

DEKRA

ROAD SAFETY REPORT 2017

Best Practices

Steps towards making Vision Zero
a global reality



Vehicle technology:
Elements of active and
integral safety offer
enormous potential for
preventing accidents

The human factor:
Improve road safety
through responsible
behavior and acceptance
of rules

Infrastructure:
Eliminate factors that contribute
to accidents by implementing
road construction and traffic
management measures



Safety is not wizardry. DEKRA child caps.

To be seen on their way to school, your children have to attract attention: To make sure they are better noticed in traffic, DEKRA in Germany is once again distributing bright red, reflecting children caps. You will find more information at www.dekra.de

www.dekra.de



On the safe side.



Best Practice for Fewer Road Casualties Worldwide

The figures for Germany sound encouraging: Following an increase in the number of traffic fatalities in 2014 and 2015 compared with previous years, 2016 once again saw a decrease in the number of people killed on our roads. According to the Federal Statistical Office, the figure of around 3,200 fatalities represents a decline of 7.3% compared with 2015 and is also the lowest this figure has been for more than 60 years. Given that the total number of accidents recorded by the police has risen by more than 3% to 2.6 million and that the total mileage covered by motor vehicles has once again increased, these figures are certainly heartening.

But there are some less pleasing developments, too. In France, for example, the number of traffic fatalities in 2016 has, according to the Observatoire national interministériel de la sécurité routière (ONISR), risen for the third year in succession – even if by only 0.2% from 3,461 to 3,469. And in the USA, to give another example, the National Safety Council estimated a rise in the number of traffic fatalities in 2016 to more than 40,000. Back in 2015, the USA saw a 7.5% increase.

Given that every traffic fatality is one too many, improving road safety remains one of the greatest challenges our society faces – and this applies all the more when you look at the scale of the problem not on a country-by-country basis, but globally. After all, according to the World Health Organization (WHO), around 1.25 million people are killed in road traffic accidents every year, all over the world, and this figure has for many years stagnated at this high level.

It is more important than ever that we look at ways of countering these trends efficiently and over the long term in order to

finally bring about a significant improvement in the situation. The current DEKRA Road Safety Report aims to make its own contribution here, too. Unlike previous reports, this report does not focus on a specific mode of transport or road user group. Instead, we are focusing on “best practices” – an approach that has been applied in the study of road safety for many years now.



Dipl.-Ing. Clemens Klinke, member of the DEKRA SE Management Board and head of the DEKRA Automotive business unit

We examine three key areas – humans, infrastructure and vehicle technology – to highlight measures that have proven successful in certain regions of the world and could potentially be applied in other regions, too – provided that the right conditions are in place and the cost-benefit ratio is justifiable. Wherever possible, we back up our “best practice” examples with meaningful figures demonstrating that the measures described really have resulted in fewer accidents, fatalities and injuries. Furthermore, we have once again managed to obtain contributions from renowned national and international experts in which they discuss, among other things, road safety measures, experiences and initiatives in their own countries or in a specific region of the world.

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The web portal: www.dekra-roadsafety.com



Since 2008, DEKRA has been publishing the annual European Road Safety Report in printed form in several languages. Coinciding with the publication of the DEKRA Road Safety Report 2016, the web portal www.dekra-roadsafety.com went online. There you can find additional content to the printed report (e.g. in the form of moving images or interactive graphics). The portal also covers a range of other topics and DEKRA activities concerning road safety. You can make the link from reading the printed version to the web portal by scanning the QR codes printed on the relevant pages, using your tablet or smartphone.

Scan the code using an ordinary QR code reader and you will be taken directly to the corresponding content.

COMPANY DETAILS DEKRA Road Safety Report 2017 – Best Practices

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Mobilized for Greater Safety

Germany is more mobile than ever before. Every day, we Germans undertake around 280 million trips and journeys, covering more than three billion kilometers in the process.

One thing is clear: Mobility comes with responsibilities. As motorists, motorcyclists, cyclists and pedestrians, we all play our part in what happens on the roads every day and, in turn, define how safe our roads are. As such, road safety is the responsibility of all of us. Thanks to its many years of expertise, its road safety campaigns and the millions of vehicle inspections it conducts every year, DEKRA plays an indispensable role, for which I am enormously grateful.

We in the government have launched a comprehensive road safety program with the clear aim of significantly reducing the number of road accidents in Germany. And according to our mid-term review, we are well on the way to achieving this. The challenge now is to keep up the good work. To ensure this, we are focusing on three key fields of action:

1. Safety through target-group-specific information: At the heart of our road safety measures are people, which is why we are investing more than ever in education and information campaigns like “Runter vom Gas” (“Ease off the gas”), which alerts people to the dangers of excessive speed, and other projects aimed at improving road safety and cutting the number of road accidents. With a range of programs aimed at different age and road user groups like “Kind und Verkehr” (children), “sicher mobil” (senior citizens), “Aktion Junge Fahrer” (young drivers) and “Fahrrad ... aber sicher” (cyclists), we talk to road users in a language they understand and raise their awareness of all aspects of road safety. We focus on active education right from the outset, for example with the popular Käpt´n Blaubär road safety guide for the very youngest among us.

2. Safety through state-of-the-art infrastructure:

During this legislative period, we have given our infrastructure a major upgrade and are investing record amounts. After all, the only safe infrastructure is state-of-the-art infrastructure.

Digitalization offers whole new opportunities here. To leverage the potential of an intelligent and fully digitalized road network, we are already trialling the necessary innovations on the “Digital Highway Test Track” on the A9 in Bavaria, including in particular new traffic management concepts and radar sensor systems for real-time communication between vehicles and the infrastructure.

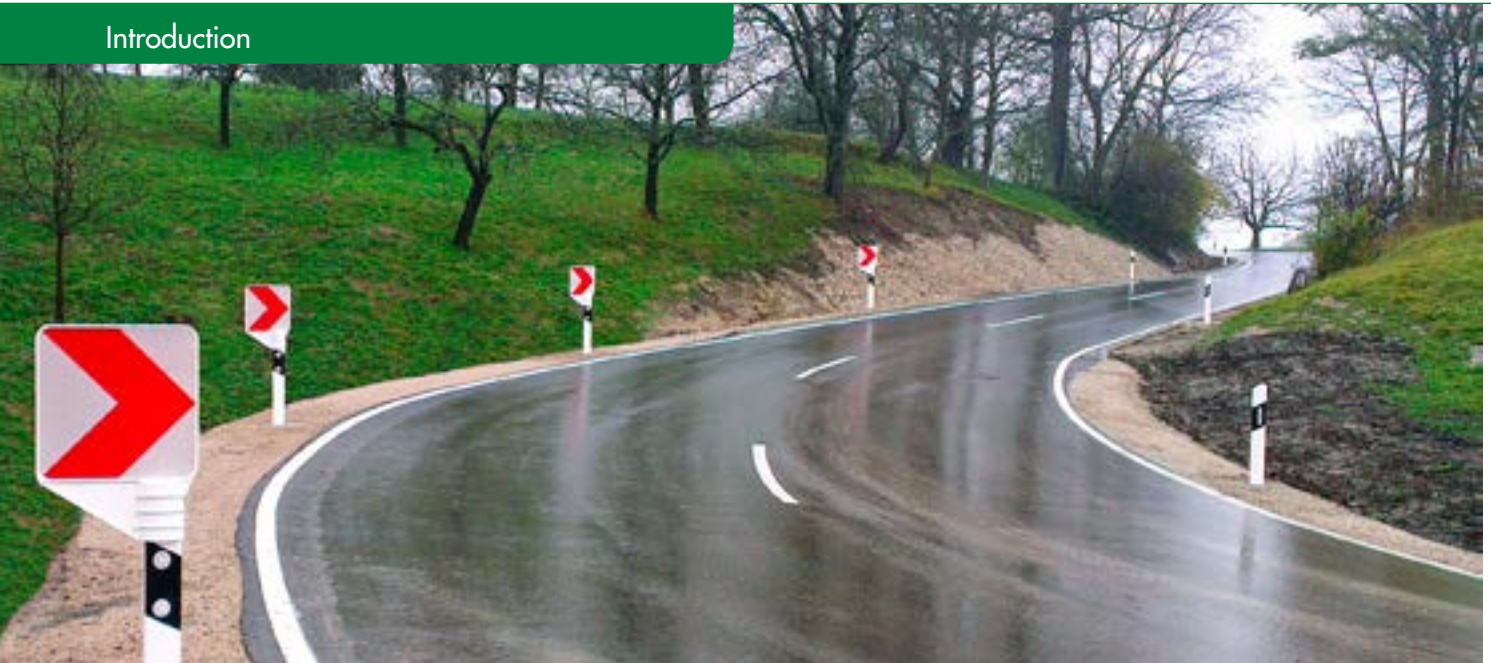
3. Safety through advanced vehicle technology:

Automated driving offers tremendous potential for significantly reducing the number of road accidents. Today, more than 90% of all accidents can be attributed to human error. Automated functions will relieve drivers of much of the driving workload and significantly reduce critical traffic situations. The shift toward automated, networked driving not only constitutes the biggest revolution in mobility since the invention of the motor car, but also offers massive safety benefits.

I am certain that, together with our strong partners, we can realize our vision of greater mobility and fewer accidents in the future, too. The DEKRA Road Safety Report highlights real-life achievements and is thus an invaluable resource. I hope you enjoy reading it!



*Alexander Dobrindt MdB
German Federal Minister of Transport and Digital Infrastructure*



Lead by Example

Considering that the number of traffic deaths worldwide every year remains, according to the World Health Organization (WHO), at around 1.25 million, work aimed at improving road safety is now a global challenge. A “best practice” approach could be the key to countering these trends over the long term. Specifically, this means applying measures that, whether in the field of vehicle technology, infrastructure or traffic education, have proven successful elsewhere and could potentially serve as a particularly effective model for reducing the number of road traffic fatalities and injuries in other regions of the world.

Whether an accident resulting in fatalities, injuries or material damage involves cars, trucks, motorized two-wheelers, cyclists or pedestrians, the question of the cause(s) inevitably arises and, ultimately, of how the accident could have been avoided in the first place. Was it human error such as inattention, excessive speed or driving under the influence of alcohol? Did one of the vehicles have a serious technical defect such as worn tires, chassis problems or defective brakes? Did the otherwise so helpful assistance systems fail to do their job properly? Was the road surface in poor condition? Or was visibility low? The list of potential causes is long.

BEST PRACTICE



Reducing the speed on a highway-like main road led to a significant reduction in the number of accidents.

Regardless of what ultimately caused the accident, the challenge is to introduce efficient measures aimed at preventing accidents from occurring in the first place. And this does not always have to mean reinventing the wheel. In fact, very often it can make sense to take a “best practice” approach and adopt methods and measures that have either proven successful elsewhere or that are so plausible in themselves that there can be no doubt as to their long-term effectiveness. This report presents a selection of such examples.

The term “best practice” originates from the English-speaking world of business administration and describes exemplary, tried-and-tested meth-

Milestones on the road toward greater mobility and road safety

1881 Jaromír Freiherr von Mundy founds the “Wiener Freiwillige Rettungsgesellschaft.” (Vienna Volunteer Rescue Society)

1926 Accident statistics are published for the first time in the UK.

1950 Germany implements its first accident prevention measures.



1951 The Bundesanstalt für Straßenbau (BASt) is founded; it is renamed in 1965 as the Bundesanstalt für Straßenwesen (German Federal Highway Research Institute).



1880

1920

1950

1952

ods, practices and procedures within companies. Over time, the term came to be used in many other areas, too, and has taken on the more general meaning of “best-possible method” or “method for success.” For a method to be considered “best practice”, it must be supported by meaningful figures – in the context of road safety, for example, this means that specific measures must have demonstrably resulted in fewer accidents, fatalities and injuries and lower consequential costs. It is essential here that the measures in question are planned, implemented and evaluated at a local level.

SUCCESSFUL APPROACHES

A good example of this can be found in Baden-Württemberg: On the highway-like main road 27 between Balingen and the Tübingen district boundary, and in the other direction from Hechingen to Balingen, the local traffic authorities had in spring 2015 imposed a general speed limit of 120 km/h in response to the above-average number of sometimes serious accidents caused by excessive speed. The impact of the speed limit imposed along this stretch of road was then carefully monitored and statistically recorded. According to an analysis by the police, the number of accidents in the period from April 1, 2015 to the end of 2015 fell by 48% compared with the same period in the previous year. The number of people suffering injuries fell by more than 60%.

Another example, this time from Hesse: The “Kempinski intersection” between Neu-Isenburg and Dietzenbach was long considered to be an accident blackspot. To improve the situation here, the police recorded and analyzed the accidents at this intersection of main road 459 and country road 3117 using the electronic accident type map (EUS-ka). This analysis resulted in the recommendation, implemented in 2012, to install traffic lights. The

EU Project: “SafetyCube”

The costs and benefits – and other characteristics – of road safety measures should be systematically comparable across Europe.

The EU continues to pursue its ambitious goal of halving, by 2020, the number of traffic fatalities on Europe’s roads in comparison with the figures for 2010. To achieve this, the EU has already launched numerous projects and initiatives. One of these is the “SafetyCube” project, which is set to run until 2018, is financed as part of “Horizont 2020” (“Mobility for Growth”) and comprises a consortium of 17 European partners, including – in addition to DEKRA – the Vehicle Safety Research Centre at the University of Loughborough (UK), Belgian Road Safety Institute, Dutch Institute for Road Safety Research (SWOV), Road Safety Board (Austria), Institute of Transport Economics (Norway), SAFER Vehicle and Traffic Safety Centre (Sweden), French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR), Center for Transportation and Logistics at the University of Rome (Italy) and the Hannover Medical School.

“SafetyCube” aims to specifically promote the selection and implementation of strategies and measures with regard to humans, infrastructure and vehicle technology in order to reduce the number of accidents in Europe and worldwide. The project involves comprehensive analyses of accident risks and will provide guidelines for registering and following up serious road

accidents. The project also aims to use these analyses to assess the extent to which road safety measures contribute to safety, calculate the consequential socioeconomic costs of accidents resulting in serious injuries and perform cost-benefit analyses.

This project will result in a tool (decision support system) designed to help decision-makers to choose the most efficient measures to combat the most urgent road safety problems, with a special focus on vulnerable road users – that is, pedestrians, cyclists, the elderly, children and persons with reduced mobility. And not without reason, because this group still accounts for more than 50% of traffic fatalities EU-wide. More information: www.safetycube-project.eu.



1951 In collaboration with Indiana State Police, accident researchers led by engineer Hugh de Haven start conducting detailed analyses of car accidents in the USA.

1954 German road accident statistics



1956 The world’s first mobile traffic radar unit is deployed for speed monitoring.

1957 A 50 km/h speed limit is reintroduced in urban areas in Germany on September 1.

1960 A coordinated rescue service is introduced in Germany.



1954

1956

1958

1960

BEST PRACTICE 
Reducing the speed limit along a particularly hazardous section of the “route nationale” helped to reduce the number of traffic fatalities.

result? According to an analysis by the police, the number of accidents in the period from August 1, 2013 to the end of 2013 fell by 75% compared with the same period in the previous year. The number of people suffering minor injuries even fell by 100%, from 7 to 0. Since 2014, the intersection has no longer been considered an accident blackspot.



Another example from France: On August 1, 2015, the speed limit along a 36-kilometer stretch of the hazardous “route nationale” 151 between Auxerre and Varzy was reduced from 90 km/h to 80 km/h. This measure is part of a comprehensive road safety plan launched by the French government and is scheduled to run until August 1, 2017 so that the effectiveness of this reduced speed limit can be examined. Between 2005 and 2015, 18 people were killed along this stretch of road; following the introduction of this measure, only one fatal accident was recorded in the period up to the start of 2017.

EU-COMMISSIONED SUPREME STUDY IDENTIFIED EXEMPLARY MEASURES FOR ENHANCED ROAD SAFETY

“Best practice” formed the content of a project commissioned some years ago by the European Commission’s Directorate-General of Energy and Transport. The project, which was entitled SUPREME (Summary and Publication of Best Practices in Road Safety in the Member States), ran from December 2005 to June 2007 and was headed by the Vienna-based Road Safety Board (KfV). Other project participants included renowned institutions such as the WHO, European Transport Safety Council (ETSC), German Road Safety Council (DVR), French National Institute for Transport and Safety Research (INRETS), Dutch Institute for Road Safety Research (SWOV), Swedish National Road and Transport Research Institute, and many more.

The aim of SUPREME was to collect, analyze, summarize and publish tried-and-tested road safety procedures from EU member states as well as Switzerland and Norway and, in so doing, encourage political representatives and decision-makers in Europe to apply, where and according to the extent necessary, successful, tried-and-tested strategies and measures to their own road safety efforts.

The measures were divided into specialist areas: institutional organization of road safety; road infrastructure; vehicles and safety systems; traffic education and road safety campaigns; driver training; enforcement of traffic regulations; rehabilitation and diagnostics; post-accident support and assistance; and road safety data and its acquisition. Requirements for classifying a measure as a “best practice” included scientific proof of a positive impact on road safety; a good cost-benefit ratio; long-term positive effects; public acceptance; and good transferability to other countries.

However, it quickly became clear these criteria were too narrow. Regarding the effectiveness and cost-benefit ratios of the measures, either no data was unavailable, or the data that was available was not reliable enough. In addition, some measures that were generally recognized as effective either were not specified at all or could not be researched in sufficient detail due to time constraints.

This is why a second step was introduced with the aim of not only re-evaluating measures that originally fell only narrowly short of meeting the “best practice” criteria, but also integrating measures that were not addressed in the original study. This resulted in two additional rating levels: first, “good practice”, which covers measures whose available data on effectiveness is not entirely to the satisfaction of the evaluator, but that are nonetheless based on a solid scientific foundation; second, “promising practice”.



■ *The SUPREME study provided recommendations for promising measures designed to improve road safety.*



1964 “Lex Zebra” introduced in Germany to protect vulnerable road users. At these specially designated sections of the road, motorists are required to allow pedestrians to cross.

1964 Luigi Locati writes a summary of vehicle safety in which the distinction was made for the first time between active safety [sicurezza attiva] and passive safety [sicurezza passiva].

1966 US President Lyndon B. Johnson signs the National Traffic and Motor Vehicle Safety Act and the Highway Safety Act.



which covers measures that are also based on a solid scientific foundation, but whose effectiveness has not yet been sufficiently demonstrated.

On this basis, SUPREME ultimately recommended 25 “best practice” measures, 21 “good practice” measures and 10 “promising practice” measures and initiatives, including many that have been covered in the DEKRA Road Safety Reports, the first of which appeared in 2008. These measures and initiatives include “Vision Zero”; measures to prevent collisions with trees; intelligent regulation of speed limits; automatic speed monitoring; targeted seatbelt reminder checks; alcohol immobilizers; driving-related psychological assessments for drivers who have been caught drunk-driving; corridors for emergency vehicle access in traffic jams; safety training; public information campaigns; and many more.

“BEST PRACTICES” AT A BUSINESS LEVEL

Another project based on the “best practice” principle is PRAISE (Preventing Road Accidents and Injuries for the Safety of Employees), which was launched in 2010 and is funded by the EU. This project, which is coordinated by the European Transport Safety Council (ETSC) and German Road Safety Council (DVR), calls upon companies, authorities and institutions across Europe to submit their ideas for improving road safety. The best contributions are presented during an international ceremony and receive the PRAISE award in the categories “Small-Medium Enterprise”, “Large company” and “Public authority.” Among

Emmanuel Barbe

Inter-Ministerial Delegate for Road Safety



Efficient Measures to Protect Lives

Road safety policy is frequently cited as an example of successful state policy. Indeed, the number of traffic fatalities on France’s roads has fallen by 80% since 1972, when 18,034 fatalities were recorded. From the mandatory wearing of safety belts (initially on the front seats, but then later on the back seats, too) and the mandatory wearing of helmets on motorbikes, through stricter speed limits, lower blood alcohol limits and automatic controls, to the introduction of a points-based driving license system – the past 45 years have seen the implementation of numerous measures that have provided our country with comprehensive and solid legislation, even if there is always room for improvement.

Given the unacceptable 3,469 traffic fatalities last year and the rise in this number since 2014, new measures that take into account social developments and explain a largely Europe-wide phenomenon had to be implemented. This was the guiding principle behind the 26 measures envisaged in the road safety action plan, which was introduced on January 26, 2015 by the Minister of the Interior and, on October 2, 2015, was expanded to include an additional 55 decisions agreed upon by the Inter-Ministerial Committee for Road Safety.

More than two thirds of these 81 measures – 55, to be precise – have already been implemented or launched. They represent a comprehensive and

decisive response to the accidents that occur on our roads today, the majority of which are still due to risk behavior: excessive speed; driving while under the influence of alcohol or drugs; inattentiveness; and noncompliance with the basic rules of the road.

While all of these measures are important, I consider some to be especially important.

- In the future, companies will be required to state which driver of a company vehicle is guilty of a road traffic violation. This law not only eliminates an area of serious inequity among road users, but also ensures that companies are no longer spaces in which compliance or noncompliance with the rules of the road and, in turn, road safety are at the discretion of the employer – at the expense of employees and all other road users.

- Dummy speed cameras are erected; in the future, companies will be allowed to equip their vehicles with radar units; the identification of road traffic violations using radar units or “vidéo-verbalisation” – that is, the recording of traffic offenses with the help of surveillance cameras – will be allowed in the future. This will help us to counteract more effectively new IT innovations designed to avoid radar and police checks, bring about further reductions in average speed and clamp down on the use of cellphones and text messaging at the wheel – an especially dangerous habit in road traffic.



1966

1967 The “Leber Plan”, named for Minister of Transport Georg Leber, introduces the mandatory wearing of safety belts in Germany, although this is not introduced in practice until, in 1974, it becomes mandatory for all new cars and light-duty trucks to be equipped with safety belts and, later, in 1984, fines are introduced for the non-wearing of mandatory safety belts on the front seats of cars.



1968

1969 The German Road Safety Council (DVR) is founded.



1970



■ Police Road Checks in Brazil

other things, processes and initiatives for improving road safety that have already been launched are considered for the award. Applicants must demonstrate that they have defined and are monitoring specific targets and that specific measures have led to a demonstrable reduction in the number of accidents, injuries and vehicle damage in the company.

The PRAISE award shows just how important road safety has become at all levels. In 2014, for example, the award in the “Large company” category went to the Danish transport company Arriva. Arriva installs alcohol immobilizers in all new buses and works closely with the Danish Cyclists’ Federation on solutions aimed at avoiding accidents in which cyclists are struck by car doors. In 2014, the PRAISE award in the “Small-Medium Enterprise” category went to the Dutch logistics and distribution company Bolk. Numerous individual mea-

asures – including vision aids for truck drivers, tire pressure monitoring systems and the installation of alcohol immobilizers – contributed to an overall package supported by ongoing training measures. In 2015, the British pharmaceutical company AstraZeneca received the award for its regular, in-house road safety campaigns as well as a concept that provides telematics support for the most at-risk drivers in the company. Another award went to the Luxembourg police force, which provides special driving safety training courses for the emergency services and equips company cars with crash event data recorders.

COST-EFFECTIVENESS ANALYSES

As this report explains in detail in the following chapters, numerous approaches to improving road safety can be taken. But where can the limited

1971 The first international conferences for sharing research findings regarding the development, construction and trialling of experimental safety vehicles (ESVs) take place.

1973 In his New Year’s address, Finland’s president Urho Kekkonen appeals for improved road safety.



1973 At Hannover Medical School, the BAST launches the “Accident Scene Studies” project (the predecessor of the “German In-Depth Accident Study” [GIDAS]).



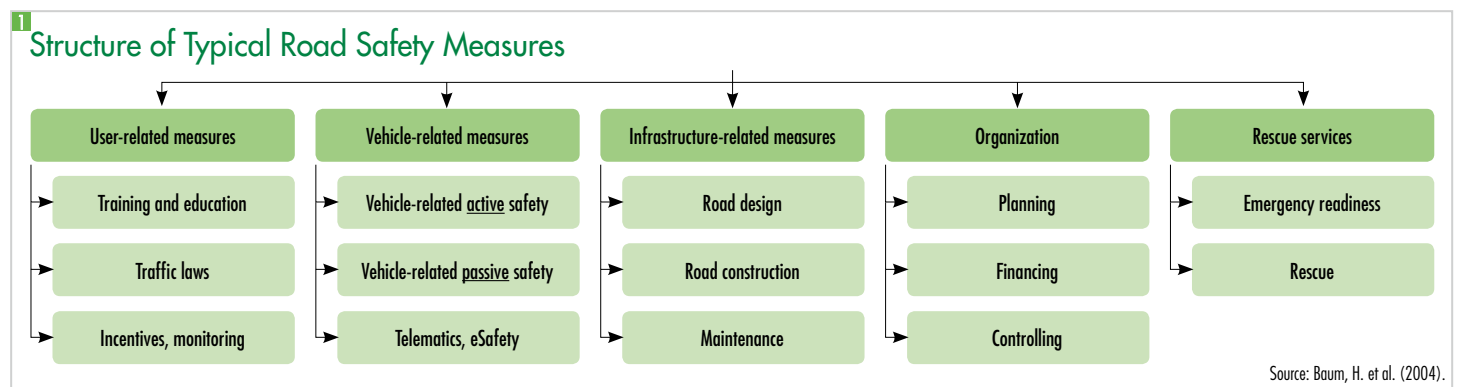
1973 The government’s first road safety program (VSP) is submitted in November to the German Bundestag.

financial and human resources be invested most effectively? In training measures for road users? In vehicle technology? In the road infrastructure? What resources are needed for organizational measures and planning? What investments need to be made in our rescue services? How can we assess the benefits of these measures? What is the value of a life saved? How much does one kilometer of a traffic jam cost? What additional benefits in terms of safety both on and off the road does one extra response vehicle generate? Generalizations are not constructive in answering these questions. The bodies responsible instead have to ask themselves, for example, in what geographical area the measures are effective; what the current situation is; how durable the measures are expected to be; how accidents can be avoided or their severity reduced; how measures are influenced by other measures; and how the measures affect non-traffic-related aspects.

In ROSEBUD (Road Safety and Environmental Benefit-Cost and Cost-Effectiveness Analyses used for Decision Making), a thematic network initiated by the European Commission as part of a research project, a procedure for conducting cost-effectiveness analyses and that can be applied at any administrative level to evaluate road safety measures was developed and trialled on concrete examples. The

project ultimately provided an overview of how different road safety measures can be evaluated in economic terms; which methodical principles can be applied here; what essential data needs to be made available to evaluators; and what obstacles to conducting evaluations might occur. The project revealed some interesting and sometimes considerable discrepancies between the effectiveness and benefits of certain measures, depending on region-specific circumstances. Or, in other words, introducing tried-and-tested methods to improve road safety does not necessarily always lead to quantitatively equivalent improvements in the situation at hand.

Overall, the tools developed as part of the ROSEBUD project help the bodies responsible to prioritize the effectiveness of different measures to increase road safety under consideration of local factors, to conceptualize and implement these measures and, subsequently, to evaluate them by conducting a “before/after” comparison. The results show that many of the measures offer considerable potential benefits, thereby underscoring the macroeconomic legitimacy of road safety policy. In addition to political framework conditions, existing holistic concepts and ethical aspects, the study provides sound parameters for decision-making processes (Figure 1).



1977 DEKRA publishes its first journal, “Technische Mängel an Kraftfahrzeugen” [Technical Defects on Motor Vehicles].



1978 The “Children and Traffic” program initiated by the German Road Safety Council (DVR) is launched.



■ In 2016, 25,500 people died on EU roads – that’s 2% fewer than in 2015

POLICE ACCIDENT DATA IS IMPORTANT FOR PREVENTIVE MEASURES

When it comes to evaluating measures to improve road safety, the problem time and time again is a lack of information on the effectiveness of a measure. This depends, among other things, on how the police record accidents. In Germany, for example, the register of accident causes introduced in 1975 distinguishes between “human error” and “general causes.” At the scene of an accident, a police officer might record up to two general causes. For the first person involved (i.e. the main perpetrator) and a second person involved, in each case up to three pieces of information can be provided. For each accident, therefore, up to eight separate causes can be recorded. However, this information is used mainly for an initial assessment of the situation. In case of doubt, the legal apportionment of blame will occur later in court. A police accident report containing all the most important information on the accident is usually prepared within 24 hours of the accident occurring. The report is usually amended only if either any persons involved in the accident later die from their injuries or once hospital staff has measured the blood alcohol of persons involved.

BEST PRACTICE 
Accident commissions are an integral part of the overall approach to improving road safety.

Additional information – such as technical defects that caused the accident and that were ascertained from expert appraisals of an accident reconstruction – is entered in a completed police accident reports only in exceptional cases. On top of this, technical defects in vehicles at the scene of an accident are difficult to spot for police officers and any experts called to the scene to identify because they are often apparent only once the vehicle has been stripped down to its component parts. It is also often the case that the causes recorded in many police accident reports are very vague – for example, “inappropriate speed” or “driver error.” Such information is not sufficiently useful for objectively clarifying all the circumstances that led to an accident and therefore of limited use in formulating long-term preventive measures.

ACCIDENT COMMISSIONS ARE ESSENTIAL TOOLS

To shine additional light onto the causes of road accidents and explore ways of eliminating accident blackspots, local “accident commissions” have established themselves as important regional institutions in Germany. They are convened locally – usually at district level – and are essentially made up of specially trained representatives of the police, road traffic and road construction authorities. When recording accidents, the police collect statistical data, evaluate it and, if necessary, monitor the measures. It is the job of the traffic authorities to introduce signage and road markings, and the construction authorities are responsible for ensuring that the necessary construction-related measures are implemented.

The police, road traffic and road construction authorities together look at why accidents keep occurring at certain spots or along certain stretches of road. Perhaps the curve radius is too small; perhaps the signage needs to be improved; or perhaps

1984 Minister of Transport Werner Dollinger presents the government’s second road safety program.



1988 The International Traffic Safety Data and Analysis Group (IRTAD) is founded.



the traffic light phases need to be reconfigured. The experts propose targeted remedial measures – such as structural modifications or changes to the traffic regulations – that could potentially prevent serious accidents in the future. Accident commissions also need to ensure that the agreed measures are implemented and their effectiveness is monitored.

As stated in an article published by the German Road Safety Council (DVR) in 2009 about the importance of accident commissions, the two documents “Analysis of Road Accidents” and “Measures to Eliminate Accident Blackspots” published by the Road and Transportation Research Association (FGSV) were, and remain, decisive. The fact that the federal states use these documents as a basis for their accident prevention ordinances is thanks primarily to the findings and engagement of the General Association of the German Insurance Industry (GDV).

ACCIDENT STATISTICS AND DATABASES ARE KEY INFORMATION SOURCES

The fact is that when it comes to evaluating road safety and implementing appropriate optimization measures, real-life accident data plays a key role. For accident researchers in Germany, for example, the detailed accident statistics published by the Federal Statistical Office are an invaluable source of data. They highlight the most important aspects of accident situations, from which the current need for action can always be derived. Successful measures aimed at improving vehicle and road safety are also reflected in historical changes observed in “long-term series” of selected accident data, where the effects of multiple measures can be mutually reinforcing. In some cases, however, the benefits of individual measures can also be clearly identified. Prominent examples include the introduction in 1984 of fines for front-seat passengers not wearing their safety belt and the sustained fall in the number of seri-

Jürgen Menge

Ministry for the Economy, Traffic, Agriculture and Viniculture of Rhineland-Palatinate, Department: Road Traffic Act, Vehicle Registration, Driving License Law, Road Safety, Road Operations



More Money for Accident Commissions

To bring about a sustained reduction in the number of traffic fatalities and serious injuries in the future too, close collaboration among all those involved in efforts to improve road safety is – and will remain – indispensable. Especially important here are the synergy effects that are to be achieved through the linking of behavior and infrastructure among vulnerable road users such as the elderly, young drivers and motorcyclists, also against a background of demographic change. In addition to police work and the diverse array of safety campaigns and training initiatives for road users, one of the most important approaches is to improve the infrastructure.

A central element should be the work of accident commissions, which are an integral part of the overall concept to improve road safety. These commissions give the federal states institutional knowledge in this area, with Rhineland-Palatinate serving as an example for their nationwide development. For more than 15 years now in a state-wide accident conference, key program points such as the prevention of motorcycle accidents and collisions with trees are defined. Training sessions and courses are also offered nationwide for accident commission members. Ongoing follow-up

training ensures that the level of knowledge among members remains high. However, central accident analysis offices – such as those in Bavaria and Rhineland-Palatinate – also serve as examples here and not only lay the foundations for targeted and effective road safety measures but also conduct state-wide controlling.

But it is impossible for accident commissions to carry out their work effectively without the necessary financial resources, which is why a special budgetary approach is needed that serves exclusively the interests of road safety. Such an approach ensures that, during the evaluation of plans for constructing and upgrading main and country roads, road safety is weighted such that accident blackspots in particular are given special priority.

These approaches with strategies from a state-wide accident conference, targeted training, financial resources and support and controlling by a central accident analysis office represent both an opportunity and a challenge for the work of accident commissions in the future.



1995 The “Vision Zero” initiative is launched in Sweden.

1997 Euro NCAP publishes first crash test results.



1990

1992

1994

1996

1998

2000

BEST PRACTICE 

Official statistics and accident databases are indispensable elements for introducing targeted measures to reduce the number of road accident victims.

■ *The first Mercedes-Benz crash test on September 10, 1959: frontal collision of a W 111 (1959-1965).*



ous car accidents on country roads following the introduction of the electronic stability program (ESP).

Another measure that has provided an important foundation for improving vehicle and road safety was the German In-Depth Accident Study (GIDAS) project, which was initiated in Germany in 1999 by the German Federal Highway Research Institute (BAST) and Research Association of Automotive Technology (FAT). Every year, as part of GIDAS, around 2,000 accidents resulting in personal injury are recorded in the regions of Dresden and Hanover. At the scene of the accident, the survey team documents all the relevant information concerning vehicle equipment and damage, injuries suffered by the persons involved, the rescue chain as well as the conditions and circumstances at the scene of the accident. Following this, they question the persons involved and carry out a detailed survey of the scene of the accident complete with the accident traces. As well as documenting the scene of the accident, the team works closely with the police, hospitals and rescue services to gather all the information that subsequently becomes known and available. In addition, every documented accident is reconstructed using a simulation program. The scope of documentation in GIDAS covers up to 3,000 coded parameters for each accident.



In many other countries of the world, too, official statistics and accident databases are a key foundation for optimizing road traffic accident situations. In France, these statistics are gathered by the Observatoire national interministériel de la sécurité routière (ONISR); in Italy by the Istituto Nazionale di Statistica; in Spain by the Dirección General de Tráfico; and in the UK by the Department for Transport. In the USA, the National Highway Traffic Safety Administration (NHTSA) has documented every fatal traffic accident since 1975 using its Fatality Analysis Reporting System (FARS). The USA also has the National Automotive Sample System – Crashworthiness Data System (Nass-CDS) since 1979, which – like GIDAS in Germany – is maintained by interdisciplinary teams who record accidents resulting in personal injury and/or serious material damage.

AVAILABILITY OF WELL-FOUNDED ACCIDENT DATA MUST BE IMPROVED

Also of relevance in this context is the International Road Traffic and Accident Database (IRTAD), which is maintained by the Paris-based Organisation for Economic Cooperation and Development (OECD) and collects official accident statistics from different countries including Australia, Chile, Jamaica, Cambodia, Morocco, New Zealand, Nigeria, South Africa and South Korea. However, significant differences exist between the countries regarding the methods used for collecting the data and the scope of data available. IRTAD also does not contain any more detailed information concerning the circumstances of an accident.

