DEKRA Automobil GmbH

ROAD SAFETY REPORT 2015
A future based on experience

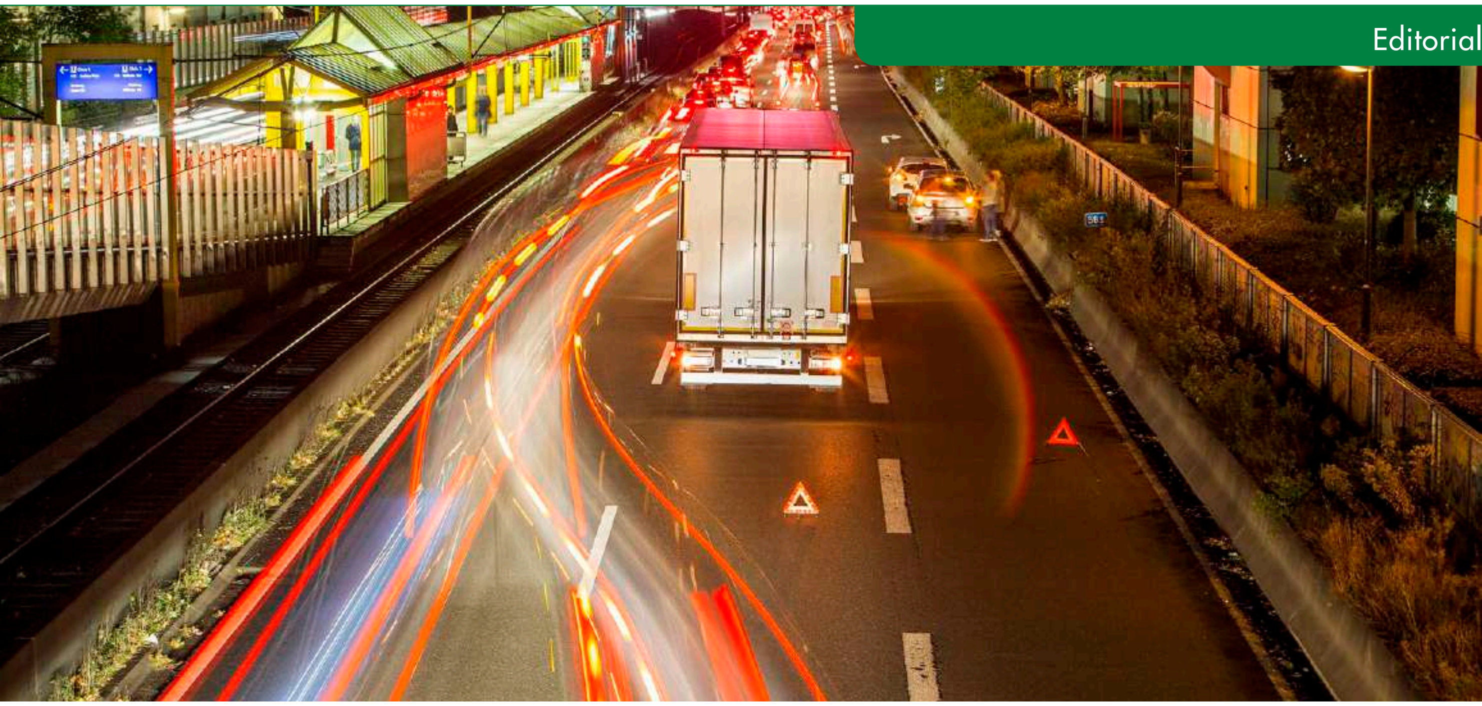
Strategies for preventing accidents on European roads

DEKRA

Accidents: number of road traffic fatalities dropped by 65 percent across Europe since 1991

The human factor: lower risk of accidents due to alcohol interlocks and improved driving instruction

Vehicle engineering: still many unresolved questions before autonomous driving can potentially become a reality



Sustainably committed to road safety

DEKRA is continuing its success story with the now eighth edition of the Road Safety Report in a row. The international resonance with which this publication is received, as well as the fact that the report is also frequently quoted by politicians, associations and organisations, emphasise the reputation it has gained over the years. It sustainably complements DEKRA's commitment to road safety that began 90 years ago.

Our founding fathers documented the aim of improving road safety in our statutes in 1925. We are committed to this aim, not just in Germany and Europe but in more than 50 countries all over the world where DEKRA is active. For example, we lay the very important cornerstones for improving road safety with periodic vehicle monitoring and the numerous crash tests performed. Our accident analysts are also regularly involved when it comes to establishing the causes of road accidents. At the same time, our experts are also valued as professional and competent consultants on numerous national and international boards.

The annual road accident figures show that there is still a great deal to do with regard to further reducing the number of fatalities and injuries on roads. Although the positive trend in the EU continued in 2013 with the number of road fatalities decreasing by roughly 7.3 percent from 28,136 to 26,073 compared to 2012, this figure is still far too high. Major efforts are still required from everyone involved if we are to achieve the EU's target of halving the number of annual road fatalities by 2020 compared to 2010. The declared target is that less than 16,000 people will lose their lives in road accidents in the EU in 2020. This can just about be achieved with a percentage drop similar to that from 2012 to 2013 and will become more and more difficult in light of the decreases already achieved so far.

Dipl.-Ing. Clemens Klinke, Member of the Executive Board at DEKRA SE and Chair of the Management Board at DEKRA Automobil GmbH

In this report we show where the greatest potential lies to achieve this target or at least get as close to it as possible, in our opinion. Besides areas for action, this also refers to preventative measures, including for example alcohol immobilisers, and driving instruction, the rescue services, infrastructure and road construction, as well as vehicle monitoring and legislation, and vehicle engineering in particular. In this area specifically we have been experiencing development for years that could turn the vision of autonomous driving into a reality in the not too distant future. Just recently, the German Minister of Transport Alexander Dobrindt announced the setting up of a digitalised test track on the A9 motorway for this purpose. The fact that many unresolved issues and numerous legal hurdles still have to be overcome for autonomous driving to become a reality is also raised in this report. At the same time, we take a look back at the past and highlight which measures or developments were of major importance to the progress made to date.

IMPRINT
DEKRA 2015 Road Safety Report – A future based on experience

Publisher:
DEKRA Automobil GmbH
Handwerkstraße 15
70565 Stuttgart, Germany
Phone (07 11) 78 61-0
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April 2015

Responsible on behalf of the publisher: Stephan Heigl
Concept/coordination/editorial: Wolfgang Sigloch
Editorial: Matthias Gaul
Layout: Florence Frieser
Translation: Macfarlane International Business Services

Realisation: ETMservices, ein Geschäftsbereich der EuroTransportMedia Verlags- und Veranstaltungs-GmbH
Handwerkstraße 15, 70565 Stuttgart
www.etmservices.de
Head of Business Division: Thomas Göttl
Managing Director: Oliver Trost
Project Manager: Alexander Fischer

Picture credits: Atelier Busche: page(s) 1; Daimler und Benz Stiftung: 1; A. Berg: 11; K. Bergman: 37; W. Blaube: 65; BMVI: 5; BMW: 12, 50; Daimler: 9, 10 (2), 12, 13, 14, 17; DEKRA: 6–7, 28–33, 60, 66; Dräger: 38; DVR: 42; A. Fischer: 22, 24, 44, 63, 64; Fotolia: 13, 65, 67; F. Frieser: 68; Getty Images: 72; Google: 17, 49; HeERO project coordinated by ERTICO ITS-Europe: 26; Honda: 15; Imago: 3, 5, 8, 11, 34, 36, 54, 56, 59; M. Hernandez: 53; T. Küppers: 3, 16, 22, 46, 54, 58; F. Van Loock: 43; Michelin: 8; ÖAMTC: 46; J. Pauls: 11; picture-alliance: 41; A. Rosar: 18, 20; H. Schacht/www.berlinpressphoto.de: 5; Karin Berg/Taxikurir: 37; Volvo: 9, 16, 48, 51, 52; Wikipedia: 24; K. Yves: 47; A. Zweygarth: 62.

Road safety influenced by new trends in mobility and digital networking

Our country is more mobile than ever. And the mobility requirements and related traffic dynamics will continue to increase. It is therefore even more important to design mobility as efficiently, environmentally-friendly and above all as safely as possible. Germany in particular has enjoyed major success with road safety. However, we cannot afford to relax our efforts.

The world of mobility is in the midst of radical change: digitalisation and networking are its significant driving forces. There is significant value added for every single road user, enormous potential to increase efficiency for the entire system and considerable extra safety with the proliferation of digital systems throughout all mobility. Key digital innovations in car development, such as sensor controlled distance or turning assistants, improve road safety. The same applies to intelligent traffic technologies in vehicles and infrastructure as well as their networked communications. We will promote and push these developments.

Road safety is an important task under the conditions of digital change and the ever increasing demands for speed and comfort. Mobility 4.0 developments, such as automated or autonomous driving raise new issues relevant to road safety. We are tackling these issues. In the "Automated Driving Round Table" initiated by us, we identify the key legal, scientific and social aspects and draw up possible action. Issues of data ownership and privacy, technical standards and future responsibilities must be clearly regulated. As mobility of the future also needs acceptance, comprehensible and binding regulations and technical reliability.

Alexander Dobrindt (MdB), German Federal Minister of Transport and Digital Infrastructure

We rely on professional partners like DEKRA in this process. Founded in 1925 as the Deutscher Kraftfahrzeug-Überwachungsverein (German Motor Vehicle Inspection Association), DEKRA has been committed to better active and passive road safety for 90 years now. I would like to offer my sincere congratulations on this year's anniversary. At the same time, I am delighted that the DEKRA 2015 Road Safety Report reflects a range of topics that especially picks up on the new mega trends in the mobile world and looks at them in depth. DEKRA is once again emphasising with this that road safety work is an ongoing task that constantly has to be in keeping with the times. And it is a task that as many people as possible have to embrace.

On the road to a safer world

DEKRA has every reason to celebrate in 2015: our experts have been ensuring safety for 90 years. This Road Safety Report shows that motor vehicles and road safety still play a key part today. Yet our claim has been going beyond that for a long time now: be it on the roads, at work or at home – DEKRA meets people's key need for safety.

Every age has its visionaries. At the start of the 20th century, the great industrialist Hugo Stinnes was one of them. He recognised the challenges for safety resulting from rapid motorisation. Together with other people he therefore developed the idea of the voluntary technical monitoring of motor vehicles. DEKRA was born: the Deutscher Kraftfahrzeug-Überwachungs-Verein e.V. (German Motor Vehicle Inspection Association) was registered at the Berlin-Mitte district court on 30th June 1925. The mandate was formulated unambiguously in the statutes: "The association's purpose, (...) is to support and promote the operational safety and road safety of motor vehicles (...)."

The idea caught on quickly. Companies and public organisations with their own fleets join the association; as a professional partner DEKRA ensures the reliability and safety of vehicles. At the start of the 1930s, DEKRA is already represented with test centres at roughly 80 locations. The Second World War initially puts a stop to the positive trend. But rebuilding already starts in 1946 from Stuttgart. DEKRA is soon represented all over Germany.

■ Fleet operators in Germany recognised as early as 1925, DEKRA's foundation year, that safety was an important basis for their business success. Back then motor vehicle transport was opening up new opportunities and was at the same time unnerving due to the rising number of accidents. The founding fathers of DEKRA e.V. therefore elevated the promotion of road safety to the association's statutory mandate.

Stefan Kölbl, Member of the Executive Board at DEKRA e.V. and DEKRA SE.

When the periodic vehicle inspection is introduced in 1960, DEKRA is recognised as a monitoring body. As a result, private car owners also benefit from our expertise. DEKRA has been making an important contribution to road safety in passenger transport since then. And not just in Germany, but meanwhile internationally too: with 26 million vehicle inspections every year, 11 million of them in Germany, we are the number one in the world by a long way.

COMMITTED TO SAFETY

In the 1990s DEKRA starts expanding into new business areas based on its many years of expertise in vehicle testing. With innovative services we establish ourselves among other things in product and system certification, material testing and used car management. At the start of the new millennium, DEKRA has a presence in almost all European countries. Today we operate in more than 50 countries on all five continents and are in a good starting position for further international expansion. We are more committed to our safety mandate than ever, in road safety and also at work and at home. Thanks to our testing, certifications and inspections, industrial companies can produce safely and consumers can rely on the safety of products. We also support process reliability and occupational health and safety in businesses with professional consultancy services and qualifications. More recently, we have also started ensuring greater safety in rail and air transport.

