested in pilot projects, so Alcolock programs can not really be regarded as a measure. From the evidence in the U.S., however, it appears that the Alcolock has the potential of becoming a best practice in the near future.

Transferable effects

Alcolock programmes are applied in Europe on a limited scale. In the USA alcolocks are frequently applied (70,000 per year) mainly to convicted drink drivers. Drink drivers in Belgium easily accept the Alcolock program but they don't have to pay for it. Interviews reveal that driver value their driving license so high that they are prepared to pay the costs of an Alcolock programme themselves.

In the SARTRE-studies on attitudes of European car drivers towards road safety, the interviewees were asked 'would you find it useful to have a device on your car like an alcohol-meter to check if you had been drinking and that prevented you driving if you were over the limit'.

In each country of the 24 participating countries 1000 drivers were interviewed, leading to an average of 32% finding it useful to have such a system; varying between only 12% in Austria to 64% in Sweden (source: Cauzard, 2004).

Measure is also applicable to other road users (bus- and truck drivers).

References

Alvarez et al (2005): Alcolock implementation in the European Union: an in-depth qualitative field trial.

http://www.bivv.be/main/PublicatieMateriaal/research/catalogDetail.shtml?detail=715654137&language=nl

Alvarze, Assum, Evers, Drevet, Silverans, Mathijssen and Vanlaar (2005): Integrated study design Alcolock implementation in the European Union. www.bivv.be

Bax, C., Karki, O., Evers, C., Bernhoft, I., Mathijssen, R. (2001) Alcohol Interlock Implementation in the European Union: Feasibility Study. SWOV Institute for Road Safety Research.

Beirness, D. J. and Marques, P. (2004). Alcohol ignition interlock programs. Traffic Injury Prevention, 5: 299-308.

BIVV (2001). Verkeersveiligheid. Jaarverslag 2001. Belgisch Instituut voor de Verkeersveiligheid, Brussel.]

Bjerre, B. (2005). Primary and secondary prevention of drink driving by the use of Alcolock device and program: Swedish experiences. Accident Analysis and Prevention, Volume 37, Issue 6, November 2005, Pages 1145-1152

Braun, E. and Christ, R. (2002). Immortal Deliverable R4.1. Review of impairment and accident risk for alcohol, drugs and medecines. http://www.immortal.or.at/deliverables.php]:

Cauzard, J.-P. (Ed.) (2004). European drivers and road risk. Part 1 Report on principal results. SARTRE 3 reports, INRETS, France

Coben J. H., Larkin, G. L. (1999), Effectiveness of Ignition Interlock Devices in Reducing Drunk Driving Recidivism. American Journal of Preventive Medicine, Volume 16, Issue 1, Supplement 1, January 1999, Pages 81-87

Department of Transport (2004), The effects of breath alcohol ignition interlock devices in cars. Department of transport, UK.

DeYoung, D.J. (2002). An evaluation of the implementation of ignition interlock in California. J. of Safety Research 33: 473-482.

ICADTS (2001) The International Council on Alcohol, Drugs and Traffic Safety .Alcohol Ignition Interlock Devices 1: Position paper. Working group on Alcohol Ignition Interlocks, International Council on Alcohol, Drugs and Traffic Safety.

Immortal: www.immortal.or.at

NHTSA, National Highway Traffic Safety Administration (1999). Alcohol related traffic accidents. [http://www.a1b2c3.com/drugs/alc01.htm]

ROSITA (20006). http://www.rosita.org/

Silverans, Alvarez, Assum, Evers and Mathijssen (manuscript in preparation). Alcolock implementation in the Europe: Description, results and discussion of the Alcolock field trials.

Vlakveld, W., Weseman, P., Devillers, E., Elvik, R., and Veisten, K. (2005). Immortal. Deliverable D-P2 Detailed Cost-Benefit Analysis Of Potential Impairment Countermeasures. www.immortal.or.at

Ward Vanlaar, W. (2005). Drink driving in Belgium: results from the third and improved roadside survey. Accident Analysis and Prevention, Volume 37, Issue 3, May 2005, Pages 391-397

9 Bicycle side reflection

Description of the measure

Fotograph: Ben Immers

The measure implies that all bicycles have to be equipped with side-reflection on both wheels. Bicycle side reflection is obligatory for all bicycles in the Netherlands.

The aim of the measure is to increase the visibility, and thus safety, of cyclists during night- and twilight time.

Definition of target group

The target group consists of all travellers that use their bicycle for making a trip.

More specifically this measure is only relevant for accidents that comply with the following criteria:

- the opposite party (in the conflict) is a motor vehicle (including moped),
- both vehicles (motor vehicle and bicycle) are approaching each other at right angles
- the accident took place during night- or twilight time.

Size of road safety problem

The following characteristics apply to accidents on the Dutch road network:

- In 6% of all accidents a bicycle user is involved
- 27% of all accidents took place during night- or twilight time in 1990

- 33% of all accidents were side-collisions in 1990
- 3,5% of all accidents were bicycle-passenger car accidents in 1990.

Consequently 0,37% of all accidents took place during night- or twilight time and were side-collisions between bicycles and passenger cars in 1990.

3% of these accidents was fatal for the bicycle user in the period 1987-1988.

29% of these accidents caused serious injuries for bicycle users in the period 1987-1988.

Expected effects on safety

It was estimated that the maximum reduction of the number of accidents would be 14% for all relevant accidents (complying with all above mentioned criteria) and would be 7% for semi-relevant accidents. Semi-relevant accidents are accidents where the approaching angle between the vehicles was not perpendicular.

Evaluation of effects

Table 1 provides information on the number of victims before and after introduction of the measure.

The results clearly show that introduction of the measure has a significant impact on traffic safety for cyclists and has no impact on safety for pedestrians (this is obvious as the measure was not applied to pedestrians).

Mode	Severity injury	Period before 1983 - 1986		Period after 1987 + 1988		Ex-pected	Differ-ence Abs.	Differ-ence %
		day	night	day	night	night		
Cyclists	Fatalities	1070	312	489	104	143	-39	-27.3
	Hospital	12012	2818	5077	1138	1191	-53	-4.5
	Other	29006	6195	13568	2815	2898	-83	-2.9
	Total	42088	9325	19134	4057	4232	-175	-4.1
Pedestrians	Fatalities	492	409	198	175	165	10	6.3
	Hospital	4951	1857	2231	803	837	-34	-4.0
	Other	8023	2205	3816	1072	1049	23	2.2
	Total	13466	4471	6245	2050	2051	-1	-0.0

Table 7: Number of victims amongst cyclists and pedestrians before and after introduction of the measure (Source: Blokpoel, 1990)

During night- and twilight time there are 4% less bicycle victims. The effect on the total road un-safety for bicycle users is less than 1%, this means for the Netherlands a maximum of 100 bicycle victims (deaths and injuries) less each year.

Costs and benefits

As side reflection is put on almost all tyres by the manufacturers, the costs associated with introduction of the measure are negligible.

- The benefits are calculated in the following way:
- Costs per fatality in the Netherlands: 1.39 million euro.
- Costs per (hospital) injury in the Netherlands: 0.18 million euro.
- Costs per (first aid emergency assistance) injury in the Netherlands: 0.001 million Euro.

Considering a saving of 1% due to the measure gives a reduction when all bicycle use the side reflection of 2.7 fatalities + 24.5 (hospital) injuries and 61.1 (first aid emergency assistance) injuries.1.39 * 2.7 + 0.18 * 24.5 + 0.001 * 61.1 = 8.2 million Euro each year. In reality 75% of all bicycles use side reflection (side reflection is not yet applied on most racing bikes and all terrain bikes) so the benefits become 0.75 * 8.2 = 6.1 million Euro. As there are hardly any costs involved, thus the benefit/cost ratio is very high.

Public acceptance

The measure is widely accepted. Tyres are standard equipped with reflection material. Coverage of measure on regular bicycles is almost 100%. Side reflection is not or hardly applied on tyres of racing bikes and all terrain bikes.

Sustainable effects

First of all the focus of this measure is on the protection of vulnerable road users. This is important as there are only a limited number of possible measures addressing this group.