This also applies to the CARE database maintained by the EU Commission and containing accident data from all EU member states. One thing that is certainly clear is that any strategy designed to reduce the number of traffic fatalities requires



2001 A road safety program is developed in Austria.

2001 The White Paper "European Transport Policy for 2010: Time to Decide" is published.

2002 The ROSEBUD road safety project funded by the EU Commission is launched. A range of methods for assessing the economic impact of road safety measures is compiled and refined.



2003 The "Towards Zero Deaths" road safety program is launched in the US state of Minnesota.



■ In this accident, the driver of the truck had lost of control of his vehicle due to traveling at excessive speed on an icy road.

well-founded, high-quality accident data, which is why the EU Commission, in a report published in December 2016 for the European Parliament and European Council (“Saving Lives: Boosting Car Safety in the EU”), called for the greater availability of accurate and well-founded EU-wide accident data. This type of data is a prerequisite for the development and monitoring of EU road safety policy. Specifically, the data is required to assess the effectiveness of the measures in terms of road and vehicle safety and to support the development of new measures. It was clear even many years ago that no single existing accident database in the EU was capable of meeting all the relevant requirements. To this day, severe shortcomings also exist when it comes to the analysis of accidents and injuries.

FUNDAMENTAL TERMS OF ACCIDENT RESEARCH AND VEHICLE SAFETY

To systematically research the risks associated with traffic accidents and to identify action areas and the potential of protection measures, standardized terms are essential for allowing the knowledge acquired to be shared and built upon with others. The Haddon Matrix (see next page) was an early

approach that was later modified to allow holistic accident research.

A distinction between active and passive safety was made back in the 1970s: Active safety systems prevent accidents; passive safety systems mitigate the consequences of accidents. Brakes, therefore, or electronic stability programs (ESP) are active safety systems because they can help to avoid potential accidents by allowing the vehicle to be decelerated to the required extent or preventing uncontrolled skidding. A stable passenger compartment and restraint systems are examples of passive safety systems because they can help to reduce the severity of a collision for the vehicle occupants. The terms “active safety” and “passive safety” to this day still have these precise meanings.

In the 1990s, however, accident researchers increasingly noticed that systems originally designed to improve active safety can also help to mitigate the consequences of accidents that still occur, despite efforts to prevent them. For example, effective braking can significantly reduce the collision speed and, in turn, the severity of an accident; ESP can help to induce, instead of a serious side collision, a less serious frontal collision.

2004 The European Road Safety Charter is launched.



2006



2006 The Finnish road safety program “Road Safety 2006-2010” is launched.

2008

2008 DEKRA publishes its first Road Safety Report, focusing on cars. Further reports are published in the following years focusing on trucks, motorcycles, pedestrians and cyclists, humans and technology, rural roads, urban mobility, the future based on experience and passenger transportation.

2010

Haddon Matrix as Accident Prevention Tool

Reducing the number of people killed or injured in traffic accidents can be achieved through measures that are designed to prevent accidents from occurring in the first place, protect people to the greatest possible extent from injury during the accident or mitigate the consequences of an accident through optimal medical assistance. One method of systematically analyzing such measures and the interaction between the possible areas of influence of vehicle and road safety is the Haddon Matrix (Figure 2). Arranging three columns for “humans”, “vehicle” and “environment” and three lines for “pre-event”, “event” and “post-event” gives us a total of nine cells.

The causes and/or associated improvement measures for each accident can then be entered in this matrix.

This matrix is named for William Haddon, the first director of the US National Highway Safety Bureau, the predecessor organization of today’s National Highway Traffic Safety Administration (NHTSA). It is extremely popular in Scandinavia and throughout the English-speaking world in the field of accident research and prevention. In Germany, however, it is hardly known at all. The Haddon Matrix can also be applied in an extended form, whereby the “environment” column is subdivided into the physical environment (roads) and social environment (social behaviors and standards, laws, economic conditions). This results in twelve cells (Figure 3).

This added understanding gave rise to the term “integral safety”, blurring the distinction between definition-specific functional system limits. On top of this, some passive safety systems can fulfill their role of mitigating the consequences of accidents even more effectively when they are activated – usually reversibly – before a collision even occurs. One example here is the electric belt tensioner, which, even before a collision, eliminates the otherwise harmful slack in a belt so that, shortly before the col-

2 Example of a Haddon Matrix

		Factors		
		Human factors	Vehicles and equipment factors	Environmental factors
Phases	Pre-crash	Alcohol and drugs	Defective brakes	Darkness, rain, fog, snow, ice
	Crash	No safety belt worn	No airbag	Tree too close to road
	Post-crash	No or inadequate first aid	Fire due to fuel leakage	Slow response of rescue services

3 Example of an extended Haddon Matrix

		Factors			
		Human factors	Vehicles and equipment factors	Physical environment	Socioeconomic environment
Phases	Pre-crash	Poor visibility, slow reaction time, alcohol, excessive speed, excessive risk	Defective brakes, poor lighting, no warning systems	Narrow shoulder, incorrectly erected road signs	Cultural norms that permit speeding, jumping red lights and driving under influence of alcohol/drugs
	Crash	No safety belt worn	Failure of safety belt, poorly designed airbags	Poorly designed crash barriers	Lack of regulation in vehicle construction
	Post-crash	Sensitivity, alcohol	Poorly designed fuel tank	Inadequate emergency call systems	Lack of support for mobile communications EMS* and state-of-the-art rescue service

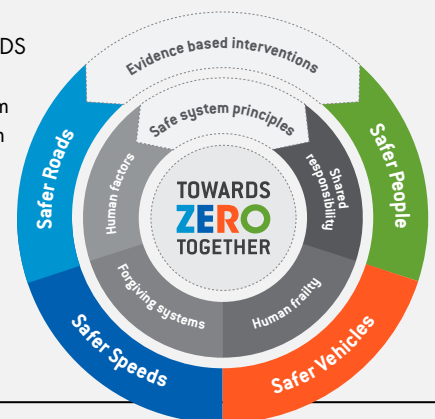
*EMS: Enhanced message service

2010 Policy guidelines are published for EU road safety (2011-2020)



2010

2011 The “TOWARDS ZERO TOGETHER” road safety program is launched in South Australia.



2011

2012

lision occurs, the belt tensioner normally triggered through braking can function even more effectively.

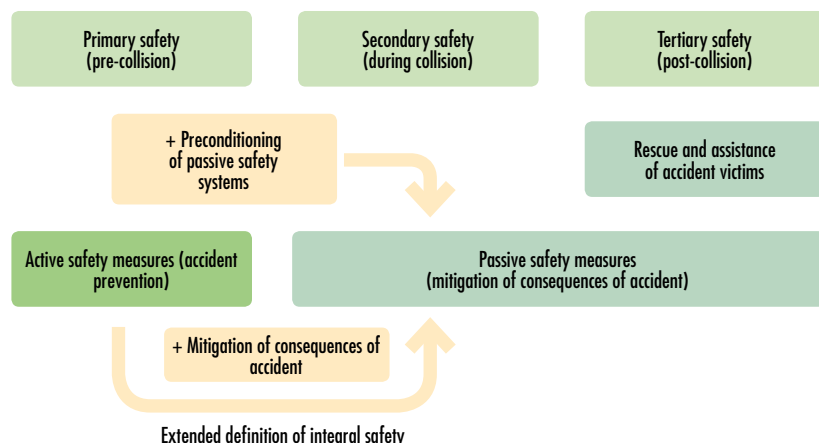
Action plans designed in response to holistic accident research and aimed at improving vehicle and road safety also encompass the rescue services. In this context, the terms “primary safety”, “secondary safety” and “tertiary safety” are used. Since tertiary safety measures are designed to mitigate the consequences of accidents, they are also classed as “passive safety” measures. Only by taking a holistic perspective can we recognize the overall benefits of an individual safety measure or a combination of safety measures (Figure 4).

ON THE ROAD TO “VISION ZERO”

This report is also designed to contribute to improved road safety by highlighting which particularly promising potential approaches can be pursued and where, as well as which tried-and-tested measures might also be applied elsewhere to bring about further improvements in road safety. This report puts the spotlight on humans, infrastructure and vehicle technology, but of course also addresses the further development and combination of existing assistance systems for automated and connected driving. After all, this could – once the still numerous legal and technological barriers have been overcome – be key to longer-term development on the road toward “Vision Zero,” that is, safe roads on which nobody dies or is seriously injured in accidents.

4 Holistic Accident Research: Terms and Perspectives

Chronologically separate effective ranges of vehicle and road safety



The Facts at a Glance

- The “best practice” approach has been tried and tested in many different areas all over the world.
- At-the-scene police accident surveys and detailed analyses are important foundations for introducing preventive measures.
- Not every measure that was and is successful in one region can be automatically rolled out in every other region.
- The work of Germany’s accident commissions is essential for identifying and permanently eliminating accident blackspots.
- Every planned road safety measure first has to be analyzed in detail in terms of its costs and benefits.
- The availability of comparable, well-founded accident data and statistics must be improved internationally.



2011 Decade of Action for Road Safety 2011-2020



2014 The “Vision Zero Action Plan” is launched in New York City by mayor Bill de Blasio.



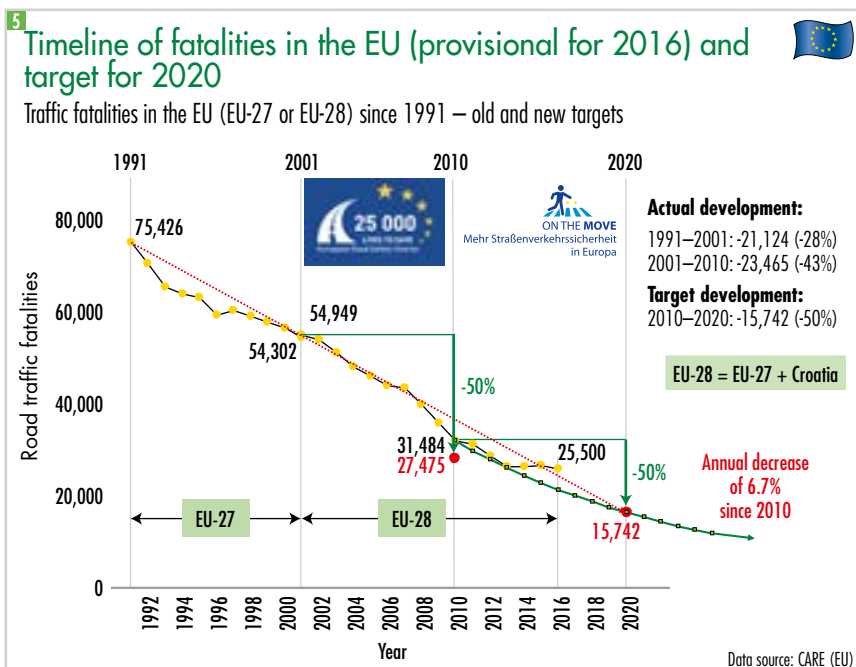


Big Differences Around the World

The development in the number of traffic fatalities in many countries around the world is a clear indication of the huge challenges involved in improving road safety in the long term. While there was a positive trend in the EU in 2016, for example, the number of traffic fatalities in the USA increased significantly, meaning that the USA has the highest traffic fatality rate among industrialized nations. Action is urgently required. However, the EU must also continue to work hard to achieve the stated objective of halving the number of fatalities on the road by 2020 in comparison with 2010.

Around 25,500: The number of people who died on the road in EU member states in 2016 according to preliminary figures released by the EU Commission. This is 600 less than in 2015,

and over the last six years the number of traffic fatalities has decreased by 19% (Figure 5). Although the positive trend observed over recent years (Figure 6) is generally pleasing, according to statements made by the EU Commissioner for Transport, Violeta Bulc, this still might not be enough if the EU wants to achieve its objective of halving the number of traffic fatalities between 2010 and 2020. She believes that everyone involved needs to do even more to support this objective. This applies in particular to national and local authorities that bear the most responsibility on a day-to-day basis for implementing regulations and raising the awareness of all road users, for instance.



COMPREHENSIVE PACKAGE OF EU MEASURES

The EU has already established a general regulatory framework with legal provisions and recommendations for improving road safety –

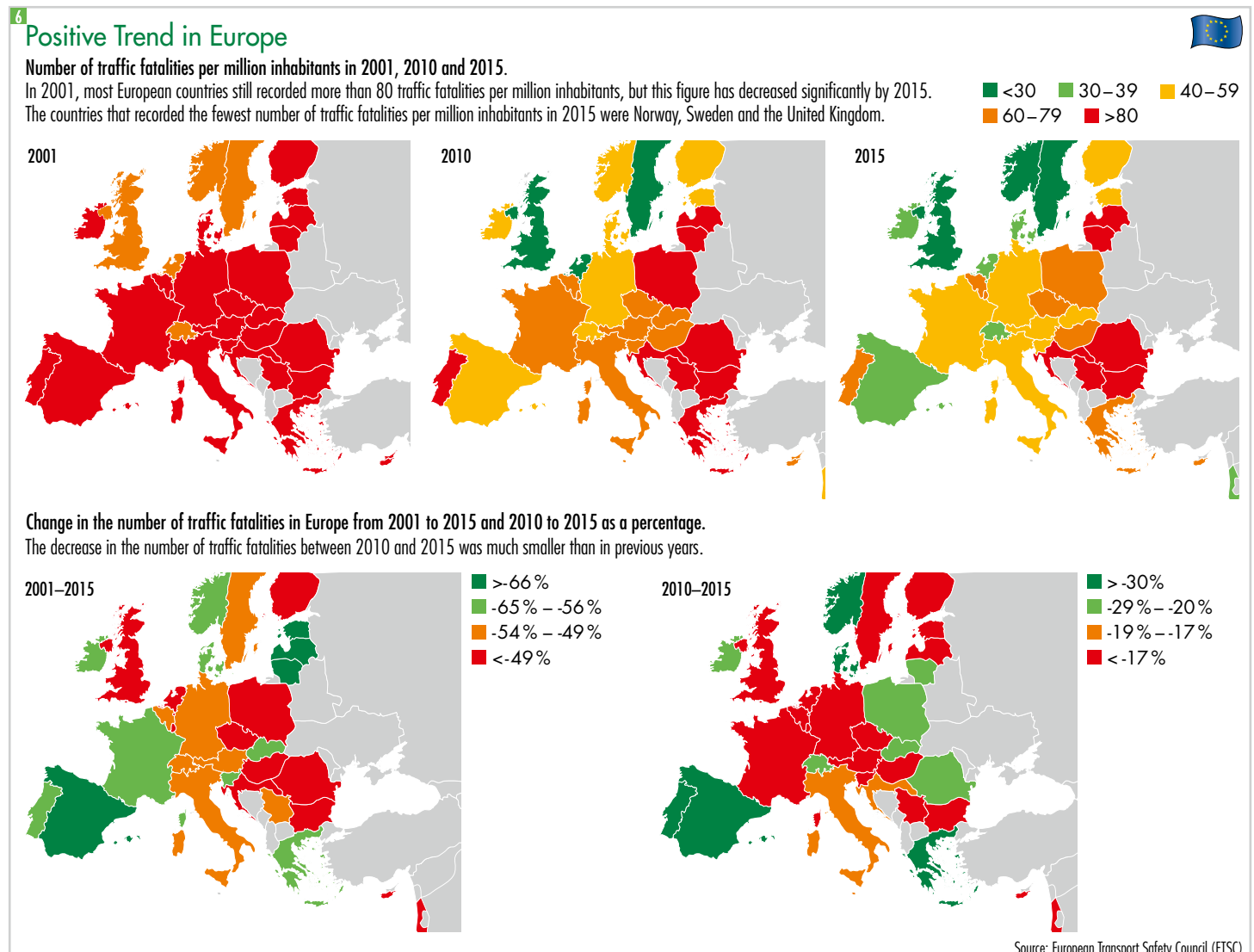
for example, by introducing minimum requirements for managing safety across trans-European networks and technical requirements for the safe transportation of hazardous goods. Furthermore, the cross-border enforcement directive that entered into force in May 2015 enables driving offenses committed abroad to be punished. In addition, the new legal provisions implemented in April 2014 regarding the testing of the roadworthiness of vehicles are designed to reduce the number of accidents caused by technical faults.

According to the EU Commission, the agreement on the introduction of new lifesaving technology in 2015 represented another milestone for road safety: From March 2018, all new models of cars and light commercial vehicles will be equipped with the eCall system. In the event of a serious traffic accident, this system automatically contacts a permanently manned emergen-

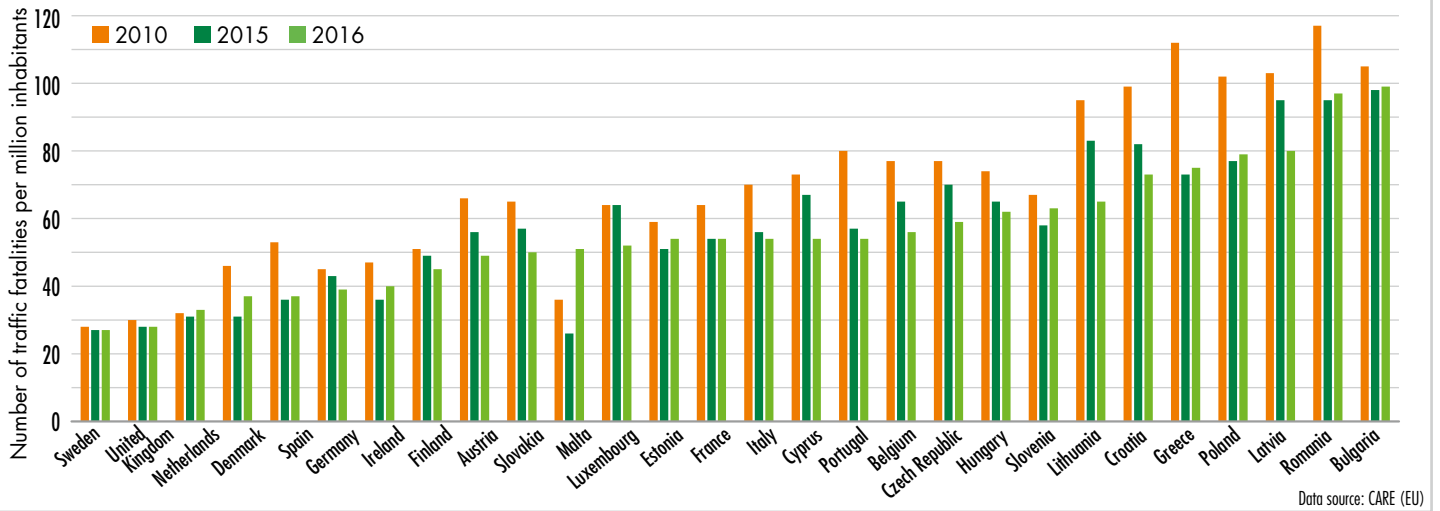
cy call center, for example via the Europe-wide emergency number 112, and sends emergency services the exact location of the vehicle involved in the accident, as well as information about the anticipated severity of the accident. With eCall, the time taken for emergency services to arrive should be cut by up to 50% in rural areas and 40% in urban areas. According to estimates, this will reduce the number of fatalities by at least 4% and the number of serious injuries by 6%.

A COMPARATIVELY HIGH LEVEL OF SAFETY EU-WIDE – WITH BIG DIFFERENCES BETWEEN MEMBER STATES

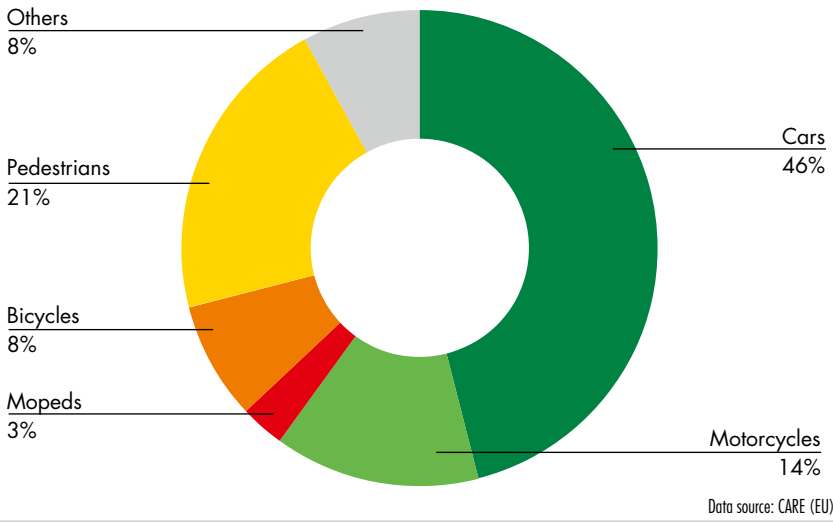
Nevertheless, Europe's roads remain some of the safest in the world according to a fact sheet issued by the EU Commission: The road traffic fatality rate was 50 per million inhabitants in 2016 in the EU, compared with 174 worldwide. There are big differences in this figure between the individu-



7 Number of traffic fatalities per million inhabitants in EU member states

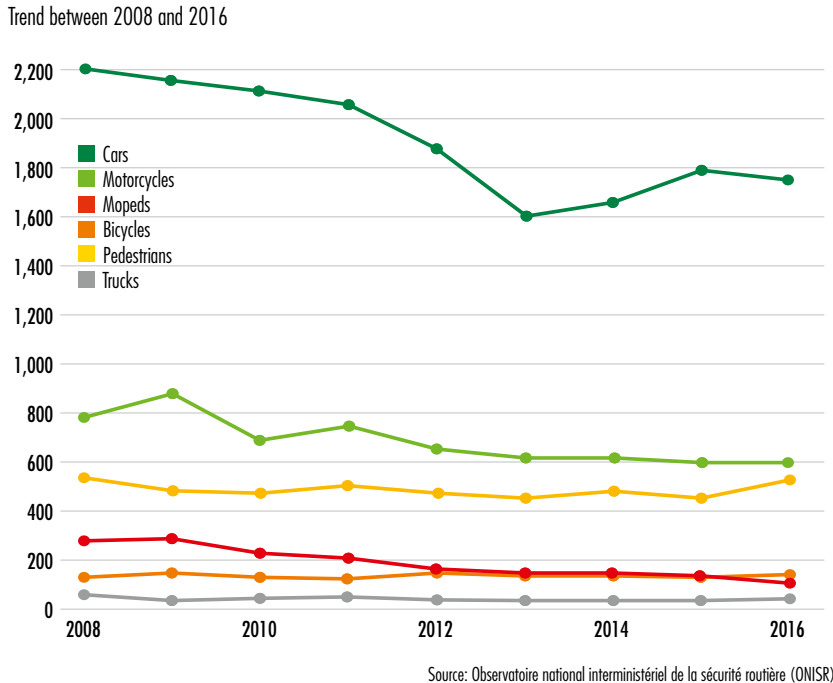


8 Traffic fatalities in the EU in 2016 by road user group



al EU member states (Figure 7). In 2016, Sweden was the country with the fewest number of traffic fatalities per million inhabitants (27), followed by the United Kingdom (28), the Netherlands (33), Spain (37), Denmark (37), Germany (39) and Ireland (40). On the other end of the scale are Bulgaria (99), Romania (97), Latvia (80) and Poland (79). The countries that saw the biggest decrease in the number of traffic fatalities in 2015 and 2016 include Lithuania (22%), Latvia (16%) and the Czech Republic (16%). 2016 was the second year in a row in which none of the member states exceeded a traffic fatality rate of 100 per million inhabitants, with most figures staying below 80. Furthermore, almost half of the member states recorded their best road safety levels since 1965.

9 Traffic fatalities in France by road user group



In terms of types of road, on average only around 8% of all fatalities occurred on highways in 2016 across the EU, with 37% occurring in urban areas and 55% on country roads. At 46%, car occupants are the largest group of traffic fatalities (Figure 8). Combined, the most vulnerable road users such as pedestrians, cyclists and motorcyclists make up the same percentage and are particularly at risk in urban areas. Pedestrians represent 21% of all traffic fatalities. This figure is decreasing more slowly than for other road users (by 11% since 2010, compared with a decrease of 19% overall). 8% of all people killed in road accidents in the EU are cyclists. Motorcyclists, who also have very little accident protection, represent 14% of traffic fatalities. The decrease in the number of deaths of more vulnerable road users is significantly lower than that of all road users.

As mentioned, the traffic fatality figures for 2016 again differed greatly between EU member states.

While Germany, for example, recorded a decrease of 7.3% in traffic fatalities compared with the previous year, thereby halting the negative trend of the two preceding years, the figure for France (Figure 9) remained relatively consistent with a very small increase of 0.2% from 3,461 to 3,469 traffic fatalities. This does, however, mean that France saw an increase in the number of traffic fatalities for the third year in a row. A large proportion of the accidents involving personal injury were caused by excessive speed, drunk-driving (particularly among young drivers), violations of the rules of the road and driver distraction. With 15% more traffic fatalities, the biggest increase was among pedestrians.

Spain also saw an increase of 2.5% from 1,130 to 1,160 traffic fatalities in 2016, while Italy is one of the EU member states that recorded a significant decrease in the number of traffic fatalities in 2016. According to preliminary figures, 5% fewer people died on the road at least in the first six months of 2016 compared with the first half of 2015.

EU PLACING MORE FOCUS ON SEVERE INJURIES

According to information from the EU Commission, statistically, for every traffic fatality that occurs, a great many more people will suffer severe, often life-changing injuries. Not only do severe injuries occur more frequently, they also entail significant costs for society due to the lifelong need for rehabilitation and care. It is the more vulnerable road users such as pedestrians, cyclists, motorcyclists and the elderly who are particularly affected.

Since 2015, member states have been reporting data on severe injuries based on a new, mutually agreed definition in accordance with medical standards. The EU uses the international AIS code (Abbreviated Injury Scale) to define severe injuries in traffic accidents. Injuries classified as 3 or above (MAIS3+) are defined as severe injuries. This can sometimes result in significant deviations from the figures for “severely injured” road users previously collated differently at a national level.

In November 2016, the Commission published data on the severity of injuries from 16 member states: Belgium, the Czech Republic, Germany, Spain, Ireland, France, Italy, Cyprus, the Netherlands, Austria, Poland, Portugal, Slovenia, Finland, Sweden and the United Kingdom. Based on the data available, it is assumed that around 135,000 people suffer severe injuries on the road in the EU

Jacobo Díaz Pineda

Director General of the Asociación Española de la Carretera (Spanish Road Association)



An Outworn Model

Unfortunately, 2016 marks the end of a long streak of success in the area of road safety in Spain. After the number of deaths caused by road accidents in Spain declined consistently over a period of ten years, and the statistics stabilized at a good level over three years, 2016 will go down in history as the first year in a long time to see an increase in deaths caused by road accidents in Spain. Therefore, one could be tempted to pursue the current approach even more vigorously, even if signs of fatigue are already showing.

Measures such as alcohol and speed checks on main roads and campaigns to promote the wearing of seat belts have largely achieved the desired success. Even though they must not be neglected in the future, it is evident that a reversal of the statistical trend cannot be achieved if the current measures continue to be the main focus of the policy for increasing road safety.

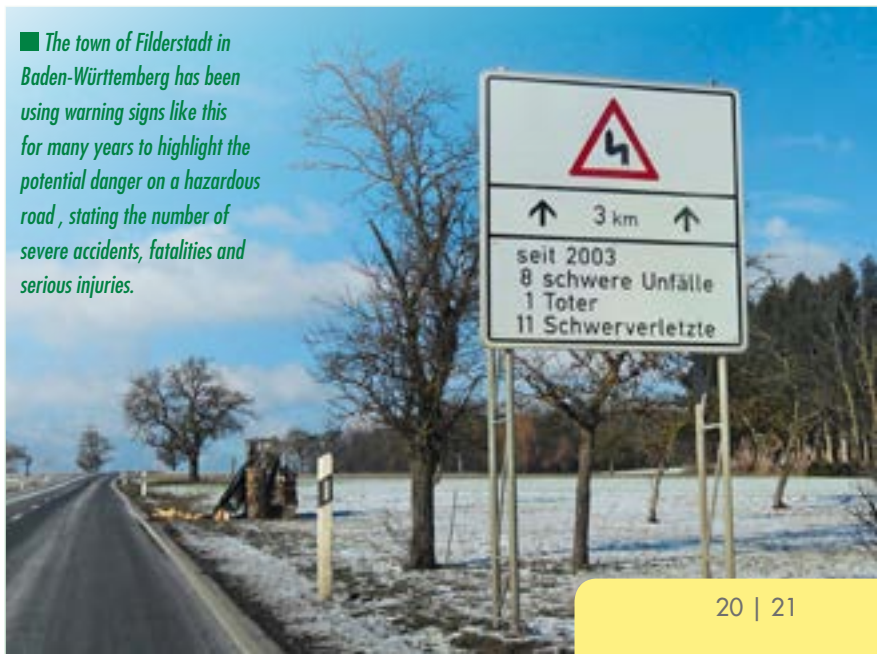
For this reason, other factors must play a greater role in reducing the number of deaths caused by road accidents in Spain. In our view, infrastructure plays a key, central role. Here, the efforts should focus on two main areas: the frequency of accidents in the conventional road network, and the more complex problem of accident frequency in the urban environment.

While there are various methods for the first area that would have to be applied systematically to achieve acceptable results, the urban environment requires integrated programs in order to provide better protection for our most vulnerable road users – pedestrians, cyclists and motorcyclists. The possible campaigns and initiatives must be tailored to these three target groups.

We have more experience in the measures for conventional roads, on which 80 percent of all deaths caused by road accidents are recorded. Of these, 45 percent of people die when leaving lanes; 25 percent die in frontal collisions; and 20 percent die in lateral collisions. With this type of road network, the advantage lies in the fact that various methods are already available that produce promising results in the short term – for example, road safety checks, an instrument that is also recognized by the European road safety directive.

To improve road safety on a sustained basis, solutions in combination with a change to the technical structure of the road appear promising. The systematic introduction of 2+1 roads according to the Swedish model as well as an adjustment of the lane widths by means of innovative lane markings in the lane axis and at the sides are affordable solutions that can contribute to higher road safety for all vehicles.

■ The town of Filderstadt in Baden-Württemberg has been using warning signs like this for many years to highlight the potential danger on a hazardous road, stating the number of severe accidents, fatalities and serious injuries.

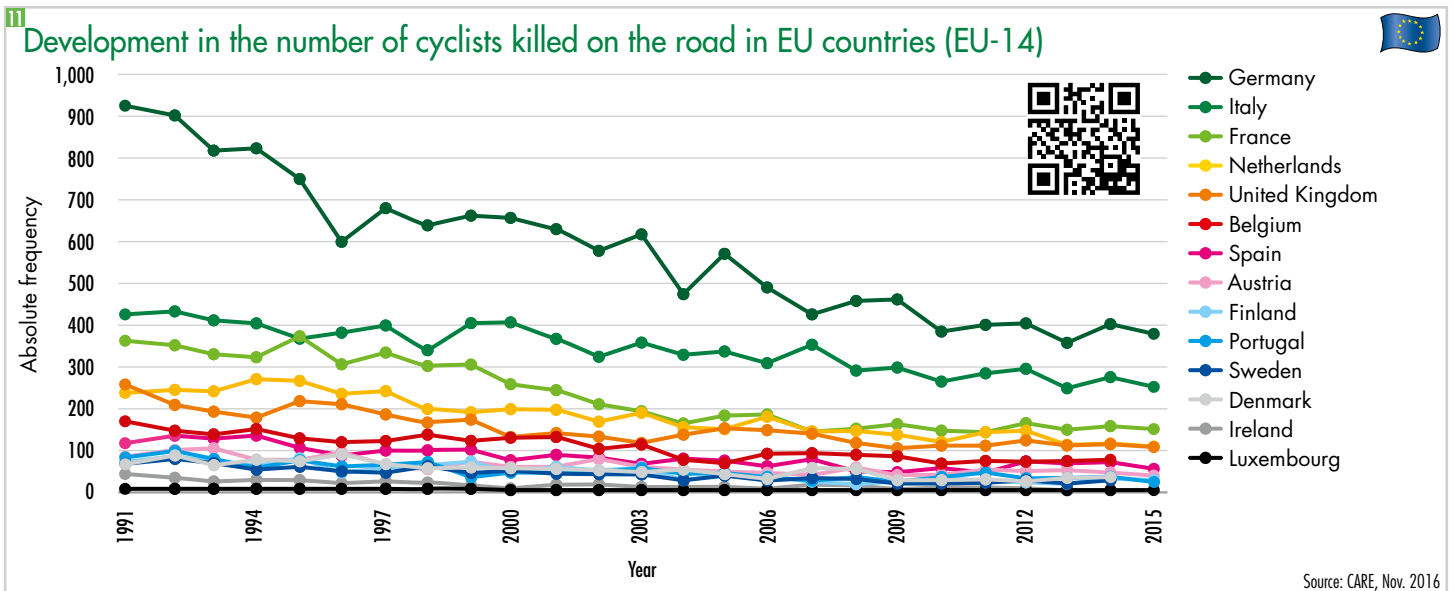
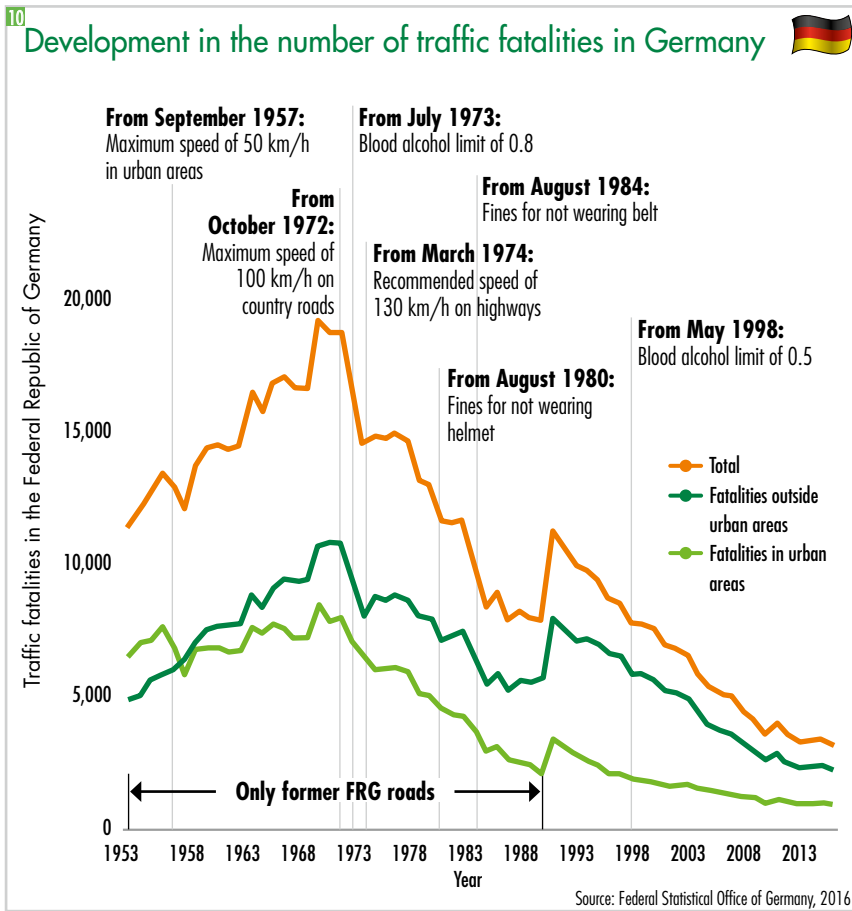


every year, meaning that for every traffic fatality in the EU, 5.2 people are seriously injured. The road users who are particularly at risk also make up a disproportionate number of those seriously injured – this includes pedestrians, cyclists, motorcyclists and, in most cases, the elderly.