DEKRA will continue to expand its role as a driving force and visionary for greater safety throughout the world based on its many years of experience. We want to become the global partner for a safer world. That’s an ambitious goal. But we have every chance of achieving it. One thing is clear though: when it comes, for example, to further progress in road safety, then visionaries are also called for today. History shows that we need bold visions to achieve great goals.

VISION ZERO IS POSSIBLE

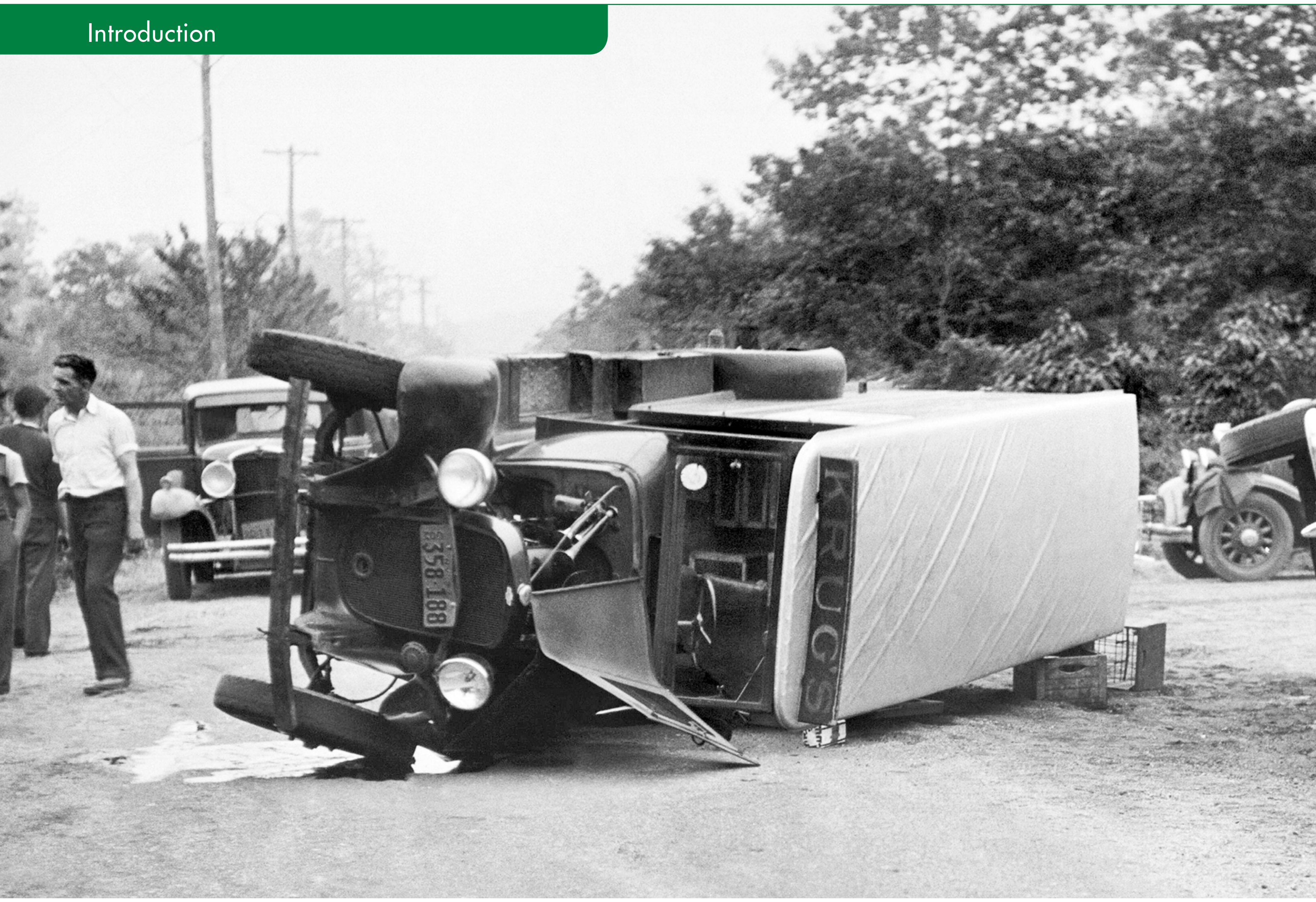
DEKRA supports the German Road Safety Council’s Vision Zero. In light of the 26,000 road fatalities in Europe alone it seems impossible to achieve the target of zero deaths caused by road accidents at first glance. However, the progress made so far inspires confidence. For example, the number of road fatalities has dropped by 85 percent from 21,300 to 3,300 in Germany since 1970. In roughly 600 European cities with more than 50,000 inhabitants there has been at least one year when no deaths caused by road accidents were reported. In the USA there are more than 100 of these kinds of cities and there are examples in Japan too. And as we all know: mobility is on the brink of an innovation drive. Driver assistant systems and new technologies to do with automated driving will open up totally new dimensions of safety.

Whether Vision Zero becomes a reality is therefore down to our will and determination. I am sure that if industry, science and expert organisations like DEKRA work closely together, even more lives can be saved. At DEKRA we are totally determined to make a significant contribution to Vision Zero, among other things by supporting new technologies during the development phase and testing vehicles using state-of-the-art methods and based on high standards.

■ *Truck tests have been part of DEKRA’s portfolio for decades too.*

■ *DEKRA has been ensuring better road safety in France since the mandatory introduction of “Contrôle Technique” in 1992.*

■ *With the nationwide introduction of the PTI scan tool the basis has been provided to be able to check that the electronic safety systems installed in vehicles are present and in good working order during the vehicle inspection.*



Fewer deaths and injuries caused by road accidents thanks to consistent safety measures

Our experience over the last few decades has shown time and time again that road safety work cannot be a nine day wonder but can only be successful as an ongoing process. The fact that the number of fatalities and injuries caused by road accidents, in particular in Europe, has been dropping for decades is mainly thanks to the interplay between technical, organisational and infrastructure measures to prevent accidents and minimise the consequences of accidents. Numerous safety technologies have been consistently further developed over time and have now opened up a new dimension in terms of road safety with the possibility of semi-automated driving.

Milestones on the road towards better mobility and road safety

1902 The Brit Frederick W. Lanchester invents the **disc brake** and applies for a patent.

1921 The Duesenberg Model A is the first vehicle with **hydraulic brakes**.

1946 The French tyre manufacturer Michelin patents the first **radial tyre** which is presented under the brand name Michelin-X in 1949.

1947 Colonel John Paul Stapp carries out the first self-experiments at the Muroc test site in the US-American Mojave desert as part of the **"deceleration project"** conducted by him where he exposes himself to several decelerations on a rocket sled until he reaches his breaking point.

1900 1910 1920

Be it studies by the WHO World Health Organisation, the EU Commission's directives or national programmes and campaigns in countries all over the world: the issue of road safety has become incredibly important over the last few decades. And not without good reason. Although the figures for deaths and injuries caused by road accidents are more or less constantly decreasing in numerous states all over the world, there is still a major need for action. This is shown, among other things, by the "Global Status Report on Road Safety" from the WHO. The figures in this report from 2013 are anything but reassuring: although 88 countries have been able to reduce the number of road fatalities since 2007, the figure has increased in 87 countries. Countries with high incomes in particular achieved corresponding success, while by contrast countries with average and low incomes had recorded far more road fatalities.

In 2004 the WHO defined five key factors, among others, which should be incorporated into law in every country: speed limits, in particular in urban traffic (maximum 50 km/h), maximum permissible blood alcohol level of 0.5 g/l, mandatory helmets for motorcyclists and their passengers, mandatory seat belts for all vehicle occupants and the use of child seats. The problem: according to the WHO, out of the 182 states studied only 28, including most of the EU member states, have passed appropriate regulations for all five risk factors. There are only four states (Estonia, Finland, France and Portugal) where the implementation of these regulations was rated as "good" according to the WHO report.

The "Global Status Report on Road Safety" 2013 is the second report from the World Health Organisation WHO, which is dedicated to the topic of road safety. According to this, an estimated 1.24 million people die in road accidents every year, up to 50 million people are injured per year, 59 percent of road fatalities are aged between 15 and 44. And the most common cause of death in the 15-29 year old group are injuries caused by road accidents.

EU TARGET: 50 PERCENT FEWER ROAD FATALITIES BY 2020

Although the trend looks significantly better in Europe compared to many other regions in the world, the EU Commission still classifies road accidents and their consequences as a major social problem. The EU Commission's working paper published in October 2014 states that a focus of the ongoing action programme should increasingly be on measures that contribute to preventing accidents in advance as far as possible. The declared aim as part of the current action programme "On the move – for safer roads in Europe" is to halve the number of deaths caused by road accidents by 2020 compared to 2010.

1951 The Hungarian Béla Barényi applies for a patent for his concept of a **"rigid passenger cell with front and rear crumple zones".**

1951 **Vehicle inspection** is introduced for motor vehicles in Germany.

1954 **Medical/psychological examinations (MPU)** are introduced in Germany to check driving aptitude.

1959 The Volvo engineer Nils Ivar Bolin files a patent for the **three-point safety belt**.

1959 Mercedes-Benz launches the first car with a **safety passenger cell** on the market with the Mercedes 220 S/SE (W 111).

1930 | 1940 | 1950 | 1960

The first Mercedes-Benz crash test on 10th September 1959. The Mercedes crash tests start with this frontal collision of a series W 111 vehicle (1959 to 1965).

It is the EU Commission's view that this aim can be achieved by compensating for human error as the most common cause of accidents by using electronic systems. The following are particularly suitable for this: EVSC (electronic vehicle stability control), speed alerts, AEBS (advanced emergency braking systems), lane support (= lane departure warning + lane keeping), alcohol interlocks, an automatic emergency call system (eCall) for all vehicles including motorcycles, heavy commercial vehicles and buses, seat belt reminders for all vehicle occupants and tyre pressure monitoring systems. The EU also attaches great importance to the event data recorder to obtain more accurate knowledge about the events in an accident.

PIONEERS OF PASSIVE SAFETY

These still relatively new systems are currently at the end of a long row of milestones that have significantly contributed to road safety. The new driver assistant systems also make you forget sometimes that today's "good-natured" driving characteristics of vehicles were only made possible by the development of the radial tyre at the end of the 1940s: the tyre is the component that keeps the vehicle on the road through its grip on the road surface. Disc brakes also shouldn't be forgotten. In contrast to drum brakes, their braking force decreases less drastically when they warm up, so that "brake fading", which used to be particularly feared on longer downhill drives, is no longer an issue today, at least for cars. The good controllability of hydraulic disc brakes specifically is an important prerequisite for modern, effective brake-based assistant systems, such as ABS and ESP. The Brit, Frederick W. Lanchester, obtained a patent back in 1902 and has been considered to be the inventor of disc brakes since then.

One particularly revolutionary basis for all subsequent safety systems was undoubtedly created by the designer Béla Barényi who worked for the former Daimler-Benz AG for several decades: the native Hungarian applied for a patent for his concept of a "rigid passenger cell with front and rear crumple zones" in 1951. All the other occupant safety systems could not be effective in serious accidents without this kind of car body, which is standard today.

The "safety steering shaft for vehicles" registered for a patent in 1963 also goes back to Barényi. Its innovation: these kinds of systems only penetrate the passenger cell very slightly and if combined with a safety steering wheel yield in the

1963 Béla Barényi applies for a patent for the **"safety steering shaft for vehicles"** developed by him.

1965 The consumer advocate Ralph Nader publishes his **book "Unsafe at Any Speed"** and draws attention to glaring safety faults in US-American vehicles back then.

1971 Daimler-Benz AG files a patent for the practicable **driver airbag.**

1960 | 1965

event of driver impact. A steering wheel that does not penetrate the interior in an uncontrolled fashion in the event of a serious frontal collision is still important today and the prerequisite for the driver airbag being able to provide perfect protection.