Furthermore the measure is rather unique in that it improves visibility of bicycles during night- and twilight time. Other important sustainability aspects of the measure are:

- the measure is easy to implement
- application of the measure is cheap
- there are no adverse impacts related to the application of the measure
- there is no indication that the effect of the measure will decrease in course of time, although tear and wear may reduce the visibility of the reflection circles.

Transferable effects

Measure is easy transferable to other countries. It is a simple and cheap measure. There are hardly any costs involved. A significant impact on traffic safety can only be realised in countries with a reasonable amount of bicycle users.

Furthermore, the measure could be extended to include reflection to all sides, i.e. bicycle reflection that makes the bicycle visible for motor vehicles from all angles.

Fotograph: Ben Immers

References:

Blokpoel, A. (1990). Evaluatie van het effect op de verkeersveiligheid van de invoering van zijreflectie bij fietsen. SWOV, Leidschendam, 1990.

SWOV traffic accidents database (www.swov.nl)

Blokpoel, A., Schreuder, D.A. & Wegman, F.C.M. (1982). De waarneembaarheid bij duisternis van de zijkant van fietsen; Effecten op de verkeersveiligheid van een verbetering van de waarneembaarheid bij duisternis van de zijkant van fietsen met behulp van reflecterende materialen. R-82-36. SWOV, Leidschendam, 1982.

Wesemann, P. (2000). Kosten van de verkeersonveiligheid in Nederland, 1997.

SWOV, Leidschendam, 2000.

Varkevisser, G.A.& Vis, A.A. (1994). Zijreflectie bij fietsen: een onderzoek naar de aanwezigheid van zijreflectie bij fietsen. SWOV, Leidschendam, 1994.

10 EuroNCAP

Description of the measure

EuroNCAP provides consumers with independent information about a car's safety. It also provides an incentive to manufacturers to improve passive safety of cars. EuroNCAP was originally developed by the Transport Research Laboratory for the UK department of Transport. Subsequently many other interested parties have joined. Current members include the Catalonian region of Spain, France, Germany, the Netherlands, Sweden and the UK. Consumer groups in Europe are represented by International Consumer Research and Testing. Motoring Clubs are represented by members of the FIA Foundation and ADAC, the German Motor Club. British Insurers are represented by Thatcham. The European Commission is an observing member of EuroNCAP's board and provides additional support.

As a result of the project PENDANT (Fifth Framework) there will be a coordinated system to inform European vehicle safety policy in a systematic and integrated manner. The results of the data analyses will provide new directions to develop injury countermeasures and regulations.

The database was created in 2004 with the objective to enhance the quality of real-accident reconstructions. It includes frontal, side and pole impacts of EuroNCAP crash tests and rear end car to car impacts of Swiss and Austrian crash tests.

The wide consortium of members ensures the independence of EuroNCAP. EuroNCAP itself is an International Association under Belgian law. It is independent of the automotive industry and political control. No individual member can bias EuroNCAP towards their individual interests.

Tests performed include a frontal impact test at 64 km/h into an offset deformable barrier, a side impact test at 50 km/h, a side impact pole test at 29 km/h and tests with pedestrian head and leg forms at 40 km/h. Safety performance is evaluated for adult occupants and children. Seat-belt reminders are also taken into account in the evaluation.

Based on the results, occupant protection, pedestrian protection, and child protection are evaluated on scales with 1 to 5 stars, more stars indicate better protection. Additionally, EuroNCAP recommends cars which are equipped with electronic Stability Control. Test procedures evolve continuously to take account of new developments.

Similar test procedures are used by the NHTSA (National Highway Traffic Safety Administration) in USA, in Australia and in Japan.

(www.euroncap.com)

Definition of target group

The target groups of this measure are the car manufacturers that produce the passenger cars and the consumers who choose their car based on the EuroNCAP test results.

Size of road safety problem

Passive safety contributes to a large degree to the occurrence and severity of injuries in all types of accidents.

Expected effects on safety

Improved passive safety of cars (occupant and passenger protection) reduces accident severity. Test procedures include front collisions, side collisions, and pedestrian collisions. Not included are for example rollover- and rear-end collisions.

EuroNCAP results provide guidance for consumers in choosing safe vehicles, and incentive to manufacturers for developing safe vehicles, and thereby contribute to the increase in the number of vehicles which offer good protection for occupants and pedestrians (www.euroncap.nl).

Evaluation of effects

Euro NCAP has been responsible for a dramatic change to overall car safety. This is readily seen in how quickly manufacturers improve their safety equipment and the steps they take to do well in the tests (www.euroncap.com).

The number of accidents is not assumed to be reduced. A study by Lie and Tingvall (2001) found that the risk for being killed or seriously injured in a car with 4 stars is ca. 30% lower than in a car with 2 stars. The risk of severe or fatal injuries is reduced by ca. 12% for each EuroNCAP star rating. For lighter injuries no difference was found.

(www.euroncap.com)

Costs and benefits

Costs include developing and evaluation of test procedures, carrying out tests, and publication of test results. No information about the require amount of financial resources is available.

In a cost-benefit analysis that has been conducted in Norway (Erke & Elvik, 2006) it has been estimated that each additional EuroNCAP star increases the costs for new cars by ca. € 600. Benefits associated with this measure are reduced accident severity. The Norwegian benefit-cost analysis showed a benefit-cost ratio of 1,31.

ETSC (2003) does not quantify the results of EuroNCAP because it is too difficult to assess, but it does indicate that EuroNCAP is contributing to an improvement in vehicle crashworthiness, likely providing benefits significantly greater that the cost to society of achieving these improvements.

Public acceptance

According to EuroNCAP, car manufacturers believe that if such tests are to be carried out, the work should be undertaken in an objective way by an independent expert organisation. There is a general acceptance that EuroNCAP has been responsible for improving overall safety standards. Euro NCAP conducts a regular dialogue with the motor industry, discussing technical issues.

No information is available the degree to which consumers base their decisions on new cars on EuroNCAP results. The increase in the numbers of cars with more EuroNCAP stars indicates that safer cars are increasingly both produced and bought (www.euroncap.com). As a consequence EuroNCAP is looking for additional safety related topics that could be incorporated in their test program.

Sustainable effects

It can be assumed that the effects of the EuroNCAP measure are sustainable. The passive safety of the passenger cars will not decline.

Transferable effects

The measure is already on a European level; transferability to other European countries is therefore not relevant. Similar test are conducted in USA, Australia, and Japan.

References:

Website of the European New Car Assessment Program at http://www.euroncap.nl (website consulted on November 10, 2006).

Lie, A. & Tingvall, C. (2001). How does Euro NCAP results correlate to real life injury risks – a paired comparison study of car-to-car crashes. Traffic Injury Prevention, 3, 288-293.

Erke, A. & Elvik, R. (2006). Effektkatalog for trafikksikkerhet (Road Safety Measures: A Catalogue of Estimates of Effect). Oslo: Institute of Transport Economics. Report 851/2006.

ETSC (2003), Cost effective EU transport safety measures. ETSC, Brussels, Belgium.

11 Seat belt reminders

Description of the measure

A seat belt reminder is a device that gives a warning whenever a seat is occupied, but the seat belt is not fastened. Research has shown that many of the non-wearers of seat belts would use their seat belt with some encouragement. Seat belt reminders are intended to bring these "part time users" to wearing their belt, whilst at the same time not be so annoying that the small proportion of non-wearers would try to disable the system.

In 2006, a new Directive came into force that extends the obligatory use of seat belts to all motor vehicles, including trucks and buses. At the moment front seat belt wearing rates vary between 53% and 92% in the EU member states. Misinformation is part of the reason why belts are not yet always buckled: people think that seat belts are not a necessity in urban locations or at slow speeds.

People simply forget to wear seat belts. 99% of people who unbuckle don't fundamentally disagree to use their seat belt but simply need a system that reminds them to wear it. In this circumstance having a seat belt reminder makes sense and would be very useful to save lives (ETSC, 2005).

European Transport Safety Council (ETSC) experts estimate that audible seat belt reminders for front seats can raise seat belt wearing among front seat occupants to 97%. Various studies showed that seat belt reminders are most effective when they are both visible and audible. But it is less clear whether seat belt reminders should be installed in all seats (ETSC, 2005).