2016 TRAFFIC ACCIDENT STATISTICS FOR GERMANY

According to preliminary figures from the Federal Statistical Office, in 2016 Germany recorded the highest number of accidents since reunification, with police recording around 2.6 million accidents (2.8% higher than the previous year). 2.3 million accidents involved material damage, and people were injured or killed in 308,000 of the accidents. In total – also according to preliminary figures – 3,206 people lost their lives in traffic accidents in Germany in 2016. That equates to 253 fatalities or 7.3% less than in 2015, when 3,459 fatalities were recorded, meaning that the number of traffic fatalities reached its lowest level for over 60 years (Figure 10). In terms of absolute figures, the picture within Germany is very varied. According to estimates, the biggest decrease was in Baden-Württemberg with -78 people (-16.1%), followed by Brandenburg with -58 people (-32.4%). There were increases in the city states of Hamburg (+9/+45%) and Berlin (+8/+16.7%), as well as in Saarland (+3/+ 9.7%), Schleswig-Holstein (+7/+6.5%) and Bavaria (+2/+0.3%). The exact circumstances behind this overall development in accidents are not yet available, according to statements by the Federal Statistical Office. However, the decrease in the number of traffic fatalities in 2016 can be attributed to the generally unfavorable weather during the first half of the year.

The current detailed figures for January to December 2016 show that much fewer motorcycle and motor scooter riders were killed in traffic accidents (-99 fatalities = -15.7%). The number of car occu-



pants killed also decreased (-170 fatalities = -6.5%). However, more people were killed on mopeds and motor-assisted bicycles (+6 fatalities = +8.5%) and on bicycles (+8 fatalities = +2.5%). The increase in the number of cyclists killed can be attributed to the huge popularity of pedelecs and the fact that they are, in turn, more frequently involved in accidents (61 fatalities = +70% in total compared with 2015). In accidents involving trucks weighing more than 3.5 metric tons, 40 more people lost their lives in 2016 than in 2015. In accidents involving trucks weighing less than 3.5 metric tons, however, 56 fewer fatalities were recorded.

Most road users were killed on rural roads (1,855). In urban areas, the number of fatalities was 958, while 393 people were killed on highways. In accidents resulting in personal injury, almost 370,000 cases of driver error were recorded. The most common cause was driver error during left/right turns, U-turns or when reversing (almost 58,000), followed by nonobservance of right of way (almost 53,500), insufficient distance (51,200) and excessive speed (almost 47,000). Although it is not possible to determine how many accidents were caused by drivers being distracted by cellphones and similar because there is no way to verify this, it is likely to be a not-insignificant figure.

CYCLISTS CONTINUE TO BE AT SERIOUS RISK

As the figures from Germany show, cyclists did not benefit from the general positive trend observed for traffic fatalities in 2016. Although Germany, together with France, Italy, the Netherlands and the United Kingdom, is one of the EU member states (Figure 11) that has recorded the biggest decrease in cyclist deaths since 1991 – with some countries cutting this figure by up to 60% – since 2010, this progress has stagnated in various countries with the number of fatalities remaining at more or less the same level. Almost 2,100 cyclists – that's around 8% of all traffic fatalities – lost their lives on EU roads in 2015.

The number of fatalities could be reduced further if cyclists were even more aware of the traffic regulations that apply to them or did not disregard the regulations. A study published in 2015 on behalf of insurance company CosmosDirekt found that 83% of German cyclists do not always observe traffic regulations. 14% of those surveyed said that they disobeyed the regulations quite frequently, while 5% even said that they disobey them very frequently. Alarmingly, among 18–29-year-old people, only 1%

Luisa López Leza

Head of European affairs, MOVING International Road Safety Association



Preventing accidents among cyclists under 16 years of age

According to the Law on Traffic and Road Safety, which has been in force since May 2014, children under the age of 16 are required to wear a helmet when riding a bicycle. This applies regardless of whether they are outside or inside urban areas or whether they are riding or are passengers on a bike. For other cyclists, the mandatory wearing of helmets depends on whether they are riding in urban or non-urban areas. As such, helmets are voluntary in urban areas and mandatory in non-urban areas. Prior to the adoption of this law, the mandatory wearing of helmets was the subject of extensive debate.

With regard to bicycle accident rates among cyclists before the wearing of a helmet became mandatory for children under the age of 16, according to a research study carried out by the Fundación MAPFRE during the period from 2003 through 2011 in Spain, there were:

- 711 fatalities: 537 in non-urban areas and 174 in urban areas
- 4,896 seriously injured: 2,706 in non-urban areas and 2,190 in urban areas
- 25,400 with minor injuries: 7,631 in non-urban areas and 17,769 in urban areas
- 31,007 casualties in total: 10,874 in non-urban areas and 20,133 in urban areas

When we focus more specifically on accident rates between 2008 and 2013 and look at the data presented in a report published by the Ponle Freno (Slow Down) Study Cen-

tre-AXA Road Safety, the number of accidents involving cyclists has been increasing continuously from 2,964 in 2008 to 5,806 in 2013. Unfortunately, there is a lack of concrete measurements of accident rates among bicycle users under 16 years of age. Therefore, we have not been able to assess the effectiveness of the measure that makes the wearing of helmets mandatory. However, it is remarkable that, according to the Cycling Barometer in Spain, "only four in ten Spaniards say that they are aware of the regulation regarding cycling in the city. By contrast, this percentage is almost 55% among bicycle users and exceeds 60% among those who use bicycles extensively".

Based on the information revealed by this Barometer, the mandatory wearing of helmets has once again become a topic of discussion. There continues to be greater effort devoted to its discussion rather than to its value as an indicator in measuring accidents involving cyclists before and after the wearing of helmets became mandatory. As a result, we must call upon the authorities to take into account cyclists under 16 years of age when measuring accidents in order to evaluate the effectiveness of the measure. On behalf of MOVING, we also call for further action on road safety education and training, with a particular focus on those who are under 16 years of age in Spain and, in this respect, we welcome the European STARS project, which is currently underway.



Jack Danielson

Acting Deputy Administrator, National Highway Traffic Safety Administration, U.S. Department of Transportation



Three Lanes on the Road to Zero

Traffic safety is a global issue that transcends borders. Societies must continually adapt to meet new challenges and identify ways to better mitigate threats that put people's lives at risk. In the United States, we're on the cusp of a technological revolution in transportation that has the potential to advance safety on America's roads. Through a three-lane approach, our goal is to transform public safety for motorists and achieve zero traffic deaths on our nation's roads.

Our first lane focuses on human factors, which contribute to 94 percent of traffic accidents in the U.S. Examples include drivers speeding, failing to buckle up or making the reckless decision to drive drunk. We've made a big difference through an effective formula of strong laws, high-visibility enforcement and education. These efforts have brought seatbelt use to all-time highs and have saved countless lives, but we know it's not enough. Everyday, lives are still lost, and it's the reason we're partnering with the National Safety Council, the Road to Zero Coalition and other safety organizations. We're taking our successful formula and applying lessons learned from other successful public health initiatives to add new, innovative strategies that could benefit safety in the short-term and long-term.

Our second lane is about advanced safety technologies, includ-

ing automated vehicle technologies. For example, lane departure warning systems that can alert a drowsy driver to stay in their lane; advanced emergency braking that can stop a car from striking a pedestrian; or a highly automated vehicle that can safely transport a person to work. We see amazing potential in these technologies to transform, even revolutionize, road safety by helping to address the 94 percent of traffic accidents tied to human errors. In addition to preventing crashes, technology in transportation holds enormous promise for providing mobility to millions of Americans without easy access to personal transportation—that includes the elderly and people with disabilities.

Our third lane is proactive vehicle safety, which is about working with automakers to make sure they are prioritizing safety and building vehicles without dangerous safety defects. We're moving from a reactive model where defects are identified and remedied only after crashes or malfunctions occur, to a new model that promotes industry-wide collaboration to integrate best safety practices that can prevent crashes from happening in the first place.

Through technology and our three-lane strategy, our long-term traffic safety goals align with other nations around the globe – to reduce crashes and injuries – and reach the ultimate goal of zero deaths on our roads.

of the cyclists surveyed said that they always followed the traffic regulations.

As the Federal Ministry of Transport and Digital Infrastructure and the German Cyclists' Association (ADFC) state, one of the important regulations defined in the German road traffic regulations is that cyclists must use an explicitly signposted cycle path, even if they think that they would make better progress by cycling on the road. Where a separate cycle path and footpath are provided, cyclists must not cross onto the footpath, not even to overtake. Where a combined cycle path and footpath is provided, cyclists must share the designated space with pedestrians. Cyclists do not have priority here, but pedestrians must allow them to pass. Footpaths are no-go zones for cyclists, except for people accompanying children up to the age of 8 on bicycles. When accidents occur, courts almost always hold the cyclist on the footpath solely responsible. If no signposted cycle path is available, cyclists may use the road. Here, as always, the obligation to keep to the right – in this case, to the right of the right hand lane – applies.

One thing worth noting is that only pedelecs with motor support up to 25 km/h are legally classed as bicycles, which means that they can also be ridden on cycle paths. However, this does not apply to the more powerful "S-Pedelecs" (motor support up to 45 km/h), which are classed as mopeds rather than bicycles. With the e-bike – a type of electric moped that can reach speeds of up to 25 km/h with the aid of a motor even without the rider pedaling – riders are permitted to use cycle paths only in urban areas if these paths have an "E-Bikes frei" (E-bikes allowed) sign. It is also important to note that when cyclists are on the road, they must observe the traffic lights that apply to all road users. If a dedicated traffic light is provided for cyclists, they must observe this light on the cycle path. If the cyclist is on the cycle path and no dedicated traffic light is provided for cyclists, the cyclist must observe the traffic lights that apply to all road users. Light signals for pedestrians generally do not apply to cyclists.

When it comes to alcohol, even cyclists with a blood alcohol concentration as low as 0.3 may be liable to prosecution and will be held accountable in the event of an accident. If cyclists have a blood alcohol concentration of 1.6 or above, they are breaking the law even if their cycling behavior is not noticeably unsteady or erratic. Furthermore, like for drivers, cyclists may use cellphones only if they are using a hands-free device.

What is the situation in terms of helmet for cyclists? In Germany, it is not yet legally compulsory to wear a



helmet. The same applies in countries such as France, Switzerland, the United Kingdom, Italy, Poland and the Netherlands. In Austria, the Czech Republic, Lithuania, Croatia, Sweden, Slovenia, Slovakia and Spain, children and young people at least must wear a bicycle helmet. For safety reasons, though – and in light of the growing number of pedelecs on the road – the number of people wearing helmets must be increased. This is also the recommendation of organizations such as the German Road Safety Council. According to the German Road Safety Council, wearing a bicycle helmet should become the rule rather than the exception in the future, and parents should lead the way here by setting a good example.

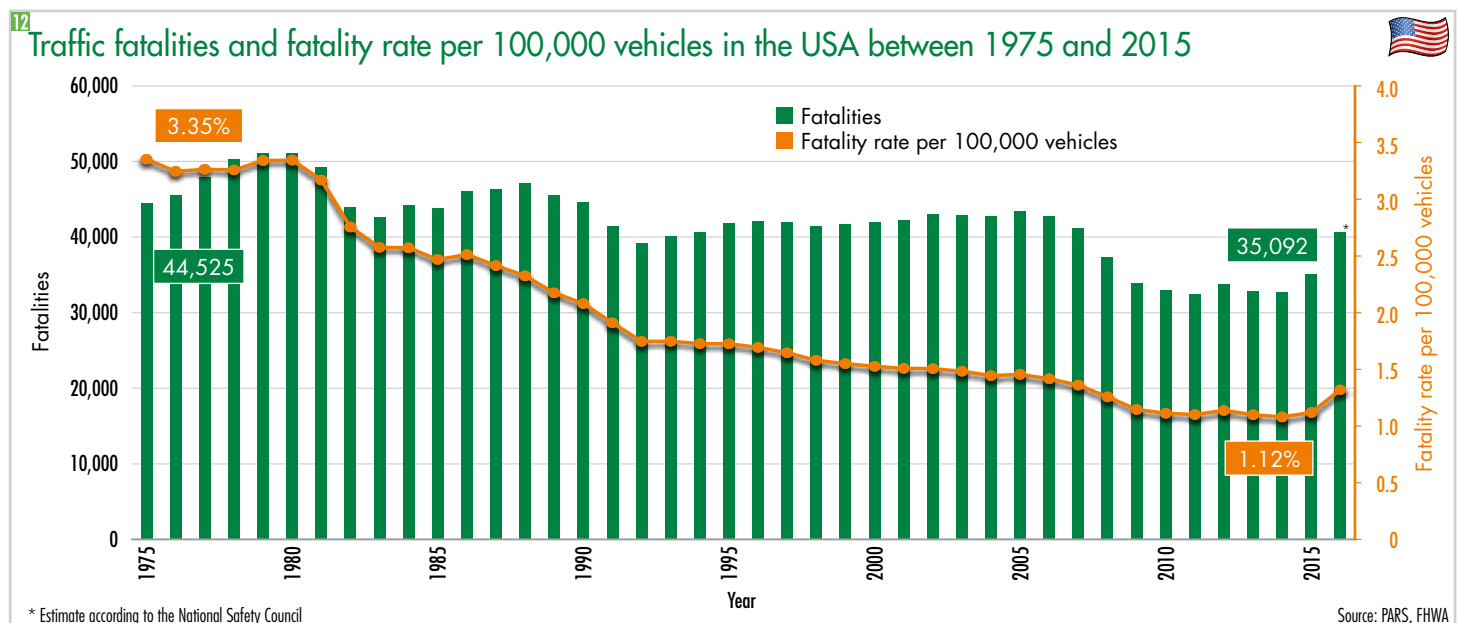
DRASTIC INCREASE IN THE NUMBER OF TRAFFIC FATALITIES IN THE USA

Let's return to the topic of accidents in general. The picture in the USA is very different to that in the

EU. In the USA, according to information provided by the National Safety Council (NSC), the number of traffic fatalities increased to over 40,000 in 2016. This equates to an increase of 15% compared with 2015, when just under 35,100 traffic fatalities were recorded. This development is even more dramatic given that the USA already recorded a 7.2% increase from 2014 to 2015. This means that within two years, the country has seen the biggest increase for over 50 years (Figure 12). In view of the increase in vehicle safety thanks to the large range of assistance systems available and the hundreds of millions of US dollars that have been invested in campaigns against speeding, alcohol and driver distraction, many road safety experts are at a loss to explain this trend.

As well as drunk-driving, drivers being distracted by their smartphone seems to be an especially widespread problem in the USA. As recently as the end of March 2017, 13 people lost their lives in a

■ The number of traffic fatalities rose again in the USA in 2016.



■ **Warning – drive on the left:** Between 2011 and 2015, an average of 6% of all traffic accidents resulting in fatalities and/or injuries in New Zealand involved drivers with foreign driving licenses. 77% of these were only in New Zealand for a short time/on vacation. Almost 60% of the accidents occurred outside of built-up areas.



Road Safety Strategy 2020 and accidents in South Australia

South Australia has also adopted "Vision Zero" as the main motivation for its road safety work: The name of the current program is "Towards Zero Together." Around 1.7 million people live in the state, which includes the metropolitan region of Adelaide. The aim is to reduce the number of traffic fatalities per year here to no more than 80 (4.5 per 100,000 inhabitants) and the number of people seriously injured to a maximum of 800 (45 per 100,000 inhabitants) by 2020.

The brochure for South Australia's Road Safety Strategy 2020 includes the annual figures for people killed and seriously injured in traffic accidents between 1981 and 2010 (Figure 13). To compensate for fluctuations in the absolute, relatively small figures, the figures are examined in three-year blocks when changes are evaluated. From 1981 to 1983, an average of 252 traffic fatalities were recorded and 3,104 people were seriously injured; between 2008 and 2010, however, an average of 112 fatalities were recorded and 1,126 people seriously injured. This means that over 30 years, the number of fatalities decreased by 56% and the number of people seriously injured by 64%. Further reductions in the absolute figures to 80 fatalities and 800 people seriously injured by 2020 would represent relative decreases of around 30%.

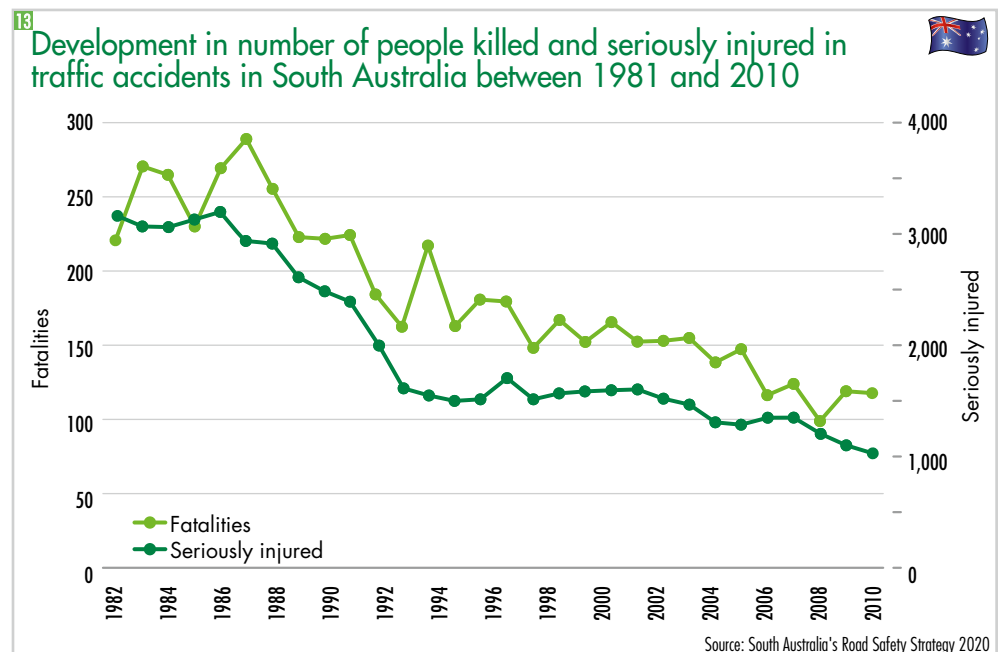
South Australia's 2020 strategy is supported by action plans and prioritized measures. This includes the need for road transport systems to be designed to be more forgiving and the requirement for each and every road user to be even more aware of their responsibility on the road. Taking into

account the accident statistics, the South Australian road safety program is aimed in particular at risk groups such as aboriginal people, people over the age of 70, young people aged between 16 and 24, cyclists, pedestrians, motorcyclists, drivers of heavy-duty vehicles and drunk-drivers.

Although Australia is seeing much fewer serious traffic accidents and victims compared with Europe and the USA, some of the main factors relating to the accidents and the recognized risk groups are very similar. It therefore makes sense to engage in discussions about potential measures and their impact at an international level so that all those involved in improving road safety can learn from experience, advise one another and implement findings locally in each region with even more background knowledge.

traffic accident in Texas because the pickup driver who caused the accident had been sending texts while driving. The problem is confirmed by a recent study conducted by Cambridge Mobile Telematics, which found that in 52% of journeys that ended in an accident, a smartphone was being used. According to an analysis of telephone data, 20% of those involved in an accident used their smartphone for over two minutes on average during the journey up to the time the accident occurred. In 30% of cases, the cellphone was used at speeds of over 90 km/h.

The fact that safety belts are often not worn in the USA despite the average usage rate having now reached over 90% could also be partly responsible for the comparatively high number of traffic fatalities. In 2015, for instance, 22,441 car occupants were killed in traffic accidents, according to data from the National Highway Traffic Safety Administration (NHTSA). This is an increase of 6.6% compared with the previous year. A huge 48% of those people



killed – that is, around 10,770 – were not wearing a safety belt. In the two years previous, 49% of car occupants killed were not wearing a safety belt – with this figure as high as 52% in 2012. In some US states such as Montana, Nebraska, North Dakota and Wyoming, the percentage of car occupants killed in a traffic accident who were not wearing a safety belt climbs to 70% or even higher.

The importance of wearing the belt for safety reasons has been clearly proven time and again through countless international studies. Rune Elvik and his colleagues at the Institute of Transport Economics in Oslo, for instance, have proven that wearing a safety belt in the front of a car reduces the risk of fatal injuries by 45–50% and the risk of minor and severe injuries by 20% and 45% respectively. When passengers in the back of the car wear a safety belt, the risk of suffering fatal and severe injuries is cut by 25% and the risk of minor injuries is cut by up to 75%. Passengers in the back seats who do not wear a safety belt are not just putting their own lives at risk in the event of an accident – the collision can cause these passengers to be thrown forward and collide with the driver or the passenger in the front or push their seat backs forward, which can result in additional injuries to the chest and pelvic area of the front passengers in particular.

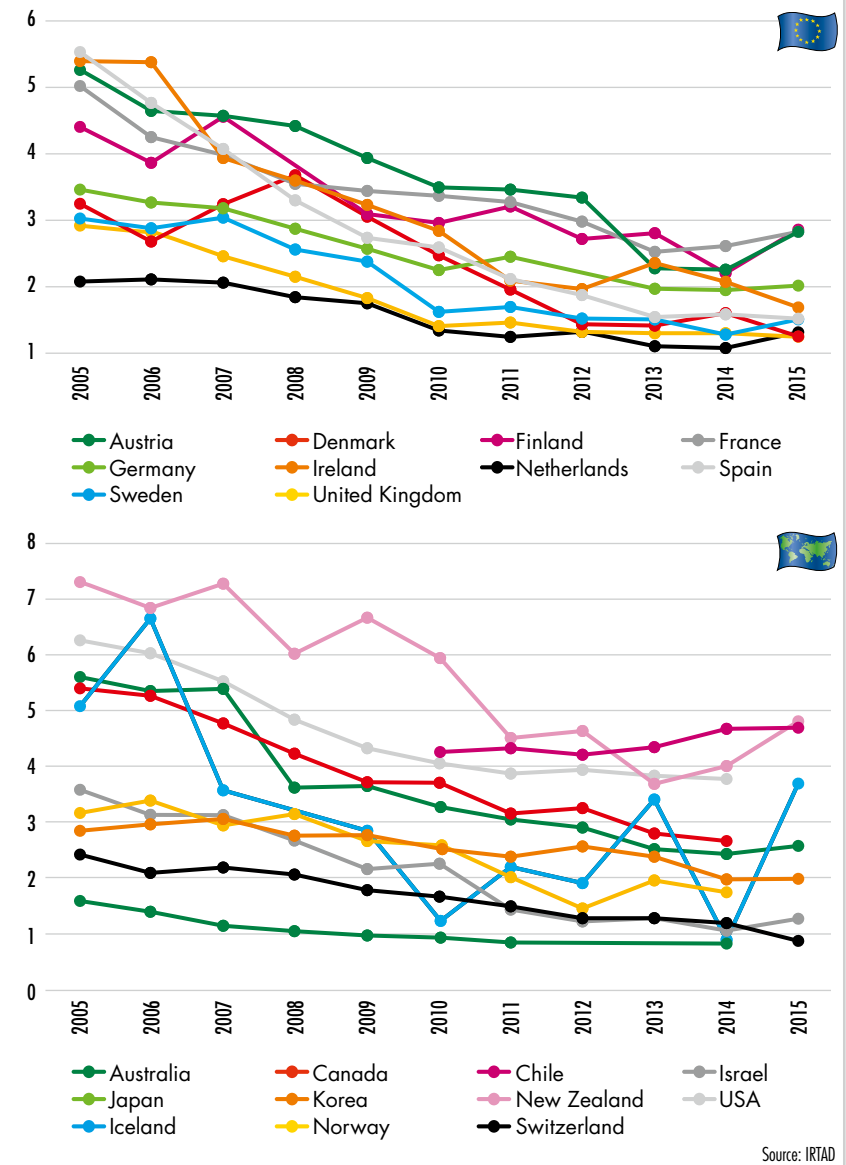
More stringent controls with corresponding fines therefore seem to be urgently required. Currently, primary belt laws allow police to issue a fine to drivers alone if they are not wearing a safety belt in 34 US states. In the remaining states, only secondary belt laws are in force. This means that police may issue a ticket only if the road user has committed another infraction. Not wearing a safety belt is in itself not reason enough for a fine. And what's more, even today there is no legal requirement for anyone over 18 to wear a safety belt in New Hampshire, the only US state where this is the case.

ROAD SAFETY IS A GLOBAL CHALLENGE

A total of around 65,000 traffic fatalities were recorded across the EU and the USA in 2016 – and this is just a fraction of the 1.25 million people who are killed on the road every year worldwide according to the WHO's "Global Status Report on Road Safety 2015." The differences between the individual regions are immense (Figures 14 to 16). While the number of traffic fatalities in most of the world's more prosperous nations has been falling more or less continuously for decades, the

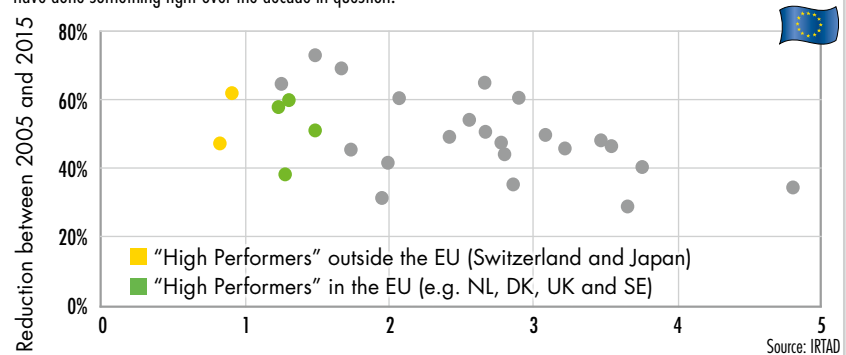
14 Car occupants killed per 100,000 inhabitants from 2005 to 2015

With regard to the number of car occupants fatally injured per 100,000 inhabitants, the Netherlands, the United Kingdom and Sweden had already reached a level in 2005 (two to three fatalities) that other nations did not achieve until 2015. These three countries managed to reduce this figure to 1.5 fatalities per 100,000 inhabitants or less by 2015. In Japan and Switzerland, this figure was even below 1.0 in 2015.



15 Car occupants killed per 100,000 inhabitants from 2005 to 2015

Countries that have implemented a wide variety of measures relating to occupant safety have seen a significant reduction in this figure (= high percentage value). The very high reduction percentages combined with very low comparative figures for 2015 show that a number of nations have now achieved the level of "High Performer" – they seem to have done something right over the decade in question.



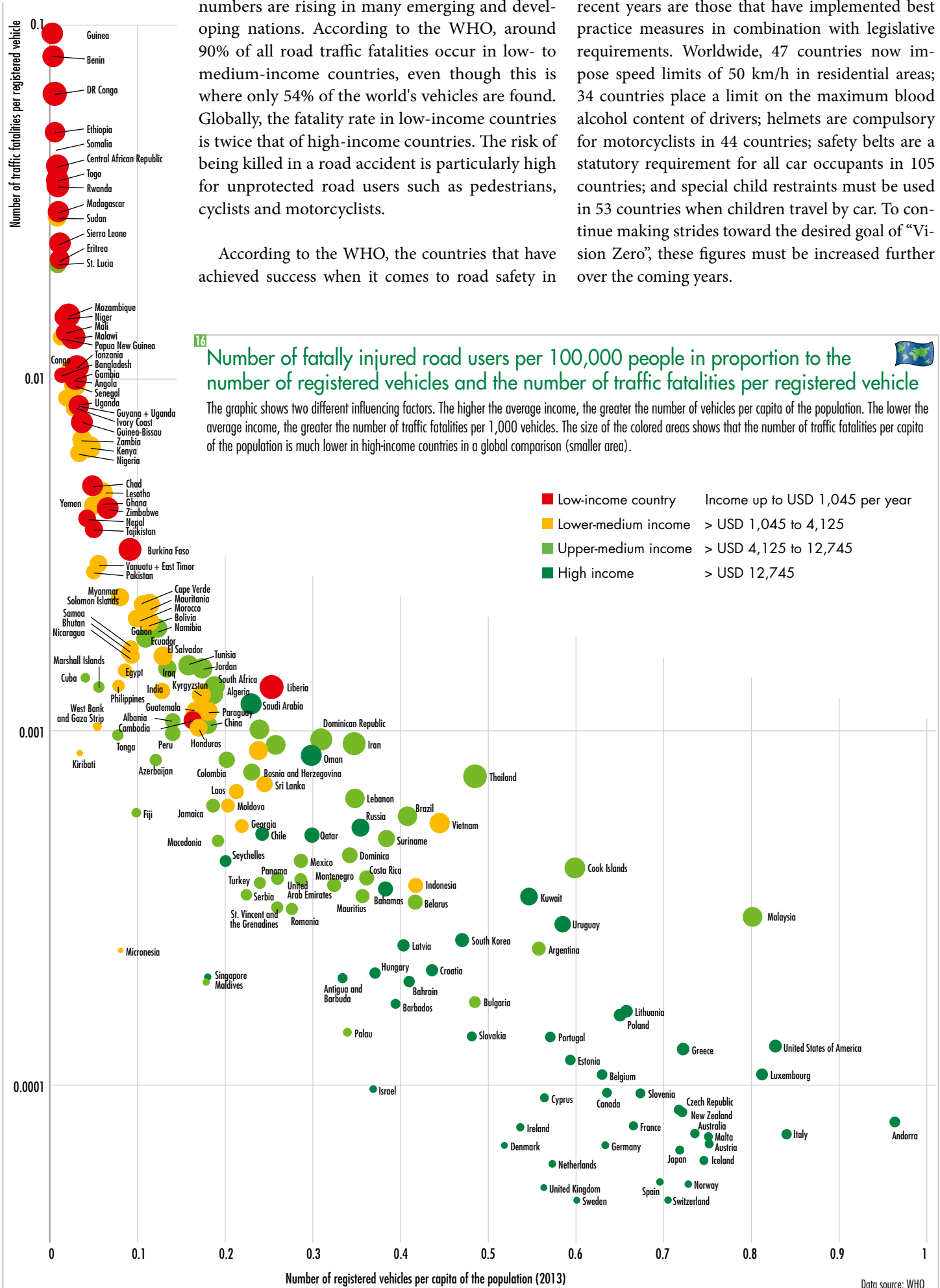
numbers are rising in many emerging and developing nations. According to the WHO, around 90% of all road traffic fatalities occur in low- to medium-income countries, even though this is where only 54% of the world's vehicles are found. Globally, the fatality rate in low-income countries is twice that of high-income countries. The risk of being killed in a road accident is particularly high for unprotected road users such as pedestrians, cyclists and motorcyclists.

According to the WHO, the countries that have achieved success when it comes to road safety in

recent years are those that have implemented best practice measures in combination with legislative requirements. Worldwide, 47 countries now impose speed limits of 50 km/h in residential areas; 34 countries place a limit on the maximum blood alcohol content of drivers; helmets are compulsory for motorcyclists in 44 countries; safety belts are a statutory requirement for all car occupants in 105 countries; and special child restraints must be used in 53 countries when children travel by car. To continue making strides toward the desired goal of "Vision Zero", these figures must be increased further over the coming years.

16 Number of fatally injured road users per 100,000 people in proportion to the number of registered vehicles and the number of traffic fatalities per registered vehicle

The graphic shows two different influencing factors. The higher the average income, the greater the number of vehicles per capita of the population. The lower the average income, the greater the number of traffic fatalities per 1,000 vehicles. The size of the colored areas shows that the number of traffic fatalities per capita of the population is much lower in high-income countries in a global comparison (smaller area).





DEKRA Vision Zero – Interactive Map

“Vision Zero” – this term is often used when it comes to the qualitative description of road safety. The concept of this strategy, which was originally developed in Sweden, means 100% safe arrivals, zero fatalities. Overall, we are still a relatively long way away from realizing this vision. Even so, it is no utopia. Many towns and cities have achieved this aim in recent years in Europe as well as in the United States and Japan. DEKRA has created an interactive map of the findings, which can be found at www.dekra-vision-zero.com. For this reason, the accident statistics available from a wide range of countries are continually being evaluated. Data is currently available from almost 2,500 cities in 22 countries across Europe, North America and

Asia. This data shows that 922 towns/cities with over 50,000 inhabitants recorded at least one year with zero traffic fatalities between 2009 and 2015, while 16 towns/cities recorded six or seven years with zero traffic fatalities. For towns/cities with over 100,000 inhabitants, the figures since 2009 are as follows: 193 towns/cities recorded at least one year with zero traffic fatalities between 2009 and 2015 and three towns/cities recorded five years with zero traffic fatalities. And in towns/cities with over 200,000 inhabitants, 29 towns/cities recorded at least one year with zero traffic fatalities between 2009 and 2015 and three towns/cities recorded four years with zero traffic fatalities.



Largest towns/cities with zero traffic fatalities in at least one year from 2009 to 2015



Belgium	Elsene	82,202
Germany	Aachen	260,454
Finland	Espoo	259,383
France	Le Havre	177,259
Greece	Larissa	145,981
Italy	Reggio di Calabria	185,577
Japan	Yotsukaichi	305,840
Lithuania	Alytus	54,437
Luxembourg	Luxembourg	103,641
Netherlands	Almere	193,163
Norway	Stavanger	199,237
Austria	Salzburg	150,887
Poland	Zielona Góra	117,253
Serbia	Čačak	113,383
Slovenia	Maribor	94,984
Spain	L'Hospitalet de Llobregat	253,782
Sweden	Uppsala	140,454
Switzerland	Lausanne	127,821
Czech Republic	Olomouc	100,233
Hungary	Szombathely	79,534
USA	Alexandria (VA)	148,892
United Kingdom	Wandsworth	308,304

Data source: DEKRA

The Facts at a Glance

- The fundamentally positive trend in the occurrence of traffic accidents in the EU may not be enough to achieve the stated objective of halving the number of traffic fatalities between 2010 and 2020.
- Across the EU, on average around 8% of all fatalities occurred on highways in 2016, with 37% occurring in urban areas and 55% on country roads.
- Statistically, for every traffic fatality that occurs, a great many more people will suffer severe, often life-changing injuries.
- In Germany, the number of traffic fatalities reached its lowest level for over 60 years in 2016.
- In the USA, the number of traffic fatalities in 2016 increased to over 40,000. Drivers being distracted by smartphones is a particularly big problem there.
- With 1.25 million traffic fatalities per year worldwide, road safety work remains a global challenge.
- According to the WHO, around 90% of all road traffic fatalities occur in low- to medium-income countries, even if this is where only 54% of the world's vehicles are found.

Compelling Examples of Accidents in Detail



1 Course of the accident
2 Marks on the tree
3+4 The vehicle involved in the accident



Example 1 – Accident

INFLUENCE OF ALCOHOL

Sequence of events:

Due to excessive speed in combination with tires worn down to the minimum tread depth of 1.6 mm, the drunk driver of this car lost control of his vehicle on a wet road while negotiating a long right-hand bend. The car skidded off the left-hand side of the road, and the B-pillar and right rear door collided with a tree next to the road.