Another ground-breaking system was also created in 1959. The Swedish Volvo engineer Nils Ivar Bolin filed a patent for the three-point safety belt. Rigid passenger cells with crumple zones and integrated seat belt, today with seat belt tightener and seat belt force limiter, are still important prerequisites for vehicle occupants' passive safety. This not only applies to frontal collisions but also with side collisions and rollover accidents.

TRAILBLAZERS IN TERMS OF ELECTRONIC SAFETY SYSTEMS

A practicable driver airbag was registered for a patent by Daimler-Benz AG in 1971. It supports the seat belt's restraining effect in the event of a serious frontal collision. Passenger airbags, various side airbags and the knee bag were progressively introduced later on. Today, a car's standard equipment usually includes six to eight airbags. ABS started to be installed in series vehicles from October 1978 also at Daimler-Benz. ABS enables full braking with almost maximum deceleration at the same time as maintaining the vehicle's steerability and directional stability. The system was soon expanded by a TCS, traction control system, to guarantee driving stability with fast acceleration.

In 1995, Robert Bosch GmbH and Mercedes-Benz introduced another brake-based driving dynamics assistant system with the electronic stability programme, ESP. This provides the driver with additional active vehicle support in situations that are critical with lateral dynamic manoeuvres, for example over or under steering. The term Electronic Stability Control, ESC, has become the international standard. The importance of the system is shown by the fact that according to neutral studies, ESP can prevent almost half of usually serious or fatal single vehicle accidents. This makes it the second most important safety system in cars after the seat belt and ahead of the airbag.

Electronic vehicle stability controls (EVSC) have been mandatory equipment for almost all cars, caravans, trucks and buses that have received type

Dr Walter Eichendorf
President of the German
Road Safety Council (DVR)

Educational measures are essential

Campaigns are essential in road safety work, but are not the "universal remedy" that solves all problems of course. Road safety campaigns first and foremost try to grab attention, convey knowledge, create awareness of the problem and raise awareness for the issue. They should have an impact on road user behaviour in a way that promotes safety. Campaigns make it clear what a difference desirable behaviour makes in traffic.

However, an intelligent campaign first of all has to create awareness among as wide an audience as possible. In doing so, it should not rely on shock effects that lose their impact very quickly. If a campaign only consists of "colourful posters" it also will not achieve a long-term effect. That's why it is important to focus on smaller communication projects aimed at target groups, for example in schools, driving schools or discos, if it's a campaign specifically for young drivers.

Even if the impact of behaviour-influencing measures on reducing accident figures cannot always be defined, it is internationally undisputed that educational work is important. In terms of the "Vision Zero – nobody dies. Everyone arrives" safety strategy, publicity campaigns that positively influence the behaviour of road users are still an important element of prevention work for the DVR too. For life is too wonderful to recklessly gamble with it in road traffic, as the key message from the national "Slow down" road safety campaign so eloquently puts it.

1971 The first headlights with a **twin filament halogen bulb** (H4) are fitted on vehicles for dipped and full beam.

1974 From 1st January, **three-point safety belts are mandatory for front seats** in newly licensed cars in the Federal Republic of Germany. The **seat belt obligation for back seats** in all new cars comes into force on 1st May 1979. A **warning fine** is issued for not wearing the seat belt from 1st August 1984.

1970 1975

approval for Europe for the first time since 1st November 2011. Since 1st November 2014, all vehicles must be fitted with EVSC when they are launched on the market. According to information from Robert Bosch GmbH, this was already the case with 84 percent of all new vehicles in 2014 across Europe, in contrast to just 59 percent worldwide. According to the latest calculations from Bosch, 91 percent of newly licensed cars and light trucks up to six tons will already be fitted with these kinds of systems in Europe in 2016. This percentage will increase to 94 by 2021.

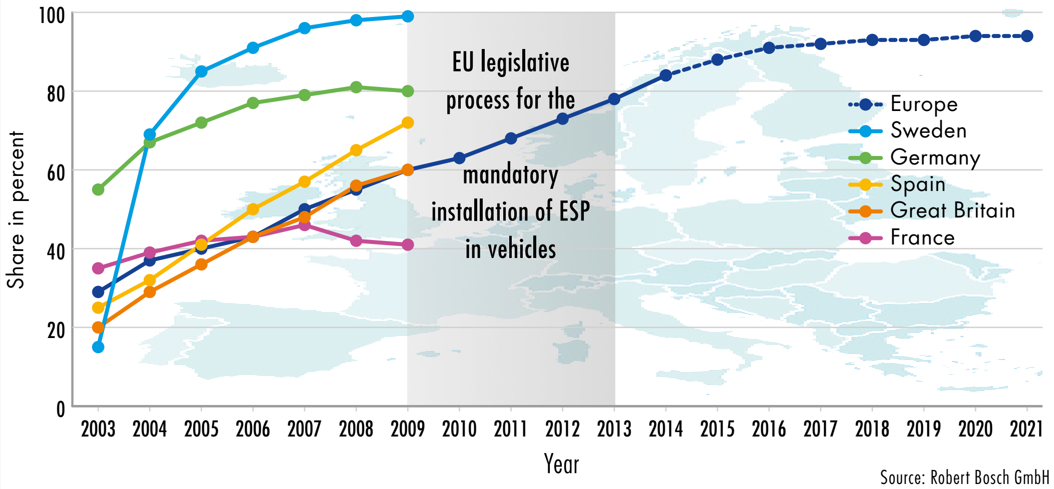
This development naturally progressed in stages in Europe and differed greatly from country to country (Figure 1). For example, in Sweden the installation rate rose pleasingly from 15 to 69 percent between 2003 and 2004 and then increased again to 85 percent by 2005. This is mainly due to Trafikverket, the Swedish State Central Office for Transport, recognising the potential of ESP to reduce serious accidents and prevent accidents very early as a result of its own studies and then exerting pressure on vehicle importers. Correspondingly, Sweden (almost) exclusively imported vehicles equipped with ESP and ESP was already part of the series equipment at Volvo. In Germany, the increase was fairly steady from 55 percent in 2003 to 80 percent in 2009. Development was different again in France. While the country was still in second place behind Germany with an ESP installation rate of 35 percent in 2003, it rose comparatively modestly to 46 percent in 2007 and even decreased to 41 percent by 2009. One of the reasons for this was the state regulation to promote vehicles that emit less than 120 grams of CO_2 per kilometre driven. This mainly benefited small vehicles that were equipped with ESP to a much lesser extent. The mandatory introduction of ESP is also logical in light of this.

REGULATIONS AND A BETTER INFRASTRUCTURE MAKE ROADS SAFER

Apart from vehicle engineering, there are a range of other milestones that have contributed to improving road safety. For example, the introduction of the first general speed limit in Germany on 1st September 1957. Since then, the maximum speed limit of 50 km/h has applied "in built-up areas", unless regulated otherwise by road signs. In the meantime, other general speed limits have been introduced in Germany, for example 100 km/h on rural roads. The reference speed of 130 km/h has applied on motorways since 1974. As kinetic energy increases quadratically

1 ESP installation in stages

According to the latest calculations, 91 percent of newly licensed cars and light trucks up to six tons will already be fitted with electronic vehicle stability control systems in Europe in 2016.



Source: Robert Bosch GmbH

1976 From 1st January, it is **mandatory for motorcyclists in the Federal Republic of Germany to wear a helmet**, from mid-**1978** for **moped riders** too. In the event of infringement, this breach can be **punished with a fine** from 1st August **1980**. From 1st October **1985**, **scooter riders** also have to wear a helmet.

1978 Vehicles from Mercedes-Benz are equipped with **ABS** as standard from October. The first model with ABS is the S-Class (W 116).

1975 1980

with speed and therefore goes hand in hand with a vehicle's "risk potential", appropriate speed limits, among other things adapted to the road quality, are essential for a safe traffic system.

The first blood alcohol limit was introduced for motor vehicle drivers in Germany in 1953. Back then it was a BAC of 1.5 and was only liable to prosecution if a driver had caused a road accident. From today's perspective, this first limit was irresponsibly high in light of the impairing effect and loss of inhibitions that the consumption of alcohol may have. The limit of a BAC of 0.8 was passed by the Bundestag on 14 June 1973. Later on the limits were gradually lowered even more. Today, driving errors can already have legal consequences with a BAC of 0.3. There is a total ban on alcohol at the wheel for new drivers during their probationary period.

In terms of infrastructure, fitting roads with guard rails and concrete barriers also contributed to preventing the vehicle from leaving the road, thus under circumstances preventing serious accidents such as rollover accidents, collisions with obstacles, in particular trees, at the side of the road or fatal collisions involving oncoming traffic on motorways or trunk roads similar to motorways. Motorways were first fitted with guard rails in Germany at the start of the 1960s. For a long time these restraint systems were only designed for the impact of cars and commercial vehicles. However, the remaining clearance from the ground poses the risk to motorcyclists of sliding underneath the guard rail or being thrown against a post in the event of a crash. The consequences are often serious or even fatal injuries. Roads that are particularly popular with motorcyclists are in the meantime therefore being increasingly equipped with a safety system with underride guard on many critical stretches of road.

■ *Compliance with the legal speed limit alone could prevent many accidents.*

TECHNICAL SYSTEMS HAVE TO WORK PERFECTLY

Last but not least, periodic vehicle inspection also must not be forgotten as an important contribution to greater road safety. Vehicle inspection was already introduced in Germany in 1951. The French equivalent to this, the "Contrôle Technique" was first introduced as being mandatory for all cars, commercial vehicles and buses in 1992. Basically, it has to be guaranteed that any system relevant to safety works reliably throughout the vehicle's life. The maintenance or servicing of the systems concerned therefore cannot be neglected, all warning signals and error alerts in the car must be taken seriously by the user. However, experience shows that periodic vehicle inspection is becoming even more important as many older vehicles are no

1981 From July, Mercedes-Benz offers a **vehicle with airbag as standard** for the first time in the S-Class (W 126).

1983 The German accident researcher Max Danner publishes his **book "Gurt oder Tod"** (Seat belt or death) highlighting the benefits of a seat belt wearing law, which was a highly contentious topic among the population back then.

1985

■ *Important knowledge can be gained for the development of new and safer passenger cells using a whole variety of sensors during crash tests.*

longer serviced according to the manufacturer's specifications. The European Commission has in the meantime also picked up on the importance of electronic systems especially for vehicle safety and incorporated it into the framework specifications for European-wide vehicle monitoring. With the nationwide introduction of the PTI scan tool in Germany in 2015 the basis has been provided that the electronic safety systems installed in vehicles are existent and in good working order during the vehicle inspection.

ACCIDENT RESEARCH: THE FIRST IMPORTANT IMPETUS CAME FROM THE USA

Regardless of all the technical and infrastructural developments, real accidents on the roads must always be authoritative when assessing vehicle and road safety. Fundamental knowledge for further improvements can be derived from the results of road accident research. This research first started in the USA where the physicist William Haddon began the first investigations at accident sites in the early 1950s. He was also the one who developed a method at the end of the 1960s, which is ultimately still an important theoretical framework for systematic thinking regarding road safety to date. The "Haddon Matrix" is on the one hand based on breaking accidents down into three time phases – before, during and after the crash – and on the other hand assigning the causes to human error, the vehicle and traffic infrastructure.

In 1966, Haddon was made Head of the National Traffic Safety Agency and National Highway Safety Agency, which was merged into the National Highway Traffic Safety Administration (NHTSA) in 1970. The NHTSA was and still is an important driving force for the global improvement of motor vehicle safety. Under its leadership, experts from all over the world meet at the ESV conferences and exchange the latest knowledge on vehicle

1986 The **possibilities of autonomous driving are researched** for the first time as part of the European EUREKA research project PROMETHEUS (PROgraMme for European Traffic with Highest Efficiency and Unprecedented Safety).

1988 BMW presents the **first series motorcycle with ABS** with the K100.

1985 | 1990

safety. ESV initially stood for "International Technical Conference on Experimental Vehicles" and since 1998 for "The International Technical Conference on the Enhanced Safety of Vehicles". The first conferences of this kind took place in Europe by the way, in Sindelfingen and Wolfsburg in 1971.