The European New Car Assessment Program (EuroNCAP) has started providing added point bonuses for vehicles fitted with seat belt reminders. In the June 2004 rating, all but two of the new models added to the website had some form of intelligent seat belt reminder, and an intelligent seat belt reminder for the rear seats was introduced on a car (Volvo's S40) for the first time. While new cars are increasingly equipped with seat belt reminders, efforts are also being made to promote retrofitting of old cars (ETSC, 2006).

Finally ACEA, the European Automobile Manufacturers Association, has expressed its commitment to deliberately take the initiative of implementing measures going beyond the regulatory requirements in force, namely: To continue to equip progressively passenger cars of categories M1 and commercial vehicles with seatbelt warning for the driver's seat, taking into account the main purpose of the product, its distinctive characteristics and general capacities, resulting in an overwhelming majority of new models to be equipped accordingly by 01.01.09 at the latest and of new vehicles by 01.01.10 at the latest. ACEA will also provide on a regular basis statistics regarding the availability of seatbelt warning on vehicles registered in the EU

Definition of target group

The target group is car passengers who forget to use their seat belts. The seat belt reminder will notify them when they forget to use their seat belts.

Size of road safety problem

The IRTAD database shows that 23.781 car occupants were killed in road accidents in the EU in 2000. A disproportionally large fraction of this group did not wear their seat belt.

Expected effects on safety

An enormous part of the fatalities among car occupants are unrestrained occupants. Even in countries with high rates of seat belt use many more lives could be saved. In Sweden and Finland, where around 90% of the front seats occupants wear a seat belt, almost 40% of those killed as car occupant were unrestrained (Janitzek & Achterberg, 2006).

Evaluation of effects

According to Anders Kullgren, there could be at least 7000 lives saved and many more injuries avoided if everybody wore their seat belt (ESTC, 2005).

Research shows that using seat belts is a highly effective way of reducing serious and fatal injuries to car occupants. Seat belts are somewhat less effective in preventing serious or slight injuries than in preventing fatalities. ETSC estimates that about 50% for front seat occupants dying in crashes in the EU-15 could survive if front seat usage rates were at 97% (ETSC, 2003).

97% is a reachable rate if all cars are equipped with seat belt reminders for the front seats. It is assumed that 85% were front seats occupants and 15% rare seats occupants. Hence, it is more cost-effective to install seat belt reminders in the front seats only than to install them for all seats of the car.

Costs and benefits

A seat belt reminder costs around 60 Euro (price level 2000). The purchase of the reminder is the only cost for implementation. The benefits are the enormous savings in fatalities and injuries.

The ETSC has undertaken a cost-benefit analysis for the mandatory introduction of audible seat belt reminders for front seats in 2004. This analysis was based on the assumption that roughly 50% of fatally injured front seat car occupants killed in the EU did not wear seat belts and that audible seat belt reminders for the front seat could increase seat belt wearing among front seat occupants to 97%. After 12 years of introduction, the costs would amount to about 11 billion euros while the benefit would be 66 billion euros. This results in a cost/benefit-ratio of 1:6 (Janitzek & Achterberg, 2006).

The benefits of audible seat belt reminders for front seats thus clearly exceed the costs.

Public acceptance

The public acceptance for seat belt reminders is high. Nearly everybody (99%) is convinced that using a seat belt makes sense. Negative responses from customers to cars with seat belt reminders are very rare and mainly concern the intensity and length of the noise. Consumers are however given the possibility to reduce such noise in more and more types of seat belt reminders.

Sustainable effects

The effect of the seat belt reminder is expected to be sustainable, since most of the car occupants wants to use the seat belts but just forget to use them. When they hear or see the alarm they have reminded to use their seat belt.

Transferable effects

There are no problems with transferability. This measure can easily be transferred to other countries in the European Union.

References

ETSC (2006), website: http://www.etsc.be/enforcement-seatbeltuse-vehicle.php.

ETSC (2005), website: http://www.etsc.be/ETSC_3_May_SBR.php.

Janitzek, J. & Achterberg, F. (2006), Seat belt reminders. ETSC, Brussels, Belgium.

ETSC (2003), Cost effective EU transport safety measures. ETSC, Brussels, Belgium.

12 In-car data recorders for trucks and delivery vans

Description of the measure

The driving behaviour can be monitored using an on-board computer, which leads to less accidents en damages. The superiors of the driver should give feedback on the driving style of the truck driver to keep him focused on cautious driving. It is assumed that this kind of data recorders can just be effective in the larger companies with more than five trucks and/or delivery vans a hierarchical structure within the company.

In-car data recorders can be used to monitor driving behaviour of truck drivers and to collect vehicle data. Two types of in-car data recorders are currently used: the accident data recorder (ADR) and the journey data recorder (JDR). The accident data recorder collects data a certain period before and after the accident, whereas the journey data recorder collects all the data during driving (Langeveld & Schoon, 2004).

The system also makes it possible to report drivers who exceed the speed limit to the office automatically (and immediately).

This measure consists of a voluntary introduction of the data recorders and monitoring. It is considered to be impossible to make monitoring an obligation, so this measure can just by used on a voluntary basis.

At this moment it is estimated that 20% of the trucks is equipped with an on-board computer and 10% of the trucks is equipped with a black box. The on-board computers are currently mostly used for automatic registration of labour hours. Equipment for extracting the driving behaviour data is generally not present (Transumo, 2007).

Definition of target group

The target group for this measure is companies with more than five trucks or/and delivery vans for transport on public roads. In the Netherlands 92% of the trucks are owned by companies with more than five trucks (Langeveld & Schoon, 2004).

Based on a questionnaire conducted by NIPO (1997) is estimated that approximately 50% of the delivery trucks in the Netherlands is owned by companies with more than five delivery vans.

Size of road safety problem

The size of the road safety problem as a result of the unsafe driving behaviour of trucks or delivery vans in the Netherlands has been estimated by Langeveld & Schoon (2004). They estimate that driving behaviour of trucks or delivery vans results in 165 fatalities and 641 heavy injuries in the Netherlands.

Expected effects on safety

The drivers of the vehicles will drive more cautious, since their driving behaviour is monitored and evaluated. This will result in a lower driving speed, leading to less accident en less victims.

When the number of revolutions is taken into account, it is assumed that the drivers will also drive more economically. This has positive effects on the environment.

Evaluation of effects

Several studies have been performed to assess the safety impact of data recorders in trucks or delivery vans. Wouters & Bos (2000) investigated that data recorders lead to an average reduction of 20% on the number of accidents and damages. The lowest value is 5% reduction and the highest 30%. This interval is rather large, probably because of the difference in the application for the monitoring of the drivers. The number of victims can be reduced by 5.5% for fatalities and 3.5% for heavy injuries.

Costs and benefits

In the study of Langeveld & Schoon (2004) some assumptions are made about data recorders. For the application of JDR it is assumed that the on-board computer has already been purchased. Only the software for monitoring the driver has to be purchased (1000 Euro per company, price level 2001). For the application of ADR also the costs of the additional recording equipment have to be taken in consideration (900 Euro per vehicle).

One hour per driver/truck is necessary yearly to discuss driving behaviour of the driver with his/her superior. The costs of this discussion have to be taken into account.

The benefits of the data recorders are estimated as a saving of 12 fatalities and 46 heavy injuries with a JDR and 13 fatalities and 51 heavy injuries with an ADR in the Netherlands. These savings are translated into monetary values.

The benefits and costs of JDR and ADR lead to the following benefit/cost-ratios for society:

- Journey data recorders: 20:1
- Accident data recorders: 6:1

In the ratios above the benefits for the companies are no taken into account. These benefits consist of 20% less accidents and damages.

Public acceptance

Based on the benefit/cost-ratios it can be expected that public acceptance for in-car data recorders is rather high. Drivers might have problems with in-car data recorders because their driving behaviour is monitored.

Sustainable effects

Sustainability is not an issue if it is assumed that data recorders will be active and working properly throughout the lifetime of the data recorder. The lifetime of an in-car data recorder is approximately ten years.