Vehicle:

Car

Consequences/injuries:

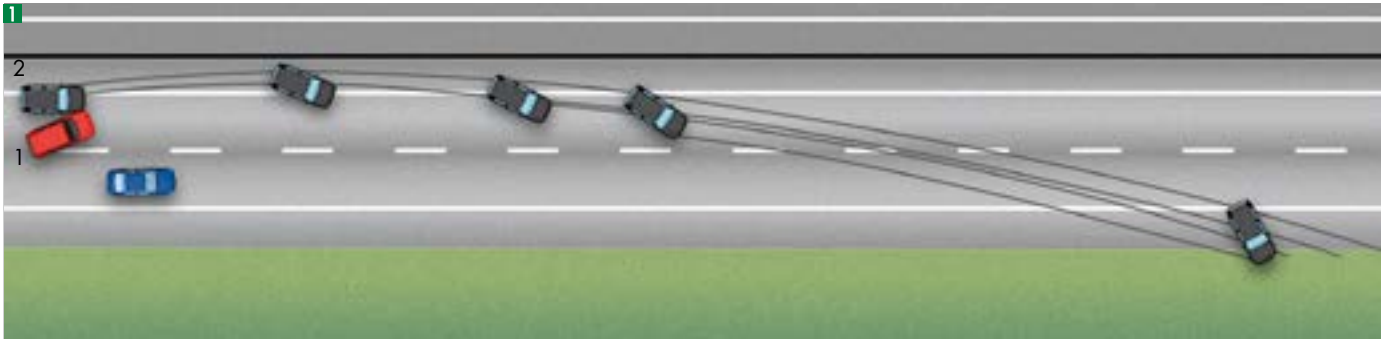
The driver suffered minor injuries, his two passengers suffered serious injuries.

Cause/problem:

Influence of alcohol; excessive speed; insufficient tire tread depth

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- Not driving under the influence of alcohol.
- Keeping within the speed limit and drive in a manner appropriate for the road and weather conditions.
- Making sure that your car is fitted with high-quality tires with sufficient tread depth.
- ESP could have prevented the accident within the limits of what is physically possible or reduced the severity of the consequences.



Example 2 – Accident

SAFETY BELT

Sequence of events:

The driver of a car (1) started to overtake on the highway but failed to indicate in time her intention to change lane by operating the turn signal and did not notice the car traveling next to her (2). This resulted in a collision; the driver of car 2 lost control. Car 2 then collided with other vehicles before skidding off the right-hand side of the road. The vehicle rolled over three times in the embankment and field adjacent to the road.

Vehicles:

Multiple cars

Consequences/injuries:

The driver of car 2, who was wearing a safety belt, suffered minor injuries; his passenger, who was not wearing a safety belt, was thrown out of the car and died of his injuries in hospital.

Cause/problem:

Mistake by the driver of car 1 when attempting to overtake. Passenger in car 2 not wearing a safety belt.

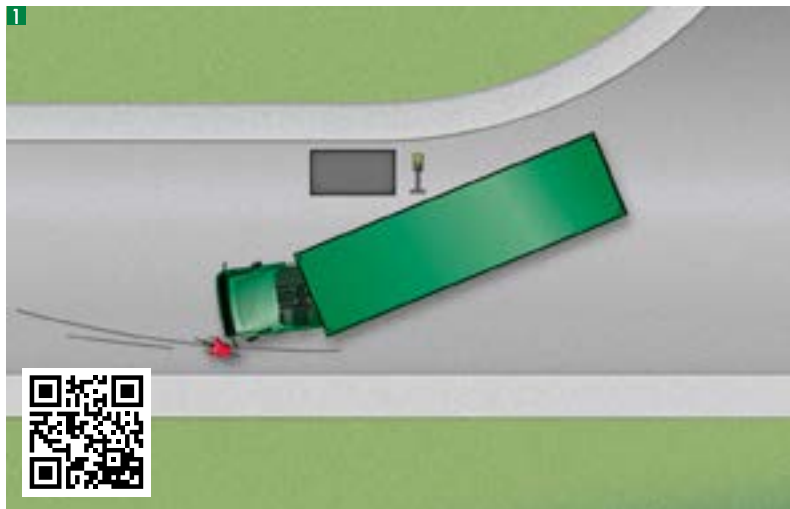
Avoidance measures, mitigation of consequences/strategy for road safety measures:

- The accident could have been prevented if, before attempting to overtake, the driver of car 1 had checked the traffic situation behind her car, operated the turn signal in time and glanced over her shoulder.
- In situations like this, a lane change assist system could have prevented the accident.
- Had the passenger in car 2 been wearing his safety belt, he would also have most likely survived with minor injuries.



1 Course of the accident
2 Evidence of the accident

3 Belt buckle
4+5 Final position of car 2



Example 3 – Accident

CYCLING WITHOUT LIGHTS

Sequence of events:

The driver of a semitrailer tractor with tipper was waiting at a roadworks traffic light at night in a built-up area. A cyclist approached from the left and rode past the truck. When the lights turned green, the truck set off. To drive around the traffic lights, which were positioned on the road, and past the roadworks, the driver steered left. During this maneuver, the front left corner of the truck collided with the cyclist. The cyclist was then run over by the truck, suffering fatal injuries. The bicycle's lights were defective, and the cyclist was wearing dark, low-contrast clothing. For the truck driver, the cyclist would have been only fleetingly visible in the wide-angle mirror.

Vehicles:

- Bicycle
- Semitrailer tractor

Consequences/injuries:

The cyclist was fatally injured.

Cause/problem:

Riding past the truck at an unsuitable place; defective bicycle lights; dark, low-contrast clothing worn by the cyclist; large areas insufficiently visible or invisible from the truck.

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- Not passing vehicles at unsuitable places.
- Ensuring your own safety by making sure that your bicycle lights work and are on and by wearing high-visibility, contrasting clothing.

1 Accident
 2 Evidence of the accident
 3+4 Bicycle
 5 Final position of the truck

Example 4 – Accident

COLLISION WITH A TREE

Sequence of events:

While negotiating a right-hand bend at excessive speed, a car driver ended up on the wrong side of the road. The driver then countersteered with excessive force, causing the car to lose stability and end up on the unpaved verge. The driver again attempted to countersteer, this time causing the car to skid. The rear right door area of the car collided with a tree next to the road. The rear head airbag, which was also deployed, was of no use to the child strapped into the child seat because, due to the small size of the child, the child slipped through under the airbag.

Vehicle:

Car

Consequences/injuries:

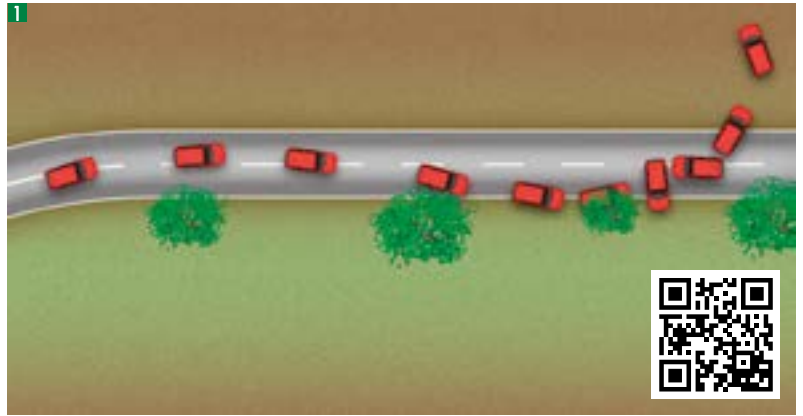
The child in the rear seat on the right was killed when the car collided with the tree. The driver and his passenger suffered serious injuries.

Cause/problem:

Inappropriate speed. Inappropriate reactions by the driver

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- Keeping within the speed limit and drive in a manner appropriate for the road and weather conditions.
- Within the limits of what is physically possible, ESP could have helped to avoid the accident or reduce the severity of the consequences.
- No trees directly next to the road; installing protective systems on existing trees.



1 Course of the accident

2 Scene of the accident

3+4 Final position of the vehicle

Example 5 – Accident

MOTORCYCLE

Sequence of events:

A motorcyclist braked excessively while entering a left-hand bend. As he began to steer into the curve, he released the brake, at which point the motorcycle suddenly jolted upright before tipping to the right. The motorcycle and motorcyclist then skidded along the road until the motorcyclist collided with the post supporting a curve marker sign. The motorcyclist became entangled with the pole before coming to rest directly behind it. The motorcycle skidded into the field behind.

Vehicle:

Motorcycle

Consequences/injuries:

The motorcyclist died from his injuries at the scene.

Cause/problem:

Rider error and excessive speed in combination with critical infrastructure design

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- The motorcyclist should have reduced his speed.
- Curve-capable ABS (ASC).
- Rider safety training in order to better understand how a motorcycle responds in critical situations.
- Yielding curve marker signs
- Although the newly planted trees at the scene of the accident help road users to see earlier how the road curves, they will in a few years constitute deadly obstacles.



1 Accident

2 Damaged post supporting the curve marker sign

3 Evidence of where the motorcycle left the road

4 Final position of the motorcycle

6 Evidence of where the motorcycle left the road

Example 6 – Crash tests

CURVE MARKER SIGN

Crash tests:

Two motorcycles were each crashed at a speed of 60 km/h against two different curve marker sign systems. In both cases, the Hybrid III crash test dummy representing the rider was wearing full protective clothing. In the first test, the dummy motorcyclist collided – as in the previous crash example – with a conventional marker sign post made from steel; in the second test, the dummy motorcyclist collided with a post on which a marker sign made from plastic was mounted. Most guide posts in Germany are made from plastic. The ones used in the test had a conventional shear-off attachment, with which they are connected to the foundation in the ground. In the event of a collision, the post becomes separated from the attachment without causing significant material damage or personal injury. After an accident, the post can generally be reinserted for further use.

Vehicle:

Motorcycles

1 Top view of the scene of the collision

2–5 Crash test with steel post

6–9 Crash test with plastic post

Note: 2–9 are mirrored for clarity



Crash test results:

Steel posts: The measured stress values were well above the biomechanical limits. The shoulders, chest and head were subjected to extreme forces. No human could survive a crash like this.

Plastic posts: All measured values were in the noncritical range, well below the biomechanical limits. Provided no follow-on collision occurs (e.g. against a tree), a crash like this would be survivable.

Strategy for road safety measures:

Safety-oriented roadside design must form a key part of road planning and maintenance.





Example 7 – Accident

TECHNICAL DEFECT

Sequence of events:

A motorcyclist was riding along a main road when he lost control of his motorcycle while taking a left-hand bend. Prior to this, the motorcyclist had not noticed that engine oil was leaking. While he was traveling along, some of the oil ended up on the rear wheel. This caused the tire to lose grip, causing the motorcycle to roll from side to side and then skid off the right-hand side of the road. The motorcycle collided with an obstacle, and the motorcyclist was thrown into the roadside ditch.

Vehicle:

Motorcycle

Consequences/injuries:

The motorcyclist was fatally injured.

Cause/problem:

A technical inspection revealed technical defects, severe enough to cause the accident, in the area of the engine block. A loose bolt and an incorrectly applied seal resulted in an oil leak. The oil ended up on the rear wheel.

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- Using suitable spare parts and ensuring that they are correctly fitted in a specialist workshop.
- Conducting regular checks of the vehicle's technical condition and ensuring that the vehicle is serviced regularly.
- Visual inspection before setting off.

1 Diagram of the oil leak

2 Final position of the motorcycle/damage

3 Detail: rear wheel exhibiting traces of liquid

4 Overview: final position of the motorcyclist and final position of the motorcycle

5 Oil supply line: bolt and seal set used on the motorcycle

6 Oil supply line: bolt and original seal set

Example 8 – Accident

SAFETY VEHICLE

Sequence of events:

The driver of a trailer truck was driving along the highway in the right-hand lane, but failed to react in time to a traffic guidance trailer that had been put in position by the highway maintenance authorities and was easily visible from a distance. The trailer truck crashed into the guidance trailer. The truck was deflected to the left and crossed the middle and left-hand lane. The central crash barrier prevented the trailer truck from ending up on the wrong side of the highway.

Vehicles:

Trailer truck

Tipper truck with warning sign trailer

Consequences/injuries:

The driver of the trailer truck died from his injuries at the scene.

Cause/problem:

Unknown; the vehicle showed no signs of relevant technical defects.

Avoidance measures, mitigation of consequences/strategy for road safety measures:

- Drivers must ensure that they concentrate on the road and traffic.
- High-performance emergency braking systems in the truck could help to prevent such accidents entirely or at least significantly mitigate the effects of an accident.
- Deformation elements on warning sign trailers absorb a huge proportion of the energy introduced, thereby protecting the occupants of the impacting vehicles as well as any persons in the secured area.



- 1 Accident
- 2 Scene of the accident
- 3+4 Damaged warning sign trailer
- 5 The articulated truck that caused the accident



Greater Risk Awareness Urgently Required

Driving under the influence of alcohol, excessive speed, getting distracted by smartphones and other electronic communication systems, and lots more: The human factor plays a key role in road accidents. Almost 90% of accidents in Europe can be attributed to human error, which means that efficient measures aimed at eliminating this problem are indispensable. As much as vehicle technology and road infrastructure can help to prevent risky situations from arising in the first place or mitigate the consequences of accidents, the most important factor is the human factor: Responsible behavior, a proper assessment of one's own capabilities and a high level of acceptance of rules among all road users are absolutely essential.

The numbers are worrying: According to the National Highway Traffic Safety Administration (NHTSA), one person is killed on US roads every 51 minutes in accidents in which one road user had a blood alcohol concentration of 0.8 or more. In 2015, the total number of traffic fatalities in the USA was almost 35,100, 10,265 of whom – that is, almost 30% – were killed in accidents in which alcohol was a factor (blood alcohol concentration of 0.8 and more). While this percentage sank continuously between 2006 and 2011, it has since remained at roughly the same level.

And things don't look much better in other countries either. According to the World Health Organization (WHO), and insofar as national figures are available, this black list is headed by South Africa with 58%, followed by Uruguay with 38% and Vietnam with 34%. In the EU, drunk driving was responsible for around 6,500 deaths in 2015 – that's around 25%. The differences between the figures among the individual member states are rela-

tively large. In 2015, Germany recorded 256 deaths caused by drunk driving (7.4%), while France recorded 866 (25%). In Estonia and Latvia, however, almost one in two traffic fatalities was the result of drunk driving.

PRIMARY PREVENTION THROUGH ALCOHOL INTERLOCKS

For several years now, various countries have made attempts to introduce a technical solution to prevent alcohol-related accidents: the alcohol interlock, an immobilizer that is built into the car and allows the engine to be started only when the driver has given a breath sample containing no trace of alcohol. This system helps to prevent drunk-driving by stopping people who have consumed alcohol from being able to start the engine in the first place.



Alcohol interlocks are currently used worldwide for primary and secondary prevention purposes. One example of primary prevention by means of

BEST PRACTICE



Greater safety thanks to alcohol interlocks: An immobilizer allows the engine to be started only after the driver has successfully passed a breathalyzer test.

alcohol interlocks is offered by a Dutch transport company, which has had breath-alcohol-controlled immobilizers installed in all vehicles as a way of enforcing a zero-tolerance policy toward alcohol among its drivers. The working conditions of truck drivers in particular, who carry out their duties under intense time pressure and frequently alone, can put them at risk of using alcohol to “switch off” during rest periods. If people drink more alcohol in the evening, they often underestimate how long it takes for the alcohol to be metabolized in the body, which means that they may still have residual alcohol in their blood the next morning. Despite initial skepticism among some of the company’s drivers who felt that they were being watched, immobilizers have become standard and helped to promote a more responsible attitude toward alcohol than before. In addition to direct improvements for the safety of the drivers and other road users, the logistics company has also seen business benefits thanks to less vehicle damage, which, in turn, is advantageous in the company’s dealings with its insurance company.

POSITIVE EXPERIENCES FROM FINLAND



Alcohol interlocks act as a secondary prevention measure when they are installed in the vehicles of known drunk-drivers, that is, as part of “offender” programs for drivers who have been stopped or convicted for drunk-driving. Such programs are currently in place in the USA, Canada and Australia as well as in some European countries (Finland, Sweden, Norway, Denmark, Belgium, France and Poland and as a research project in Austria).

In a report published in 2013, the Finnish traffic authorities detailed their experiences with the alcohol interlock program (Figures 17 and 18). In the period under analysis (2008-2012), an alcohol interlock had been fitted in the vehicles of 1,687 drivers. Once a driver has been convicted of drunk-driving, a court decides upon a “probation period” of one to three years with the alcohol interlock; in Finland, the costs of €110 to €160 per month are paid by the convicted person themselves.

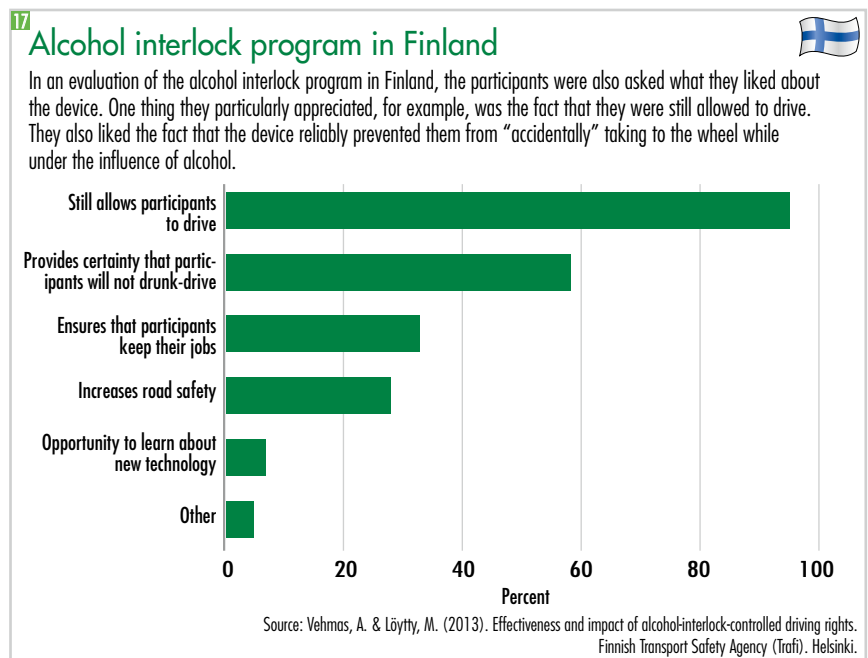
The parameters are adjusted in line with the application in question and according to the statutory requirements in the countries in which alcohol interlocks are used. In Finland, for example, the interlocks have been calibrated such that they prevent the engine from being started when a blood alcohol concentration of 0.2 or more is detected. This tolerance range is necessary because eating certain

foods can cause the body to produce small amounts of alcohol without any alcohol actually having been drunk. When the engine is turned off, it can be restarted within five minutes without the driver having to provide another breath sample.

If a participant fails to stick to the rules of the alcohol interlock program, for example by driving a car that is not specified on their driver’s license, attempting to manipulate the alcohol interlock or driving another vehicle under the influence of alcohol, they will have their driver’s license withdrawn. This is also the case if the participant decides that they no longer want to take part in the program. Of the more than 19,000 people convicted of

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“Offender” program: alcohol interlock programs help drivers who have been caught or convicted for drunk-driving and help prevent drunk-driving in general.



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Therapeutic psychological support reduces recidivism rates (drunk-driving re-offenders).

drunk-driving in Finland in 2012, 511 volunteered to take part in the alcohol interlock program. As a sign of the program's success, just 5.7% of all participants were re-arrested for drunk-driving either during or after the end of their "probation period." This form of legal probation is therefore much more effective than for drunk-drivers without an alcohol interlock, of whom 29% to 30% in Finland re-offend. Twenty-four people died while the alcohol interlock was in use, with 37.5% of deaths the result of alcohol poisoning and alcohol-related illness.

TRAFFIC THERAPY SUPPORT FROM PSYCHOLOGISTS



To ensure that any changes in people's behaviors toward healthy, responsible alcohol consumption or even teetotalism are as long-lasting as possible and

remain effective even after the alcohol interlock has been removed, therapeutic support from psychologists is essential, as a 2016 study from Florida clearly shows. The researchers headed by Robert Voas compared alcohol interlock users who were simultaneously receiving a therapeutic intervention with interlock users who were not. They demonstrated that, among the group receiving a therapeutic intervention, the recidivism rate – i.e. drunk-driving re-offenders – was 32% lower than in the group not receiving a therapeutic intervention. The authors estimate that they have prevented 41 rearrests, 13 accidents and 9 accident injuries following removal of the alcohol interlock among the 13,458 alcohol interlock users receiving support.

Another important criterion for a successful alcohol interlock program is that the data stored in the device is also evaluated so that, for example, repeated unsuccessful attempts to start the engine can be discussed with the user. This requires a trained person who acts as an interface between the device manufacturer, the controller – e.g. the driver's license authorities – and the user. Repeated unsuccessful attempts to start the engine on a Monday morning, for example, would indicate that the person in question is not aware of the problem of residual alcohol. Awareness-raising and behavior-changing measures with the support of a traffic psychologist would certainly prove useful here.

Gunnar Meinhard

Head of the Traffic Behavior Development Center and adviser to the Estonian authorities in matters of road safety



Efficient Rehabilitation Courses for People Stopped for Drunk-Driving

In the SUPREME study, which dates back to 2007, one demonstrably effective method of improving road safety was the introduction of rehabilitation courses run by traffic psychologists for motorists who had been caught drunk-driving.

In Estonia in 2011, following the adoption of the road traffic act (Ls Section 100 lg. 6), a program was launched in which novice drivers stopped for drunk-driving were offered courses in "correct" driving. These courses are designed to have a long-term effect and offer added value for the target group.

The Estonian Police and Border Guard Board, which over the course of three years had evaluated the results of the program for novice drivers, decided in 2014 and 2015 and as part of a pilot program to offer 300 drunk-drivers who had been convicted of breaking the law – i.e. who had recorded up to 0.74 mg/l in their breath or recorded a blood alcohol concentration of 1.5 – the opportunity to take part in this program, regardless of their level of driving experience.

Within 18 months of the program ending, only 7.5% of the course

participants had been caught again drunk at the wheel. In 2016, following minor amendments to the law, the program was rolled out nationwide to all drivers stopped for drunk-driving. As motivation to take part in the program, the court-imposed fines were waived, although participants would have to pay to take part in the program. The program must be completed within ten months of the participant having been caught driving under the influence of alcohol.

In fall 2016, the Estonian Ministry of Justice teamed up with the department of public prosecution to launch a project offering even first-time drunk-driving offenders with high alcohol levels at the wheel (0.75 mg/l to 1.00 mg/l in their breath or a maximum blood alcohol concentration of 2) the opportunity to take part in the rehabilitation courses in "correct" driving. Since this target group is also considered to be a "complicated" target group, psychiatric clinics, laboratories and legal advisers are also involved in the project. Time will tell whether this project is successful.

The result of a DEKRA-supported study into the introduction of an alcohol interlock program in Germany included proposals for accompanying therapeutic measures. After an initial diagnosis and a preliminary consultation with the traffic psychologist before the alcohol interlock is installed, six two-hour consultation sessions should take place over a six-month period, supported by a range of exercises taking place between the consultation sessions (intersession work). In addition to the educational content, the sessions should also involve an analysis of the alcohol interlock results, including discussion of any areas of concern in relation to the alcohol interlock data, the self-monitoring/drink logs and the lab-based parameters.

LEGISLATIVE MEASURES AND MONITORING

To monitor compliance with the rules as part of road safety measures, different approaches – or "enforcement" measures – are used worldwide. One way of ensuring that drivers do not exceed alcohol limits and are drug-free while behind the wheel is "road-side testing", whereby all drivers – whether or not

their driving was otherwise erratic or suspicious – are tested in a police check for alcohol or drugs. To increase the monitoring intensity, these controls are carried out on a regular basis.

The effectiveness of toxicological testing of all drivers in roadside checks is especially evident in Australia, where roadside testing has been carried out since the 1980s. To combat drunk-driving, the Australian authorities can perform breath alcohol analyses on every driver. Such analyses are called “random breath tests” and can be performed using mobile or stationary equipment. In mobile tests, a police officer in a car stops drivers and makes them blow into an analysis device. It does not matter whether or not the driver was driving erratically, smells of alcohol or has caused an accident. To perform random testing, the police do not require any initial suspicion. In temporary stationary tests, “checkpoints” are set up on the roadside. Every driver who passes this checkpoint has to take an alcohol test.

The widespread use of alcohol tests in Australia has prompted drivers to change their drinking habits. In a study conducted in 2011, 80% of Australians surveyed said that, over the past six months, they had observed these alcohol tests taking place. For comparison, a European survey conducted in 17 countries in 2015 revealed that only 19% of respondents had undergone alcohol testing over the last 12 months and that just 4% had been tested for drugs over the last 12 months.



Testament to the success of random breath tests is the Australian state of New South Wales, where alcohol checks were introduced back in December



■ Alcohol checks in the Netherlands

1982. In the program’s first year, almost one million breath alcohol tests – that’s one for every three drivers – were conducted. In 1987, more than 50% of all drivers in Sydney had been tested for alcohol once. The result was a drop in alcohol-related accidents – whether fatal accidents or single-car nighttime accidents. The number of fatal accidents initially fell by 48%, serious accidents by 19% and single-car nighttime accidents by 26%. This measure also had an impact on drivers’ attitudes. Five years after random breath tests were introduced, drivers said that they made arrangements not to drive on occasions when they knew they would be drinking. In addition, drunk-driving was seen as criminal and irresponsible. By 2012, an estimated 85 million breath tests had been performed and 545,000 drivers had been reported for drunk-driving. This allows the conclusion that around 7,000 lives have been saved since alcohol tests were introduced in 1982.

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Random alcohol checks in Sydney have reduced the number of fatal alcohol-related accidents by 48%.

Some years ago, Brazil adopted a much more hardline approach to combating the many fatalities on its roads. In June 2008, the “Lei Seca” (dry law) was enforced, which imposes a strict alcohol ban for motorists – with no tolerance range. The minimum penalty for anyone caught violating the law is a fine of almost €400 and the revoking of their driver’s license for one year. Anyone drunk-driving is already committing a crime, which could be punished with up to three years in jail. And if a drunk-driver causes a fatal accident, they are punished in the same way as murderers and rapists – in the worst case, they could face up to 20 years in jail.

However, the effectiveness of the law is hotly debated among experts. Standardized and reliable figures on alcohol-related traffic fatalities in Brazil are almost impossible to come by. The fact that the overall number of traffic fatalities increased from almost

■ Alcohol interlocks: To be able to start the engine, drivers must provide a quick and easy breath alcohol sample.



37,600 in 2009 to almost 45,000 in 2012, however, suggests that the percentage of alcohol-related traffic victims has also increased. Even as recently as 2014, more than 43,000 people were killed on Brazil's roads. According to the Associação Brasileira de Estudos de Álcool e Outras Drogas, alcohol plays a role in 61% of accidents and as much as 75% of fatal accidents. The figures suggest that the Brazilian police needs to further increase the intensity of checking and surveillance measures in order to improve the effectiveness of the "Lei Seca."

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"Avtorevost" (which translates roughly as sobriety at the wheel) is a pilot project launched in Russia in which a 90-minute interactive training unit educates people about the dangers of drunk-driving.

EU member states have also responded. On July 1, 2015, France reduced the permissible blood alcohol concentration for drivers under the age of 25 from 0.5% to 0.2%. This measure was not without reason: In 2015, young drivers in France aged between 18 and 24 accounted for one quarter of all drunk-drivers involved in fatal accidents.

TARGETED EDUCATION OF RISK GROUPS

Another method of preventing alcohol-related accidents is to provide targeted education measures for risk groups. In Portugal, for example, campaigns have been conducted since 2013 at areas where students are known to gather in an effort to stop them from drunk- or drug-driving. A team of volunteers travels around at night and educates young people about the dangers of drunk-driving. The students are encouraged to take a breath test, and drivers with no alcohol in their system earn a reward. In response to the high number of accidents involving tractors, another Portuguese awareness-raising campaign targeted farmers, warning them of the dangers of drunk-driving. Again, alcohol analyses were used, which met with a positive response from participants.



In another example of targeted risk awareness-raising, 67 driving schools in the Smolensk region of Russia introduced the "Avtorevost" (which translates roughly as sobriety at the wheel) training module as a pilot project. Here, learner drivers can volunteer to attend a 90-minute interactive training unit on the subject of drunk-driving. This module looks at statistics, the risks associated with driving under the influence of alcohol, the legal consequences and the various police initiatives that have been launched to combat drunk-driving. This project aims above all to change people's attitudes toward driving under the influence of alcohol by making participants even more aware of the risks. The project also aims to decrease society's tolerance toward drunk-driving among the population. In 2015, 34% of people surveyed in Smolensk said that drunk-driving was a regular feature of everyday life; nonetheless, this figure is 12% down on the previous year.

Dr. Walter Eichendorf

President of the German Road Safety Council (DVR)



Public Campaigns for Improved Road Safety

Educational prevention campaigns are integral to efforts aimed at improving road safety. Ideally, they attract people's attention, convey knowledge and raise awareness of a problem. They are designed to induce safety-conscious behavior among road users. The road safety campaign "Runter vom Gas" ("Ease off the gas"), which was launched in 2008 by the Federal Ministry of Transport and Digital Infrastructure (BMVI) and the German Road Safety Council (DVR), encompasses a range of measures to improve road safety such as standard awareness-raising work, extensive media work, PR campaigns and special events.

The prevention campaign puts the spotlight on all of the myriad accident causes and risks. In addition to excessive speed, these include above all driver distraction, dangerous overtaking maneuvers, reckless tailgating and driving under the influence of alcohol. The campaign

also focuses on the importance of wearing motorcycle helmets and of mutual respect among all road users. The campaign is aimed above all at young people and bikers.

The campaign website offers all the latest news, surveys, interviews, numerous films and a wealth of material that you can order or download, including for multipliers. Around two thirds of all Germans are aware of the campaign, many by having seen the huge boards erected along the side of Germany's Autobahns. In addition to direct appeals to the population through safety messages, the indirect and social effects of this nationwide campaign are important because placing the emphasis on desirable behaviors turns "risk groups" into outsiders in society. The campaign also provides ongoing opportunities for the media to report more broadly on the subject of road safety and, in turn raise the necessary awareness of the problem.

HIGH RISK OF ACCIDENTS THROUGH SMARTPHONE USE AT THE WHEEL

For many years now, the use of smartphones at the wheel has become an increasing risk to road safety. As a study conducted by the Allianz Zentrum für Technik (AZT) and published in November 2016 showed, one in ten fatal accidents in Germany is caused by drivers being distracted by their smartphones, navigation systems or other in-vehicle technology. In 2015, 3,277 fatal accidents were recorded in Germany, meaning that almost 330 of these victims will have died through being distracted at the wheel.

According to the National Highway Traffic Safety Administration (NHTSA), the figures are at a

similarly high level in the USA, too, where almost 10% of traffic fatalities in 2015 were a result of driver distraction (in figures: 3,477 of a total of 35,092). A study published in early 2016 by a team of traffic researchers headed by Thomas Dingus from the Virginia Tech Transportation Institute (VTTI) also gave cause for alarm. The team fitted more than 3,500 cars belonging to people aged 16 to 98 with cameras, sensors and radars that recorded not only the vehicle data but also driver behavior. Over a period of three years, the “test subjects” caused 905 accidents resulting in personal injury or material damage. 88% of these could be attributed to human error.

The fact that driver distraction can, from a purely mathematical point of view, have similarly grave consequences as “microsleeps” can be seen in the following example: When a car is traveling at 80 km/h and the driver is distracted for five seconds by, say, an incoming text message and is unable to respond to what’s happening on the road ahead, in that time the vehicle covers a distance of 111 meters without the driver being fully in control.

Given this problem, the installation in vehicles of driver assistance systems that can potentially mitigate the consequences of accidents caused by driver distraction – for example, lane keeping assist, distance control systems and emergency braking systems – should be promoted, a view also shared by DEKRA’s accident researchers. Road safety experts in Germany are also urgently calling for “distraction” to be included as a cause of accidents in Germany’s accident statistics, as has been the case for many years now in, among other countries, the USA, Austria and Switzerland.

Something else worth considering in this context is a recommendation proposed in fall 2016 by the US National Highway Traffic Safety Administration (NHTSA), whereby smartphones should be equipped with a simplified user interface that is activated as soon as the device is connected to the vehicle. According to the NHTSA, this approach could involve extra-large buttons and fonts or reduced functionality – for example, the disabling of the Internet browser and social media apps while the vehicle is in motion. Nowadays, it is possible to buy in-vehicle systems that can be programmed so that certain cellphone functions are automatically disabled during driving. These systems have already been installed in, for example, numerous company fleets to stop employees from getting themselves into life-threatening situations while they are on the road.



■ Udo Weiss, Head of the Transport Directorate of the police in Münster, Germany, presents the shocking banner “Die letzte SMS” [“The Last Text Message”].

That many countries in the world have long identified driver distraction as a problem can be seen in all the public awareness-raising campaigns that various institutions are always launching, featuring sometimes shocking photos and videos. The need for such campaigns – along with road safety education in schools, driving schools and companies – as a means of raising awareness of the road safety risks associated in particular with driver distraction seems to be more urgent than ever.

ROAD SAFETY EDUCATION IS THE BEST PREVENTION



The most important and effective measure, however, is continuous road safety education – from our very earliest years to the end of our lives. Indeed, as early as 1997, the Ministère des Transports/Directorat Sécurité Routière in France developed the concept of “continuum éducatif,” whereby road safety education is seen as an ongoing process that extends across all phases of our lives – family, school, when we start taking driving lessons, throughout our professional career and into our retirement. Since most accidents can be attributed to inappropriate behavior and/or responses, road safety education should take into account individual behavioral aspects regardless of a person’s age or level of education.

A variety of programs aimed above all at young people have been available in many EU member states for years now. A couple of examples: An integral part of the curriculum of schools in Belgium are “De Grote Verkeerstoets” and “Het Grote Fietsexamen” with special tests on road traffic behavior and cycling proficiency for children aged up to 12 years old. The response has been overwhelming: In 2016, al-

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Improved safety through ongoing road safety education taking into account individual behavioral aspects regardless of a person’s age or level of education.



■ DEKRA campaign raising awareness of children's safety on the way to school



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Driver training courses help participants to identify hazardous situations and respond quickly and appropriately.

most 45,000 schoolchildren nationwide took part in these two programs.

Another road safety education measure in a broader sense was the “Truckveilig Charter”, which was launched in 2012 by the Belgian Flemish Government and is aimed at transport companies and truck drivers. Anyone who signs this charter obligates themselves to implement at least seven road safety action points of their own choosing every year. These action points could include, to name just a few, adopting a more anticipatory driving style with the appropriate speed and sufficient distance from the vehicle in front, making sure that the mirrors are set correctly, complying with driving and rest periods or taking part in training sessions. Anyone who can prove after a few months that they have met these obligations receives the “Truckveilig Charter” label. The declared aim of this measure is to raise awareness of safety within the industry.

One example from Brazil is the “Maio Amarelo” (“Yellow May”) campaign launched by the Brazilian Observatório Nacional para Segurança no Trânsito (national road safety authorities) to prevent road accidents. The title of this campaign, which is aimed at all road users, refers to the month in which the United Nations launched the “Decade of Action for Road Safety” in 2011. May is also the month in

which “Pedestrian Safety Week” is celebrated worldwide. The vivid color of yellow symbolically refers to road warning signs.