Back to the USA. Here a team of scientists led by the former military pilot Hugh de Haven at Cornell University started empirically analysing car accidents in the 1950s. The researchers published the legendary ACIR study (ACIR = Automotive Crash Injury Research) in 1955, setting standards in accident research. One result of the study was that many vehicle occupants only died in an accident because they were thrown out of the car.

Systematic studies of this kind only started in the late 1950s in Europe. For example, the effectiveness of seat belts was analysed based on real accident data in Sweden. Car manufacturers then increasingly got into accident research in the 1960s. For example, accident research at Mercedes-Benz has been analysing and reconstructing real road accidents since 1969 to gain further knowledge to develop the safety of its own models.

MORE THAN 3,000 CODED PARAMETERS PER ACCIDENT

The "European Enhanced Vehicle-Safety Committee" (EEVC) was founded in 1970 to coordinate all the national research and development work on vehicle safety in Europe and to reap the best benefits from existing resources by participating in the ESV programme. The German Road Safety Council (DVR) had already been founded the year before. The focus of its work to date includes dealing with issues of traffic engineering, road safety education and awareness, traffic law as well as traffic medicine and monitoring. At the same time, the DVR pools the efforts of all the agencies involved in one common, effective action to improve road safety. This and similar activities also showed the first favourable impacts. Although a record high of 21,332 road fatalities was recorded in Germany in 1970, it was managed to permanently break the fatal trend of previous years afterwards though.

On the initiative of the German federal government, scientific teams in Heidelberg, Berlin and Hannover started to document accidents on site at this time. A pilot study on accident analysis commissioned by a NATO committee for environmental issues, which the Federal Highway Research Institute (BASt) was involved in on Germany's behalf, led to the foundation of accident research at the Medical University of Hannover in 1973. Under the leadership of Professor Dietmar Otte in particular, it has contributed to understanding problematic, high-risk and often also fatal injury mechanisms and developing countermeasures by continuously documenting and analysing road accidents using combined medical and technical analysis. The effectiveness of improved vehicle structures, seat belts and airbags, as well as bicycle helmets and protectors could be evidenced as a result, among other things.

The Medical University of Hannover has been cooperating with the Technical University of Dresden on a joint project GIDAS (German In-Depth Accident Study) from the BASt and Research Association of Automotive Technology since 1999. Roughly 2,000 accidents with personal injury are investigated every year in the regions of Dresden and Hannover as part of this. The survey team documents all the relevant information about the vehicle equipment and damage, injuries to the people involved, rescue chain and the conditions at the accident site. Each documented accident is reconstructed in detail starting with how the accident came about and

1995 Robert Bosch GmbH and Mercedes-Benz introduce another brake-based driving dynamics assistant system with the **electronic stability programme, ESP.** The first vehicle equipped with this is the S-Class Coupé CL (C 140) from Mercedes-Benz.

2002 Mercedes introduces the **preventative occupant safety system PRE-SAFE** in the S-Class (W220).

2006 The Honda Gold Wing is the **first series motorcycle with airbag.**

1995 | | | | | 2000 | | | | | 2005

■ *With this crash test it becomes clear that the driver, for example in a VW Golf II, only had a low chance of survival in the event of a frontal impact.*

the reaction of those involved to the collisions and the vehicles' final position. At the same time characteristic parameters such as brake deceleration, approaching speed and collision speed as well as data about the pattern and severity of injuries are defined. The scope of documentation is more than 3,000 coded parameters per accident in GIDAS, these are in turn the foundations for later research on the effects and potential benefits of new and improved vehicle safety elements and protection systems all over Europe.

INTERNATIONAL INSTITUTIONS AS A DRIVING FORCE FOR BETTER ROAD SAFETY

When it comes to impetus for greater road safety, it is the cooperation between state and private institutions that drives road safety forward as a common goal. In Germany, the Münchner Büro für Kfz-Technik, which was renamed the Institut für Fahrzeugsicherheit München (IFM), founded by the HUK Association of liability, accident and car insurance companies in 1969 is one of those private institutions. Many important ideas that have served to improve the safety of trucks, cars and motorcycles were circulated around the world from here under the leadership of Professor Klaus Langwieder. Improvements to child seats in cars must also be mentioned specifically here. The IFM's activities were taken over by the Unfallforschung der Versicherer (UDV – German Insurers' Accident Research) founded in Berlin in 2006.

DEKRA Accident Research was set up in 1978. Its tasks initially included developing and improving the largely inadequate methods of reconstructing road accidents back then. The knowledge and expertise of DEKRA experts were also more and more in demand though for improving vehicle and road safety too. As a result, DEKRA Accident Research has worked on several national and international projects on the safety of trucks, tankers, cars, motorcycles, pedestrians and safety equipment for roads since the 1980s. DEKRA Accident Research's commitment is recognised by its involvement in more and more new road safety projects.

The Austrian Road Safety Board was founded in the 1960s, which is still dedicated to the issue of preventative road safety work today. The Transport Research Centre (CDV) has been working in the Czech Republic since 1992 and was turned into a public research institute in 2007. Finland's Liikenneturva is a research institute with the aim of improving road safety by raising the population's awareness and understanding. In France, the IFSTTAR institute (Institut français des sciences et technologies des transports, de

2011 All new vehicle models launched on the market in Europe must be fitted with **ESP as standard** since 1st November.

2013 The **pedestrian airbag** from Volvo wins the **"Future" special award** at the AutoScout24 portal's 11th Internet Auto Awards.

2010 2011 2012

l'aménagement et des réseaux) resulted from merging the renowned institutions INRETS (Institut national de recherche sur les transports et leur sécurité) and LCPC (Laboratoire central des ponts et chaussées) in 2011. Various perspectives on safety are possible and new impetus is created thanks to the integrated approach of research into road safety, sustainability, ecology and training. The SWOV (Stichting Wetenschappelijk Onderzoek Verkeersveiligheid) research institute in the Netherlands covers the whole range of road safety.

Road safety research traditionally has a strong position in Sweden. Examples of this are the VTI (Statens väg- och transportforskningsinstitut) and NTF (Nationalföreningen för Trafiksäkerhetens Främjande) network. Two institutions for road safety must be highlighted in the United Kingdom: the VSRC (Vehicle Safety Research Centre) was founded in 1983 and the TRL (Transport Research Laboratory) has been committed to preventing accidents and injuries for more than 50 years now. Internationally there is a lively exchange of knowledge between the institutions. The IRTAD (International Traffic Safety Data and Analysis Group) associated with the OECD (Organisation for Economic Co-operation and Development) is one option for exchanging information that has existed since 1989.

INTEGRATED CONCEPTS OPEN UP NEW POTENTIAL FOR SAFETY

Ultimately it is the effort of all those involved that has led to road traffic in Europe becoming considerably safer in Europe over the course of the last decades. This development is not over for a long time yet. Although passive safety seems to be largely exhausted by now, there is still new potential resulting from the possibilities of active safety and specifically with the wider perspective of integrated safety. Integral concepts pool elements of active and passive safety in one sophisticated whole system to prevent accidents or reduce their consequences. The long-term goal results from Vision Zero, i.e. no deaths and serious injuries in road accidents. Along the way there is a new challenge every year of continuing to reduce the number of road users killed and seriously injured in traffic. This DEKRA Road Safety Report wants to contribute to this once more.

Brief facts

- **Road safety work is only successful as an ongoing process.**
- **The EU Commission is focusing more on measures that prevent accidents in advance as far as possible.**
- **Human error as the most common cause of accidents can be reduced by using electronic systems.**
- **Radial tyres, disc brakes, rigid passenger cells, safety steering shafts, three-point seat belts and airbags were important pioneering achievements.**
- **Traffic accident research has provided important impetus for better road safety together with car manufacturers.**
- **Semi-automated driving may reduce the number of deaths and injuries caused by road accidents further.**

2014 In May, the Internet corporation **Google** presents the prototype of a **self-driving car.**

2014 Daimler AG presents the **"Mercedes-Benz Future Truck 2025"** on the new stretch of the 14 motorway near Magdeburg in July. With the help of the intelligent "Highway Pilot" system, the truck can drive completely autonomously at motorway speeds up to 85 km/h.

2014 **ESP is mandatory for all new cars** in the EU since 1st November.

2013 2014 2015

On the right track but still a long way to go

Basically the trend could not be much more positive: the number of road fatalities has dropped almost everywhere in Europe over the last few decades. And that's even though the number of vehicles on the roads and volume of traffic has drastically increased. However, all the potential to prevent accidents has not been adequately exploited yet by far.

Germany in 1906: the automobile was just 20 years old, traffic on the roads was still very limited and so was the number of accidents. Regardless of this, the government arranged to introduce "statistics about harmful events when operating motor vehicles" from 1st April 1906, as can be seen in a publication by the Federal Statistical Office from 2006. Road traffic accident statistics are therefore already more than 100 years old.

The number of motor vehicles on the roads was also documented for the first time a few months later in January 1907. The statistics documented 27,026 licensed motor vehicles on the first record date, 15,954 of them motorcycles, 957 trucks and 10,115 cars. In the first year of reporting road accident statistics (October 1906 to September 1907), 4,864 accidents were counted in which 145 people died and 2,419 were injured. 85 percent of those killed on the roads in 1906/1907 lost their lives in accidents with cars, although the share of cars in the number of vehicles on the road at this time was just 37 percent.

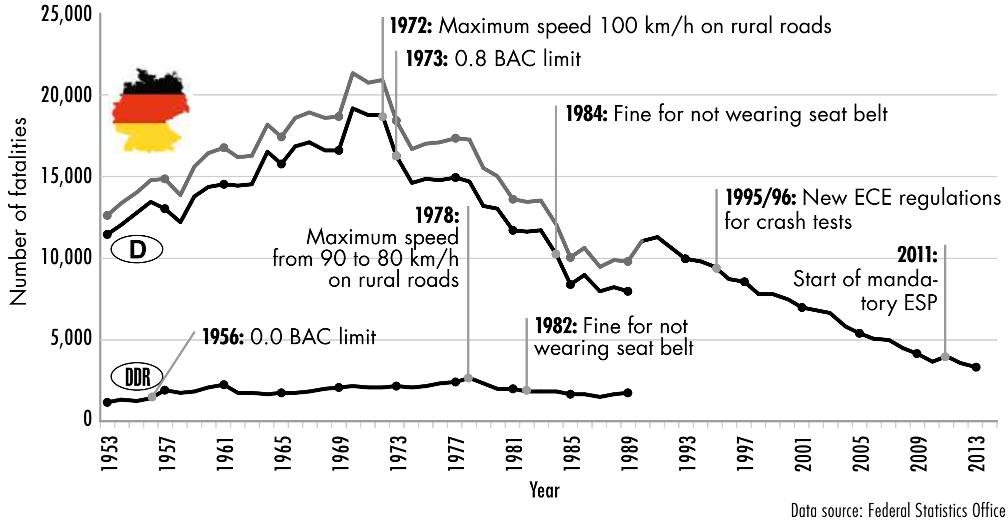
In relation to the number of vehicles on the roads, car driving was significantly more dangerous during the pioneering years than today. In 2013, 3,339 people lost their lives on German roads, 374,142 were injured, the number of vehicles on the roads rose to just under 54.5 million. As a result the risk of dying in a road traffic accident in 1906/1907 was 87 times higher than in 2013 in relation to the number of vehicles on the roads. Overall, the number of vehicles on the roads rose roughly 2,015 times up to 2013, but the number of deaths caused by road accidents is "only" 23 times higher.

Drivers did not seem to be able to cope very well with high engine performance back then. Out of the 54 licensed motor vehicles with more than 40 hp, 48 were involved in accidents in the first year of reporting. An impact with another motor vehicle was a rather rare event with the density of vehicles back then: 196 of these kinds of collisions (four percent of all accidents) were counted in 1906/1907, 152 of these in Berlin alone. Accidents with pedestrians or cyclists (32 percent), horse riders and carriages (27 percent), trams (11 percent) or as a consequence of passing draft animals (10 percent) were far more common.

2

Fewer and fewer fatalities

Following a drastic rise between 1953 and 1970, the number of road accident victims in Germany dropped constantly over the following decades thanks to changing legal framework, among other things.