Transferable effects

There are no problems with transferability. This measure can easily be transferred to other countries in the European Union.

References

Langeveld, P.M.M. & Schoon, C.C. (2004). Kosten-batenanalyse van maatregelen voor vrachtauto's en bedrijven. Maatregelen ter reductie van het aantal verkeersslachtoffers en schadegevallen. SWOV-rapport, R-2004-11. SWOV, Leidschendam, The Netherlands.

Bos, J.M.J. & Wouters, P.I.J. (2000). Traffic accident reduction by monitoring driver behaviour with in-car data recording. In: Accident Analyses and Prevention, 32(5), p. 643-650.

Transumo (in press). Verkeersveiligheid verkenner voor de regio (VVR-GIS), Deliverable D_A16. Transumo, Zoetermeer, The Netherlands.

13 Anti lock braking systems (ABS) for motorcycles

Description of the measure

Anti-lock brake systems are a very effective countermeasure against driver misbehaviour in emergency situations. The daily training of a driver - including each and every braking manoeuvre performed - creates a clear message, "the closer the stopping distance, the harder you have to brake". In an emergency situation where the expected stopping distance exceeds the available space, within parts of a second the driver takes countermeasures according to this message. This means that the driver will pull the brake levers as hard as he can. This emergency reaction (reflex) cannot be influenced by an average driver and only be corrected afterwards by experienced and well-trained drivers (Winkelbauer, 2006).

Focussing on the motorcycle, the reflex of emergency braking usually leads to blocking one or both wheels which immediately causes a very high danger of falling off the vehicle. Motorcycle drivers are well aware of this danger and leave a huge "safety gap" between the decelerations they actually apply and the real decelerating potential of their vehicles. Practically, motorcycle drivers use only about 60% of the decelerating potential of their vehicles (Vavryn, Winkelbauer, 1998).

Anti-lock brake systems use different technical approaches. But what they do practically is to avoid blocking of wheels during braking. In most of the cases this will keep motorcycle drivers from falling off their vehicles when braking under emergency conditions. And, generally it will also enable motorcycle drivers to significantly improve their braking performance (Vavryn, Winkelbauer, 2002).

In 2006, already 27 % of the street models available in Europe were standard or optionally equipped with an advanced braking system. The ACEM's (Association des Constructeurs Européens de Motocycles) commitment to supply the majority of street models is expected to increase rapidly as many new models will be equipped with this technology.

Definition of target group

The target group for this measure is motorcyclists purchasing a new motorcycle.

Size of road safety problem

Falling off the motorcycle when an emergency stop has to be made is a major problem, responsible for a considerable part of the fatalities and injuries in traffic. No quantitative data were given.

Expected effects on safety

Studies (for passenger cars) have shown mixed results on the safety effects of ABS. No significant effect on fatal crashes was found. In some cases, increases in single vehicle accidents were found. However, for motorcycles, these results cannot simply be adopted. Particularly because the main effect of motorcycle ABS, avoiding drivers to fall of the vehicle instantly after blocking one ore both wheels, is not applicable to passenger cars. There was no evidence that ABS has any impacts on motorcycle drivers' risk taking behaviour (Winkelbauer, 2006).

Evaluation of effects

Kramlich and Sporner (2000) published a study on accident reduction potential of motorcycle ABS at the 2000 Ifz motorcycle conference. They identified accident types where ABS may influence accident numbers and severity using in-depth data from 910 motorcycle accidents which had occurred on German roads.

Among 610 crashes involving one motorcycle and one passenger car, there were 65% with the motorcycle driver using his brake prior to the collision. Among these there were 19% with the motorcycle driver falling off the vehicle. In 93% of these cases ABS would have avoided the crash or at least reduced the severity of the accident.

300 single-vehicle crashes were identified. 82,7% were accidents in curves (with 40% of the drivers falling off the vehicle before a collision with an obstacle or running off the road) and 17,3% on straight roads (50% drivers falling off). This means that for least 40% of the single-vehicle crashes ABS would be beneficial by avoiding the accident or at least reducing its severity.

Applying these results to all motorcycle accidents including all types of crashes, ABS would be beneficial in 54% of the cases. This finally gives an estimate of reducing all fatal and severe injuries to motorcycle drivers by 8 to 10% in Germany (Winkelbauer, 2006).

Costs and benefits

The costs associated with ABS are costs for fitting motorcycles with ABS. The average net market price for an ABS is considered to be 561 Euro (price level 2002). Fitting motorcycles with an ABS leads to reduction of fatal and severe injuries by 8 to 10%. This means a benefit of 623 to 779 Euro per motorcycle. This leads to a benefit/cost- ratio between 1,11 and 1,39 in Austria (Winkelbauer, 2006).

Public acceptance

There is generally a high acceptance for safe motorcycles, and for safety systems such as ABS. However, the still high purchase price may hinder the acceptance of ABS for motorcycles. A tax reduction, mentioned in the Austrian study, can help to raise the acceptance of ABS for motorcycles.

Some experienced motorcyclists may have reluctance to accept driving with an ABS system (www.nhtsa.dot.gov, 2007).

Sustainable effects

The different studies do not indicate diminishing effects for ABS over time. When motorcycles have been equipped with Anti lock braking systems it will be active and working properly throughout the lifetime of the vehicle.

Transferable effects

The measure is transferable to other countries in Europe. At this moment ABS is not mandatory in countries in Europe.

References

Winkelbauer, M. (2006), Rosebud WP4 case report: anti lock braking systems for motorcycles. KFV, Austria.

Kramlich, T. & Sporner, A. (2000), Zusammenspiel aktiver und passiver Sicherheit bei Motorrad-kollisionen. GDV, Institut für Fahrzeugsicherheit. München.

National Agenda for Motorcycle Safety, available at http://www.nhtsa.dot.gov (website consulted on January 3, 2007).

Vavryn K., Winkelbauer M. (1998), Bremskraftregeverhalten von Motorradfahrern. KfV, Austria.

Vavryn K., Winkelbauer M. (2003), Bremsbedienung von Motorradfahrern mit und ohne ABS. KfV, Austria.

14 Blind spot measures

The blind spot of trucks can be reduced by installing a blind spot camera or blind spot mirror. This makes that vulnerable traffic participants, like cyclists, at the right side and in front of the truck can be seen better.

Since 2003 it is mandatory in the Netherlands for trucks to be equipped with a blind spot mirror or a blind spot camera. Since 2003, there is an EU directive for blind spot mirrors on new trucks and since 2007 there is also an EU directive for fitting blind-spot mirrors on existing trucks (retrofitting). It is expected that around 2017 90% of all the trucks in Europe will have this equipment.

Truck drivers who did not see vulnerable traffic participants at the right side or in front of the truck were in 2004 in the Netherlands responsible for 2.1% of all fatalities and 0.3 of all hospital injuries in traffic.

It is expected that 40% of this group of victims can be saved by installing blind spot equipment on trucks. In the Netherlands the effect was, at first, even more than 50%, but it is supposed that the publicity campaign and information were the cause of this extra reduction.

The given benefit/cost-ratios below were used in the Netherlands in 2001 to calculate the value of the introduction of these measures. At that moment 35% of the Dutch trucks were already equipped with blind spot equipment, so for 65% of the trucks (91,000) the costs for installation were calculated. A mirror costs 150 Euro (price level 2001) and a camera 900 Euro. Besides that, 0.5 million Euros is necessary for legislation and information.

Benefit/cost-ratio:

- Blind spot mirrors: 6,3
- Blind spot cameras: 1,7

References

Langeveld, P.M.M. & Schoon, C.C. (2004). Kosten-batenanalyse van maatregelen voor vrachtauto's en bedrijven. Maatregelen ter reductie van het aantal verkeersslachtoffers en schadegevallen. SWOV-rapport, R-2004-11. SWOV, Leidschendam, The Netherlands.

Transumo (in press). Verkeersveiligheid verkenner voor de regio (VVR-GIS), Deliverable D_A16. Transumo, Zoetermeer, The Netherlands.