DRIVER TRAINING COURSES RAISE PEOPLE'S AWARENESS OF HIGH-RISK SITUATIONS

Another important measure for increasing road safety is driver safety training. After all, whether you are a beginner driver, a professional driver or an elderly person, whether you drive a car or truck or ride a motorbike, nearly all of us have likely encountered dicey situations on the road. Somehow, the situations usually resolve themselves without incident, but hardly any of us feel truly safe when our car starts skidding on a wet road. If this results in a crash, very often the lives and health of the people involved are endangered. And we should not ignore the financial costs of a crash, either – for example, as a result of vehicle repairs, deductibles and rising insurance premiums.

One thing is clear: Even highly skilled drivers can find themselves facing a scenario like this, but driver safety training can help people to identify potentially hazardous situations and respond to them quickly and appropriately. In Germany, many professional associations and accident insurers provide financial support for driver safety training, provided that certain requirements are fulfilled. Likewise, road haulage companies operating vehicles in ex-

Accidents in Germany Caused by Driver Error

Instances of drunk-driving combined with excessive speed have fallen considerably, but excessive speed alone remains the single biggest cause of fatal accidents

According to official figures, 253,504 of the 378,156 accidents resulting in personal injury on German roads in 2015 were caused by driver error. In 1991, this figure was 378,373 instances of driver error among 510,357 drivers, a reduction of 33% (Figure 19). Instances of drunk-driving have fallen significantly (by 75% from 29,800 to 7,553). Another cause that has fallen significantly is excessive speed (by 63% from 84,380 to 31,559). A rise was seen in the number of accidents caused by the failure of drivers to maintain sufficient distance from the vehicle in front (by 5% from 37,975 to 39,982). These figures show that measures to combat drunk-driving and excessive speed in particular have helped to make roads safer.

While excessive speed used to be by far the most common single cause of driver error in accidents resulting in personal injury, it is now only the fourth most common cause. When it comes to fatal accidents, however, excessive speed is still the most common sole cause.

The success of measures to combat alcohol-related accidents is reflected not only in the figures pertaining to accidents in which car drivers were the main culprits, but also in the decrease in the number of all road users killed in alcohol-related accidents (Figure 3). In 1991, 2,229 people were killed in alcohol-related accidents; by 2015 how-

ever, this figure had fallen by 89% to 256. The number of people killed in alcohol-related accidents as a proportion of all traffic fatalities fell from 19.7% to 7.4% in the period under analysis (Figure 20).

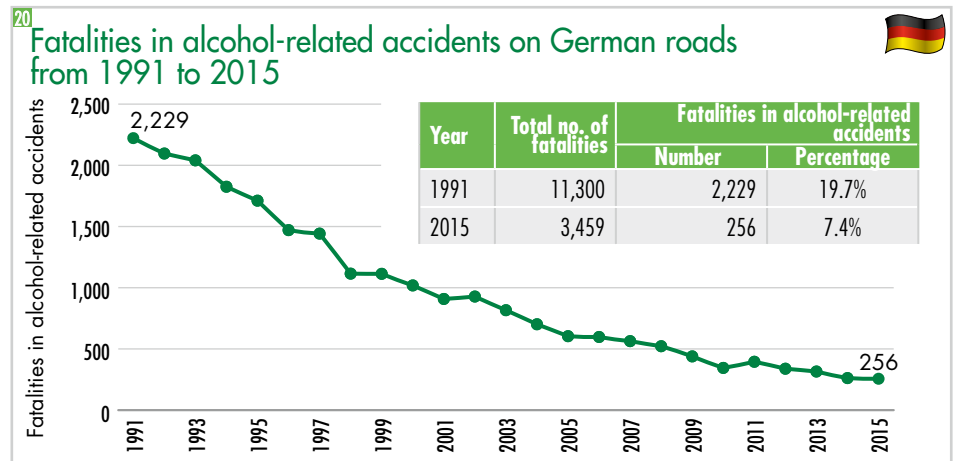
This major decline can be attributed not only to raised awareness of responsible drinking, but also undoubtedly to medical-psychological assessment (MPU). According to the current legal situation, drivers stopped by the police with a blood alcohol level of at least 1.6 or who have been stopped repeatedly for drunk-driving, have to undergo an MPU once their ban period has expired in order to demonstrate that they are once again fit to drive on the

roads. Various studies confirm that this procedure for re-issuing drivers' licenses does indeed contribute to lower levels of re-offending. This effect is also aided by the fact that, prior to an MPU, many of the persons affected have already taken measures to change their drinking habits.



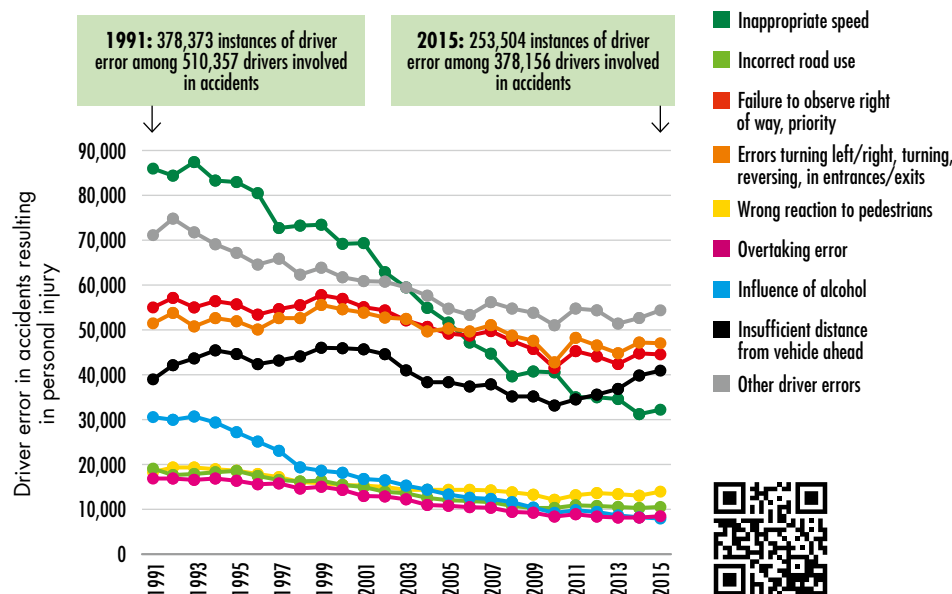
BEST PRACTICE

The medical-psychological assessment (MPU) not only helps to protect society at large from drunk-drivers, but also gives individuals the opportunity to permanently change their former problem behavior.

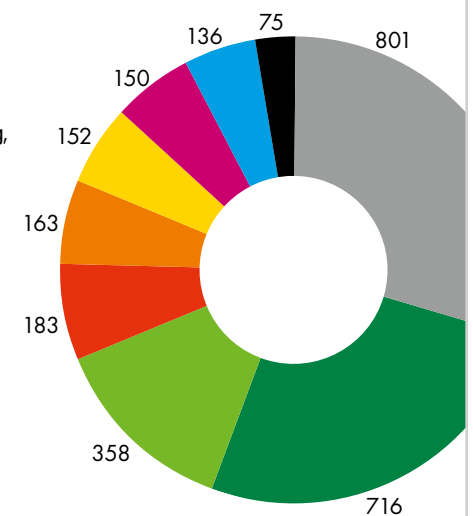


19 Car driver error

Trends in the number of accidents recorded by the police resulting in personal injury and caused by human error on German roads from 1991 to 2015



Distribution of fatal accidents in 2015 in which the police identified human error as the cause



Data source: StBA

cess of 7.5 metric tons and that are subject to toll fees are entitled to submit annual applications for the financial support of defined advanced driver training measures to the Federal Office for Goods Transport (BAG). The latter also applies for the advanced driver training courses stipulated according to the EU-wide professional driver qualification act.

Driver safety training is divided, for good reason, into a theory-based and a practical part. Before

participants get to explore not only the dynamic behavior of their vehicles but also the limits of their own capabilities in a safe environment under the instruction of experienced instructors, they first learn a little about the physics of driving and potential accident risks. For example, they learn about the relationship and dependencies between speed and braking distances, the technical condition of vehicles and road conditions. They learn about how vehicles behave during cornering and what factors potentially

Graduated Driver Licensing



In April 2004, young people in certain German states were for the first time given the opportunity to enjoy “accompanied driving” from the age of 17 (BF 17). In 2008, this was rolled out across all federal states. To assess the impact of this measure on road safety, two large random samples were analyzed in a 2011 study: former BF 17 drivers, and drivers who passed their driving test at the regular minimum age of 18. The results showed that, in their first year of independent driving, former BF 17 drivers suffered 17% fewer accidents and committed 15% fewer traffic violations than drivers of the same age who had obtained their driver’s license in the conventional way. If mileage is used as a basis, this results in a reduction in the number of accidents and traffic violations by another 4 percentage points (23% accidents, 22% traffic violations). These figures were verified by an independent random check. In 2009, therefore, accompanied driving from the age of 17 helped to prevent around 1,700 accidents resulting in personal injury. However, although it was also shown that the positive effect of accompanied driving from the age of 17 extends into the second year of unaccompanied driving, the effect declines from then on.

This “accompanied driving” model is used in other countries, too, most successfully in France, Belgium, Austria, Spain, Canada and some US states. The criteria that

qualify someone to act as an accompanying person vary from country to country. In Germany, for example, they must be at least 30 years old and have been in possession of a valid Class B (car) driver’s license for at least 5 years. In addition, they must have no more than one point on their license at the time the person they are to accompany is granted the test certificate, on which they must be specified by name. In Austria, the accompanying person must have been in possession of a B driver’s license for at least 7 years and must be able to credibly demonstrate that they have actually been regularly driving a car or van for the past three years. In addition, they must not have committed any serious traffic violation in the last three years; a complete ban on alcohol also applies during accompanied drives (limit: 0.1). In Belgium, the accompanying person must have been in possession of a driver’s license for at least 6 years. However, since experienced drivers are prone to bad habits and mistakes even after a few years of driving, and given that legal amendments may be made of which the accompanying person is unaware, accompanying persons in Belgium have been additionally required to complete refresher training since the beginning of 2017.

The US has introduced the concept of graduated driver licensing (GDL). GDL rules impose a three-level system of restrictions on young drivers:

- Learning stage: driving only under supervision, culminating in a driving test
- Transition phase: mainly unaccompanied driving, but only under certain conditions such as an absolute alcohol ban; limits on the number of young passengers; nighttime driving with accompaniment only
- Full-privilege stage: standard driver’s license

This concept was first introduced in Florida in 1996; since then it has been rolled out in identical or modified form across all US states. And the results are impressive: According to studies conducted by the National Highway Traffic Safety Administration (NHTSA), the Insurance Institute for Highway Safety (IIHS) and the associated Highway Loss Data Institute (HLDI), the number of traffic fatalities among car drivers aged between 15 and 20 fell by 51% between 2005 and 2014. Nonetheless, in 2014, no fewer than 1,717 young drivers aged between 15 and 20 died in road accidents, with an estimated 170,000 injured. Furthermore, in 2014, 9% of drivers involved in fatal accidents were aged between 15 and 20.

In New Zealand, where the DEKRA subsidiary Vehicle Testing New Zealand (VTNZ) has been responsible for practical driving tests since May 2015, a three-stage GDL applicable to all novice drivers aged between 15 and 24 was introduced back in 1987. The licensing process is divided into three stages: learner’s license, restricted license and full license.



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Accompanied driving and graduated driver licensing have led to fewer accidents involving young, novice drivers suffering serious or fatal injuries.



lead to oversteering or understeering. The theoretical part also looks at the active and passive safety systems available in and on the vehicle.

And then the fun begins. Participants experience heart-stopping moments when they are asked to brake hard while driving on a specially prepared slippery track and to regain control of the vehicle as it spins around its own axis. Others are shocked to learn how long the braking distance is at a speed of just 50 km/h even on a dry road, or how difficult it is to maintain control over their vehicle when avoiding a sudden obstacle on the road ahead.

But it is precisely these preventive exercises that could save lives in a real-life emergency. They learn about the potential consequences of misreading the traffic and not understanding how the vehicle behaves in critical situations, and also become more attuned to unpredictable risk situations.

■ *Driver training is a key measure for improving road safety.*

The Facts at a Glance

- Through responsible behavior, a proper assessment of one's own capabilities and a high level of acceptance of the rules of the road, we humans can ourselves significantly contribute to improved road safety.
- Even blood alcohol concentrations of just 0.2 can impair our driving capabilities.
- Rehabilitative measures and therapeutic support from traffic psychologists lead to reduced instances of re-offending among drivers who have already been stopped or convicted for drunk-driving.
- Alcohol interlocks are a useful method of preventing people from driving under the influence of alcohol.
- Road safety campaigns raise people's awareness of the risks on our roads.
- Ongoing road safety education from our earliest years right into old age is the best prevention.
- In driver training courses, participants learn how to identify hazardous situations and to respond quickly and appropriately.
- Although driver assistance systems such as lane keeping assist, distance control systems and emergency braking systems can help to prevent accidents caused by driver distraction or at least mitigate their often grave consequences, they should never ever be used as an excuse for driver inattentiveness.



Technology in the Service of People

Over the past few years, state-of-the-art vehicle technology and ongoing innovation in the automotive industry and by their suppliers have played a key role in improving road safety all over the world. As active and integral safety elements, new and improved driver assistance systems offer considerable potential for avoiding accidents – both today and in the future. On the road toward autonomous driving, increasingly effective systems are finding their way into our cars even today. The number one lifesaver, however, remains a properly worn safety belt.

The findings from traffic accident researchers say the same thing time and time again: The main cause of crashes resulting in personal injury and/or material damage is human error. On average, humans are responsible for more than 90% of all accidents. Experience suggests that errors occur, above all, in perception as well as in the absorption and processing of information. To compensate to a certain extent for human shortcomings and errors, the automotive industry has for many years been increasingly focusing on driver assistance systems that are capable of recognizing critical driving and traffic situations early on, warning of dangers and, if necessary, actively intervening – for example, electronic dynamic handling control systems; speed warning systems; emergency braking systems; lane support systems; alcohol interlocks; automatic emergency call systems (eCall) for all

vehicles including motorcycles, heavy-duty commercial vehicles and buses; safety belt reminders for all vehicle occupants; and tire pressure monitoring systems.

EU CALLS FOR THE MANDATORY INSTALLATION OF ASSISTANCE SYSTEMS



Given that vehicle technology as well as active and integral safety technologies help to improve road safety over the long term, the EU Commission is strongly committed to the increased use of driver assistance systems and to the potential compulsory installation of such systems in the future. This can be seen in its report, published in December 2016, to the European Parliament and the European Council (“Saving Lives: Boosting Car Safety in the EU”), in which the Commission identified four

BEST PRACTICE

Driver assistance systems help to prevent accidents or at least mitigate their consequences.



Regular Vehicle Inspections Are Increasingly Important

As long as systems for assisted and automated driving are installed in a car, care must be taken to ensure that they – along with the passive, active and integrated safety systems – work reliably throughout the vehicle’s service life. Only in this way can they have their desired impact. Regular vehicle inspections, which have been routine for many years in many countries around the world, will therefore become even more important than they already are, not least because of the growing complexity of the systems and the risk of electronic tampering. As many studies show, even vehicle electronics are not immune from wear and tear, nor are they free of system errors. They can also be tampered with, deactivated or even removed from the vehicle. Inspections conducted by the International Motor Vehicle Inspection Committee (CITA) have shown that in-vehicle electronic systems exhibit similar fault rates and aging-related failure behavior as mechanical systems. The number of faults increases with both vehicle age and driving performance.

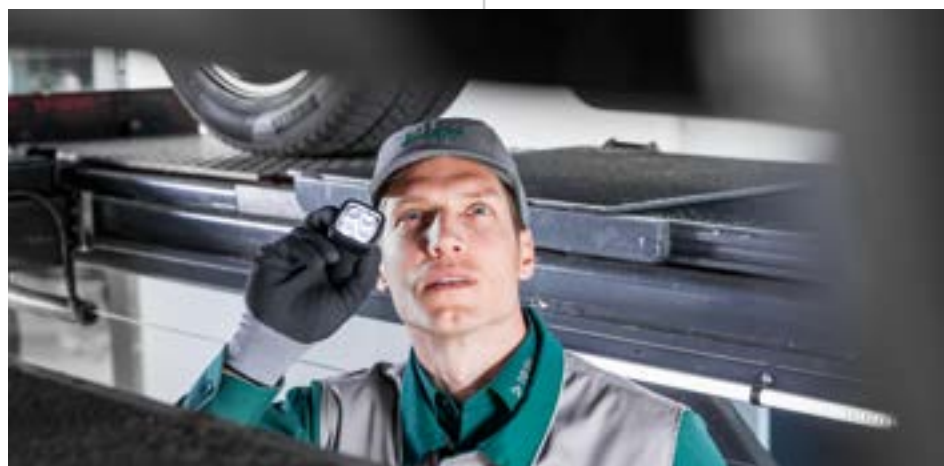
Despite all the advances made in the field of electronic components, mechanical systems will of course continue to play a key role when it comes to road safety. During regular vehicle inspections, therefore, the

brake and steering systems will be subjected to every bit as rigorous an examination as, say, the lights, axles, wheels and tires, suspension systems, chassis, frame and structure as well as visibility conditions, to name just a few examples. The importance of this can be seen in France, for example. When the mandatory Contrôle Technique was first introduced in 1992, the technical condition of the vehicles on the roads noticeably improved. According to DEKRA statistics, the defect rate of a whole range of modules including the brakes and lighting systems fell by 50% and more.

Turkey, too, is an excellent example highlighting the significant benefits of periodical technical inspections (PTI) for road safety. Up to the end of 2007, vehicle checks were performed by a Turkey-wide network of state testing centers. These checks involved a visual inspection during which the data contained in the vehicle papers were compared with the condition of the vehicle. The only decisive criterion was the roadworthiness of the vehicle upon presentation. In 2008, a PTI based on the European model with fixed, defined standards was introduced. Since then, the number of traffic fatalities has fallen by 40% within just a few years. The example in the US state of Idaho also highlights the effectiveness of periodic checks. The PTI program was stopped here in 1997. Just two years later, the number of mechanically defective or unsafe cars increased considerably. The condition of the brakes in older cars was also much worse than before the PTI was abolished. There was also a noticeable deterioration in the condition of steering, suspension and drivetrain systems. In contrast, the US state of Texas introduced a PTI program in 1999 – and within just a short period of time, the percentage of accidents caused by vehicle defects fell from 12% to 4%. Given these statistics, the introduction of PTI programs in, for example, many newly industrializing and developing countries would have many positive effects.

key action areas with 19 specific measures to improve vehicle safety. Active safety measures, which can prevent accidents altogether rather than merely mitigating the outcome, are deemed to be the most important. This area includes automatic emergency braking, intelligent speed adaptation, lane keep assistance and driver drowsiness and distraction monitoring.

So-called “passive” safety measures, which mitigate the outcome of accidents, include emergency braking displays (flashing stop lamps/automatic activation of the hazard warning indicator), safety belt reminders, utilizing the potential of the passenger cell (through frontal, side and rear crash testing), standardization of alcohol-sensitive immobilizers, crash event data recorders and tire pressure monitoring. The proposed measures to improve the safety of trucks and buses involve the introduction or improvement of front-end design and direct vision, truck and trailer rear underrun protection (rear bumper), lateral protection (side guards) and fire safety for buses. Measures for the



Accident-relevant technical defects

Accident-relevant defects were found in more than 16% of the vehicles inspected by DEKRA in Germany following road accidents and traffic checks between 1977 and 2017. This figure underlines the importance of periodical technical inspections.

	Car		Two-wheeler		Coach, truck, semitrailer tractor etc.		Trailer, semitrailer		Total		Accident-related defects
Defects as cause	3,772	6.1%	472	4.5%	1,701	15.2%	729	18.1%	6,674	7.6%	
Defects as possible cause	2,605	4.2%	712	6.8%	549	4.9%	265	6.6%	4,131	4.7%	
Defects as contributing cause	2,142	3.5%	387	3.7%	664	5.9%	313	7.8%	3,506	4.0%	
Defects with no relevance to accident	16,651	26.8%	3,941	37.8%	3,054	27.2%	1,222	30.3%	24,868	28.3%	
No defects	36,877	59.4%	4,962	47.6%	5,251	46.8%	1,526	37.8%	48,616	55.4%	
Total	62,047	100.0%	10,424	100.0%	11,213	100.0%	4,036	100.0%	87,720	100.0%	

Selected Vehicle Safety Systems at a Glance

Accident researchers and road safety experts all agree that the number of accident victims can be dramatically reduced with the support of driver assistance systems. On the one hand, the biggest possible market penetration is essential here. But even when supported by additional safety systems, drivers still have to drive in a manner appropriate to, among other things, the road and visibility conditions. After all, even with the best, most advanced systems, drivers cannot shift the boundaries of physics. On the other hand, a whole range of basic preconditions has to be met to ensure that the systems function effectively – including, for example, a functioning brake system (mechanics, hydraulics/pneumatics, sensors, actuators and electronics). Additionally, the systems must not be disabled. Some systems operate at whatever speed the car is traveling, others just at certain speeds. Below are brief descriptions of how selected assistance systems function. The system names and functional scopes designated by the manufacturers may differ from those used below. Drivers are advised to always carefully read the instructions before enabling these systems.

- **Antilock Braking System (ABS):** This system allows emergency braking on road surfaces with different levels of grip without the driver losing control of the steering or the vehicle skidding. Any excessively sudden drop in the rotational speed of a wheel is indicative of impending wheel lock. The system detects an impending wheel lock and starts to modulate the brake pressure. Here, the wheel slip is regulated close to the optimum value, whereby vehicle deceleration is maintained at the maximum level according to the available frictional connection between the tires and road surface and, at the same time, sufficient lateral force for steering and stabilization is still

available. ABS allows the driver to steer the vehicle with stable changes in direction despite applying full braking power. Even when negotiating bends, the driver can still apply full braking power, thereby ensuring maximum deceleration – within physical limits – without the vehicle starting to skid.

- **Brake Assist System (BAS):** The BAS reduces the braking distance in emergency situations if, at a critical moment, the driver does not apply the brakes hard enough. In such situations, the system automatically develops maximum brake boost within fractions of a second, thereby significantly reducing the vehicle's stopping distance. The BAS also detects a driver's intention to execute an emergency braking maneuver on the basis of the speed with which the driver initially presses the brake pedal. If the risk of a collision has been detected, more advanced systems increase the pressure in the braking system before the driver presses the brake pedal so that the driver, when pressing the brake pedal, immediately induces the full braking pressure in the wheel brake cylinder. This helps to reduce the "brake threshold duration", thereby cutting the braking distance short by valuable meters.

- **Electronic Stability Control (ESC):** ESC acts on the vehicle's drive and braking system and can help drivers to maintain control over their vehicle in critical situations. The associated control unit uses sensors to continuously monitor the vehicle's driving dynamics. If any impending oversteer/understeer is detected, it brakes one, some or all of the vehicle's wheels and, if necessary, intervenes in the engine management system. This means that the system is capable of detecting typical hazardous situations and, in response, helping drivers to maintain

control over their vehicle within the limits of what is physically possible. The severity of accident scenarios such as skidding during rapid cornering or on slippery road surfaces and sudden evasive maneuvers can be reduced and the resulting accident risk considerably minimized.

- **Adaptive Cruise Control (ACC):** Constant braking and acceleration and frequent lane changes are part and parcel of everyday driving on congested roads. For this reason, most people do not stick to the "half of the speed indicator" rule – a rule of thumb used for determining the safe distance from the car in front – with the resulting risk of rear-end collisions. The intelligent cruise control system with a front distance sensor and distance control automatically adjusts the vehicle speed during moderate deceleration of around 3 m/s^2 in keeping with the traffic flow in order to ensure that a safe distance from vehicles ahead is maintained. If the vehicle ahead brakes suddenly, the system issues a visual and audible warning, additionally allowing the driver to respond. Advanced ACC systems can slow the vehicle right down to a standstill and also move the vehicle off from standstill (follow-to-stop and stop-and-go function).

- **Advanced Emergency Braking System (AEBS):** This anticipatory emergency braking system is based on adaptive cruise control systems and is designed to prevent rear-end collisions or at least reduce the collision speed in order to significantly reduce the severity of the collision. The driver is alerted of an impending collision with the vehicle in front in a multi-stage process involving a visual and/or acoustic and/or haptic signal. The haptic signal, for example, could take the form of an initial application of the brakes. If the driver does not respond and the situation is becoming ever more critical, partial braking is automatically initiated during the course of the subsequent warning cascade. If the driver still fails to respond, advanced systems are also capable of automatically initiating full vehicle braking. Some systems respond not only to other motor vehicles, but also cyclists and pedestrians.

- **Lane Departure Warning (LDW)/Lane Keeping Support (LKS):** These systems can alert drivers traveling on rural roads or highways – i.e. outside urban areas – of when the vehicle drifts out of its lane. An additional function also keeps the vehicle





in the middle of the lane, even on wide bends. This is a valuable aid particularly on long, monotonous stretches of road when drivers are prone to falling levels of alertness. A video camera installed behind the windshield captures the road markings and a downstream electronic system analyzes the course of the lane. More advanced systems can also compensate – to an extent – for missing or poor road markings. If the system detects that the driver is moving the vehicle out of the lane without having activated the turn signal, it outputs side-dependent visual and/or acoustic and/or haptic signals. The steering wheel can draw attention to itself with a gentle movement, giving the driver enough time to correct the vehicle's course. Course corrections are also possible through gentle braking of individual wheels.

- **Blind Spot Monitoring/Lane Change Assist (LCA):** Vehicles approaching on the driver's side and rear – an area (partially) invisible to the driver (passing lane/parallel lane) – are recorded by sensors and signaled to the driver. If the driver intends to change lane despite the risk of a collision, the driver is alerted so that a crash can be avoided. The blind spot is now nothing to be afraid of – although it is essential that drivers still take the time to glance over their shoulders.

- **Attention Assist/Driver Alert:** This system uses a range of sensors and signal evaluation algorithms to permanently monitor driver behavior. Verified indicators of declining concentration and impending drowsiness include unusual steering motions and blinking intervals. The system can combine data on the type and frequency of these responses with other

data such as vehicle speed, journey duration or time of day to calculate the degree of fatigue. If the system detects that the driver is drowsy, the driver is alerted to this with visual and/or acoustic and/or haptic signals and advised to take a break.

- **Head-up display (HUD):** This display system projects information that is important to the driver directly into the driver's field of vision. The head-up display means that the driver no longer has to take their eyes off the road in order to see the information – such as vehicle speed, information provided by the traffic sign recognition system or any pedestrians or cyclists detected by the night vision system – displayed on the instrument cluster. This can help to provide a valuable increase in reaction time in hazardous situations.

- **Adaptive Frontlighting Systems (AFS):** In Germany, around 20% of road accidents resulting in personal injury and 30% of fatal accidents occur at night. State-of-the-art light systems improve visibility, thereby helping to reduce the risk of accidents at night. Xenon and high-performance LEDs can already be found in conventional headlights to ensure that the light ahead of the vehicle is distributed more effectively. Equipped with the corresponding functional scope, the systems provide optimum light distribution for the driver at all times depending on the speed, surroundings and course of the road; in addition, intelligent technology prevents drivers of oncoming vehicles from being dazzled. With dynamic curve lighting, for example, the headlamps automatically swivel in line with the course of the road, thereby allowing drivers to better see the course of

the curve ahead and react more quickly to potentially critical situations. If the curves are particularly tight or the driver intends to turn off, the static turning light ensures greater visibility. The light emitted by the Adaptive Frontlighting System (AFS) replaces the conventional functions of the static lower beam, whereby the light is automatically adjusted on the basis of the speed as well as other parameters such as the surrounding conditions in urban traffic, on country roads or highways and bad weather. If the system detects that other road users will not be dazzled by the lights, it automatically sets full illumination of the road, if necessary up to the intensity of upper beam. But here, too, responsibility lies with the driver, who may have to take sudden action to switch to the static lower beam.

- **Night vision assist:** Visibility is greatly reduced at night, especially when the situation does not allow the upper beam to be used. If it is also raining or foggy, it can be almost impossible to discern the road ahead. Pedestrians or cyclists traveling without lights along the side of the road are often spotted too late by drivers, as too are wild animals that stray onto the road without warning. The night vision assist system can help to mitigate these hazards. It uses one or more infrared cameras to observe the road and presents an image of what it can see on the road ahead on a screen. In this high-contrast electronic image, humans and animals are clearly visible against the background. The night vision assist system is even unaffected by the dazzling lights of an oncoming car. Systems from the second generation of development can evaluate image patterns to detect pedestrians, cyclists and even wild animals and provide appropriate warning for drivers with visual/acoustic signals. Even more effective are marking light pulses above the headlights directly in the detected hazard zone ahead of or next to the vehicle.

- **Seatbelt reminder:** If a vehicle occupant fails to put on their seatbelt and the vehicle is moving at a specific (low) speed, the seatbelt reminder system issues a visual and/or acoustic warning. And not without reason, because wearing a seatbelt – ideally also featuring a tensioner and load limiter – is the ultimate precondition for the passive safety of vehicle occupants and, as such, the number one lifesaver. Experts recommend seatbelt reminders for both the front and rear seats.

Eduard Fernández

Executive Director of the CITA – International Motor Vehicle Inspection Committee



Inspections offer the possibility of having an immediate impact on the fitness of vehicles

Road safety is complex, and so are the strategies that are required to reach road safety goals. Such complexity means that all aspects influencing a crash must be considered, and there is no doubt that we have to take vehicles into account when developing comprehensive road safety policies.

Quoting the AUTOFORE project, vehicles degrade over time, which means that it is necessary to ensure that the benefits accruing from the original design and manufacturing process are reasonably maintained during their lifetime. This is the main target of periodical vehicle inspections.

It is crucial that requirements for vehicles that are already in use are well balanced with the requisites set for new vehicles. New vehicle standards must provide enough transparency to ensure third-party assessment. It is also important to take into account other events in the life of the vehicle – like modifications – and to evaluate their influence on road safety.

And this is even more important in low- and middle-income countries, where vehicles are older and their fitness for purpose is often less than adequate. Periodical inspections are essential for continuously improving the fleet and ensuring the suitability of the repair and maintenance workshops network.

Vehicle inspections can have an immediate impact on the fitness of vehicles. This impact can be fine-tuned as the fleet starts to improve, while a “smart” system not only allows continuous improvement, but

also ensures that drivers enjoy maximum mobility without being impeded by unnecessary and non-timely requirements.

Establishing a vehicle inspection scheme is not by any means an isolated activity. It requires the involvement of a variety of stakeholders: vehicle drivers, large fleet owners, police, repair and maintenance workshops, car dealers and many others. Ultimately, ensuring that vehicles that are already in use comply with the relevant standards is a B2C activity, and it can succeed only with the appropriate management of the aspects related to its impact on society.

Some very good examples and studies into the impact of vehicle inspections on road safety are available. One of the most comprehensive is the aforementioned AUTOFORE study, the fatality figures in some countries before and after the implementation of a vehicle inspection scheme and, of course, accident analyses.

It is worth mentioning that the conclusions derived from accident analyses are always very conservative, since it is much easier to establish whether or not the driver was wearing a safety belt during the crash than it is to establish a failure in the steering system or that the oncoming car had misaligned headlamps that dazzled the driver, resulting in the crash.

And in addition to improving safety, vehicle inspections also play an essential role in transportation by ensuring that it is clean and more efficient overall.

safety of pedestrians and cyclists include: the introduction of pedestrian and cyclist detection (linked to automatic emergency braking systems), a front-end design optimized to mitigate the severity of collisions with pedestrians and cyclists and detection of persons behind vehicles while in reverse gear.

In its report, the EU Commission also suggests that the availability of well-founded and more nuanced accident data from across the EU is improved. This type of data, says the report, is a prerequisite for the development and monitoring of EU road safety policy. Specifically, it continues, the data is required to assess the effectiveness of the measures in terms of road and vehicle safety and to support the development of new measures.

SAFETY SYSTEMS SAVE MANY LIVES

As has been stated many times in the DEKRA Road Safety Reports published over the past few years, modern-day driver assistance systems are merely the continuation of a long series of measures that have made invaluable contributions to making our cars safer. Examples from over the years include disk brakes, which were invented as early as 1902; radial tires, which were developed at the end of the 1940s; rigid passenger cells – patent filed in 1951 – with front and rear crumple zones; three-point safety belts, patented in 1959; safety steering shafts for vehicles – patent filed in 1963; driver airbags, patented in 1971; anti-lock brake systems, which were installed in vehicles from 1978; and the electronic stability program (ESP) introduced in 1995.



The extent to which systems such as safety belts, airbags and safety steering columns in particular have increased road safety in recent decades is illus-

BEST PRACTICE 

ESC in cars could save up to 10,000 lives annually in the USA.



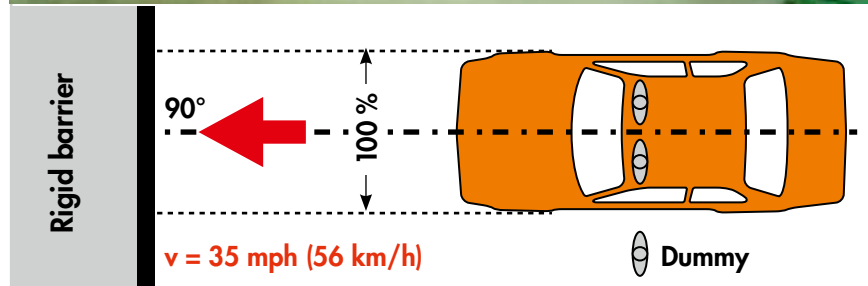
22 Lives saved in the US thanks to safety systems



Safety systems	Lives saved	
	1960-2012	2012 only
Safety belts	329,715	15,485
Energy-absorbing steering systems	79,989	2,930
Front airbags	42,856	2,407
Door locks, bolts and hinges	42,135	1,512
Protection of occupants during collision	34,477	1,362
Protection during side collision (including side airbags)	32,288	1,350
Tandem master cylinder/front disk brakes	18,350	1,127
Child seats	9,891	482
Bonded windshields	9,853	357
ESP	6,169	271
Resistance to roof crush	4,913	161
Adhesive visibility strips for trailers	2,660	122
Roll-over protection curtains	178	43
Integrity of fuel system	26	9
Total	613,500	27,618

Source: NHTSA report

trated in a study conducted by the National Highway Traffic Safety Administration for the USA. According to this study, this array of systems has helped to save more than 600,000 lives in the USA alone between 1960 and 2012 (Figure 22). Safety belts, front airbags and safety steering columns account for almost 75% of the lives saved. According to the study, systems such as ESC (electronic stability control) in particular will also offer increasing potential for preventing accidents in the future. NHTSA estimates that these systems can help to reduce the number of car and SUV crashes by 34% and 59% respectively. Given a market penetration of 100% in passenger cars, ESC could save between 5,300 and 9,600 hu-



■ Reconstruction of a historical US NCAP crash test with a Cadillac DeVille (1974) in the DEKRA Crash Test Center Neumünster

man lives a year in the USA. Admittedly, it is always important to bear in mind that it generally takes at least six to ten years before new safety systems are present in a majority of vehicles. Once it has become a legal requirement to equip vehicles with such systems, it takes around 15 years for the systems in question to achieve a sufficiently high level of market penetration.