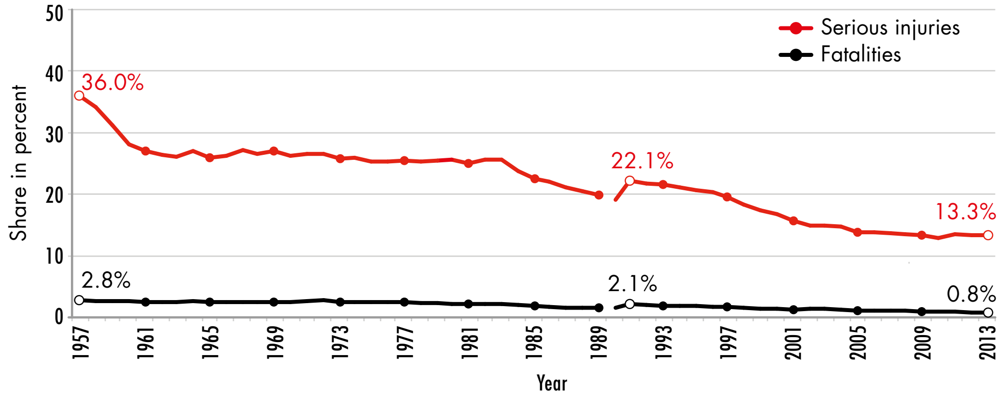


Data source: Federal Statistics Office

3

Positive trend

The percentage of serious injuries for all car occupants in road accidents dropped significantly between 1957 and 2013, as did the percentage of fatalities.



1957–1990 only the former Federal Republic of Germany's states.

Data source: Federal Statistics Office

84 PERCENT FEWER DEATHS CAUSED BY ROAD ACCIDENTS SINCE 1970

The first national result (based on today's territory) can be calculated for 1953: 12,631 road fatalities and 332,288 injuries to statistically almost 4.3 million vehicles. Both figures rise in subsequent years: in 1970 21,332 deaths and 578,032 injuries caused by road accidents were counted, the number of vehicles on the roads had increased to 20.8 million. Since then, with a few exceptions, the number of road fatalities has decreased every year (Figures 2 and 3). Vehicle engineering that has become increasingly sophisticated over the decades and the continuous development of the rescue services and care provided for accident victims in hospitals have also contributed to this, as have improvements in driving instruction and drastic measures by the legislator combined with appropriate monitoring. Measures such as introducing a maximum speed limit of 100 km/h on rural roads (1972), the maximum limit of 0.8 for blood alcohol content (1973) or the mandatory wearing of seat belts (1984) have all led to measurable positive results. Road users have also adapted more and more to the conditions of modern traffic to be able to cope better with the associated risks.

After the negative record in 1970, the number of deaths caused by road accidents dropped from 21,332 to 10,070 by 1985 alone. That's a decrease of 53 percent. As already mentioned, the decrease

Collisions between a car and motorcycle often end fatally for motorcyclists.

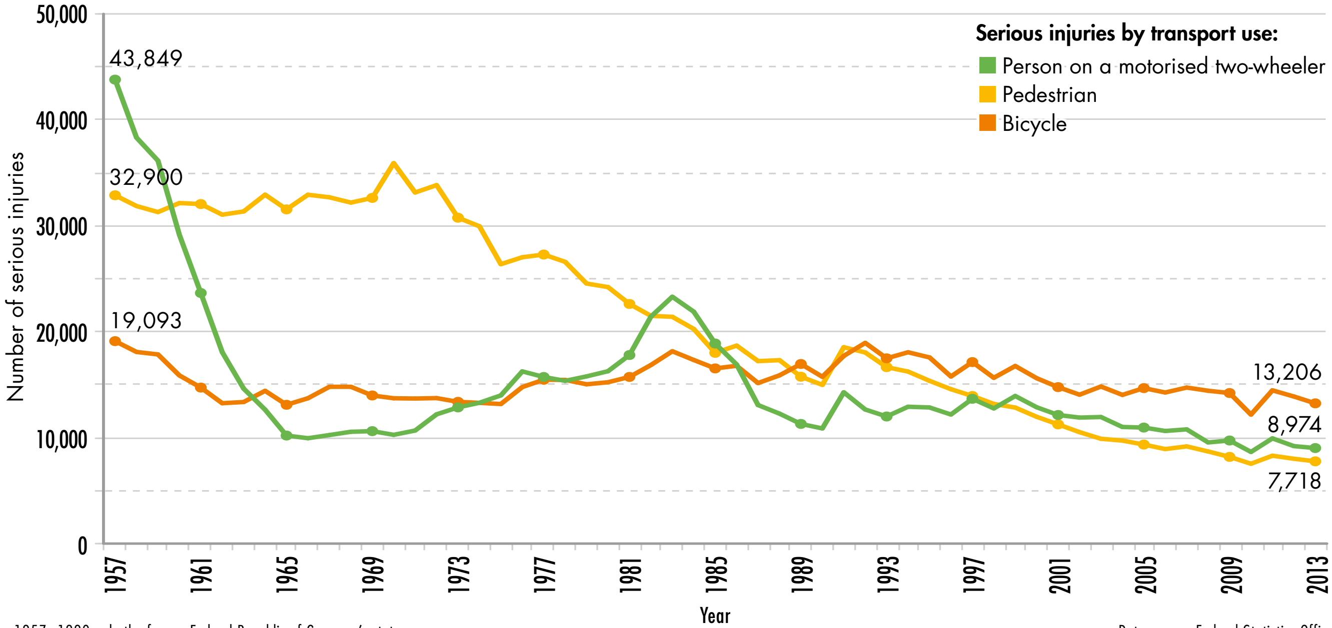
from 1970 to 2013 is roughly 84 percent overall with 3,339 road fatalities. By contrast, the number of injuries during this period decreased considerably less dramatically by roughly 35 percent to 374,142. The improvement in vehicle and road safety has therefore mainly had an impact on fatal accidents. The number of accidents with personal injury in total between 1970 and 2013 dropped by roughly 30 percent from 414,362 to 291,105, which was not to the extent actually being aimed for.

In light of the still far too high number of injuries in numerous other European countries too, the EU Commission presented a document about serious injuries in road traffic in March 2013. It outlines a strategy to reduce the number of serious injuries in road traffic (Figures 4 and 5). For better comparability within Europe and to set a clear objective, this includes the call for a standardised definition of serious injuries in road traffic, guidelines for member states to improve data collection about serious road accidents and the setting of an EU-wide target to reduce road accidents with serious injuries, for example for the period from 2015 to 2020. It is assumed that a common strategic target will be adopted for a

4

Unprotected road users are still at greater risk

While the number of seriously injured pedestrians has more or less constantly decreased, the trend with motorcyclists dramatically fluctuated sometimes. The decrease between 1957 and 2013 was relatively low for cyclists.



1957–1990 only the former Federal Republic of Germany's states.

Data source: Federal Statistics Office

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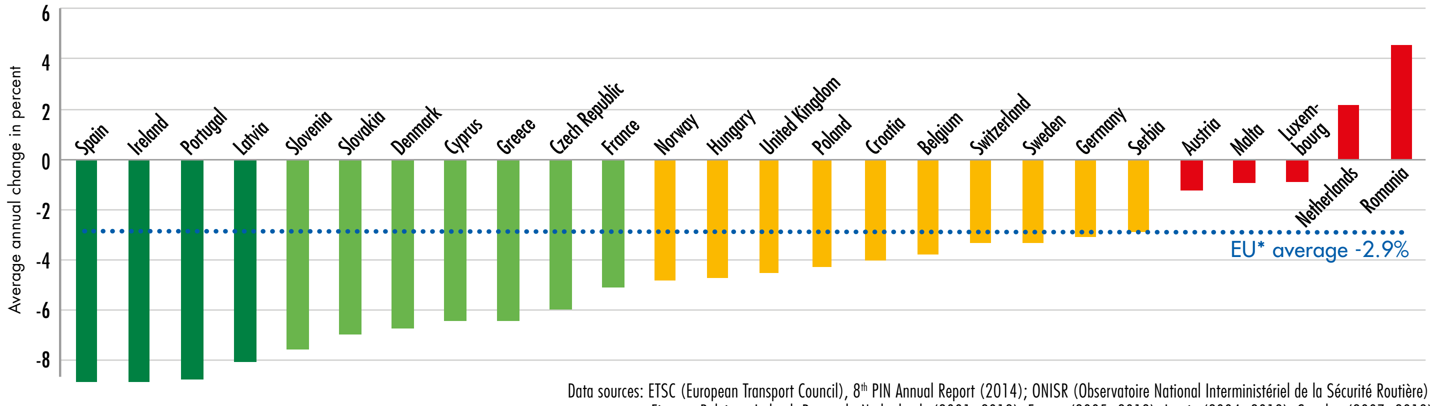
Serious injuries in Europe – a mixed picture

While the number of serious injuries has dropped on average by just under nine percent a year in Spain and Ireland over the last few years, an increase was recorded in other countries.



Data sources: ETSC (European Transport Council), 8th PIN Annual Report (2014); ONISR (Observatoire National Interministériel de la Sécurité Routière).
Figures: Belgium, Ireland, Denmark, Netherlands (2001–2012), France (2005–2013), Latvia (2004–2013), Sweden (2007–2013)

reduction in the number of serious injuries in road traffic in 2015.

The ratio in terms of location and the consequences of accidents with personal injury has remained more or less the same for the last more than 40 years (Figure 6). Roughly two thirds of these accidents happen in built-up areas and this is where most of the injuries still happen today too. The number of deaths caused by accidents is consistently highest on rural roads. The reasons for this are obvious: compared to traffic in built-up areas, driving speeds are significantly higher, added to this are risk increasing factors – specifically compared to motorways – such as

In 1970, pedestrians made up just under a third of all road users killed by accidents in Germany, in 2013 it was "just" a sixth. By contrast, the percentage of senior citizens killed by road accidents, in relation to all road fatalities, rose from 1970 to 2013.

6

Road accident trend in Germany

	1970	1980	1990	2000	2005	2010	2012	2013	Change from '70 – '13
Total accidents	**1,392,007**	**1,684,604**	**2,010,575**	**2,350,227**	**2,253,992**	**2,411,271**	**2,401,843**	**2,414,011**	**+ 73.4%**
Accidents with personal injury	377,610	379,235	340,043	382,949	336,619	288,297	299,637	291,105	- 22.9%
of these in built-up areas	254,198	261,302	218,177	245,470	225,875	195,833	206,696	199,650	- 21.5%
outside built-up areas without motorways	107,762	101,701	97,559	111,901	89,801	73,635	75,094	73,003	- 32.3%
including federal roads	47,810	35,825	34,109	38,754	30,001	24,245	24,479	23,905	- 50.0%
Motorways	15,650	16,232	24,307	25,578	20,943	18,829	17,847	18,452	+ 17.9%
Total fatalities	**19,193**	**13,041**	**7,906**	**7,503**	**5,361**	**3,648**	**3,600**	**3,339**	**- 82.6%**
of these in built-up areas	8,494	5,124	2,205	1,829	1,471	1,011	1,062	977	- 88.5%
outside built-up areas without motorways	9,754	7,113	4,765	4,767	3,228	2,207	2,151	1,934	- 80.2%
Motorways	945	804	936	907	662	430	387	428	- 54.7%
Pedestrians	6,056	3,095	1,459	993	686	476	520	557	- 90.8%
Car drivers and passengers	8,989	6,440	4,558	4,396	2,833	1,840	1,791	1,588	- 82.3%
People aged between 18 and 24	3,403	3,221	1,976	1,736	1,076	690	611	493	- 85.5%
Aged 65 and older	4,016	2,733	1,574	1,311	1,162	910	994	999	- 75.1%
Total people injured	**531,795**	**500,463**	**448,158**	**504,074**	**433,443**	**371,170**	**384,378**	**374,142**	**- 29.6%**
of these in built-up areas	331,176	323,656	265,643	300,798	274,010	238,131	250,309	241,521	- 27.1%
outside built-up areas without motorways	173,483	151,704	143,388	163,078	127,066	104,166	106,121	103,419	- 40.4%
Motorways	27,136	25,103	39,127	40,198	32,367	28,873	27,948	29,202	+ 7.6%
Pedestrians	77,449	56,451	39,169	38,115	33,916	29,663	31,310	30,807	- 60.2%
Car drivers and passengers	342,277	279,649	283,344	309,496	247,281	211,556	214,277	210,993	- 38.4%
People aged between 18 and 24	131,477	142,718	123,321	111,210	86,521	72,482	71,519	66,504	- 49.4%
Aged 65 and older	27,842	30,795	28,905	36,327	40,781	39,592	43,887	43,369	+ 55.8%
Mileage (in billion km)	251.0	367.9	488.3	663.0	684.3	704.8	719.3	725.7	+ 189.1%
Fatalities (per billion km)	76.5	35.4	16.2	11.3	7.8	5.2	5.0	4.6	- 94.0%

Data sources: Federal Statistics Office, BASt

Five generations: the vehicle body was overhauled accordingly to provide occupants with better protection in the Volkswagen van too.

no separation from oncoming traffic, poor overtaking opportunities, junctions and unprotected obstacles, such as trees, right next to the road. Collisions with oncoming traffic and accidents caused by lane departure usually have very serious consequences.