15 Mandatory bicycle helmet wearing

This measure makes the wearing of bicycle helmets mandatory for all bicyclists. Bicycle helmets contain a thick layer of polystyrene which absorbs the force of an impact and can reduce the consequences of an accident (Rosebud, 2006). The target group of this measure is bicyclists who are currently not wearing a helmet. This is the huge majority of bicyclists in Austria (Winkelbauer, 2006).

62% of the Austrian population use a bicycle at least occasionally. Annually, about 60 (in 2003: 56) Austrians are killed as bicyclists in road traffic, about 1,800 (in 2003: 1,838) are severely injured and 4,000 slightly injured. A little less than 50% of the bicyclist injured in road traffic suffers head injuries.

Although the safety potential of cycle helmet is high and well documented, the helmet wearing rates are currently very low. Only among children a considerable share wears helmets (about 60%). The average helmet wearing rate in Austria is almost constant over the recent years, currently about 11% (Furian, Gruber, 2002).

Bicycle helmet wearing campaigns have been carried out successfully, particularly targeting school children, but the total wearing rates could not be raised to a desirable level neither among children nor among adults.

Concerning safety, three effects may be considered (Winkelbauer, 2006):

- Reduced likeliness of head injury
- Increased risk by risk compensation
- Reduced risk by reduced exposure.

Otto (2001) concludes that the total number of fatally and seriously injured bicycle riders would decline by 20% if all cyclists would wear helmets. The number of slight injuries would increase by 1%, since the number of slight head injuries protected by a helmet is lower than the number of fatal and severe injuries changed to slight ones.

The costs of the measure simply consisted of the costs for supplying bicycle riders with helmets. In the Austrian study is supposed that these costs were 20 or 40 Euro per helmet. Costs of the legal process (making the law) are not being considered.

The results in Austria in a benefit/cost-ratio of 2.3 (20 Euro helmet) or 1.1 (40 Euro helmet) when just road accidents are taken in consideration. If all accidents with bicycles are taken in consideration the benefit/cost-ratio would be 4.1 (20 Euro helmet) or 2.1 (40 Euro helmet).

When making helmet wearing mandatory for bicyclists, resistance can be expected from frequent bicycle users because it decreases comfort.

References

Winkelbauer, M. (2006), Rosebud WP4 case report: Compulsory bicycle helmet wearing. KFV, Austria.

Otte, D. (2001), Schutzwirkung von Radhelmen. Verkehrsunfallforschung. Medizinische Hochschule Hannover. Im Auftrage der Bundesanstalt für Straßenwesen. Bergisch Gladbach. Germany.

Furian G., Gruber M. (2002), Einstellungen zum Helmtragen, Verwendung von Radhelmen und Empfehlungen für die Zukunft. Institut Sicher Leben. Wien. Austria.

Rosebud (2006), Examples of assessed road safety measures – a short handbook – EU.

16 Contour marking

"Contour marking" means a conspicuity marking intended to indicate the horizontal and vertical dimensions (length, width and height) of a vehicle. Retro-reflecting contour marking can increase the perceptibility of the truck. These markings can, therefore, contribute towards reducing collisions of vehicles against the side or rear-end of trucks.

The problem is relatively small in terms of absolute size. There are approximately 1,800 side or rear end truck accidents a year, as a result of which there are about 9 road deaths and 83 in-patients (estimated numbers) in the Netherlands. The number of registered accidents is 576. It can be estimated for the Netherlands that, with a large-scale introduction of contour marking on trucks, approximately the following safety increase could be realised: two to three deaths less, twenty to thirty in-patients less, and several hundred accidents less. The total costs that will have to be made for the introduction of the measure, applied to all trucks, is estimated at 57 million Euros.

The result of the benefit-cost analysis is positive. The estimated benefit-cost ratio is to be regarded as modest: not much greater than 1, which is the critical value for a socially profitable measure. The cost-effectiveness, in comparison with other potential measures, is rather low.

With large-scale application, economic efficiency is an important criterion. There is not much support for aiming at large-scale or complete application; neither from the branch and interest organisations, nor from the government (de Niet et al., 2002).

The United Nations Economic Commission for Europe (UNECE) Regulation 104 sets out an international specification for retro reflective marking tape. Vehicles fitted with tape to this standard (and meeting all other relevant requirements) can be sold freely in UNECE countries. Another UNECE regulation (R48) sets out the requirements for the installation of lighting and light signaling devices on vehicles: this regulation currently allows (but does not mandate) the installation of conspicuity markings.

References

Niet, M. de, Goldenbeld, C. & Langeveld, P.M.M. (2002), Veiligheidseffecten van retro-reflecterende contourmarkering op vrachtauto's : verkenning van ongevalsgegevens, literatuur, kosten en baten en meningen van betrokken partijen. SWOV, Leidschendam, The Netherlands.

Recommendations

The impact of vehicle related safety measures will increase considerably if we are able to increase the penetration rate of vehicles equipped with e.g. ISA, DRL, ESC, side reflection or of vehicles that generated a high score in the EuroNCAP test. Furthermore it is important that the drivers actually use the system. ESC and Side reflection are activated automatically when implemented, but the other systems need to be activated by the driver when installed in the car. Finally it is also important to inform the driver how to use the system in an optimal way, thus guaranteeing optimal safety effects (e.g. with informative ISA).

Table 8 gives an overview of possible policy measures to increase the implementation rate and the usage of vehicle safety measures. For each policy measure it is indicated (+) which safety measures could benefit from applying it. In addition to table 8, possible policy recommendations are further elaborated for six selected vehicle safety measures.

Safety measure		Policy measure					
		Promotion of equipped vehicles	Recommendation by authorities	Financial incentives[1)]	Raise awareness	Regulation	Enforcement
4.1.1	Speed Alert (ISA)	+	+	+	+	+	+
	Blind spot mirror / camera	+	+	+	+	+	+
4.1.2	Electronic stability control (ESC)	+	+	+	+	+	
	Seat belt reminders	+				+	
	Under run protection					+	+
4.2.2	Daytime running lights (DRL)	+	+	+	+	+	+
	Contour marking					+	+
4.2.3	Alcolock	+		+		+	+
4.3.1	Obligatory bicycle helmet wearing	+				+	+
	ABS on motorcycles	+	+	+	+	+	
4.3.2	Bicycle side reflection + reflective garments	+	+			+	+
4.4.1	Euro NCAP (incl. pedestrian-friendly car fronts)	+	+	+	+		
	Event data recorders	+	+	+	+		

[1)] subsidy, fiscal/ insurance incentives

Table 8: Policy measures per safety measure.

ISA

Intelligent speed adaptation (ISA) is a measure that has proven safety effects. It is waiting for implementation on a large scale. What actually needs to be done before ISA will be used on a large scale?

First, detailed maps with the speed limits of the roads should become available. This can be done quite fast.

Secondly, the demand for ISA should be raised. Car manufacturers are not expected to promote ISA. Hence, they will not introduce it in their cars. This means that authorities should promote and/or regulate the introduction of ISA.

Thirdly, it is important to give incentives to drivers using ISA. They will only use ISA when it is regulated or there are financial benefits to the driver/owner of the vehicle (fiscal, or insurance premiums), because ISA limits the driver in its driving freedom. Strict enforcement of the speed limit will also help to increase the compliance rate – as drivers choose not to override or switch off the system.

DRL

The use of Daytime Running Lights (DRL) is obligatory in many European countries and the measure is easy transferable to other countries. Actually in most countries where DRL is not obligatory, already many drivers apply the measure without a supporting system or extra incentives – they choose to always drive with the lights on. To assure that all drivers use DRL awareness should be raised for this measure. Another possibility is that manufacturers install automatic DRL (cannot be switched off) on all new cars. The implementation of DRL should also encompass a program dealing with opposition against the measure. The opposition is based on hypotheses of adverse effects generated by the introduction of DRL:

- increased risk on several types of accidents (pedestrian, bicycle, motorcycle accidents and rear-end collisions), and
- increased fuel consumption.

ESC

Electronic stability control (ESC) can only be introduced by the car manufacturers. It is available (and purchased) in many new cars, except for smaller / less expensive models, for which the addition of ESC means a substantial raise in the purchase price. The only way to achieve higher penetration rates (up to 100% for new cars) is regulation by the government; this could be accompanied by financial incentives to car buyers and owners.