TESTS FOR INFORMING CONSUMERS ABOUT CAR SAFETY

The fact that modern-day cars are so safe can be attributed to not only ongoing updates to international rules and regulations, but also and above all the research and development teams of manufacturers and suppliers. Legal minimum standards and independent testing play an important role here. The New Car Assessment Program (NCAP) tests conducted for the first time in 1978 under the auspices of the National Highway Traffic Safety Administration (NHTSA) were – and remain – truly groundbreaking. The program initially focused exclusively on testing passive safety systems for public information purposes. New vehicles from different manufacturers are to this day continuously subject to a range of crash tests and the results are evaluated in a standardized manner. The tests are based on the legally

■ The safety belt remains the number one lifesaver.



Antonio Avenoso

Executive Director of the European Transport Safety Council (ETSC)



Independent oversight of self-driving technologies

A few weeks ago my laptop decided, of its own accord, to do an automatic update just minutes before I was set to give a presentation. Two hours later, having survived the ordeal with a borrowed machine, a colleague put things into perspective with that favourite aphorism of modern office life: "Nobody died."

Quite so. It is a rare thing for a computer malfunction to be fatal. But our societies are now on the verge of putting computers in charge of cars, vans and lorries that drive in our cities – among cyclists, pedestrians and other road users – and take life-or-death decisions on our behalf. And carmakers, in the absence of regulatory guidance, are already making fundamental choices that will decide what happens next.

The risk is of a kind of lawless Wild West for the early years of automated cars, not unlike the early years of motoring itself – before speed limits, traffic lights and driver license tests started to set the rules of the road. This could be a disaster. And not least for the nascent industry.

A likely outcome is that in a few years, if independent regulation and step-by-step approval of automated systems is not in place, a number of high-profile deaths

caused by automated vehicles will so horrify and appal the public, that the vehicles will be withdrawn from use. Rebuilding trust could be a huge challenge.

Regardless of the overall likelihood that deaths could eventually go down as computers gradually remove human error and recklessness from driving, a small number of so-called "false positives", where the vehicle makes an error and causes a fatal collision, could devastate the entire industry overnight. The fears of automotive killing machines would be felt in a similar way to terrorism: To be stopped at any cost.

What's needed is a step-by-step approach, starting with approvals for systems that have been proven to work in specific scenarios such as motorways without cross-junctions or roadworks. In Europe, it should be national governments – together with the European Union – that set the rules, oversee testing and independently investigate collisions. The current regulatory environment is not set up for any of these tasks in the vastly more complex world of automated cars. It's time Europe woke up to the risks as well as the opportunities of automation.

binding configurations defined in Federal Motor Vehicle Safety Standards (FMVSS), which generally stipulate higher collision speeds. In the NCAP, the results are summarized in an overall evaluation of "crashworthiness" illustrated with star ratings. This rating system, which was chosen as a simple means of informing consumers, ranges from one star (very high risk of occupants suffering serious injuries) to five stars (very low risk of occupants suffering serious injuries).

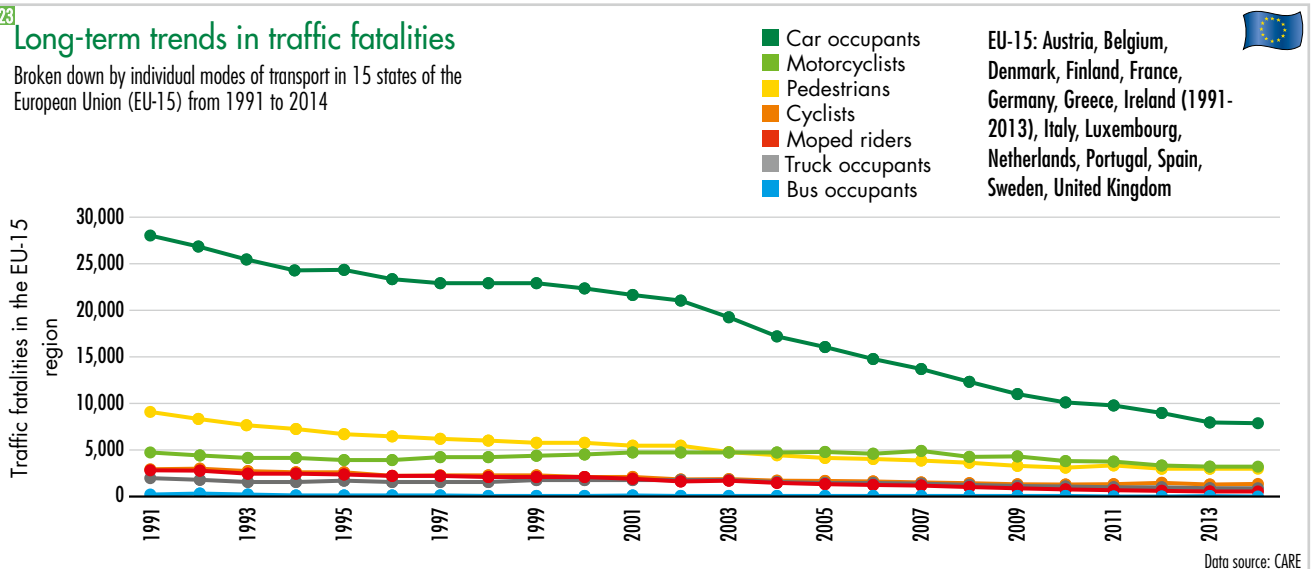
As a tried-and-tested "best practice", NCAP is used in many other regions of the world. Australian NCAP (ANCAP), for example, was introduced in 1992 and, a year later, rolled out to the Australasia region; Japan NCAP (JNCAP) was launched in 1995 and Euro NCAP in 1996. The Korean New Car Assessment Program, based on Euro NCAP, was launched in 1999, and the state NCAP in China has also since been largely adapted in line with Euro NCAP standards. NCAP has overall proved to be an effective measure to promote major and long-term improvements in vehicle and road safety. This can be seen in the EU, too, where in particular the number of passenger car occupants killed in accidents has for years been declining much more rapidly than, say, the number of motorcyclists, pedestrians or cyclists (Figure 23).

The US Insurance Institute for Highway Safety (IIHS) has also been conducting comparative crash tests since 1995. The crash test was initially designed in the form of an offset frontal collision with 40% overlap and a collision speed of 64 km/h. In 2003, an additional test was introduced in which a mobile barrier collides with the side of a vehicle at a speed of 50 km/h. The program was extended in 2012 to include a second frontal collision test, again



23 Long-term trends in traffic fatalities

Broken down by individual modes of transport in 15 states of the European Union (EU-15) from 1991 to 2014



with a collision speed of 64 km/h, but this time with just 25% coverage. The IIHS rating includes not only the injury risks derived from dummy stresses, but also an evaluation of the function of the restraint systems and the structural behavior of the car body. The results are divided into four categories ranging from “good” to “bad.”

ZERO FATALLY INJURED DRIVERS IN CERTAIN CAR MODEL SERIES IN THE USA

With regard to vehicle safety, the studies conducted by the IIHS in the USA into the number of drivers killed in car accidents per million vehicle registration years also offer some interesting insights. The first study, which was published in 1989, looked at cars only. The follow-up studies look at all varieties of “passenger vehicles” (cars, vans and pickups). The basic data used for the calculations are the numbers of fatally injured drivers registered in the Fatality Analysis Reporting System (FARS). The FARS database, which is managed by the National Highway Traffic Safety Administration NHTSA, is a full census of fatal accidents in 50 US states, the District of Columbia and Puerto Rico.

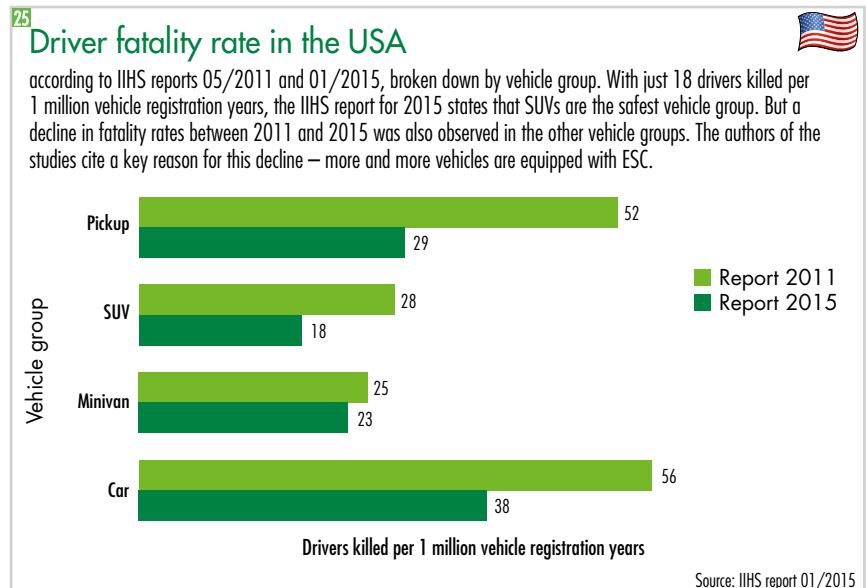
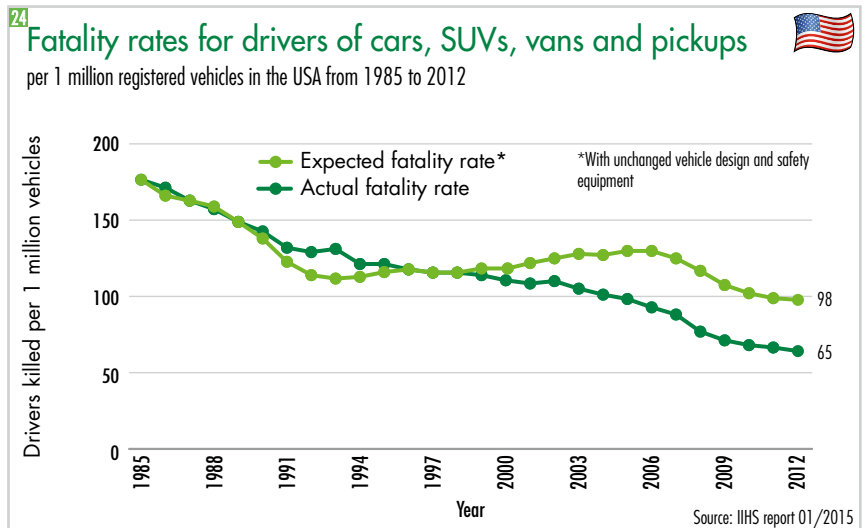
FARS contains accidents that occurred on public roads, involved a motor vehicle and resulted in the death of at least one road user within 30 days of the accident occurring. The analyses conducted by the IIHS record only the number of drivers killed because the number of occupants is not known. The annual vehicle populations (national vehicle population profile), categorized according to brand and model series, are used as reference variables for the IIHS analyses. One criterion for being included in the studies is that at least 100,000 vehicles of a specific model series must have been registered in the period under analysis. If a particular model is modified during the year to such an extent that this has a significant impact on the vehicle design and safety equipment, the fatality rate is not calculated until the year following the change.

A key result of the IIHS studies is the historical trend in driver fatality rates for cars per million registered vehicles from 1985 to 2012. The studies illustrate the trends in the actual rate and expected rate, with unchanged vehicle design and safety equipment. It is noteworthy that the curves up to 1998 lie very close to each other and, at certain phases, the actual fatality rate is higher than the expected rate with unchanged design and equipment. The authors of the study therefore conclude that the safety of the entire vehicle fleet in the US did not improve



■ By conducting crash tests, DEKRA can – among other things – demonstrate the effectiveness of front underride guards on trucks.

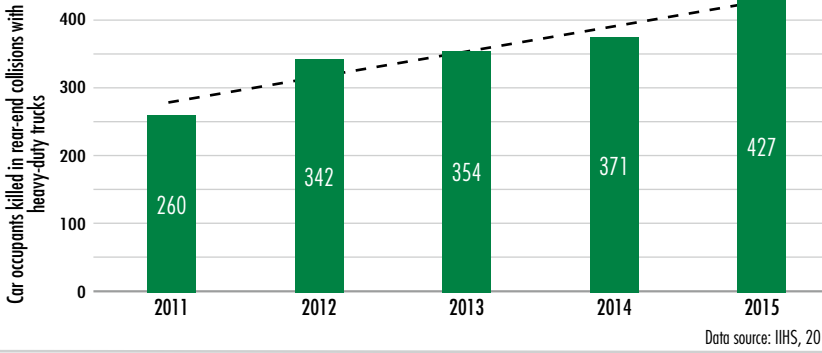
to any great extent, at least not initially. But things changed significantly in later years. The difference between both rates in 2012 (65 against 98) can be largely attributed to improved vehicle safety. Had there been no such improvements in vehicle safety, around 7,700 (absolute) additional fatally injured drivers would have been expected in 2012 (Figures 24 and 25).



26 Fatalities in truck rear-end collisions in the USA



Year	2011	2012	2013	2014	2015
Car occupants killed in collisions with heavy-duty trucks	2,241	2,352	2,410	2,485	2,646
of which in rear-end collisions	260 11.6%	342 14.5%	354 14.7%	371 14.9%	427 16.1%



UNDERRUN AND SIDE PROTECTION FOR TRUCKS



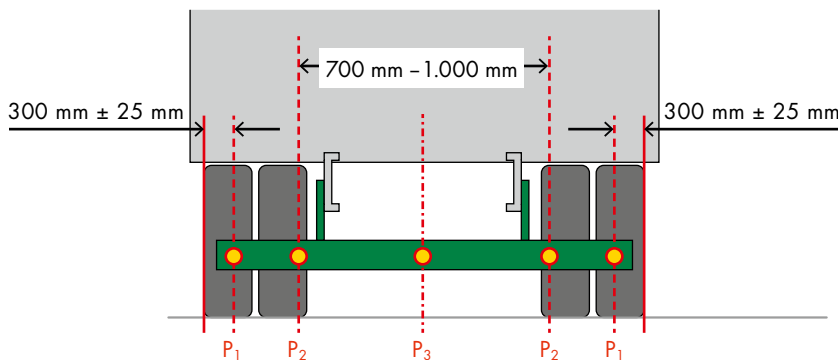
When it comes to vehicle safety, measures to make trucks safer should not be neglected either. Although heavy-duty trucks are only rarely involved in road accidents, their large dimensions and typically open frame design on the sides and at the rear make them less compatible with other road users. For unprotected road users and car occupants, therefore, the consequences of collisions with trucks can be particularly devastating. To a certain extent, measures to improve exterior passive safety such as front and rear underrun guards and side protection have helped to mitigate risks. Although state-of-the-art driver assistance systems for preventing accidents and mitigating the severity of accidents offer by far the greatest potential, these mechanical passive safety systems will remain vital as a “mechanical fallback.”

The lack of compatibility means that an accident in which a car collides with the rear of a heavy-duty truck or trailer can prove fatal. As experts from the German Federal Highway Research Institute found out, six out of ten car occupants involved in this form of accident suffered serious or fatal injuries, with around 30 to 35 car occupants dying in such accidents annually. In relation to the figures for 2015, this corresponds to around 2% of all 1,620 fatally injured car occupants. In the USA in 2015 (Figure 26), this figure was as high as 16.1%.

Accidents in which a car collides with the rear of a semi-trailer typically occur on highways. The average speed of the truck is 80 km/h and that of the car 125 km/h, which corresponds to a relative collision speed of 45 km/h in the car.



27 Real-life accident and historical development of the forces for testing rear underride guards as per UNECE-R 58



Test forces	P ₁	P ₂	P ₃
UNECE R 58-01 (1983)	12.5% GWR; max. 25 kN	50% GWR; max. 100 kN	12.5% GWR; max. 25 kN
UNECE R 58-02 (2008)	25% GWR; max. 50 kN	50% GWR; max. 100 kN	25% GWR; max. 50 kN
UNECE R 58-03 (2016)	50% GWR; max. 100 kN	85% GWR; max. 180 kN	50% GWR; max. 100 kN

GWR: gross weight rating of vehicle

Source: DEKRA

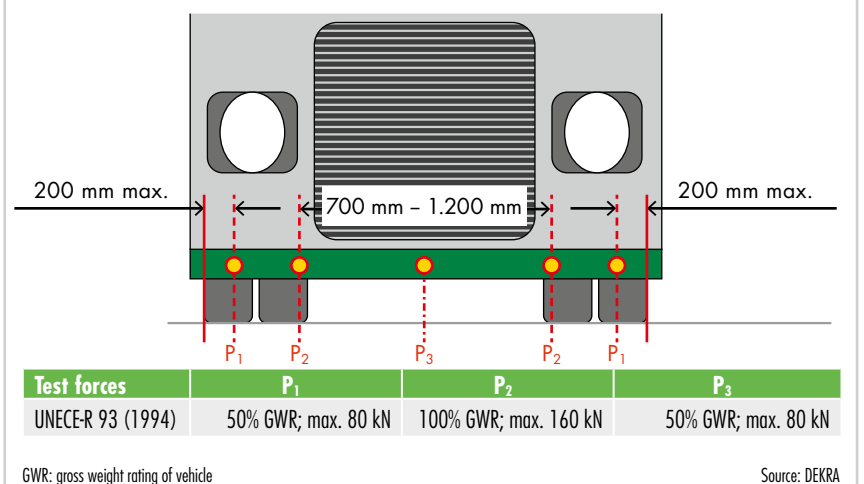
Fundamental findings from accident investigations and early crash tests at the Technical University of Berlin led to the introduction of rear underride guards back in the 1970s with the support of the German Federal Highway Research Institute. Directive No. 70/221/EEC laid down for the first time in the nations of the then European Economic Community an internationally recognized technical description for rear underride guards. When implemented at national level in the member states, it was generally used as a design specification – for example, through conversion into German registration law in 1975 with the introduction of Section 32b of the road traffic licensing regulations (StVZO): “The underride guard must have the same flexural strength as a steel beam, whose cross-section has a resistance torque against bending of 20 cm³.”



With UNECE-R 58, which was published in 1983 and also recognized outside Europe, regulations stipulating the end result to be achieved were agreed upon. The test procedures, which are still in use to this day, involve applying successive quasi-static forces at five symmetrical load application points (P1, P2, P3; see Figure 27). In response to ongoing criticism that rear underride guards did not in fact provide sufficient protection in real-life accident situations, the test loads were significantly increased. The requirements laid down in UNECE-R 58-03 currently apply, which means that the test loads for rear underride guards are now greater than those for front underride guards, which became a legal requirement in 2000 with Directive No. 2000/40/EC and for which the requirements laid down in UNECE-R 93 apply. Different deadlines – 2019 and 2021 – apply when it comes to implementing the current requirements regarding rear underride guards as per UNECE-R 58-03 in the context of vehicle approval.

The rear underride guard is a typical example of the continuous development of vehicle safety systems. First, new measures are proposed and negotiated. The result is often a compromise that is required to prove itself in real-life traffic situations. An integral part of the job of accident researchers

28 Front underride guard and test forces as per UNECE-R 93




is to assess the effectiveness of such measures and, if necessary, suggest ways in which not only the vehicle design but also test specifications could be improved. Nowadays, it is generally accepted that the rear underride guard fitted to a truck must offer at the very least adequate resistance in the event that a medium-size car collides with the rear of the truck with a differential speed of 56 km/h. This means that the car's front crumple zones and restraint systems will function as desired, thereby protecting the

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Underride and side protection on trucks will remain an indispensable element of passive safety in the future, too.



■ Side protection system on a truck

BEST PRACTICE  US standard FMVSS 223 is an exemplary model for determining the energy absorption of rear underride guards.

occupants. Another measure necessary for promoting compatibility is sufficient protection of the car's occupants, whereby requirements are to be based at least on the specifications laid down in UNECE-R 94 (front collision at 56 km/h against a stationary barrier). At higher speeds, automatic emergency braking systems could help to reduce the kinetic en-

ergy to the greatest possible extent even before the collision occurs.

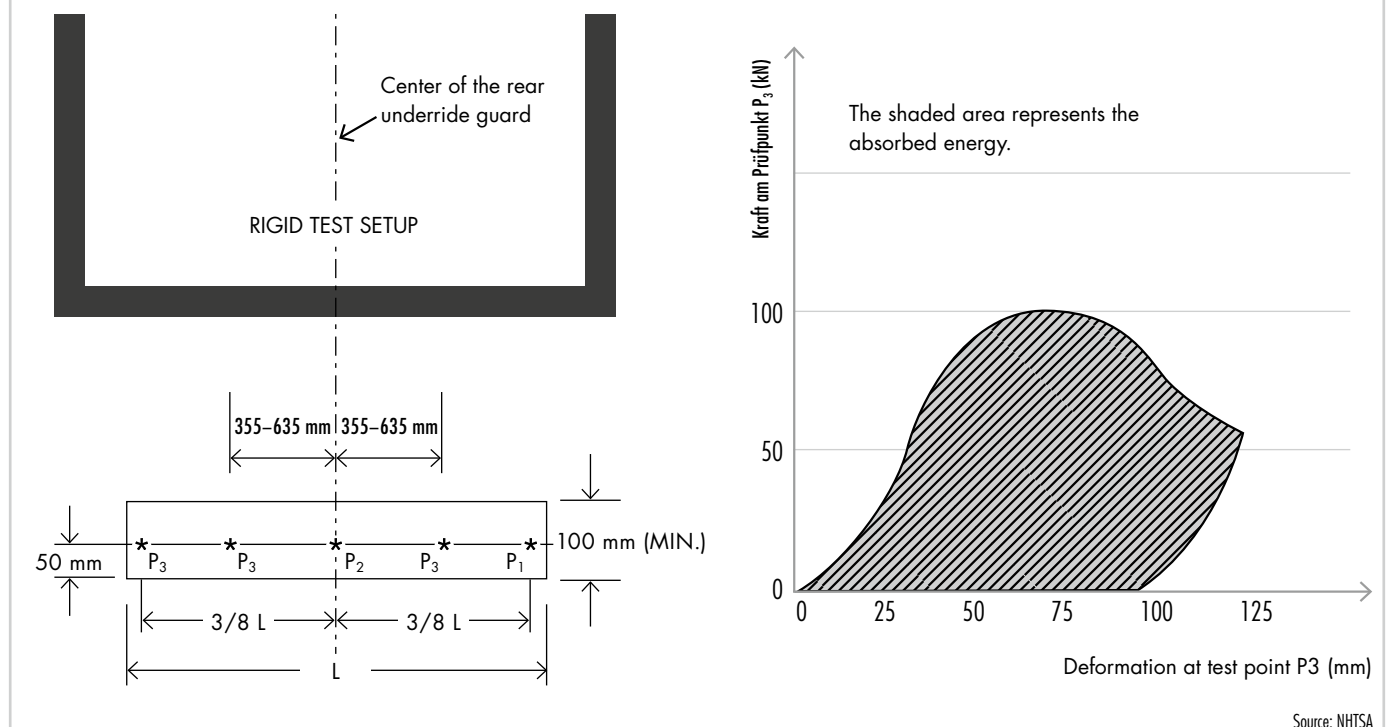
The performance of front underride guards as per UNECE-R 93 (Figure 28) is generally accepted as sufficient, which is also due to the fact that the design and geometry of the front of a heavy-duty truck are largely standardized and harmless. Much less standardized and harmless are the design and geometry of the rear, especially in the case of trailers with a long rear overhang. It will therefore never be possible to completely rule out the risk of fatal underride accidents, particularly those occurring at high speeds on highways.

STRICTER SIDE PROTECTION REQUIREMENTS



For front and rear underride guards within the scope of the EU approval procedure and in accordance with UNECE-R 58 and UNECE-R 93, still no requirements apply regarding controlled energy absorption. Calculations and crash tests performed over the past few decades have shown time and again that controlled energy absorption not only reduces the stress peaks of the mechanical structures, but also provides a valuable, additional path of deceleration for restraining the car passengers. The US standard FMVSS 223 serves as an exemplary model of "best practice" here (Figure 29). The deformation work recorded during the static stressing of individual test points is cal-

29 Stressing of a rear underride guard as per FMVSS 223 with calculation of the energy absorption through plastic deformation at specific test points



culated using a force-path line and compared with a predefined minimum value.

According to the applicable European specifications, front and rear underride guards fitted on heavy-duty trucks (classes N2 and N3) or trailers (classes O3 and O4) are designed to provide colliding vehicles (classes M1 [car] and N1 [light-duty trucks up to 3.5 t]) with sufficient underride protection. Much less stringent mechanical requirements apply to side protection systems, which have been prescribed in Germany since 1992 in accordance with Section 32c of the road traffic licensing regulations. Directive No. 89/97/EEC and UNECE-R 73 stipulate that side protection systems are to provide pedestrians, cyclists and motorcyclists with effective protection against falling under the side of a truck and being run over by the truck's wheels. In the approval test, a side protection system is considered suitable if it can withstand a force of 1 kN applied at right angles at any point from the outside.

In addition to mechanical resilience, geometric requirements regarding underride guards and side protection systems also apply. A key parameter here is ground clearance. The ground clearance for the front underride guard must be no more than 400 mm, while the ground clearance for the rear underride guard must be between 450 mm and 500 mm, depending on vehicle-specific circumstances. For the side protection system, a maximum ground clearance of 300 mm is required. Accident researchers have repeatedly called for more stringent requirements regarding side protection systems, and the issue is currently also on the agenda of the European Transport Safety Council (ETSC). In its position paper – published in March 2015 – on the revision of General Safety Regulation 2009/661, the ETSC demands, among other things, improvements in the strength of side protection systems to provide more effective protection against colliding motorcycles.

RETROREFLECTIVE SYSTEMS ON COMMERCIAL VEHICLES



Many truck accidents occur during poor weather, at twilight and in the dark. One reason for this is that trucks are often not easily identifiable as slower-moving vehicles, with the resulting risk that vehicles approaching a truck from behind might collide with its rear. In response to this hazard, internationally standardized specifications for specially identifying long, heavy-duty trucks and their trailers using retroreflective markings have

Rear-View Cameras for Small Vans

Small vans are an important part of the vehicle fleet and, for some years now, have been responsible for an ever-increasing share of transportation services in Germany and the rest of Europe. The increasingly widespread use of this mode of transport has motivated repeated discussions concerning their road safety. With the aim of objectively analyzing the prevalence of small vans in road traffic accidents, the German Federal Highway Research Institute (BAST), DEKRA accident researchers, German Insurers Accident Research (UDV) and the German Association of the Automotive Industry (VDA) a few years ago launched a research project focusing on the safety of small vans and published a study on this in 2012.

The project analyses are based on data provided by the official German road accident statistics, the accident databases of German Insurers Accident Research (UDB) and DEKRA, and the German In-Depth Accident Study (GIDAS). The project not only analyzed aspects relating to the mitigation of the consequences of accidents in relation to self- and

partner protection, but also looked at how accidents occur and how they can be avoided. The findings, on the one hand, delivered answers to questions concerning requirements and specifications and, on the other hand, led to recommendations for activities focusing on, in particular, the field of consumer protection and information in particular.

Analysis of all of the accidents recorded in GIDAS revealed that 4.7% were caused by small vans, with four main accident scenarios clearly discernible: rear-end collisions, turning/crossing accidents, driving accidents and accidents during reversing maneuvers. Compared with other vehicle types like cars or trucks, the latter accounted for a much bigger share of accidents (6%). The accident type in which a pedestrian crosses the vehicle's path at the rear was the most common, both for small vans with and without rear windows. The most common victims of such accidents are the elderly (60 plus). Rear-view camera systems and/or acoustic warning systems could help to remedy the situation.



been in place for some years now. This measure makes trucks more easily identifiable through "contour markings" consisting of retroreflective film, which mark out the vehicle contour to the side and rear. This means that trucks can be spotted from a greater distance, which is particularly important if they have come to a halt (or are lying on their side) on the road following an accident, when their own active lights are unlikely to

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"Contour markings" consisting of retroreflective film mark out the vehicle contour to the side and rear.

Erik Jonnaert

Secretary General of the European Automobile Manufacturers' Association (ACEA)



Protect Vehicle Data and Share It Safely and Securely

Today, more and more cars are either connected or come with automated driving functions, both generating a wealth of data. Most vehicle-generated data is primarily of a technical nature, existing only momentarily and never stored. Other vehicle-generated data can be put to a wide variety of uses: to increase comfort and convenience; to improve products and services; and to contribute toward achieving societal goals such as improving road safety and reducing fuel consumption.

Now the question is, how can we protect vehicle data and share it safely and securely? People are clearly entitled to have genuine concerns about the protection of their personal data and privacy. At the same time, however, many are increasingly willing to share data if it means that they can benefit from useful services. In Europe, we are fortunate that the EU has a tradition of strongly protecting our privacy. In 2015, it adopted the General Data Protection Regulation, probably the most modern data protection law in the world.

It goes without saying that data protection is an issue automakers take very seriously. Anticipating the entry into force later this year of the new EU law, the European Automobile Manufacturers' Association (ACEA) adopted in 2015 a set of data protection principles concerning connected vehicles. The bottom line of the industry's data commitment is that personal data will be shared with third parties only on the basis of a contract, with the consent of the customer or to comply with legal obligations.

However, the rise of the connected car is also increasingly linked to demands from third parties to access and use in-vehicle data. For auto makers, the major challenge here is to find the best means of providing safe and secure access to this data. Some parties are calling for direct access to data inside the vehicle. But this would facilitate hacker attacks, since every additional external data interface increases the number of potential targets. Other safety risks associated with driver distraction could arise if external parties are granted uncontrolled access to the vehicle's on-board systems. A car is not a smartphone on wheels, nor is it a PC that can be rebooted if a problem occurs while driving.

Vehicle manufacturers are fundamentally willing to share selected data, provided this can be done safely and securely. Over the last few months, the industry has been working to define the best way to provide secure and safe access to vehicle data to interested third parties. This would involve manufacturers securely communicating the relevant vehicle data to an off-board facility that, from where third parties can then access it. This should minimise the risks I mentioned before.

The increasing ability of cars to exchange data with the outside world holds great potential to revolutionise the driving experience and to improve safety in particular. But none of this comes without its challenges. To benefit from the connectivity revolution, a solid framework needs to be put in place to protect vehicle data and facilitate third-party access to data.

be working. Contour markings on trucks help to improve road safety by allowing drivers of vehicles behind to better judge how far away the truck is and how fast it is traveling.

Retroreflective red-and-white warning markings (safety signs) are also widespread on vehicles used in the construction, maintenance and cleaning of roads or systems installed on or next to roads and are used in addition to, for example, rotating beacons. Police cars, fire engines, rescue vehicles and breakdown trucks are fitted with not only blue or yellow beacons but also specific, retroreflective markings to make them more easily visible particularly at night and, during the day, to provide extra contrast.

PASSIVE LIGHTING SYSTEMS FOR UNPROTECTED ROAD USERS

An increasing variety of retroreflective products in various designs and colors is also available for unprotected road users – that is, pedestrians and cyclists – to make them more visible during the dark winter months and when out and about on the roads at night.

For example, shoes and, in particular, outer clothing are already fitted with retroreflective materials by the manufacturers, or special reflective bands and tags can be attached to these. Self-adhesive reflective film is becoming increasingly popular among parents who attach them to children's bicycles, baby carriages and bags. Even walking frames can be fitted with retroreflective material to make them really safe.

Particularly vulnerable are cyclists, who are frequently forced to join the flow of motor traffic. This is one of the reasons why so much importance is attached to safety systems for bicycles, which are the world's most popular mode of transport, some of them now also equipped with electric motors. For bicycles, properly functioning lights are vital – and not just during the dark winter months – so that cyclists can not only see well but also be seen at all times. At the beginning of this year, Section 67 of Germany's road traffic licensing regulations (StVZO), which covers lights on bicycles, was amended to include Section 67a, which covers lights on cycle trailers. This amendment ascribes cyclists a special sense of responsibility by stating that any active, removable lights – i.e. headlight and rear light – do not need to be attached or carried during the day. At night or when it is dark, however, these



Blind Spot – Greater Safety for Right-Turning Trucks

Especially in urban areas, right-turning trucks in right-hand traffic are a major hazard for pedestrians and cyclists, particularly if they stop at an intersection right next to the truck and so find themselves in the truck driver's blind spot where they are partially or completely invisible to the driver. If the truck then turns right, there is a severe risk of being run over. No less hazardous are situations in which a vulnerable road user traveling straight ahead wants to pass a (moving) truck on the right, trusting that the truck driver has seen them and confident that they have priority.

The grave consequences are clearly apparent when one looks at the statistics. Although the statistics in Germany, for example, do not contain exact figures for the "blind spot scenario", experts at the German Federal Highway Research Institute (BAST) approximately determined in a study conducted some years ago the number of cyclists seriously injured or killed due to blind spots. According to their figures, which were projected across the whole of Germany, 2012 saw around 640 turning accidents resulting in personal injury in "blind spot situations" in urban areas, whereby 118 cyclists were seriously injured and 23 killed.

In addition to infrastructural measures such as moving the stop line forward and giving earlier green lights for cyclists, driver assistance systems such as truck turning and brake assist could help to significant-

ly mitigate this potential cause of accidents. This assist system not only warns truck drivers of the presence of cyclists or pedestrians to the right of the truck if, despite taking every care while turning right, they fail to spot them, but also automatically brakes the truck to a standstill in the event of danger.

Something else that should not be forgotten in this context are the mirror systems – in compliance with 2003/97/EC – that have been mandatory for years now and help to reduce the blind spot and improve the indirect field of vision. It makes no sense whatsoever to fit more, or more strongly curved, mirrors. Truck drivers have four mirrors to their right, all of which together make visible a large area in front of and next to the vehicle. However, drivers can only ever focus on one mirror at a time and consciously process the visual information they get from there. The order in which drivers look at the mirrors is based entirely on their own assessment of the situation. Nobody can tell the truck driver whether and when a pedestrian or cyclist will appear in one of the mirrors. Likewise, even more strongly curved mirrors are of no use because the current curvature already acts at the limit of what the human eye can resolve. Much more important under these circumstances is to ensure that the mirrors are positioned correctly. And that is exactly where the problem lies, according to a DEKRA study.

For this reason, DEKRA teamed up with truck manufacturers Daimler and MAN to create a mirror setting and adjustment guide. In addition to tips on using the truck mirror systems, which are compiled in a small brochure, a quick and innovative method for checking in practice the fields of visibility – as ensured with all of the prescribed individual mirrors – was developed that allows the mirror settings to be optimized. The relevant markings can be made quickly and easily in any vehicle fleet center or at rest stops. This method is yet another example of how DEKRA is looking to achieve the aim of the EU charter to reduce the number of people killed or seriously injured in road accidents.

In Geneva, work is currently underway on revising Directive 2003/97/EC so that, in the future, cameras will be permitted as replacements for mirrors. This will also further increase the field of vision to be covered and so further reduce the extent of blind spots. At the same time, vehicle manufacturers are working on converting the images captured by the cameras into a single image on the monitor so that drivers only have to concentrate on one view. The use of cameras instead of mirrors not only achieves greater safety, but also has a positive environmental effect because of the reduced air resistance and, in turn, reduced fuel consumption and CO₂ emissions.

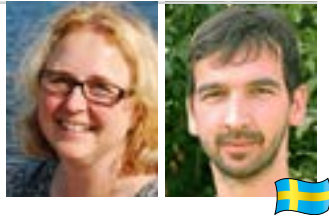


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The correct truck mirror setting is important for preventing blind spots, but in some cases the mirrors can hide road users.