The fact that the trend is still a major, sustainable success story with all the justified relativising becomes clear when you take a look at the extreme increase in mileages over the last 40 years. In 1970 these were 251 billion kilometres on all roads in

7 Fatalities in the European Union member states

The number of road fatalities decreased by roughly 65 percent in the EU states from 1991 to 2013.

	1991	1996	2001	2006	2011	2013	Change from '91–'13
Austria	1,551	1,027	958	730	523	453	-70%
Belgium	1,873	1,356	1,486	1,069	858	717	-62%
Bulgaria	1,114	1,014	1,011	1,043	657	601	-46%
Croatia	n. d.	n. d.	647	614	418	368	n. d.
Cyprus	103	128	98	86	71	44	-59%
Czech Republic	1,331	1,570	1,333	1,063	772	655	-51%
Denmark	606	514	431	306	220	180	-70%
Estonia	490	213	199	204	101	81	-83%
Finland	632	404	433	336	292	271	-57%
France	10,483	8,540	8,162	4,709	3,963	3,268	-69%
Germany	11,300	8,758	6,977	5,091	4,009	3,339	-70%
Greece	2,112	2,157	1,880	1,657	1,141	912	-57%
Hungary	2,120	1,370	1,239	1,303	638	598	-72%
Ireland	445	453	412	365	186	193	-56%
Italy	8,109	6,676	7,096	5,669	3,860	3,434	-58%
Latvia	997	594	558	407	179	179	-82%
Lithuania	1,173	667	706	760	296	258	-77%
Luxembourg	83	71	70	43	33	45	-46%
Malta	16	19	16	11	21	21	+30%
Netherlands	1,281	1,180	993	730	546	476	-63%
Poland	7,901	6,359	5,534	5,243	4,189	3,342	-58%
Portugal	3,217	2,730	1,670	969	891	650	-80%
Romania	3,078	2,845	2,450	2,587	2,018	1,861	-40%
Slovakia	614	616	614	614	324	225	-63%
Slovenia	462	389	278	262	141	125	-73%
Spain	8,837	5,482	5,517	4,104	2,060	1,721	-81%
Sweden	745	537	583	445	319	264	-64%
United Kingdom	4,753	3,740	3,598	3,298	1,960	1,791	-62%
EU total	**75,426**	**59,409**	**54,949**	**43,718**	**30,686**	**26,073**	**-65%**

n. d. = no details — Data source: CARE

Vans in road traffic – less dangerous than

Vans up to 3.5 tons have established themselves in the supply chain as a link between logistics centres and retail or the end consumer across Europe. However, the small van is also a main pillar in the fast and flexible long-distance goods and merchandise transport sector and in courier and delivery services. And last but not least, these vehicles are essential for trades to transport labour, tools and material. The highest numbers of vans are registered in France, Spain, Italy, Great Britain, Poland and Germany.

Other road users automatically became more aware of these vehicles with their increasing relevance in traffic. Over the years this has led to a not always very objective discussion about the safety of vans in the media, in politics and among the population. Statistically, the accident risk of small vans no longer has any anomalies compared to cars or trucks. They are almost as safe as cars on the roads and offer occupants protection and comfort comparable to that of cars.

In terms of the number on the roads, the percentage of vans involved in accidents has been continuously dropping since 2001. If you take the

the former Federal Republic of Germany, compared to 724 billion kilometres in Germany in 2013. That's a plus of more than 188 percent. As a result, about 76 deaths caused by road accidents happened over a billion kilometres in 1970 and just roughly five in 2013. This in turn corresponds to a minus of 94 percent.

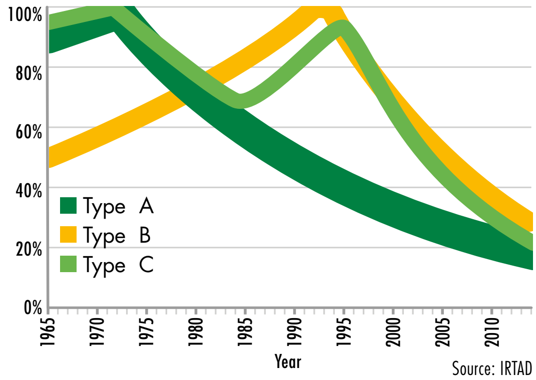
HISTORICAL RECORD HIGHS EU-WIDE MAINLY IN THE 1970S

Just like in Germany, the number of road accident victims has also more or less continuously and considerably been decreasing in many other European countries for decades (Figure 7). The example of France (Figures 11 and 12) initially also shows a sharp rise in the number of fatalities from the 1950s. The first French accident statistics for 1954 record a figure of 7,166 road fa-

8

Compelling curves

Many countries (type A) had their record highs in terms of deaths caused by road accidents at the end of the 1960s and start of the 1970s and a continuously declining trend since then. Other countries (type B) only reached their record high in the first half of the 1990s. The trend has also been declining there since then. Individual states (type C) had an "interim high" in the 1990s following the record high at the start of the 1970s.



Source: IRTAD

9

Tragic records

Historical record highs for fatalities in selected EU states.

Country	Year	Fatalities	Type
Austria	1972	3,027	A
Belgium	1972	3,101	A
Czech Rep.	1971	1,988	C
Denmark	1971	1,213	A
Finland	1972	1,156	A
France	1972	18,113	A
Germany	1970	21,332	A
Greece	1995	2,411	B
Hungary	1990	2,432	B
Iceland	1977	37	C
Ireland	1972	640	A
Italy	1972	11,964	A
Luxembourg	1970	132	A
Netherlands	1972	3,264	A
Norway	1970	560	A
Poland	1991	7,901	B
Portugal	1975	3,372	C
Slovenia	1979	735	A
Spain	1989	9,344	B
Sweden	1965	1,313	A
Switzerland	1971	1720	A
United Kingdom	1965	8,143	A

Data source: IRTAD

many people think

mileage of this vehicle group as the basis, it is obvious that vans up to 3.5 tons are not any more remarkable than cars in accidents with personal injury or accidents with fatalities. As far as involvement in these kinds of accidents is concerned, cars are strictly speaking at a level today that vans up to 3.5 tons already had more than 20 years ago (Figure 10). The latter are in fact documented less often as the main cause of accidents by the police.

The long-prevailing opinion of vans being "particularly dangerous" can therefore be disproved by current accidents. A study, which was written and published as part of a joint research project by the Federal Highway Research Institute (BASt), the German Association of the Automotive Industry (VDA), the German Insurers Accident Research (UDV) and DEKRA Accident Research, comes to this conclusion. Nevertheless, every effort should be made to continue to reduce the accident risk even with the vans vehicle group, which is still increasing in volume on the roads, and to improve safety for occupants and other road users.

Vans are mainly involved in accidents with cars due to their large numbers on the roads. Compatibility problems may arise from this, in particular for car occupants, which lead to a very high risk of injury. It is essential to attach even greater importance to partner protection here.

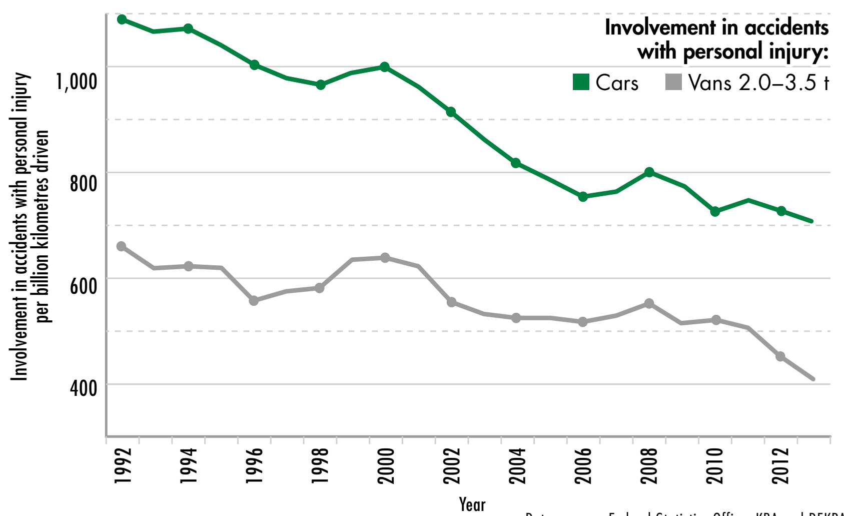
Thanks to crash tests it is possible to identify additional potential for improvement in the high safety level achieved and test new safety components before market launch. DEKRA regularly carries out these kinds of tests with vans too. Besides protecting occupants, the focus is on partner protection and cargo securing. The classic impact against the crash block is supplemented by tests against trucks, motorcycles, bicycles and pedestrian dummies.

Compared to cars, van drivers lose control of their vehicle less often but ESP is still highly justifiable here. ESP is proved to have a high potential benefit in single vehicle accidents. Brake assist systems and lane departure warning systems on the other hand show comparatively low potential but they should not be ignored nevertheless. However, the sometimes high expectations of these systems must be checked and relativised with other findings from real accidents.

10

Overestimated risk

Vans up to 3.5 tons are involved in accidents considerably less often than cars for every billion kilometres driven.



Data sources: Federal Statistics Office, KBA and DEKRA

Altero Matteoli
President of Commission Transport and Infrastructure of Senato Italiano

The Italian government's action plans are having a major impact

Improving safety on our roads, in order to significantly reduce the number of accidents and their consequences, has been a priority of governments of the center-right coalition since 2001. To achieve such an ambitious goal, the government was assumed to implement a variety of actions, with legal changes to the Highway Code and to regulations, to improve the coordination among the various players and to put into action measures to create infrastructural interventions in the road and motorway network, in order to upgrade it to the highest safety standards.

And, last but not least, it was essential to have a positive effect on the sensitivity of citizens, families and associations using for this purpose the channel of media campaigns. There is no doubt that the idea of introducing into our organization the so-called "Patente a punti", which has been in force since 1st July 2003, has represented an important turning point for road safety.

This new mechanism is proved to be highly effective (it is a deterrent due to the fact that the license will be revoked, if the initial twenty points are lost) and allowed to decrease the number of road accidents and the number of deaths and injuries.

We only need to take a look at the official data. From the peak reached in 1972 when the deaths on the roads were over 11,000, in 2010 this number decreased to 4,090. The number need to be reduced: in 2013, the deaths on roads and highways were 3,400, approximately 52% less than in 2001, in line with the previsions done by the European Commission.

"Patente a punti" is just one of the measures, which have enabled the government to achieve this result. Among them, the reform of the Highway Code approved on government's push in 2010, when I had the honor of directing the Ministry of Transport. A reform that combined great severity with great prevention.

Among the measures introduced, the prohibition of driving under the influence of alcohol and drugs for young drivers, young people up to 21 years and professional drivers assumed particular importance. Moreover, the new restrictive rules about the use of minicar and a revision of the point system of the license, which is now more strict and effective.

Of no little importance is the purpose of including road safety as a compulsory subject at school, in the absolute knowledge that without education and without the cooperation of families, the goal of zero – or in any case fewer – deaths on the roads will be never achieved.

In the program of the Ministry of Infrastructure and Transport, many interventions were planned and agreed in particular with Anas and the motorway organization in order to modernize the road network, by providing the most advanced security systems, traffic monitoring and speed controls.

talities. This figure had more than doubled by 1969 to 14,664, rising to 18,034 as the negative record high in 1972. This trend ultimately also prompted the government to appoint a special delegate to organise and coordinate the newly created "Inter-ministerial Committee for Road Safety".