Promotion of this measure or raising awareness is not necessary because the driver does not have to know how ESC works, it works automatically.

Alcolock

Large scale quantitative research on alcohol ignition interlocks in use has shown that alcolocks are 40 to 95 percent more effective in preventing drink driving recidivism than traditional measures such as license withdrawal or fines. Since drink driving, and especially drink driving by recidivating offenders, is a proven risk factor, the Alcolock may have a beneficial impact on the number of traffic casualties due to drink driving. In Europe, the measure is currently only tested in pilot projects, so Alcolock programs can not really be regarded as a measure. From the evidence in the U.S., however, it appears that the Alcolock has the potential of becoming a best practice in the near future.

Bicycle side reflection

Bicycle side reflection is a low-cost measure that can be very effective in reducing accident risks of esp. vulnerable road users. The impact of the measure will be significant in countries where the bicycle constitutes a significant part in de modal choice. But also in countries with less frequent bicycle usage application of the measure will be very effective. To stimulate cyclist (and the government) to apply the measure, promotion and raising awareness is very important, especially in low bicycle usage countries. Cyclists should be made aware that improved visibility during night- and twilight time reduces the accident risk. Regulation and enforcement can also support the use of this measure. Other recommendations to further enhance the impact of the measure are:

- combination of side reflection with reflection markings on front and rear end of bicycles
- application of side and front reflection on ATB (All Terrain Bikes) and racing bikes
- reflective garment: application of reflection material e.g. in clothes (hat, jacket, trousers, shoes) to improve visibility of cyclists; this last measure can also be applied to pedestrians

EuroNCAP

Raising awareness under potential buyers of new cars and recommendation by the authorities can help to increase the impact of EuroNCAP on the safety of cars. Important is that potential buyers know that EuroNCAP exists and that it provides valuable information regarding the safety of a car.

The impact of EuroNCAP will increase if car manufacturers become aware of the role that the EuroNCAP score plays in the selection process of a new car. Vehicles will increasingly be tested on safety but, more important, as the test results have influence on their sales, car manufacturers will build safer cars.

Summary

This report describes a selection of best practice safety measures for vehicles. Many measures were identified, based on national and European sources. An overview of EU studies targeting vehicle measures was included.

The measures were grouped into four subcategories:

- Adaptations to vehicles incl. Driver Support Systems (passenger cars, vans and trucks)
- Prevention of unsafe participation in traffic (passenger cars, vans and trucks)
- Other modes (than passenger cars, vans and trucks)
- Other measures

From the complete list of vehicle measures, the potential best practice measures were selected. Firstly, information about measures was produced by the country experts in the questionnaires. Secondly, the measures were rated according to the following criteria:

- The measure has an effect on traffic safety, i.e. the number of accidents and accident victims has been reduced.
- The effects of the measure are evidence based, or
- Risk factors are expected to have been decreased by the measure.
- The measure is transferable.
- The measure has a benefit/cost ratio greater than 1.
- The measure is accepted by the various stakeholders.
- The measure has a sustainable (i.e. long term and positive) effect on traffic safety.

The first three criteria were the most important ones and should be met by all selected vehicle measures.

The thirteen selected measures were described in more detail along the selection criteria. Finally, recommendations were given on how the impact of the selected vehicle measures can be increased. For vehicle measures, this means increasing the rate of equipped vehicles (with the systems/ measures proposed), increasing the use of systems/measures, or optimising the way they are used. Per measure, appropriate policy measures were indicated.

Annex

17 Annex 1: Questions/input for the country survey

Questions for the country experts on vehicle measures:

8. Who, in your country, could be the responsible organization for the successful implementation of the vehicle measures? And what would be the role of the EC?
9. Do you consider the costs of introduction and enforcement of the vehicle measures to be a barrier to implementation? Which are the main barriers for each measure?
10. Do you think the implementation of the measures is complex (when it comes to organizational and legal aspects)? E.g. national vs. EU regulations, number of organizations involved, etc.
11. What would be specific selection criteria for adoption of a measure in your country?

18 Annex 2: List of all measures in the Vehicles category

Subcategory	Sub-subcategory	Measures
4.1 Adaptations to vehicles incl. Driver Support Systems	4.1.1 Active Safety	Reverse safety alert,
		Blind spot mirror,
		Rear view camera,
		Navigation systems
		Speed alert/speed limiter
		ESP / ESC
	4.1.2 Passive safety	Under run protection,
		Seatbelt reminders
		Whiplash protection
4.2 Prevention of unsafe participation in Traffic	4.2.1 Vehicle inspections	Roadside inspections (belongs to category 'Enforcement')
		Maintenance programs
		Yearly inspections
	4.2.2 Regulations	Hands free use of mobile phones
		Contour marking
		Enforcement of safe loading of trucks and vans

		Daytime Running Lights
		Winter tires
	4.2.3 Prevention of Drunk Driving	Alcohol lock
4.3 Other modes	4.3.1 Powered two-wheelers	ABS on motorcycles
		Prevention of illegal adaptations to mopeds,
		Moped licensing
		Mandatory motorcycle helmet wear-ing
	4.3.2 Bicycles	Mandatory bicycle helmet wearing
		Side reflectors
	4.3..3 Pedestrians	Reflectors at night-time
		Reflective garment
	4.3.4 Buses/coaches	Seatbelts on coaches,
		Rollover strength buses
		ESP
4.4 Other measures	4.4.1 EuroNCAP	Pedestrian friendly car fronts
		EuroNCAP assessment
	4.4.2 Event data recorders	Black box

Table 9: All vehicle measures.

19 Annex 3: Questionnaire

SUPREME: Best Practice Questionnaire

Category “Vehicles”

⇨ *TNO, Isabel Wilmink, Ben Immers*

Step 1: Selection of measure

Please select road safety measures from your country that are examples for very good - and possibly best - practice in road safety in Europe. **Best practice** refers to a road safety policy that is successful. A successful road safety measure is one that brings about a sustained **reduction in the number of road accidents and accident victims**, in particular fatalities and serious injuries.

Evaluation of measures and selection of best practice will be based on a list of criteria. Each measure you select will be assessed with an individual questionnaire, i.e. you fill out one questionnaire for each measure.

As different measures require different criteria, the questionnaire you fill out depends on the type of measure. At the end of this chapter you will find an overview of **categories** of safety measures, with examples of measures included in each of the categories. To open a questionnaire, please select the category for the measure you want to assess, and click on the link provided in the overview. There are two types of criteria: General description criteria (to be assessed for all measures, except for those in the categories “Statistics and In-depth analysis” and “Institutional Organization of Road Safety”), and specific description criteria (specific for measures in each category).

The questionnaire is organised as follows:

<u>Part 1</u>: The first part of each questionnaire contains questions on **background** information about the selected measure.

<u>Part 2</u>: General description criteria are assessed in the second part of the questionnaire. This part is identical for all measures in all categories. In some cases, not all criteria are applicable. In these cases, the criteria are marked “not relevant”, or may be marked as such by the respondent. General description criteria are:

- **Focus of the measure**: A clearly defined **road safety problem** that the measure is intended to solve.
- **Size of the road safety problem**: Quantitative assessment of the number of accidents, fatalities and severe injuries that the measure is expected to influence.
- **Expected effects on safety**: Quantitative assessment of the likely impact of the measure on accidents or accident-contributing risk factors.
- **Evaluation of effects**: Actual impact of the measure on accidents or accident-contributing risk factors.
- **Costs and benefits**: Assessment and comparison to alternative measures.
- **Acceptance**: Public, policy maker, and user / driver acceptance.
- **Sustainable effects**: Commitment to the continued use of the measure, long-term effects.

- **Transferability**: Applicability on a wider scale, within and across countries.

Part 3: Specific description criteria are assessed in part 3 of the questionnaire. This part is specific for each category, you will find more detailed information in the questionnaires.

Resume: Summary of why the measure is proposed as Best Practice.