**Annika Stensson Trigell
and Daniel Wanner**

KTH Royal Institute of Technology



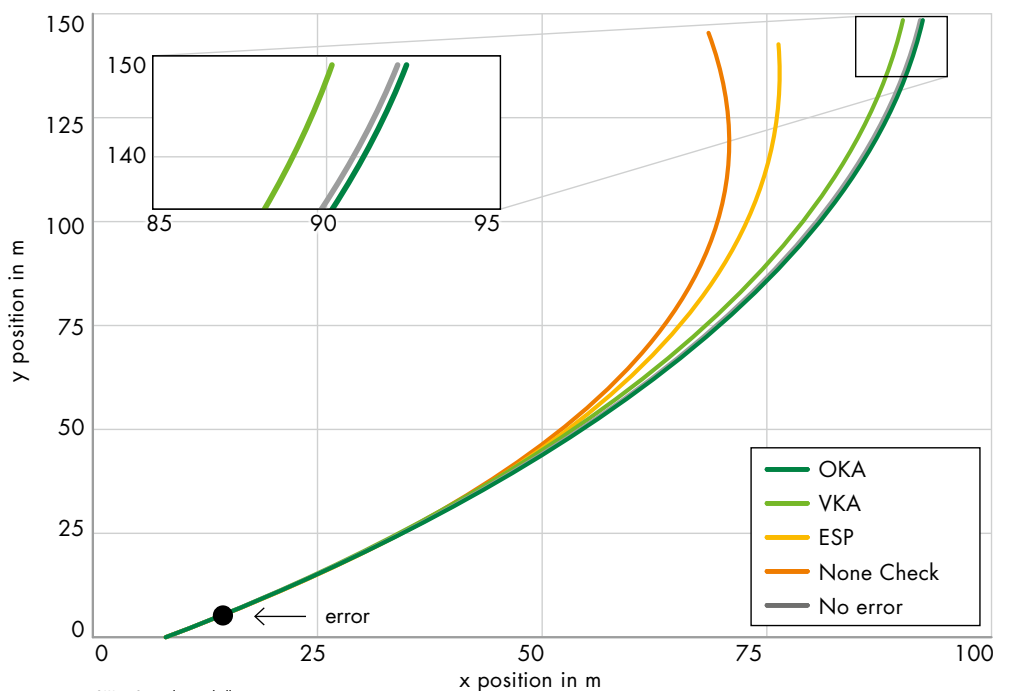
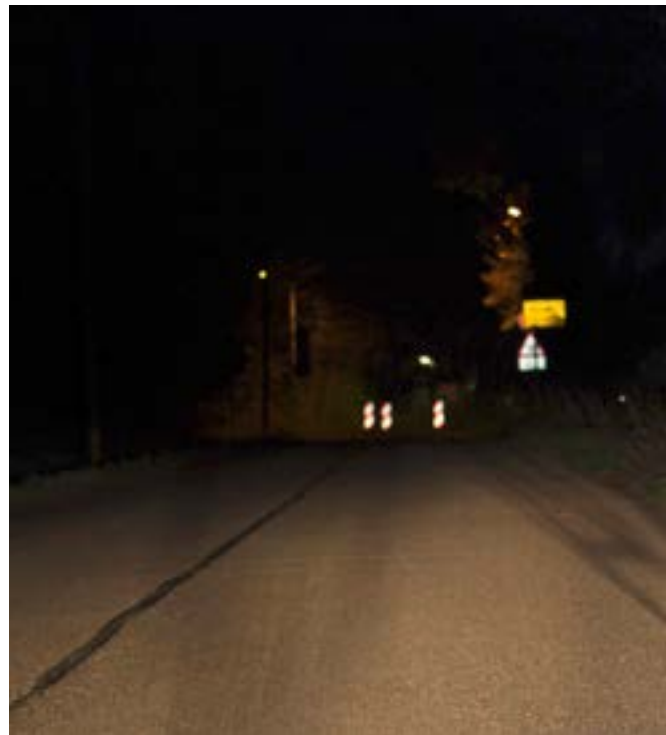
Fault-tolerant control strategies reduce the risk of accidents for electric cars

Electrified chassis and power-train systems offer a variety of features for enhanced safety and comfort in road vehicles. However, the technology increases the risk of technical faults in novel systems such as the electric powertrain. The fault does not necessarily have to be serious, but can still lead to unexpected vehicle behavior, forcing the driver to respond. If the car deviates from its planned route, it may drive off the road or collide with oncoming traffic.

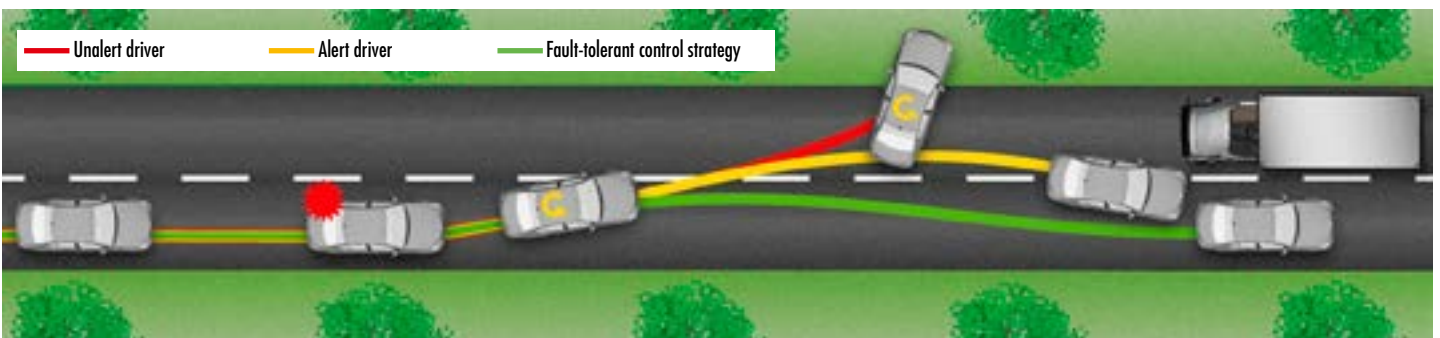
In a vehicle equipped with electric wheel hub motors, for example, a sudden fault or malfunction with one of the rear wheels can cause a sudden braking, causing the vehicle to move off course. In such situations, a car that does not have a control strategy will, according to studies on driver reactions, move about 1.3 meters sideways on the road while the driver tries to get the car back on course. One solution to the problem – a “fault-tolerant control strategy” – allows the car to retain its course even if a fault occurs. In tests, the researchers found that the lateral movement, yaw rate and steering is reduced by up to 90% if the vehicle is equipped with such a strategy, compared with a car that does not have a fault-tolerant control strategy.

The “Over-actuated fault-tolerant hybrid electric vehicles”

project has been conducted at the KTH Vehicle Dynamics, School of Aeronautical and Vehicle Engineering, KTH Royal Institute of Technology and is part of the Swedish Electric and Hybrid Vehicle Center (SHC). These studies also formed the basis for EU legislation recommendations and have been conducted as part of the EVERS SAFE project with participants from Sweden and Germany.



OKA – Optimal control allocation
VKA – Simplified control allocation (can be implemented in vehicles)
ESP – Electronic stability program





80 Prescribed minimum equipment with light systems: bicycles (up to 1 m wide)

In the future as per draft 52. ÄndV StVR.



	DURING THE DAY		Active light system Must be attached during darkness and in good working order	
	Active light system Removable lights do not need to be attached or carried during the day	AT NIGHT		
		Passive light system All lights must at all times be firmly attached and not hidden		
Front	Headlight	Reflectors, white	Headlight	
Rear	Rear light, red	Pedal reflectors, yellow	Rear light, red	
		Cat. Z reflectors, red		
Side		Retroreflective strips on tires or rims, white		
		Either Retroreflective spoke reflectors, white		
		Spoke reflectors, yellow		

lights must be attached and, of course, be in good working order.



If a cyclist fails to meet this obligation, whether because they have “forgotten” their removable lights, failed to plan the charging periods properly or it fell dark “suddenly,” passive lighting systems become all the more important. Only when all of the prescribed reflectors and/or retroreflective materials have been firmly attached and are not hidden can they fulfill their function as a potentially life-saving measure (Figure 30).

BEST PRACTICE



Responsible cyclists make sure that their bicycles are fitted with all of the prescribed active and passive lighting systems.

The Facts at a Glance

- According to studies, the wide range of different systems has helped to save more than 600,000 lives in the USA alone between 1960 and 2012. Safety belts, front airbags and safety steering columns account for almost 75% of these systems.
- The full potential of electronic driver assistance systems can be leveraged only when they function reliably throughout the vehicle’s lifetime. Periodic vehicle monitoring plays an even more important role here.
- Front, side and rear underride guards on trucks will continue to act as “mechanical fallback solutions” in order to mitigate the severity of unavoidable collisions.
- Retroreflective markings mean that trucks can be seen more easily even from a great distance. This brings about a significant and sustained reduction in the number of rear-end collisions.
- Two-wheelers such as bicycles and pedelecs need to be fitted with highly effective active and passive lighting systems.
- The NCAP tests, which are performed all over the world, were and remain an important driver for ongoing improvements to the safety of car occupants and pedestrians.



Roads Must Be Forgiving of Mistakes

Vehicle technology and the human factor are the two central pillars of road safety. A properly functioning and efficient infrastructure is important, too. The challenge here is to implement road construction and traffic management measures designed to eliminate factors that contribute to accidents and to make hazardous sections of roads safer with the aim of mitigating as far as possible the severity of accidents. When it comes to infrastructural measures, factors such as speed monitoring at accident blackspots, rescue services and the maximum possible standardization of traffic regulations should not be forgotten.

Whether traveling in a vehicle or by foot, anyone who goes out on the roads to get from A to B wants to reach their destination safe and sound. The infrastructure plays a key role here. The variety of needs that road users have, the often limited financial resources available for planning, maintaining, building and upgrading roads, aspects concerning conservation and environmental protection as well as geographical, geological and climatic conditions all pose huge challenges for planners. At the same time, however, improvements in the field of intelligent transportation systems and the potential of variable lane usage open up whole new possibilities.

Infrastructure and traffic route planning is fundamentally possible only with a long-term approach. New technologies combined with the ever more rapid changes in our mobility behavior and the associated changes in our vehicles inevitably lead to

problems. One example is the increasing use of bicycles in urban areas. In addition to increasing environmental awareness and the desire for exercise, this trend can be attributed above all to the fact that it is often simply quicker to travel by bicycle in urban areas than it is by car. The promotion of urban cycling is, therefore, in many respects a good thing. The Netherlands has for a long time been a pioneer in Europe when it comes to urban cycling and today can point to a solid cycle path network complete with the necessary accompanying legislation as the result of its efforts.

POTENTIAL FOR CONFLICT BETWEEN CYCLISTS AND MOTORISTS

The fact that expanding the cycling infrastructure in response to current trends sells well in many places has not gone unnoticed by local politicians in

Germany. However, the lack of a big-picture concept combined with an overarching desire simply to build as many kilometers of cycle paths as possible for as little money as possible in as short a time as possible are frequently counterproductive to the aims of making cycling more attractive, encouraging a spirit of partnership and, ultimately, making our roads safer. Clear regulations stating the minimum requirements that cycle facilities are to meet and where such cycle facilities are to be situated ensure clarity among all stakeholders and, in turn, enhance safety. The physical separation of cyclists and motorists is not possible everywhere. At the very latest at crossroads and junctions, cyclists and motorists are forced to share the same space – with all the potential for conflict that this entails. The following aspects must be taken into account here:

- Cycle lanes must be sufficiently wide and also able to accommodate cargo bikes;
- A safety distance must be maintained from parked vehicles to minimize the risk of cyclists colliding with car doors that suddenly open in front of them;
- Road lanes must be wide enough to allow motor vehicles to overtake cyclists at a sufficient distance from the side of the vehicle;
- The surface of cycle lanes must be suitable and flat (i.e. no storm drains or cobbled curbstones).



If it is impossible to ensure the safety of cyclists with dedicated cycle lanes, a speed limit commensurate with the volume of road and bicycle traffic may have to be introduced. Often, however, problems can be solved in other ways that do not necessarily involve integrating bicycle traffic with motor vehicles along main roads. A suitable cycling infrastructure on parallel side roads where cyclists enjoy clearly managed priority can improve safety for all road users. At the same time, systematically punishing violations will ensure that the cycle path infrastructure not only remains unobstructed by parking offenders and delivery vans/trucks, but is also used properly by cyclists themselves.

POSITIVE EXPERIENCES WITH BARRIERS AND 2+1 ROADS

Differences when it comes to accelerating ability, maneuverability and speed are critical to safety not only in mixed traffic situations where motor vehicles, cyclists and pedestrians share the same space, but also in situations where the only road users are motorists. This is especially the case on country roads where the speed of vehicles can be high

but it is either impossible or nearly impossible to overtake safely. Just how dangerous this can be is demonstrated by an example from Portugal, where – among other places – one particular section of the IC 2 linking Lisbon and Porto was a notorious accident hotspot. In 10 years, 77 people died on a section of road just three kilometers in length. In

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A suitable cycle path infrastructure on parallel side roads where cyclists enjoy clearly managed priority can improve safety for all road users.

Road safety aspects must not be overlooked in the design of roundabouts

In many countries in Europe, roundabouts have enjoyed something of a renaissance since the 1990s. The lower speed on roundabouts has helped to reduce both the number of accidents and, in the event that an accident occurs, the severity of injuries suffered. But roundabouts are not always the best solution, and, where the general conditions are unfavorable, they do not always improve safety either. Like other infrastructural measures, roundabouts also need to be announced well in advance. Especially at night, drivers need to be informed about an upcoming roundabout clearly and early on – for example, with good signage, adequate road lighting or retroreflective markings.

As a study conducted by the TU Dresden on behalf of the German Federal Highway Research Institute showed, poor recognizability of roundabouts during rainy or wet conditions leads to an increase in accidents specifically involving riders of motorcycles and bicycles, whom motorists either do not see at all or see only when it is too late. To put this in figures, one in two roundabout-based accidents investigated by the study occurred during wet conditions, and around one in three involved cyclists. In addition, the entrances and exits should be designed such that they force drivers to slow down, and

the sculptures and other forms of art installed in the center of some roundabouts must not constitute a hazard or distract drivers.

What is particularly baffling is that different rules regarding priority on roundabouts still apply in Europe. In Germany, for example, traffic about to enter the roundabout has to wait for traffic already on the roundabout; drivers indicate only when exiting the roundabout. In Austria, the “right before left” rule applies – that is, traffic about to enter the roundabout has right of way over traffic already on the roundabout, although special signage may stipulate deviations from this rule where necessary; drivers indicate when exiting the roundabout. In Italy, the “right before left” rule also applies. In practice, however, it is frequently ignored, which is why extra care is required. In France, vehicles about to enter the roundabout always have priority, although special signage can often be seen stipulating that traffic already on the roundabout has right of way. In Switzerland, Spain, Portugal and Poland, the traffic already on the roundabout has right of way (unless otherwise specified). In the UK, where you drive on the left, vehicles enter roundabouts from the left. The traffic on the roundabout coming from the right usually has right of way.



**BEST PRACTICE**

Barriers erected between the two sides of the road reduce the severity of accidents.

response, an action plan was devised at the end of 2015 aimed at improving the signage and widening the lanes. The central measure of this plan was to construct a protective concrete barrier in the middle between the two lanes. The result? While eight accidents with two fatalities, two seriously injured persons and three persons with minor injuries were recorded along this stretch of road in the first half of 2015, in the same period of 2016 no one died. Ten accidents were recorded, with seven people suffering “only” minor injuries.



Barriers have helped to make roads safer elsewhere, too, including the USA – in Missouri, for example. Between 1996 and 2004, around 380 people were killed in collisions with oncoming traffic on just three highways; 2,256 people were injured. In response, work began on constructing reinforced steel cable barriers in the middle of these highways. These measures proved highly successful: According to the Missouri Department of Transportation, the number of people killed in accidents involving

collisions with oncoming traffic fell from an average of 18 to 24 per year to 1.

The ideal way to prevent accidents involving collisions with oncoming traffic would be to construct all roads in the form of a four-lane divided highway with both sides separated by a physical structure, but this would of course be impossible for a number of obvious reasons – conservation, the amount of space required, cost and the actual need for such a measure. But there is no doubt that for busy roads – especially those frequently used by commercial vehicles – this solution would offer the greatest potential for improving safety simply because it would make overtaking virtually risk-free.

The concept of 2+1 roads, which was developed in Sweden in the early 1990s, has proved successful in situations where it is either undesirable or impossible to upgrade to a four-lane divided highway, but safe overtaking opportunities are to be ensured nonetheless. This road design consists of two lanes in one direction and one lane in the other, alternating every few kilometers. The conventional 1+1-lane configuration in the intermediate sections varies in length from an immediate transition to a stretch covering several kilometers over which drivers are forbidden from overtaking.



Experience of roads constructed in this way has shown that the number and severity of accidents are reduced and drivers are more likely to observe the ban on overtaking in the intermediate sections. 2+1 roads are popular not only in Sweden, but also in the USA, Australia, New Zealand and Germany. In Sweden, the two sides of the road are often additionally separated by steel cable barriers. Although this road design reduces the risk of front-end collisions, concerns raised about the potentially higher risk of injury to motorcyclists have prevented this system from being introduced in many other countries.

A modified form of 2+1 roads is also ideal on sections of road that are heavily used by commuter traffic in the morning in one direction and, in the evening, in the other direction. By ensuring that the middle lane is utilized according to demand, the flow of traffic can be optimized with minimal land usage. Either electronic display systems or mobile separators are used to indicate the direction of traffic. The most prominent example of the use of mobile lane separators is the Golden Gate Bridge between San Francisco and Marin County. Here, the six lanes can be divided up into a 4+2, 3+3 or 2+4 configuration, depending on require-

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2+1 roads reduce the risk of frequently fatal front-end collisions.

Luis Jorge Romero

Director General of the European Telecommunications Standards Institute (ETSI)

**ICT Standards for Road Safety**

We are already in the 21st century. So many technological developments have taken place in the last 100 years! We've sent men to the moon and brought them back, alive. We've eradicated diseases that once were fatal for humankind. In transport, we've evolved from animal traction to supersonic jets. And where once we used horse-power, now we have mechanical machines.

In the world of ICT, what was once the telegraph has evolved into the Internet and mobile communications. Thanks to this evolution, nothing escapes us. We can be notified within seconds of what's happening on the other side of the world. And not just with words: We can even watch live video streams on our mobile handset. Amazing!

What seems most amazing, though, is that despite all these advances, traffic accidents are one of the main causes of death today. How is it that we know what

is happening in the antipodes in real-time, but cannot be warned about what's coming after the next bend? Isn't this crazy? It seems obvious that most of these casualties could be avoided by just having proper communication, enabling vehicles to communicate with each other and with their surroundings. And this is precisely what we, in ETSI, are helping to develop: The standards that are vital for facilitating communication among vehicles and between vehicles and infrastructure. The aim is not only to prevent accidents and therefore enable safer roads and streets, but also to make better and more efficient use of transport.

The challenge is massive, and the participation of all stakeholders – automotive industries, road users, traffic authorities and agencies and so on – is crucial if we are to make it a reality. We believe the result is very much worth the effort.

ments. Since the separators are moved automatically, lane usage can be configured very quickly, traffic guidance is clear and safety is very high. The system is ideal not only for bridges, but also for longer stretches of road.

FLEXIBLE RESPONSE TO CHANGING TRAFFIC SITUATIONS

A similar approach can be seen when the breakdown lane is opened for vehicles. When traffic is particularly dense, variable signage indicates that the shoulders are temporarily open as additional lanes, often ahead of exits. As well as having many other positive effects, this measure helps to prevent jams and, in turn, accidents. But this system works properly only if the shoulders along the relevant sections of road are permanently monitored and can be blocked off for vehicles that have either broken down or were involved in an accident.

Nevertheless, the ability to respond flexibly to ever-changing traffic situations is a key element of improving road safety. Variable signage on highways or in the vicinity of exhibition and event centers has been around for a long time now, and major advances in the field of sensor, telecommunication and, of course, computer technology as well as in our understanding of traffic flows have seen the development of ever more refined and enhanced systems. The dovetailing of information and telecommunication technology and the interconnection of different forms of road use mean that it is now possible to implement targeted traffic management measures not only nationwide, but also in busy urban areas.

The pairing of traffic regulation and traffic information for road users is also showing some success. In the UK, the National Traffic Control Centre (NTCC) offers real-time information on traffic conditions on highways and arterial roads. In London, the London Streets Traffic Control Centre (LSTCC) monitors and manages the traffic on the capital's roads. Similar – in some cases even more advanced – centers have been established in, for example, Warsaw, Moscow and Tokyo. Ongoing advances in the field of telematics will see lots more exciting and useful developments to come.

NODE-BASED INFRASTRUCTURE

But it is not only technology that plays a key role in increasing road safety, but each individual road user, too. As long as drivers trust non-networked navigation systems more than traffic management centers



■ In Germany, the shoulder along certain sections of highway is opened as an additional lane when traffic is particularly dense.

or take shortcuts through residential areas to avoid jammed-up main roads, there will always be avoidable traffic risks. Rigid adherence to one mode of transport – usually the car – also causes unnecessary congestion, with all the accident risks that this entails. The increasing popularity of car-, scooter- and bike-sharing schemes, using public transport for at least some journeys as well as traveling by bicycle or on foot are not just worthy trends for “other people.” Flexibility in our mobility starts with each and every one of us. Technology is just a means to an end.

To encourage people to use different modes of transport, a node-based infrastructure is essential. In particular, this involves creating secure facilities for parking cars, bicycles and alternative forms of transports like Segways at locations with good public transport links. Proper bicycle parking garages situated close to busy train stations can be frequently found in the Netherlands and in certain Asian countries. Kyoto in Japan even has fully automatic underground garages. Covered, secure bicycle stands should be available at as many stations as possible. In addition, measures designed to ensure that bicycles can be safely transported on public transport

BEST PRACTICE 
Crash barriers with skirting developed in Germany offer comparatively high protection for colliding motorcyclists.

and long-distance trains can help to improve road safety. The more attractive the options, the greater the acceptance among potential users.

MORE FORGIVING SAFETY SYSTEMS FOR MOTORCYCLISTS

Considerable room for improvement also exists outside of urban areas, too. The higher speeds on rural roads mean that it is no longer pedestrians and cyclists who suffer the most accidents, but motorists. Infrastructural improvements for motorcyclists aim to reduce the risks associated with what is an especially dangerous form of road transport.

Measures designed to keep the road surface in good condition benefit all other road users as well. The bituminous mass used in some countries to repair potholes or cracks in the road can quickly pose a major risk to motorcyclists, which is why repairs

■ *“Trees don’t step aside”:
 An initiative launched by the Lower Saxony association for the prevention of road accidents.*

should be undertaken using only materials with a similar frictional coefficient to the rest of the road surface. Quickly repairing potholes prevents further damage to the road surface and the prevalence of loose chippings during larger-scale repairs.

In addition, crash barriers should be designed to offer the best possible protection for colliding motorcyclists. The combination of a large upper surface – for example, a box section – with skirting installed under the pillar to stop motorcyclists from hitting the post has proved effective not only in crash tests, but also in real accidents. In many cases, skirting can be fitted to existing systems. The “Euskirchen Plus” system, for example, which was developed by DEKRA on behalf of the German Federal Highway Research Institute, offers comparatively greater protection for colliding motorcyclists.

MORE EFFECTIVE PROTECTION IN COLLISIONS WITH TREES

A continuing problem in Germany and other countries is collisions with roadside trees. Accidents of this kind frequently have grave consequences. According to information from the Federal Statistical Office (Destatis), in 2015, 603 people in Germany were killed in road accidents after collisions with a tree. This accounts for around 17% of all 3,459 road users killed. Rural roads carry the greatest risk. Here, in 2015, 517 people were killed in collisions with trees in Germany, equivalent to around 26% of all traffic fatalities on rural roads. In comparison, in 2015, 2,175 people were killed in road accidents on rural roads in France, 316 of which were collisions with trees. This is equivalent to around 15%. In Italy, the problem appears to be slightly less severe. In 2015, 1,495 people were killed in rural road accidents, 127 of which were collisions with trees, which is just under 9%.

The risk of being killed in a collision with a tree is generally twice as high for the occupants of cars compared with other obstacles. In a collision with a tree, all the impact energy is concentrated on a small area of the vehicle. The occupant safety elements in-built in the vehicle therefore have limited effect, resulting in a very high risk to the occupants. Today, infrastructure measures hold huge potential for minimizing the number and consequences of accidents involving collisions with trees on the side of the road.

When new roads are built and trees planted, a roadside safety zone, as already seen in some Scan-



dinavian countries, should be planned. If this is not possible or possible only to a certain extent, suitable restraining systems should be installed, even on existing roads. Two-wheeled drivers can also be effectively protected by suitable designs.

Optical guidance systems situated on or right next to the road can improve visual guidance, as can yielding guidance posts fitted with reflectors. Bushes and shrubbery are also an environmentally friendly and safe road design measure because they ensure that vehicles are stopped by something large and relatively soft. Damaged or destroyed trees should not be replaced. Along hazardous stretches of road, trees should be removed from the roadside and replanted at a safe distance from the road. At spots where trees are a known hazard but it is not possible to replant the trees, not only crash barriers but also impact attenuators that provide a larger surface against which a vehicle collides and that deform in order to absorb additional energy could potentially be used.

Speed limits and overtaking bans can also help to improve safety on stretches of road with a high number of accidents, provided such measures are properly monitored. A good example of this can be found in the German state of Brandenburg, which has a high number of tree-lined roads and, consequently, a high number of fatalities as a result of collisions with trees. In 2015, almost 40% of all road traffic fatalities occurred following collisions with trees (in figures: 69 of a total of 179). Compared with 2014, during which 54 people were killed in collisions with trees, this represented an increase of almost 28%. But the situation improved significantly in 2016. According to preliminary figures, the number of fatalities as a result of collisions with trees fell from 69 to 30, a decrease of almost 60%. This can most likely be attributed to the fact that Brandenburg had introduced, among other measures, a speed limit on all tree-lined roads where no roadside crash barriers were installed. Where before the limit was 80 km/h or 100 km/h, it is now 70 km/h. Another reason for this significant reduction in the number of fatalities from 2015 to 2016 could be the fact that additional crash barriers had been extensively installed along tree-lined roads and on certain trees.



SPEED SURVEILLANCE MEASURES

In many countries, speed limits that are now legally standardized – 30 km/h in residential areas, 50 km/h on main roads, 65 km/h to 100 km/h on country roads and 100 km/h to 130 km/h on high-

ways – are the basis for the largely safe coexistence of all sorts of different modes of transport. The management authorities responsible can also erect special traffic signs stipulating additional, location-specific speed limits.

But the simple imposition of speed limits does not lead to greater safety – road users have to actually stick to the rules in order for the desired effects to be achieved. Therefore, drivers have to know that they may be caught and punished if they violate speed limits. All over the world, a wide range of different surveillance methods have been implemented – from having police officers estimate how fast a vehicle was traveling, through local surveillance with measurement devices, to a variety of air surveillance methods. A great deal of variation also exists when it comes to the level of penalties imposed. In some parts of Canada, for example, exceeding the speed limit in non-urban areas by 20 km/h could result in a fine of around €20; in Switzerland, however, the same offense could see you landed with a fine of at least €240. The greater the speed by which drivers exceed the speed limit, the greater the punishments can potentially become – for example, drivers risk having their vehicles impounded or even facing prison. The level of punishment is frequently left to the discretion of the police officer(s) that issued the



■ [Link to a crash test in which DEKRA demonstrated the devastating consequences of a car colliding with a tree.](#)

BEST PRACTICE 
On tree-lined roads in Brandenburg, speed limits and additional crash barriers led to a noticeable reduction in the number of accidents and fatalities as a result of collisions with trees.

Kathrin Schneider

Minister for Infrastructure and Spatial Planning
in Brandenburg



Comprehensive package of measures encompassing prevention, control and investment

In response to the worryingly high number of accidents in the 1990s, it was essential to step up efforts in all areas to improve road safety in the state of Brandenburg. Now, the number of people injured or killed in accidents on our roads is much lower.

This can be attributed to the introduction of a whole raft of measures encompassing prevention, control and investments. The numerous volunteers involved in the road safety network and our “Lieber sicher. Lieber leben.” road safety campaign have done much to raise awareness among road users. By conducting speed checks, the police ensure that everyone

sticks to the rules. Investments in road infrastructure, the elimination of accident blackspots and a comprehensive crash barrier program have made many of the tree-lined roads in Brandenburg safer. In 1995, the number of people killed following collisions with trees was 409 – last year, it was just 30. And the speed limit along the sections of road where crash barriers cannot be installed is to be reduced to 70 km/h.

But despite the success we have enjoyed, people are still dying on our roads, which is why we will be continuing our road safety work at all levels in the coming years as well.

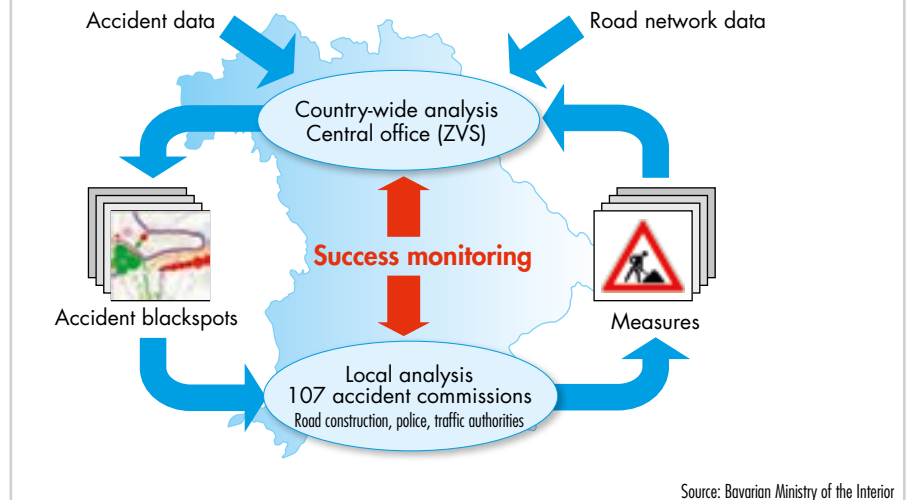
Effectiveness of safety measures on rural roads in Bavaria

A safe road infrastructure ultimately has to be ensured at regional and local level. Previous DEKRA Road Safety Reports have referred multiple times to the outstanding role performed by the accident commissions. The Bavarian Ministry of the Interior, for example, reported on a range of positive experiences with tangible success: In a report published in 2011, the ministry described the effectiveness of road safety measures aimed at eliminating accident blackspots on country roads.

Since their founding in 2000, the 107 Bavarian accident commissions have been engaged in identifying accident blackspots on interurban roads (highways, main roads, state roads and some district roads) and eliminating them by introducing measures aimed at improving safety. This is now being followed by an analysis of their effectiveness (success monitoring) in order to identify any further potential for improvement (Figure 31). All the relevant information is recorded in a central database. This information includes specialist data and geodata relating to the road network and accident data collected by the police stations with electronic accident type maps. The accident commissions record other relevant information about accident blackspots and for documenting measures.

A detailed compendium has been prepared for documenting safety measures that have been implemented, how effective these measures were and how much they cost. Effectiveness (benefits due to fewer accidents) is indicated by means of a three-color system (green: optimum effect; yellow: partially effective; red: not effective). Figure 32 shows an example of a summarized evaluation of measures implemented to reduce road accidents on longer stretches of roads in a total of 86 cases. In ten cases, for example, speed was limited only by a sign stipulating a speed limit (of 60 km/h, 70 km/h or 80 km/h depending on the local conditions). Although this was a low-cost measure, its effectiveness was considered optimal in less than a quarter of cases. In 25 cases, speed limits were subjected to intensive surveillance, which resulted in average annual costs of around €10,000. The effectiveness of this measure was considered optimal in around one third of cases. The most effective measure proved to be upgrading existing sections of roads or constructing new roads in line with the relevant standards. The effectiveness of this measure was considered optimal in more than 75% of the ten cases analyzed.

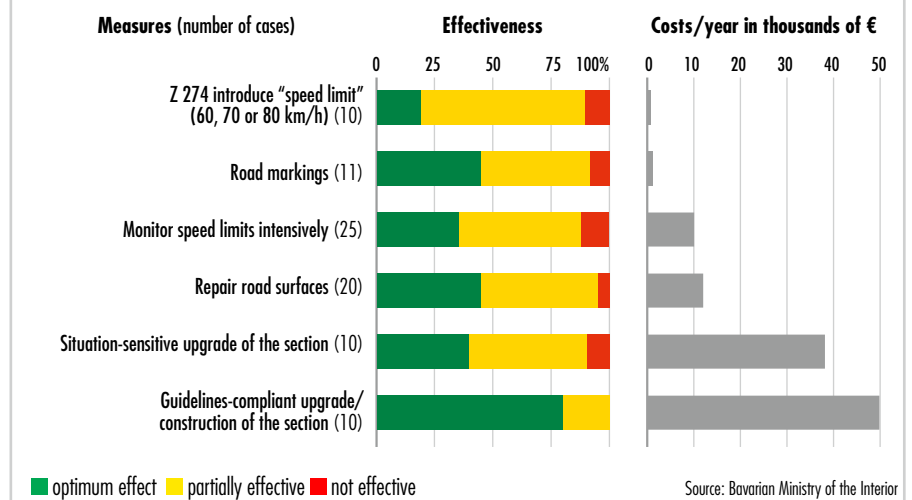
31 Diagram showing measures for eliminating accident blackspots on interurban roads in Bavaria



Source: Bavarian Ministry of the Interior

32 Evaluation of the effectiveness of measures and their associated average cost

Example: Prevention of road accidents on longer stretches of non-urban roads in Bavaria



Source: Bavarian Ministry of the Interior

With average annual costs in excess of €50,000, however, this measure is the most expensive.

In total, improvements in road safety were observed in 83% of the detected accidents blackspots where evaluable measures had been implemented. 80% of the measures were considered effective in terms of cost and safety. Before the accident commissions were set up, the cost of accidents on non-urban main roads and state roads in Bavaria had fallen by 16% between 1991 and 2000. As soon as the accident commissions were set up, this trend increased significantly.

Between 2000 and 2009, there was a 37% reduction, which means that the annual decline in accident-related costs has more than doubled. In the accident blackspots identified and eliminated through various measures, accident-related costs fell by around eightfold compared with those on the rest of the road network. Since the launch of the accident commissions in 2000, the number of serious accidents – especially on non-urban roads – in Bavaria has declined significantly. The economic benefit of all the measures introduced outweighs their cost more than twelvefold.

warning. Many countries also have points systems, whereby not only serious, one-time infringements but also multiple relevant infringements can result in drivers having their driver's license revoked, at least temporarily.

The first mobile speed surveillance radars were introduced 60 years ago. These allowed vehicle speeds to be accurately determined in either a stationary or mobile installation. The risk of measurement errors was minimal provided that the systems were used properly, and so the technical basis at least for ensuring fair punishment for speeding had been established. Over time, speed surveillance systems became ever more sophisticated.

The Australian state of New South Wales broke new ground by introducing a zero-tolerance policy to speeding. In terms of ensuring the safety of pedestrians, even small reductions in speed can play a big role. Zero or near-zero tolerance to speeding among stationary and mobile speed camera installations is therefore designed to reduce overall speed in built-up areas. Simply calibrating speedometers so that the displayed speed is higher than the actual speed should ensure sufficient tolerance.