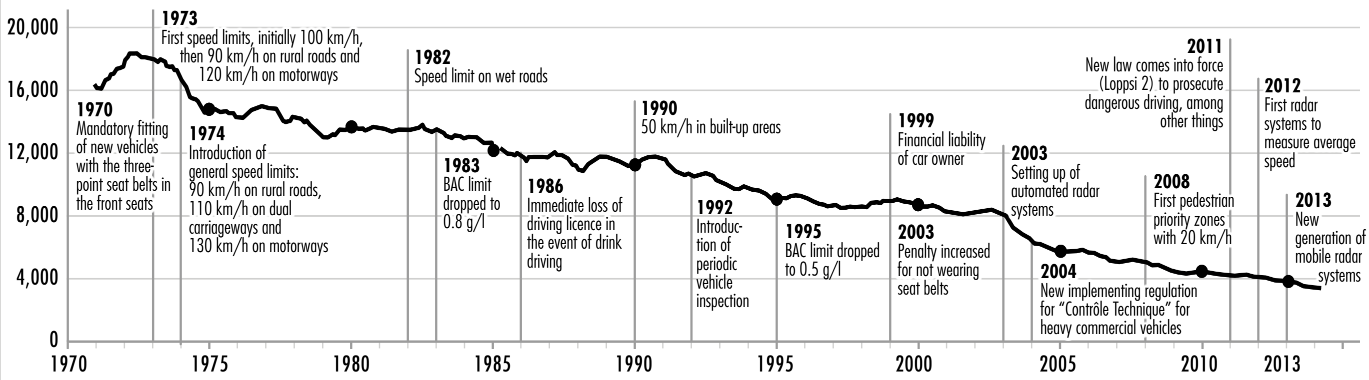
Speed limits were introduced in France for the first time on rural roads and motorways and the mandatory wearing of a seat belt in the front was introduced outside built-up areas in 1973. The number of road fatalities decreased to 14,166 between 1972 and 1975 as a result, a drop of more than 20 percent in three years. Although this pace was not sustained afterwards, the trend still continued in a positive direction.

In 1979 it was then mandatory to wear seat belts in the front on all roads and in 1980 motorcyclists had to start wearing a helmet. The technical inspection became statutory for the sale of cars more than five years old in January 1986. The technical condition of vehicles on the roads noticeably improved by introducing the obligatory Contrôle Technique in 1992. The percentage of faults then dropped by 50 percent or more in numerous assemblies. However, in contrast to Germany for example, there is not a vehicle inspection for motorcycles in France. What was subsequently particularly radical was the introduction of automation-supported traffic monitoring CSA (= Contrôle sanction automatisé) in December 2002 for the improved monitoring and punishment of speed limit offences. Beforehand, the former French President Jacques Chirac had declared road safety his top priority and called previous action ineffective in terms of monitoring and sanctions in his inaugural address.

11

Positive trend in France

Among other things, measures against excessive speeds and drink driving have ensured a constant drop in road accident victims on French roads.



Source: Observatoire National Interministériel de la Sécurité Routière (ONISR)

Following this, roads were densely equipped with mobile and stationary automated radar monitoring devices nationwide. This action, which was accompanied by an extensive information campaign, certainly led to a considerably more careful and cautious driving style by many road users. The number of road fatalities decreased by roughly 27 percent from 7,655 to 5,593 from 2002 to 2004 alone.

In Italy, a rapid increase in accidents with personal injury was recorded from the 1950s too (Figure 13). As in France, the number of road fatalities reached a historical record high in 1972: 11,078 people lost their lives and more than 267,000 were injured in just under 200,000 road traffic accidents. 3,434 fatalities in 2013 mean a drop of just under 70 percent. In Spain (Figure 14) the record high was reached much later, namely in 1989 with 9,344 fatalities. In 2013, there were "only" 1,721.

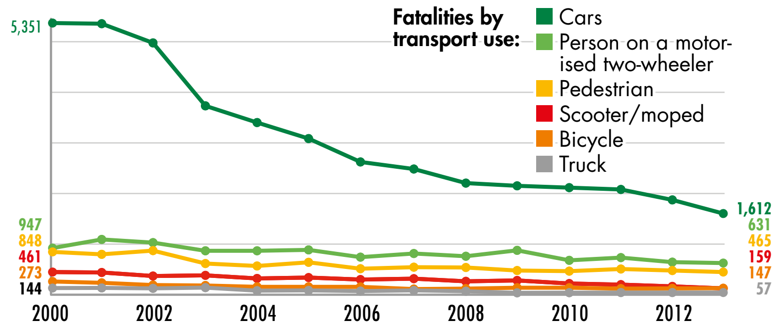
MAJOR EFFORTS STILL REQUIRED

The fact that the number of fatalities and injuries has been constantly decreasing for many years in Europe in particular is even more impressive evidence for positive developments in road safety in light of the increasing volume of traffic and above all the number of licensed vehicles in the EU. According to information from the European car manufacturers' association ACEA, there were just under 180 million vehicles on Europe's roads in 1990, this number had risen to roughly 265 million by 2011 (Figure 17). The trend will continue to rise for the time being. For example in Germany: in its "2030 Transport Forecast", the Federal Ministry of Transport and Digital Infra-

12

Strong downward trend

The number of road fatalities in France halved from 2000 to 2010. This dropped by another 18.5 percent up to 2013. It is mainly car occupants who have benefited from this positive trend.

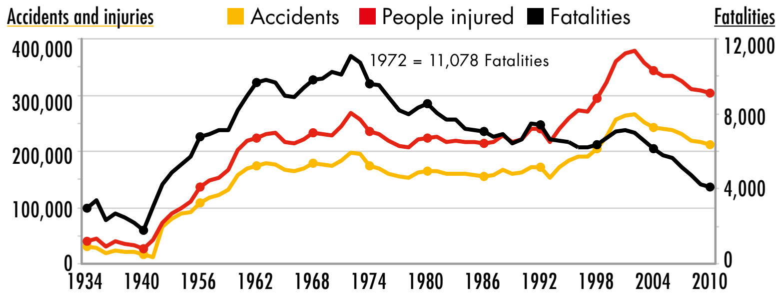


Source: Observatoire National Interministériel de la Sécurité Routière (ONISR)

13

Comparable trend

Like many other countries in the EU, Italy shows a strong increase in road fatalities up to and well into the 1970s.

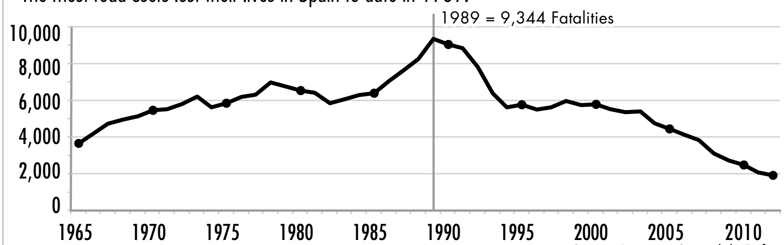


Sources: ISTAT, ACI

14

Negative record set later on

The most road users lost their lives in Spain to date in 1989.



Source: Dirección General de Tráfico

All together for safer roads in Europe

Highlights of the EU Commission's work from 2010–2014

● The European driving licence

The new European driving licence in credit card format was launched across Europe with a standard design and improved security features in January 2013. Among other things, it improves the protection of the most at risk road users as the age limit was raised for the most powerful motorcycles.

● Prosecution of road traffic offences abroad

Since November 2013, the EU Member States, with the exception of Denmark, Ireland and the United Kingdom, have to apply the new directive about prosecuting road traffic offences beyond national borders. This makes it easier to enforce road traffic regulations as police authorities have the possibility of exchanging information about traffic offences in other member states.

● Stricter regulations for vehicle testing to protect road users

In 2012 the Commission presented a proposal to update the regulations about the regular technical inspection of vehicles, roadside inspections of commercial vehicles and car registration documents. The aim was to raise the minimum standards for vehicle testing, to ensure more uniform conditions within the single market and to reduce the number of accidents caused by unsafe vehicles. The package was adopted by the European Parliament in March 2014.

● Launch of eCall from 2015

The Commission presented proposals that the rescue services should automatically be informed in the event of serious accidents by the eCall system (see figure below) to be installed in all new cars from October 2015. According to the proposal, all new car models and light commercial vehicles are to be fitted with the 112 eCall system. Based on estimates, the time until the rescue services arrive could be shortened by 40 percent in built-up areas and by 50 percent in rural areas with the introduction of the eCall system.

● Safety management for the infrastructure

The directive on safety management for the road traffic infrastructure provides for a range of processes that are to guarantee that safety is already taken into account when planning and building the infrastructure and regular safety tests are then carried out afterwards.

● Strategy to reduce the number of serious injuries in traffic

Until now road safety has usually been evaluated just by the number of fatalities. However, for every road fatality there are ten to twelve accidents with serious injuries that have life-changing consequences and also cause high socio-economic costs. That is why the EU took an important step in 2013 to reduce the number of serious injuries. First of all, a common EU-wide definition of injuries was determined to be able to collect reliable and comparable data. This data was collected for the first time in 2014 and should make it possible to analyse the problem of injuries and define the most effective countermeasures.

● Strategies and action plans for road safety

The Commission initiated an exchange of experiences between member states to be able to use the knowledge gained from national authorities in terms of road safety when implementing national strategies and action plans across Europe.

● European Road Safety Day

The Commission regularly offers stakeholders in road safety, i.e. experts, political decision-makers, associations and clubs, the industry etc. the chance to exchange opinions and knowledge on how road safety work can be further improved taking into account all the relevant perspectives.

● European Road Safety Charter and data for road safety

The European Road Safety Charter initiated by the European Commission is the largest civil society platform in this area. More than 2,300 public and private institutions have already signed the charter so far. In addition, they have implemented road safety measures and initiatives that are geared towards their members, employees and civil society as a whole. Two important platforms for knowledge building are also the European Monitoring Centre for Road Safety and the "EU CARE" database where data and information about road safety is collected and made publicly available.

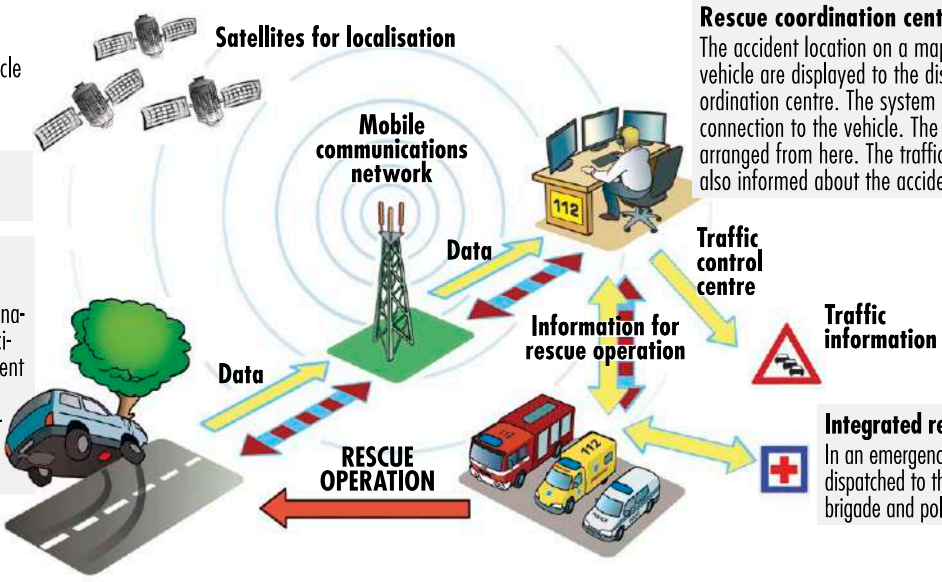
Key page

Data — Information from the vehicle
Data connection
Voice connection

Exact determination of vehicle location by satellite signals.

eCall (Emergency Call)

The vehicle sends the following information to the rescue coordination centre straight after the accident: time and location of accident direction, number of occupants. A voice connection is then established between the vehicle and the rescue coordination centre.