Categories

4.1 Adaptations to vehicles (passenger cars / vans / heavy vehicles), including Driver Support Systems

4.1.1 Active safety (support in vehicle control)

4.1.2 Passive safety

4.2 Prevention of unsafe participation in traffic (passenger cars / vans / heavy vehicles)

4.2.1 Vehicle inspections

4.2.2 Regulations

4.2.3 Prevention of drunk driving

4.3 Other modes

4.3.1 powered two-wheelers

4.3.2 bicycles

4.3.3 pedestrians

4.3.4 buses / coaches

4.4 Other measures

4.4.1 EuroNCAP assessment

Step 2: Questionnaire

Part 1: General background information (all categories)

Name of the measure

- Please give the name of the measure as it is called in your country, and a common English name of the measure:

Classification of the measure

- This measure has been classified as:

[*the classification (selected in the first step) will be repeated here to make sure that the correct questionnaire is being filled out; the answer boxes for "OK" and "not OK" will be linked to the rest of the questionnaire and the classification grid, respectively*]

- This is: OK (continue questionnaire): ☐

  Not OK (return to classification grid): ☐

Description of the measure

- Please give a short description of the measure.

Can or should the measure be combined with other measures to optimise the impact? Which measures are these?

Information source and contacts

- Please give relevant references to the measure, e.g. web-sites or reports.
- Please give information about the institution / organization that is responsible for the measure, and contact information (name of the institution, e-mail, telephone number):

Implementation of the measure

- **When** was the measure implemented?
- **Status of implementation**: What is the current status (e.g. fully implemented, partly implemented, implementation under progress)?
- **Duration of the measure**: Is the measure implemented permanently / once or for periods / in intervals / as a pilot scheme / …?
- **Level and density of implementation**: At what level and in which density is the measure implemented (e.g. number of units on national / regional / local / … level?
- How long does it **take to implement** the measure (e.g. may be implemented immediately, in 5 years, long term)?

- When can (90% of the) effects be expected (e.g. immediately, in 5 years, long term)?

In which other European countries is the measure currently in use or available?

- Please give information, if available.

Who is responsible for the measure?

- Responsibility refers to implementation, enforcement, incentives to use the measure, and activities related to the measure.

  E.g.: Legal form of implementing body/bodies, international organisation, authority, industry, NGOs, others.

What is the legal background for implementation of the measure?

- Legal background includes laws, directives, norms, certificates, incentives, voluntary measures.

Part 2: General description criteria

In this part of the questionnaire, the safety measure will be assessed by 8 general description criteria. This part is identical for all categories.

If a criterion is not applicable to your measure, please answer ”not relevant”, and give a short explanation why the criterion is not applicable.

1. Focus of the measure

The focus of a safety measure is the **road safety problem** the measure is intended to solve. It may be a specific type of accident, a type or group of road users, or a type of accident location. Some measures may be more general.

What is the focus of the measure?

Please specify the focus of the measure in terms of **at least one** of the following aspects.

If the focus is a **combination** of factors (e.g. group of road users with specific type of accident), you can describe the focus under both aspects, or under the aspect that seems most important. (*If you are uncertain, it may be helpful to look at question “2. Size of the road safety problem”*).

- **Accident types**, specified by type of collision, condition under which the accident occurs, or type of vehicle involved in the accident:

  E.g.: Single accidents, side collisions, animal collisions, head-on-collisions, night time-accidents, accidents on wet roads, accidents involving heavy trucks, accidents in working zones.

- **Road users**, specified by personal or demographic characteristics (e.g. age, sex, length of licence ownership, car- or truck driver) or by certain types of behaviour (e.g. speeding, driving under influence, traffic violations):

E.g.: Children, inexperienced drivers, old people, drunk drivers, drivers not using seat belts, speeding drivers.

- **Accident locations**: Specified by road category, type of intersection, driving conditions, or other characteristics of accident locations.

  E.g.: highways, acceleration lanes, rural roads, urban areas, roundabouts, pedestrian crossings, roads or location with specific characteristics, slippery roads.

- **Vehicles**: Specified by adaptations to vehicles, prevention of unsafe participation in traffic, other modes/vehicle category, etc.

  E.g. adaptations to (the use of) heavy vehicles, passenger cars, mopeds, bicycles.

- **Unspecified** / **all accidents:** If a specific focus cannot be defined, please give a short explanation.

How does the measure affect accidents?

- Please describe the **mechanism** by which the measure has an impact on the specified focus. If available, please refer to relevant **theoretical background** or empirical **studies**.

  E.g.: Avoidance of skidding due to improvement of vehicle dynamics, reduction of exposure, improvement of skills, change of attitudes, decrease of impact (air bag).

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

2. Size of the road safety problem

In a first step we would like to know how large the focus of the measure is. In a second step we would like you to describe the risk of accidents, fatalities, and severe injuries within the focus of the measure.

How large is the focus of the measure?

Please give your assessment according to the specified focus of the measure. If a quantitative assessment is not possible, please give an estimation and explain the rationale.

- **Accidents**: If a type of accident is the focus of the measure, what is the **proportion** of the specified type of accident, relative to all accidents?

  E.g.: "X% of all accidents are head-on-collisions."

  E.g.: "X% of accidents occur on slippery roads."

- **Source/s** (Accidents): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **Road users**: If a type or group of road users is the focus of the measure, what is the **proportion** of the specified type of road users, relative to all road users. If possible, also include **exposure** data in your answer.

  E.g.: "X% of all driving license holders are over Y years old."

E.g.: "X% of all vehicle kilometres travelled (VKT) are driven by professional drivers of trucks over 20t."

E.g. "X% of road users do not use seat belts, exceed speed limits, are fined more than twice a year…."

- **Source/s** (Road users): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **Locations**: If a type or group of accident location is the focus of the measure, what is the **proportion** of this type of location relative to the whole road net (in terms of km or vehicle kilometres travelled), or relative to other variants of this type of location.

  E.g.: "X% of all roads in this country are rural roads."

  E.g.: "X% of all VKT are travelled on rural roads."

  E.g.: "X% of all motorway crossings are designed as cloverleaves."

- **Source/s** (Locations): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **Vehicles**: If the measure focuses on a specific group of vehicles (or how these vehicles are used), what is the proportion of the specified type of vehicle, relative to all vehicles. If possible, also include exposure data in your answer.

  E.g.: "in X% of all accidents, a heavy vehicle is involved."

  E.g. "the share of moped kilometres is X% of all kilometres travelled, while the share of moped accidents with fatalities/injuries is Y%"

  E.g. "X% of heavy vehicles is not equipped with blind spot mirror."

- **Source/s** (Vehicles): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **Unspecified focus / all accidents as focus of the measure**:

- **Source/s** (Unspecified focus): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

What is the accident risk within the focus of the measure?

The definition of accident risk varies, depending on the specified **focus:**

- **Accidents**: If a specific type of accidents is the focus of the measure, please give information about

  - the probability of the accident being **fatal**
  - the probability of the accident having **serious injuries** as a consequence.
  - If possible, relate these risks to **other** types of accidents.

  E.g.: "X% of all side-collisions are fatal, Y% of all side-collisions result in serious injuries. The risk of being fatal is Z times higher for side-collisions than it is for frontal collisions."

E.g.: "Night-time accidents have X times higher risk of being fatal than daytime accidents."

- **Source/s** (Accidents): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **<u>Road users</u>**: If a group of road users is the focus of the measure, please give information about

    - the probability of an **accident** within this group of road users,
    - the probability of a **fatal** accident within this group of road users,
    - the probability of a **severe injury** accident within this group of road users.
    - If possible, relate these risks to **other** groups of road users.

  E.g.: "The risk of being involved in a fatal accident for inexperienced drivers is X."

  E.g.: "Young and inexperienced drivers have X times higher risk of being involved in an accident than experienced drivers, who are aged over 20 and have minimum 2 years unrestricted driving licence."

  E.g.: "Professional drivers have X times higher risk of being involved in an accident due to sleepiness than non-professional drivers."

  E.g.: "Drivers not using hands free mobile phones have X times higher risk of being involved in an accident than drivers using hands free mobile phone."