Who is responsible for speed surveillance, and by what means, varies across the world. In certain regions, the police alone might be responsible for speed surveillance; in other regions, the relevant regulatory authorities and even municipalities themselves might also be authorized to install speed cameras. However, problems can arise if the body responsible for surveillance also profits directly from the revenue. In this case, clear legal specifications must ensure that traffic surveillance measures are appropriate and do not serve simply to fill the coffers of the body responsible for surveillance. In some countries such as France, traffic surveillance is permitted only within defined zones. Often, upcoming speed checks must be announced in advance on specially erected signs. In other countries, however, it is forbidden for the location of stationary speed cameras to be indicated in navigation systems or speed camera warning apps for cellphones.

So-called "speed camera marathons" are also becoming increasingly popular. Announced in advance and generally enjoying high media attention, speed camera marathons are organized on certain days of the year at either regional or national level and place the focus of traffic surveillance measures on speed over a 24-hour period. Mem-



■ *By conducting more radar speed checks, the authorities can also raise people's awareness of the dangers of excessive speed.*


bers of the public are often invited to name specific roads or sections of roads where, in their opinion, speed controls might be particularly beneficial. Experience from other European countries shows that campaigns like this enjoy a high profile and are well received by the public. Whenever speed camera marathons are held, the number of people caught speeding is very low.

A major problem with the systematic punishment of road safety violations is the risk of corruption. Particularly in certain developing and newly industrializing countries, such tendencies can be seen. In consequence, motorists do not see the purpose of traffic surveillance, meaning that even the imposition of fines has no effect whatsoever on improving road safety.

One method that has proved especially effective is the use of "dialog displays", particularly at spots where compliance with speed limits is especially important such as where roads enter towns or villages, in front of schools and kindergartens or at pedestrian crossings. Here, drivers get to see their current speed displayed on a large board along with, for example, a happy or sad face. A raised, admonishing index finger in conjunction with an emotional display, or some form of direct and immediate congratulations for sticking to the speed limit visible to all drivers and not just the driver being praised, are often much more effective at instilling safe driving habits over the long term than speeding tickets.



PEDESTRIAN CROSSINGS AND TRAFFIC-CALMED ZONES

To make it safer for pedestrians to cross our increasingly busy roads, the first three to four decades of the past century saw the construction of special “crossings” of different kinds. The first pedestrian light in Europe was installed in Copenhagen in 1933. In Germany, the first pedestrian light entered service in Berlin in 1937. At pedestrian lights, broken white lines in the direction of walking to the left and right delimit the pedestrian crossing. Where pedestrians walk directly across wide white stripes painted laterally across the road, this is known as a “pedestrian crossing.” In Germany, these “zebra crossings” are not light-controlled and, in built-up areas, are clearly signposted. 


Since many road users in built-up areas are “unprotected” road users like pedestrians and cyclists, special safety measures are essential. Given the fact that speed is a primary risk factor, different strategies have been implemented all over the world to manage this. In addition to pedestrian zones that are off limits to motor vehicles and a range of different concepts for bicycle boulevards and cycle paths, traffic-calmed zones have also been introduced in Germany. In these zones, the maximum speed for motor vehicles is around 7 km/h, and cyclists, too, are forbidden from significantly exceeding this limit. All road users enjoy equal rights and must not unnecessarily obstruct each other.

A maximum speed of 20 km/h applies in many residential areas in, for example, Russia, Latvia, the Ukraine and Belarus. In 2014, Portugal also followed their example and imposed a 20 km/h limit in selected residential areas; in Switzerland, these areas are known as “encounter zones.” 30 km/h speed limits have become widespread in many European countries and have proved effective. In fact, some countries are even considering introducing a maximum speed of 30 km/h in built-up areas, although a 50 km/h limit would continue to apply on through roads and roads that are vital for ensuring the continued flow of traffic. However, this is a highly controversial concept.

30 km/h zones were first introduced in Germany in 1983 in a series of model trials and then quickly rolled out in a number of towns and villages. In 20 km/h zones, speed is reduced even further. Specially signposted sections of road to this effect have been introduced in many residential and commercial areas. In these zones, pedestrians enjoy full right of

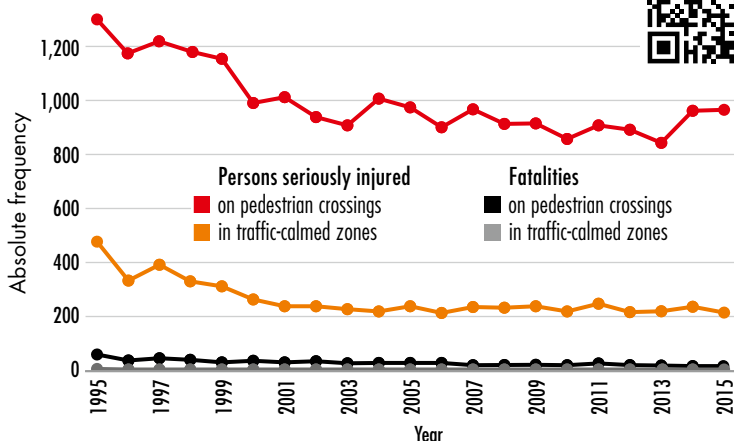
BEST PRACTICE

Dialog displays tell road users clearly and unmistakably how fast they are traveling and, ideally, encourage drivers to change their habits.

 *Parents should teach children as early as possible how to cross roads safely.*

Accidents on pedestrian crossings

The number of people seriously injured or killed on pedestrian crossings and, in particular, in traffic-calmed zones is already very low



Pedestrian lights come in a variety of forms

Conventional pedestrian lights (Figure 1) are increasingly being complemented with additional information, including static information such as "Please wait"/"Signal coming" (Figure 2), with more advanced designs even showing how much time is left before the signal changes (Figures 3 and 4). The solution shown in Figure 4 shows how much time is left before the signal turns back to red or green (depending on the current phase). This light does not require an additional display field because the remain-

ing time is displayed using the LED field that is not currently in use during the current red or green phase. A rather more unusual idea is to upgrade the standard request button to include a touchscreen. When the button is pressed, a video game (here: StreetPong) starts up, allowing pedestrians to occupy themselves while waiting for the lights to change. Initial observations show a decrease in the number of pedestrians who cross the road when the light is red. Some traffic planners provide information for pedestri-

ans explaining the purpose of the traffic lights and how to use them (Figure 5).

A fundamentally different solution can be found in, for example, Japan and Australia, whereby all pedestrians are given the green light to cross simultaneously. When pedestrians are in the middle of crossing the road, what measures can be taken to ensure that they are not suddenly caught out when the lights turn red again? One solution is to provide additional information for a "clearance" phase (Figure 6).



Conventional pedestrian light



Pedestrian light with additional information prompting pedestrians to wait



Pedestrian light with additional display showing the amount of time left before the light turns green



Light with variable display showing the remaining green/red phase



Explanation on a pedestrian light



Pedestrian light with amber light informing pedestrians how much time they have left to cross the road

BEST PRACTICE

The introduction of speed limits, accompanying road construction measures and appropriate signage in built-up areas has helped to significantly reduce the number of fatalities in traffic-calmed zones in Germany.

way on all public thoroughfares, but are not allowed to unnecessarily obstruct the flow of motor traffic. In traffic-calmed zones, motor vehicles can drive at “walking pace” only and drivers are not allowed to endanger or obstruct pedestrians. If necessary, they have to wait for pedestrians. Likewise, however, pedestrians are not allowed to unnecessarily obstruct motor vehicles in traffic-calmed zones. The first traffic calming models were trialled in Germany back in 1977. In 1980, the concept of traffic-calmed zones was legally incorporated in the German road traffic regulations.

Łukasz Puchalski

Director of Public Road Authority in Warsaw
(Zarząd Dróg Miejskich)

**Integrated Traffic Control System in Warsaw**

The huge increase in road traffic and traffic jams is an ongoing problem for major cities worldwide.

However, significant infrastructural investments and the construction of roads and road links cannot keep pace with the ever-increasing number of vehicles, with the result that public and private transportation is becoming less and less effective. In response, the Warsaw city administration, together with the Public Road Authority, has set up an integrated, EU-funded traffic control system. The system aims to optimize the flow of traffic in the city center and make public transport more attractive thanks to shorter journey times. In addition, this traffic management system aims to increase safety on the roads and to reduce environmental pollution from traffic.

The basis for this is software developed by Siemens that allows traffic flows to be monitored, controlled and optimized at 37 junctions around the district of Powiśle in the center of Warsaw and, on the Jerozolimskie Avenue, to prioritize tram traffic over private transport. Video surveillance of the Wisłostrada Tunnel is also integrated in the Warsaw traffic management system. The system also includes five boards for displaying up-to-date information for road users and 22 surveillance cameras. The modular structure means

that the system can be expanded to integrate additional signal controls and a range of new functions.

So how does the system work? Using video surveillance, weather stations and detectors, the system determines the volume of traffic and traffic conditions at the connected junctions and roads. By detecting the movement of public transport using on-board units, the system can also display traffic flows and recognize the current traffic situation. Based on satellite-supported GPS, the units continuously report the locations of the vehicles to the traffic management headquarters. Information on traffic density and jams can then be derived on the basis of the vehicles' duration of movement or standstill. All this data is analyzed and condensed to create an overall picture of the current traffic situation.

The team based in the traffic management headquarters then uses this data to decide on traffic-light circuits and traffic routing measures in the center of Warsaw. In addition, forecasts regarding expected traffic volumes are made, which can be accessed as traffic information via the Internet or other media. In this way, road users can choose alternative routes so that they can reach their destinations faster and more safely.

Since 1995, the German statistics on traffic accidents have listed the number of accidents and casualties on pedestrian crossings (zebra crossings) and in traffic-calmed zones. Until the start of the 21st century, these figures showed a clear and long-term decline in the number of casualties as a result of such measures. Figure 33 shows an example of the absolute frequencies of the numbers of seriously injured people and fatalities.

The huge importance of speed limits in built-up areas and the accompanying road design and signage measures is especially evident in traffic-calmed zones. Here, the number of people seriously injured in accidents Germany-wide since the beginning of the 21st century is between 200 and 250, while the number of fatalities since 1996 remains in the low single figures. In 2012, just one fatality in a traffic-calmed zone was recorded, which means that we are already very close to achieving the aim of “Vision Zero.”



While the priority once used to be on simply enabling pedestrians to cross roads safely, the focus today is on facilitating the considerate, safe coexistence of different road user groups in what have become known internationally as “shared spaces.”

CONSISTENT IMPLEMENTATION OF THE “SHARED SPACE” APPROACH

For many years now, more and more European cities have designed selected traffic zones according to the “shared space” principle. The idea behind this is to completely reshape how traffic moves through our urban spaces. Wherever possible, stop lights, signage and road markings are dispensed with completely. The aim is to encourage, without the imposition of restrictive rules, a voluntary change in the behavior of everyone using our public space. At the same time, all road users are to enjoy equal rights. In November 2005, for example, an urban object in the form of a “city lounge” covering several hundred square meters and based on the ideas of artist Pipilotti Rist and architect Carlos Martinez was opened in St. Gallen in Switzerland. On this space, which has since become known as “Red Square”, pedestrians, bicycles, mopeds, motorcycles and cars – and sometimes even delivery vans and trucks – all share the road; the square also features “relaxation zones” with various items of furniture, all in red. It’s hard to imagine how the “shared space” concept could be implemented more consistently and in a more eye-catching manner.

Promenades like “Red Square” were incorporated in the Swiss Road Traffic Act as “encounter zones” back in 2002. Since then, several hundred roads and squares in Switzerland have been modified on the basis of this successful model and similar concepts have since been introduced in France and Belgium.

OPTIMIZING RESCUE SERVICES

When it comes to infrastructure, simply upgrading and maintaining roads, installing safety systems and introducing no-overtaking zones and speed limits along hazardous stretches of road are themselves not enough. Additional optimization potential also lies with, among other things, the rescue services. After an accident, it is vital that the scene of the accident and the situation at the scene, for example, is reported quickly and as accurately as possible so that the right life-saving equipment and support vehicles can be deployed to the scene of the accident as quickly as possible.

Automatic emergency call systems play a key role here, while standardized emergency numbers ensure significant improvements. In the USA and Canada, the number “911” has been in use for many years as the emergency number for the police, rescue services and fire department. In Europe, lots of different emergency numbers are in use. Thanks to the introduction of the Europe-wide emergency number “112”, the public can now reach a permanently manned and at least English-speaking control center throughout Europe and in many



■ “Red Square” in St. Gallen in Switzerland is an excellent example of urban “shared space.”



neighboring countries. A standardized emergency number is also the basis for eCall systems, in which the calls are not routed to a dedicated emergency call center. The emergency numbers are known to the road users and the caller does not have to select a specific service – whether the police, rescue services, fire department or a combination of these services are needed. In addition, all emergency calls relating to an incident are routed to one

BEST PRACTICE 
Adoption of a tried-and-tested system following detailed analysis.

Emergency rescue pilot project in China

The People’s Republic of China is planning to set up a state-of-the-art rescue service based on the German model. To this end, the Björn Steiger Foundation was commissioned in June 2016 to set up a pilot project in the city of Jieyang (population: 7.5 million) in Guangdong Province in southern China for an integrated rescue system encompassing everything from the emergency call center to the rescue helicopter. The project is acting as a model for a nationwide emergency land and air rescue service “Made in Germany.” The aim

is to ensure that the service can respond to 95% of all medical emergencies within 15 minutes.

A number of German and European companies such as Airbus Helicopter, Ford, Mercedes-Benz, Bosch Sicherheitssysteme, Deutsche Telekom and Drägerwerk are all involved in the development of this integrated rescue service under the auspices of the Björn Steiger Foundation. In addition to response vehicles, rescue helicopters, rescue coordination centers and state-of-the-art medical equipment, the project also involves professional training of the required personnel. Among other things, the foundation is providing training for control center operators, emergency paramedics, pilots and, for technical rescue assistance, firefighters, as well as re-skilling doctors to take on the role of emergency doctors.



The project costs for the initial phase of implementation in the center of Jieyang for 550,000 inhabitants by the end of 2017 will be almost €43 million. If all goes well with the pilot project, the rescue service is to be rolled out across Guangdong Province, which has a total population of around 125 million, by 2028. The service might also potentially be expanded step by step to include other provinces, too.

Ana Tomaz

Director Road and Rail Safety Department,
Safety Division, Infraestruturas de Portugal, SA



No one should pay with their life for a driving error

In recent decades, Portugal has made major strides in reducing the number of traffic accidents. While 1996 saw more than twice the number of per capita fatalities compared with the European Union average, 20 years later this indicator is down 92%, now at 10% above the European Union average.

The National Road Network ("RRN"), managed by Infraestruturas de Portugal, SA and its predecessors, with over 15,000 kilometres of roads, has contributed decisively toward this reduction, particularly in the past 15 years: While Portugal has cut the number of accidents with injured persons by 25% and the number of fatalities by 49%, the RRN, under the management of IP, has cut the number of accidents with injured persons by 56% and the number of fatalities by 79%.

20 years ago, with one fourth less road traffic and 3,200 fewer kilometres of constructed roads, the RRN had more than 1,100 fatalities, accounting for nearly 60% of accidents in Portugal. Currently, the 176 fatalities occurring on the RRN under IP's management account for just 37%.

One of the main contributing factors to these results was the high level of investment over the past 20 years in road infrastructures, particularly in safer, higher-quality roadways such as freeways, resulting in progress in implementing the National Road Plan from around 23% in 1995 to 73% at the present time. One of many examples of these good investments are two crossroads freeways: the A4 that links Porto to Bragança, and the A25 that links Aveiro Port to the border with Spain, which, respectively, were completed in 2016 and 2007 and were upgrades of the roads that existed before – the IP4 and IP5.

The IP5 was completed in 1989 and was at the time referred to as the "most sensational advance this

country's interior has seen since the times of the railway". However, and despite having satisfied various needs – higher use, less travel time and greater mobility – it failed to meet the most important requirement, that of road safety, which has since become one of society's key demands. As such, the first steps were taken to construct third-generation roads to ensure safety and mobility, with the completion of this route's upgrading in 2007 and its transformation into a freeway, the "A25."

In operation for around 10 years, the A25 has seen an 82% reduction in fatalities compared with the last 10 years of operation of the IP5. In fact, from 1996 to 2006, there were 206 fatalities on the IP5 compared with 38 on the A25 from 2007 to 2016.

Similar conclusions can be drawn from the various investments over recent decades in road infrastructures to reduce road accidents by 85%, even with the volume of traffic more than tripling.

These investments have had a major economic and social benefit on society by helping to save thousands of lives, thousands of injuries and millions of euros. For example, if we had achieved the results from 2015 fifteen years earlier, we would have saved 7 billion euros and prevented 5,000 deaths and more than 200,000 injuries.

Despite the positive results, there is still much work to be done. Demands on the infrastructure will continue, creating the need for fourth-generation roads following the essential principles of the "Safe Transport System" (STS) based, among other things, on acknowledging human error and the fact that, although accidents cannot be completely avoided, it is unacceptable for anyone to die or be seriously injured as a consequence of a traffic accident: No one should pay with their life for a driving error.

control center, where the information received is quickly evaluated so that the appropriate measures can be implemented.

To reduce the response time of the police, fire department and rescue services, the use of GPS in emergency vehicles is recommended. In this way, the control center responsible can see the location of each rescue vehicle, which, in turn, means that the nearest available rescue equipment can be commissioned. Measures to ensure that rescue vehicles can reach their destinations without obstruction must be firmly anchored in infrastructure planning. In urban areas in particular, traffic flows and speed are reduced by various structural measures. However, such measures can make it harder for rescue vehicles to reach the scene of an accident – at any time of the day, never mind just during rush hour. Priority light control systems designed to ease the passage of rescue vehicles responding to incidents have been in place for many years now in many different forms. When an emergency vehicle approaches a light-controlled intersection, the lights change to allow backed-up traffic along the route of the emergency vehicle to start moving and ensure that the emergency vehicle can pass through a green light. However, such systems have to be integrated in the traffic light controller such that the responding emergency vehicles do not cause additional traffic jams due to incompatibilities with the traffic control center's computer.

To minimize any potential traffic restrictions, the time taken for the emergency services to respond, carry out the necessary rescue operations and clear the scene of the accident must be kept to a minimum in order to ensure that the affected section of road can be reopened as quickly as possible. An approach employed in the Netherlands appears to be highly effective here. As part of a raft of measures aimed at keeping the amount of time a road is blocked off and the resulting traffic jams to a minimum, the Directorate-General for Mobility and Transport, which belongs to the Ministry of Infrastructure and the Environment, has entered into an agreement with insurance companies. This agreement states that when an accident is reported, at least one breakdown/rescue vehicle is automatically deployed. In the event of a false alarm, the cost of the deployment is borne by the ministry; in all other cases, the cost is borne by the insurance company. This measure has reduced the breakdown service's response time to actual incidents (as opposed to false alarms) by an average of 15 minutes. The system has been introduced on



Rapid assistance in emergencies thanks to “DocStop”

This idea really is something special – and, so far, one of its kind in the whole of Europe: The DocStop initiative, which was launched in 2007 and counts DEKRA among its sponsors, is designed to contribute to greater road safety and greater safety at the workplace of bus drivers and other professional drivers in the transport industry. The initiative was the brainchild of DocStop initiator Rainer Bernickel, who came up with the idea of providing rapid medical assistance for professional drivers suffering from health problems during the course of their work and that this medical assistance should be provided by professionals – after all, self-medication often does not lead to the desired improvements.

To prevent accidents caused by drivers falling ill at the wheel, DocStop has over the years established a Germany-wide network of more than 700 doctors and hospitals, as well as rest stops, truck stops and logistics companies, which act as info stations along highways and main roads.

At the DocStop stations, which can be easily identified by the green and blue DocStop logo, and via the hotline 01805 112 024, drivers in need can report any health problems they may be experiencing. They will then be told where

the nearest doctor or hospital is where they can go for treatment, allowing them to continue their journey – provided, of course, that they have been given the all-clear – with the right medication. “Ultimately, only a healthy driver is a safe driver who will endanger neither themselves nor other road users,” says Joachim Fehrenkötter, CEO of the logistics company of the same name and honorary chairman of DocStop.

The initiators of DocStop have long since expanded operations to other countries, too. Since 2013, four Doc-

Stop info points have been set up in Denmark in partnership with the Danish transport company association, while in Poland, the DocStop network now comprises more than 50 doctors and info stations. The first DocStop station opened in the Netherlands in April 2015, while Austria now has seven info stations. The initiative is currently helping to set up a DocStop association in the Czech Republic, and intensive discussions are currently underway with partners in Hungary and France.



all main roads and on some of the regional road network.

SECURING THE SAFETY OF VEHICLES INVOLVED IN ACCIDENTS OR THAT HAVE BROKEN DOWN

Measures designed to secure the safety of vehicles on or on the side of the road that have either been involved in an accident or have broken down are also crucial for avoiding accidents and promoting road safety. Warning triangles are used in many countries all over the world. The bright red, reflective warning triangle is not only easily recognizable but also highly effective as a warning system. However, its full effect can be achieved only if it is properly erected and positioned. Binding specifications in this regard help to make life easier for people who are already in a stressful emergency situation. UNECE-R 27-approved warning triangles also feature fluorescent strips around the perimeter that, thanks to photoluminescence, can be seen even

more clearly and from a greater distance when natural light shines onto them. Active light elements further enhance the warning effect. Hazard warning lights have for a long time been mandatory on motor vehicles; drivers of vehicles weighing 3.5 t or more also have to carry a portable warning light. Modern LED technology and cost-effective long-life batteries make this increase in safety easy to implement – but the legal framework needs to be put in place first.

In addition, however, officers from fire department and rescue response teams and other similar organizations have to be trained in how to properly secure the scene of an accident. Many breakdown service providers offer excellent training in this field. In addition to ensuring the safety of the response personnel, properly secured areas with clear route guidance make it easier for passing motorists to find their way past the scene of an accident. As well as training measures for the response teams, the response vehicles themselves

BEST PRACTICE 
In the Netherlands, to reduce the amount of time it takes to clear the scene of an accident, at least one breakdown/rescue vehicle is automatically deployed as soon as an accident – primarily on main roads – is reported.



■ Providing members of the public with first aid training is extremely important.

of course also have to be provided with their own safety systems and material.

MANDATORY FIRST-AID MEASURES

The more quickly and effectively the various forms of rescue and assistance are dovetailed, the better the chances of survival and recovery for road users involved in accidents. The most important basis for ensuring this is first aid provided by passers-by and/or volunteers, including by uninjured persons involved in the accident. Providing proper first aid at an early stage can help to prevent a patient's condition from deteriorating. According to a study conducted by the University of Würzburg, the number of road traffic fatalities in Germany could be reduced by 10% if first aid were provided immediately following an accident.

Since anybody may at any time find themselves in a situation where they have to provide first aid, proper training for as many people as possible would be a major benefit. Worldwide, various approaches have been adopted to address this aspect. In some countries, first aid is taught in schools; in other countries, first aid training is a mandatory part of driver training lessons. In additions, companies of a certain size are required to offer first aid training and regular refresher courses. Even if the scope of required training varies and, in many

cases, refresher training is not mandatory, such measures do at least raise awareness of the importance of first aid and, as a result, people's inhibitions about getting involved are lowered.

When it comes to people's obligation to provide first aid, very different approaches exist. In Argentina, Denmark, Germany, France and Serbia, for example, people are legally required to provide first aid. Anyone who fails to provide any necessary and reasonable help risks imprisonment. In Commonwealth nations, the USA and large parts of Canada with common law systems, clear guidelines often are lacking. That said, "common law" usually encompasses a "Good Samaritan" law, which stipulates a duty to offer assistance.

Just as important as the duty to help is the legal protection of those who do help. In this regard, the German system is quite rightly seen as a "best practice." As long as a first-aider acts to the best of their knowledge and conscience, they are protected from all forms of legal repercussions. This also applies if the assistance offered proves detrimental, either unintentionally or unavoidably in the context of the assistance given. Additionally, first-aiders are insured by German statutory accident insurance against all physical injury that they cause or suffer themselves as well as against any material damage that they might cause during the course of assis-

tance. An example from China highlights the negative consequences of the failure to legally protect first-aiders: In 2006, a first-aider was brought to trial by the woman he tried to help in a bid to make him pay for the medical treatment costs of the injuries she suffered in a fall caused by the first-aider. Despite a lack of evidence, the court ruled in favor of the patient, stating that nobody needs to help anyone else if they do not feel responsible for a person's plight. As a result, people in China are now much less prepared to help people in peril.

QUICKER RESCUE OF PASSENGERS TRAPPED IN VEHICLES

In traffic accidents in particular, one of the main tasks of the fire department is to rescue passengers trapped in vehicles. However, rescue teams face myriad challenges here. Increasingly strong materials designed to enhance the safety of vehicle occupants mean that fire crews need state-of-the-art rescue equipment to provide their usual rapid assistance. When money is tight, not every fire department can adequately keep up with the pace of developments. As vehicles become ever safer, the number of accidents involving trapped victims has also fallen. But as valuable as this factor is for road safety, the consequence is that fire crews have less and less experience of rescuing people trapped in vehicles as it becomes an increasingly less routine part of the job.



Training in realistic conditions is also difficult because the vehicles available are usually old junk cars that are not equipped with the corresponding reinforcements. Furthermore, the training vehicles are generally undamaged or only slightly damaged, which can lead to relevant differences when compared to rescue operations. On top of this, recent years have seen the introduction of a whole range of new vehicle concepts featuring alternative drives and fuels, which means huge training expenditure that the often voluntary rescue crews cannot even begin to fund to the required extent. Even for professional fire departments whose range of tasks and responsibilities is becoming ever bigger and more complex, vehicle-specific issues are frequently neglected.

Investment in rescue-mission-related research and the provision of training material is therefore a key aspect of road safety work. DEKRA Accident Research is currently conducting a study into rescue methods in collaboration with the University Medical Faculty in Göttingen and Weber Rescue. The

study involves investigating different rescue methods multiple times on modern cars that have undergone crash-testing with impact speeds of 85 km/h and have suffered identical damage as a result. In this way, any difficulties and positive experiences encountered can be highlighted and the different methods compared. This allows us to develop tactical decision-making aids and highlight potential for optimization. The same applies to vehicles equipped with alternative drive systems. How can fires in batteries in electric vehicles be extinguished? What are the risks? What needs to be taken into account? Here, too, DEKRA Accident Research has been involved in a series of studies looking at these issues. The US-based NFPA Fire Protection Research Foundation has conducted research in precisely this area and developed a comprehensive and free training course for rescue services covering, for example, rescue missions involving vehicles equipped with alternative drives or using alternative fuels. Ultimately, such measures are also a key contribution to improving road safety.

BEST PRACTICE



The training provided for fire departments means that they can now rescue trapped vehicle occupants more efficiently and quickly after an accident.

The Facts at a Glance

- **Special road construction and traffic management measures should ensure that potentially hazardous stretches of road can, as far as possible, be made safer.**
- **One recommended method of achieving this to upgrade hazardous stretches of road to create a four-lane divided highway with both sides separated by a physical structure.**
- **Given the severity of accidents involving collisions with an obstacle (tree, post etc.), passive safety systems should be installed along roadsides.**
- **The simple imposition of speed limits does not lead to greater safety – safety is ensured only when road users actually stick to the limits. Speed limits must always make sense.**
- **An unbroken, suitable and safe cycle path network must be set up in response to the increasing popularity of bicycles.**
- **To ensure that accident victims receive the medical assistance they need as quickly as possible and to minimize traffic jams, it is vital that emergency calls are made quickly and contain accurate information on the location and severity of the accident. eCall systems installed in all vehicles offer major benefits here.**
- **The ability to provide rapid assistance for accident victims requires a comprehensive network of well-trained and well-equipped fire departments and rescue services. Investment in this area offers a range of benefits – and not just for road safety.**
- **To prevent secondary accidents, scenes of accidents and broken-down vehicles must be properly secured.**



Road Safety Is and Remains a Global Challenge

Around 1.25 million traffic fatalities per year worldwide means that over 3,400 people are killed on the road every single day. To effectively counteract this trend, action is required on various levels. This is particularly the case given how much the circumstances vary from continent to continent, for example with regard to the infrastructure, the type of road users and the age and safety level of vehicles. The best practice measures described in the previous chapters provide valuable starting points in this regard.

Whether it is speed limits, alcohol interlock programs and breathalyzer tests, driving safety training, public information campaigns, traffic education from an early age, periodic technical inspection to detect vehicle faults, driver assistance systems, barriers between the two sides of the road, 2+1 roads, additional crash barriers to prevent collisions with trees or more – when it comes to improving road safety, no stone must be left unturned. But before any measures can be implemented, it is important to always analyze in detail whether the measure concerned is actually suitable for the relevant problem in view of regional or local circumstances and is therefore an effective solution. It is also important not to forget to follow up these measures to see if they worked as expected or whether even more improvements can be made.

In this regard, the best practice examples presented in this report from various countries around the world are not to be considered as a final solution, but rather as potential starting points for preventing traffic accidents and reducing the consequences of these accidents. A measure that has proven successful in Sweden or in a US state, for instance, will not necessarily also achieve the desired effect in another country or region.

One reason for this is that mobility behavior can vary greatly between countries and regions around the world. In many emerging and developing countries, for example, the fact that the level of motorization in terms of car ownership is still comparatively low is due quite crucially to the often tight financial situation in the country in question. People who cannot afford a car will travel by bicycle, by

motorcycle or on foot. According to data from the WHO, over 90% of traffic fatalities worldwide occur in countries with low to medium incomes. The risk of being killed in a road accident is particularly high for unprotected road users such as pedestrians, cyclists and motorcyclists.

One solution to the challenges associated with road safety in the more motorized regions currently being considered by many politicians and the automotive and automotive supply industry is to equip vehicles with more systems for partial, highly and fully automated driving. These systems – in conjunction with assisted driving systems – will no doubt become increasingly important in vehicles of all types in the future if our roads are to become safer. Nevertheless, the one factor that is and remains the most important when it comes road safety must not be forgotten: people.

OPTIMUM INTERACTION OF PEOPLE, VEHICLES AND THE ENVIRONMENT

Although the systems in question are designed to help people, there is a risk that people will then pay less attention. Studies involving pilots, for example, show that those who frequently fly using autopilot find themselves in difficulty in situations where their flying skills are called upon. What's more, the better the systems become, the less often drivers will need to intervene in events themselves. This means that as automated driving becomes more widespread, drivers will find it more and more difficult to acquire and maintain the skills necessary for handling difficult driving situations. Furthermore, drivers may also be inclined to take more risks on the road because they rely on the intervention of “intelligent systems” in critical situations.

As things stand today, in accordance with the March 2016 amendment to the “Vienna Convention on Road Traffic”, automated functions are allowed in vehicles if they can be manually overridden or disabled by the driver at any time. The all-important question is: How much time does a person need in order to intervene where necessary when prompted by the system? Researchers in the “Human Factors in Transport” department at the University of Southampton are investigating this very question. As part of this research, 26 subjects aged between 20 and 52 covered approximately 30 km of highway at around 113 km/h in a driving simulator. During the journey, the autopilot randomly and repeatedly prompted the subjects to take control of the vehicle. The measured reaction times varied greatly from

driver to driver, with the longest response time being 25.8 seconds. In this case, the vehicle would have traveled over 800 m before the driver responded.

The study confirms what traffic psychologists are also constantly calling for: People must not be absolved of their responsibility for what happens on the road. They are and remain the decisive element for road safety. Or in other words: In the future, responsible behavior combined with a proper assessment of one's own capabilities and a high level of acceptance of rules will continue to be the most important conditions for ensuring that even fewer people lose their lives on the road. Infrastructure must also be safe by design – the “forgiving road” is part of this.

As William Haddon demonstrated in the mid-twentieth century with the matrix that bears his name, the key to preventing accidents to the greatest possible extent or at least mitigating their consequences is to find the optimum interaction between people, vehicles and the environment in the phases before, during and after a collision. This applies to every single country on earth – and to all groups of road users.

DEKRA's Demands

- **The availability of well-founded accident data and statistics that are as comparable as possible must be improved at an international level.**
- **National, regional and local measures taken to improve road safety must be evaluated even further with regard to their actual effect. At a national level, a framework must also be established that enables new road safety concepts to be tested.**
- **Before a road safety measure that has proven to be successful elsewhere is implemented, it must be analyzed in detail to determine whether it is transferable to the relevant local conditions and so can also be implemented with the same degree of success.**
- **Driver assistance systems that improve safety should achieve even greater market penetration.**
- **The functional capability of mechanical and electronic vehicle safety components must be ensured throughout a vehicle's entire lifetime.**
- **As the number one lifesaver, the safety belt must be worn on both the front and back seats on every journey.**
- **Road construction measures and transparent traffic management measures should ensure that potentially hazardous stretches of road can, as far as possible, be made safer.**
- **Ongoing traffic education is the best form of prevention – it should therefore start as early as possible, be tailored to each group of road users and continue into old age.**
- **Road traffic must be understood as social coexistence and therefore requires all road users to behave responsibly and in compliance with regulations.**
- **Particularly dangerous violations such as drunk-driving, being distracted by smartphones and excessive speeding, must be subject to even stricter control and punished accordingly.**

Any Questions?

TESTING TECHNOLOGY

Hans-Jürgen Mäurer
Tel.: +49.7 11.78 61-24 87
hans-juergen.maeurer@dekra.com

Reiner Sauer
Tel.: +49.7 11.78 61-24 86
reiner.sauer@dekra.com

Florian von Glasner
Tel.: +49.7 11.78 61-23 28
florian.von.glasner@dekra.com

ACCIDENT RESEARCH

Alexander Berg
Tel.: +49.7 11.78 61-22 61
alexander.berg@dekra.com

Markus Egelhaaf
Tel.: +49.7 11.78 61-26 10
markus.egelhaaf@dekra.com

Walter Niewöhner
Tel.: +49.7 11.78 61-26 08
walter.niewoehner@dekra.com

ANALYTICAL EXPERTISE ON ACCIDENTS

Jens König
Tel.: +49.7 11.78 61-25 07
jens.koenig@dekra.com

Michael Krieg
Tel.: +49.7 11.78 61-23 19
michael.krieg@dekra.com

DEKRA Automobil GmbH
Handwerkstraße 15
70565 Stuttgart

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PRINCIPLES/PROCESSES

André Skupin

Tel.: +49.3 57 54.73 44-2 57
andre.skupin@dekra.com

Hans-Peter David

Tel.: +49.3 57 54.73 44-2 53
hans-peter.david@dekra.com

DEKRA Automobil GmbH
Senftenberger Straße 30
01998 Klettwitz

TRAFFIC PSYCHOLOGY

Dr. Karin Müller

Tel.: +49.30.2 93 63 39-21
karin.mueller@dekra.com

DEKRA Automobil GmbH
People and health
Warschauer Straße 32
10243 Berlin

Dipl.-Psych. Caroline Reimann

Tel.: +49.3 31.8 88 60-16
caroline.reimann@dekra.com

DEKRA Automobil GmbH
Branch office Potsdam
Verkehrshof 11
14478 Potsdam

CORPORATE COMMUNICATIONS

Wolfgang Sigloch

Tel.: +49.7 11.78 61-23 86
wolfgang.sigloch@dekra.com

DEKRA e.V.
Handwerkstraße 15
70565 Stuttgart

DEKRA SERVICES

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Training & Education



Temporary Work

A stylized world map in shades of gray, overlaid with a white grid of latitude and longitude lines. Several white arrows are scattered across the map, pointing in various directions. The map is centered on the Atlantic Ocean.

DEKRA

Handwerkstrasse 15

70565 Stuttgart

Germany

Tel.: +49 (0)7 11 78 61-0

Fax: +49 (0)7 11 78 61-22 40

www.dekra.com

85431