- **Source/s** (Road users): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **<u>Locations</u>**: If a specific type accident location is the focus of the measure, please give information about

    - the probability of an **accident** at this type of accident location,
    - the probability of a **fatal** accident at this type of accident location,
    - the probability of a **severe injury** accident at this type of accident location.
    - If possible, relate these risks to **other** types of accident location.

  E.g.: "On ramps of grade-separated junctions without an acceleration lane, the accident risk is X accidents per million vehicle km travelled. The risk of a fatal accident is Y, and the risk of a severe injury accident is Z accidents per million vehicle km travelled."

  E.g.: "X% of all fatal accidents happen on rural roads in areas with low population density."

- **Source/s** (Locations): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

- **<u>Vehicles</u>**: If a group of vehicles is the focus of the measure, please give information about

    - the probability of an **accident** for this group of vehicles,

- the probability of a **fatal** accident for this group of vehicles,
- the probability of a **severe injury** accident for this group of vehicles.
- If possible, relate these risks to **other** groups of vehicles.

E.g.: "The risk of being involved in a fatal accident for trucks is X."

E.g.: "The risk of being involved in accidents is X times higher for moped riders than for cyclists."

- **Source/s** (Vehicles): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.
- **Unspecified focus / all accidents as focus of the measure**:
- **Source/s** (Unspecified focus): Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

3. Expected effects

Were the effects of the measure estimated before it was implemented?

- Yes or No? If yes, how and by whom where the effects estimated?
- **If yes**, what were the expected effects?
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.
- If effects where estimated, was this assessment **taken into account in decisions** concerning the measure?

4. Evaluation of effects

Evaluation of effects refers to the effects on numbers, types or proportions of **accidents**, **fatalities or severe injuries**, on **risk factors** that are known to contribute to accidents, and on **side effects** of the measure.

How does the measure affect accidents in terms of reduced numbers of accidents, fatalities or severe injuries?

- Please give information about the effects of the measure, preferably from **empirical studies**. If a quantitative assessment is not possible, please give an estimation and explain the rationale or the source of the estimation.
- Please give **background information** about the evaluation of effects of the measure on accidents, fatalities, and severe injuries. The summary should include
    - a description of how the effect has been **calculated** (e.g. accident counts, indirect measure),

- information about the **type of study** (e.g. accident analysis, accident statistics, observational studies, survey)
- information about the **design of the study** (e.g. control group, duration of before and after periods),
- If the measure is a **part of a larger measure**, if road safety effects were evaluated separately.
- Please also make a short comment on the **quality** of the study, especially about possible confounding factors.

E.g.: "Study X estimated a reduction of the total number of accidents in urban areas by Y%"

E.g.: "Based on the evaluation, X% of all accident fatalities are expected to be avoided by the measure. Y% of all fatal accidents will not be avoided but have less serious consequences (severe or light injuries), due to (…)"

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

How does the measure affect accidents in terms of reduced accident-contributing risk-factors?

- Please give information about effects of the measure on accident-contributing factors (e.g. changes in behaviour or attitudes, traffic offences, exposure, traffic conditions), preferably from **empirical studies**. The summary should include information about
  - the type of **contributing factor**, and why, how, and to what degree it contributes to accidents,
  - the **design** of the study (e.g. control group) and how the effect has been calculated, and a comment on the **quality** of the study, especially about possible confounding factors.
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Are any positive or negative side effects of the measure expected or witnessed?

- Side-effects can be expected or unintended. Unintended side effects include positive and negative effects on accidents or behaviour which are not specifically within the focus of the measure. Side effects also include those not directly related to traffic safety (i.e. health, environment). Please describe the side-effects and whether they were expected or not.
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

5. Costs and benefits

Please give a summary of the costs and benefits of the measure in your country.

The analysis may be based on empirical results or on estimations. If a quantitative assessment is not possible, please give an estimation and explain the rationale or the source of the estimation.

Please describe precisely, what types of costs / benefits you are referring to, how they are related to the measure, and how they have been computed.

What cost are associated with the measure?

- Costs in **financial** terms: e.g. investments, maintenance costs, enforcement costs, reward systems, administration costs, long-term costs (ecological or social costs). Please specify **type** and **amount** of financial costs associated with the measure.
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.
- **Who** bears the financial costs of the measure (e.g. user group, state government)?
- What **other types of costs** are there, for example ecological or social consequences, mobility, etc.?
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

What benefits are associated with the measure?

- Benefits in **financial** terms, e.g. cost savings. Benefits include financial effects of reduced accident costs. Please specify **type** and **amount** of financial benefits, and specify the exact figures used in the analysis (e.g. the economic value attached to a saved live).
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.
- What **other types of benefits** are there, for example environmental or social effects, and traffic performance?
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

What is the benefit-cost-ratio for the measure in your country?

- What **benefit-cost ratio** is associated with the measure? Please specify if the computed ratio is a benefit-cost-ratio or a cost- benefit-ratio.
- How has the benefit-cost ratio been **calculated**: Based on which types of costs, types of benefits, relevant actors, timeframe etc. has it been computed?
- At which **stage of the implementation** of the measure has the benefit-cost analysis been conducted (before, during or after implementation)?

- How do you judge the **quality** of the benefit-cost analysis (e.g. if the effect is likely to be over- or underestimated, consideration of confounding factors)?

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Has the benefit-cost-ratio of this measure been compared to the benefit-cost-ratio for other measures aiming at reducing accidents within the same focus?

- If so, please give the benefit-cost-ratio for these measures.

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

6. Acceptance

Acceptance of the measure includes **public acceptance**, **acceptance by road users, policy makers,** and **other stakeholders (e.g. automotive industry)**. It is related to attitudes and behavioural consequences of the measure, especially to willingness to apply the measure, or to comply. Other relevant issues can be political, legal, financial, technical and administrative aspects.

To what degree is there acceptance for the measure?

- If possible refer to empirical quantitative or qualitative **studies**. Information about public acceptance may be based on surveys, media, consumer and / or behaviour studies, decision-making processes (e.g. in parliament). Please include information about the type and design of the study. In the absence of such a study, what is the perceived level of acceptance of the measure?

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Has acceptance been taken into account in the planning and implementation process?

- At which stages of implementation (before, during or after) has acceptance been measured? Has there been public participation in the planning / implementation process?

7. Sustainability

Sustainability includes **long-term effects** and **changes of effects** over time. Effects are considered to be sustainable when the effect is permanent and does not decrease over time.

To what degree are the effects of the measure expected to be sustainable?

- The assessment can be quantitative or stated in qualitative terms. It can be based on
    - a **study** of earlier similar measures: if so, please provide a short description and source,
    - a scientific **analysis**: if so, please provide a short description of the scientific basis, or
    - an assessment of **contributing factors** (factors necessary to achieve and maintain the effectiveness) to its effectiveness (e.g. commitment to make use of the measure, requirement of police enforcement, skill improvement, risk compensation, exposure effects, public support, quality assurance, continuous monitoring).
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

8. Transferability

Transferability includes prospects for using the measure successfully in other **countries** or **regions**, or on a **larger scale**.

To what degree is the measure transferable?

- If available, refer to studies of the measure in other countries, explicit comparison with other countries, and publications about the measure in other countries.
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Which factors contribute to the transferability of the measure?

- Contributing factors include **conditions for the effectiveness** of the measure in other countries or regions, or on a larger scale, and **specific requirements** necessary which may be difficult to fulfil elsewhere.

  E.g.: “The measure can only be expected to be effective if it is combined with enforcement”

  E.g.: “The effects of the measure within the focus are expected to be larger if measure Y is also implemented”
- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Which factors limit the transferability of the measure?

- Limiting factors include potential **obstacles** for the effectiveness of the measure in other countries or regions, or on a larger scale.

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

To what degree can the measure be effective for types of accidents, groups of road users, or accident locations, other than those specified as the focus of the measure?

- **Source/s**: Please make clear whether the information is based on: empirical evidence (published / unpublished), expert opinion, own considerations etc. In case of published studies, please give full reference.

Resume

Why should the measure be included in the list of best-practice road safety measures in Europe?

- Please give a short statement about what qualifies the measure as “Best Practice” in Europe.