Rescue coordination centre for eCall

The accident location on a map and data from the vehicle are displayed to the dispatcher in the coordination centre. The system establishes a voice connection to the vehicle. The rescue operation is arranged from here. The traffic control centre is also informed about the accident from here.

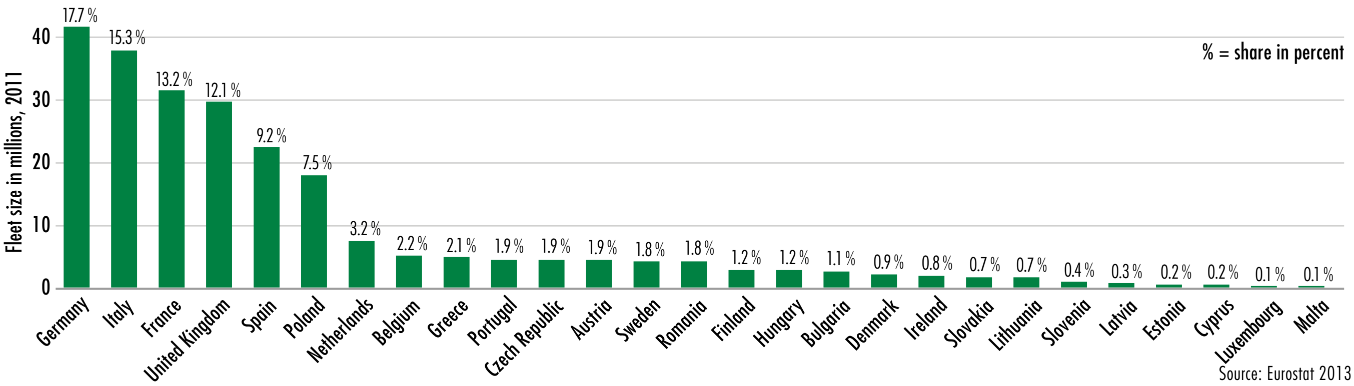
Integrated rescue services

In an emergency, vehicles are dispatched to the accident site (fire brigade and police too if necessary).

15

Wide scope

Germany has the largest car fleet among all EU member states.

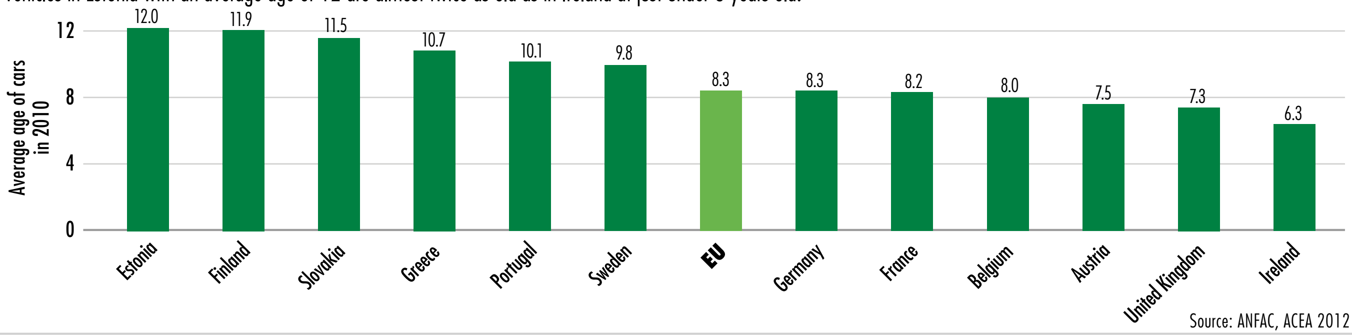


Source: Eurostat 2013

16

The age of fleets differs very much in the EU

Vehicles in Estonia with an average age of 12 are almost twice as old as in Ireland at just under 6 years old.



Source: ANFAC, ACEA 2012

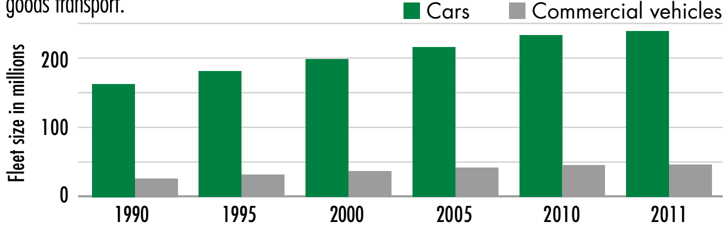
structure is assuming that motorised passenger transport will grow by ten percent, and road traffic freight by even 39 percent by 2030 compared to 2010.

As a result, major efforts are still required from everyone involved if we are to achieve the EU's target of halving the number of annual road fatalities by 2020 compared to 2010. There is undoubtedly significant potential in vehicle engineering. But infrastructure and road construction, legislation and traffic monitoring, rescue services, road safety education and other prevention measures must continue to contribute. All of them are topics that are looked at more closely in the following chapters.

17

Continuously rising

The number of vehicles has been rising for years across the EU both for cars and in commercial goods transport.



Source: Eurostat 2013

Brief facts

- **The number of road fatalities has dropped by 84 percent in Germany since 1984.**
- **The number of road fatalities has dropped by 65 percent in the EU since 1991.**
- **Strikingly many of the record highs for fatalities across Europe were in the 1970s.**
- **There has been a consistent picture across the EU for decades: Most accidents happen in built-up areas but the number of deaths caused by accidents is highest on rural roads.**
- **Speed limits, BAC limits and the mandatory wearing of seat belts were important measures for greater road safety.**
- **Vans up to 3.5 tons are not any more remarkable than cars in accidents with personal injury or accidents with fatalities.**
- **The EU's strategic target to reduce the number of serious injuries in road traffic accidents is to be adopted in 2015.**

A comparison of generations of vehicles

Example 1

FRONTAL COLLISION INVOLVING TRUCK AND CAR

Accident circumstances:

A car was taking a long sweeping left-hand bend in a built-up area during the day in sunny weather. After the left-hand bend the vehicle was steered into the oncoming lane for unknown reasons where it crashed head on into an oncoming truck.

Despite the truck driver's emergency braking, there was a collision with the front left of the car. The car careered under the truck and was then thrown back again roughly 25 m against the original driving direction.

1 Final position of both the vehicles involved in the accident

2 Massive damage to the car in the top area of the engine compartment and passenger cell. Due to its lack of compatibility with the truck, the bottom area of the engine compartment and front wheel are hardly affected at all. The crumple zone could not be effective at all.

3 Damage to truck

Vehicles:

	Vehicle that caused the accident	Parties involved in the accident
	VW Golf III	Truck: MAN 17,232 (M06), Trailer: Kässbohrer V14 L
Registration date	1992	1989/1989
Speed of collision	35 km/h	45 km/h
Mass	1,155 kg	16,175 kg

Consequences of accident:

	Vehicle that caused the accident	Parties involved in the accident
Occupied with	2 people	1 person
Injuries	Driver killed (cranio-cerebral trauma and chest injuries), passenger seriously injured (head injuries and chest injuries)	Driver slightly injured (bruising to right knee)

Cause/problem:

The cause for lane departure into oncoming traffic could not be identified. The cause may have been distraction or physical deficits. The car was inspected for technical faults that may have caused the accident. There were not any faults of this kind.

As the Golf's main chassis beam that is important for absorbing the energy could not find support in the truck's structures, the crumple zone was ineffective. The car was pushed under the truck which led to massive deformation of the passenger cell.

Example 2

TRUCK AND CAR CRASH TEST

Crash test:

An trailer truck and a car collided head-on with each other in a crash test. The trailer truck was fitted with an innovative energy-absorbing underride guard. The car's crumple zone could work perfectly effectively as all the vehicle's relevant front structures could be supported on the underride guard. Energy was also dissipated by the underride guard. The trailer truck was effectively prevented from driving over the car and the occupants' injuries remained non-critical.

Vehicles:

	Car	Truck
	VW Golf IV	MAN TGA
Registration date	2000	2000
Speed of collision	21 km/h	43 km/h
Mass	1,378 kg	15,150 kg

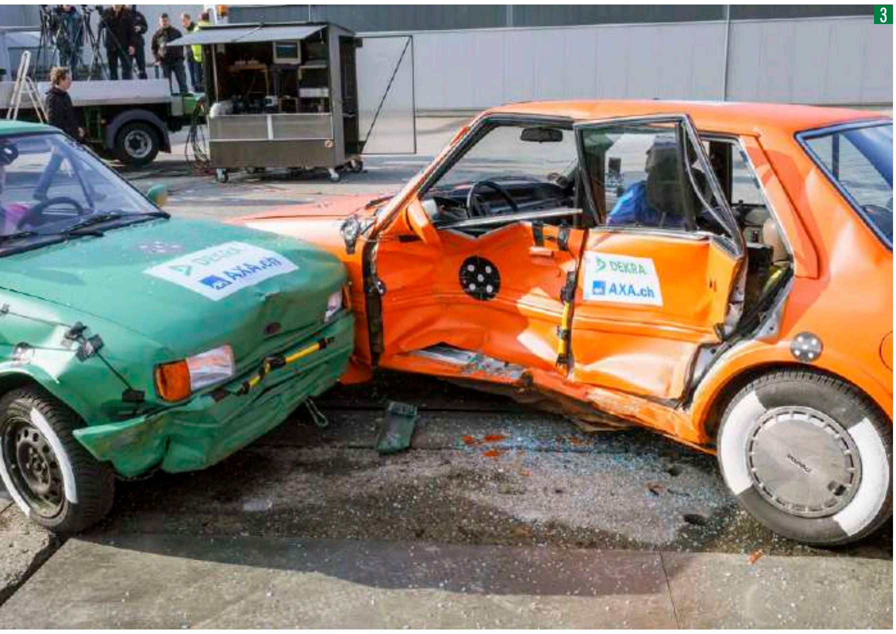
Crash outcome:

The energy-absorbing front underride guard tested showed outstanding results. The potential protection went far beyond that stipulated by law. The enormous risks flagged time and time again by DEKRA among others and a large number of victims in collisions without front underride guard prompted the European Parliament to stipulate these kinds of protection systems from 2003 with the 2000/40/EC Directive for all new commercial vehicles with a permissible gross weight of more than 3.5 t Europe-wide.

The driver dummy's measurements in the truck did not identify any risk of injury, the driver and passenger dummies' values in the car were significantly below the set limits for crash tests. The risk of injury can therefore be classified as low.

1 The car can support itself on the truck in the crash, the crumple zone is totally effective.
2 Thanks to the energy absorption in both vehicles the car is not thrown back.
3 The car's passenger cell remains stable, the risk of injury for occupants wearing seat belts is very low.
4 The car's safety concept worked effectively.

1 *Deep penetration of the green Ford Fiesta in the passenger cell of the orange Mazda 626*
2 *Low loads for the Ford occupants, life-threatening loads for the Mazda occupants*
3 *Damage to both crash vehicles*



Example 3

T-BONE JUNCTION COLLISION IN THE PAST

Crash test:
In the crash test an older Ford Fiesta crashed into the side of a Mazda 626 at right angles with a collision speed of 50 km/h. Due to the very soft design of the side structure, typical of vehicles back then, the Ford penetrated the Mazda's passenger cell very deeply. Due to the Mazda's side structure giving way, the Fiesta was only damaged slightly in the front area, most of the energy was dissipated through the Mazda.

Vehicles:

	Vehicle 1	Vehicle 2
	Ford Fiesta	Mazda 626
Registration date	1987	1983
Speed of collision	50 km/h	0 km/h
Mass	869 kg	1.060 kg

Crash outcome:
The Ford Fiesta's occupants wearing seat belts would only have had a comparatively low risk of injury in this accident. Due to the soft side structure of the Mazda 626, the Ford decelerated slowly, which keeps the load values low. This resulted in a totally different picture for the occupants of the Mazda. The dummy measurements here revealed terrifyingly high values. Based on the load values measured on the pelvis, chest and neck, life-threatening injuries can be expected in a comparable real accident. The vehicles were not fitted with airbags in accordance with the year of manufacture. The B-column deeply penetrated the passenger cell.

Example 4

T-BONE JUNCTION COLLISION TODAY

Crash test:

The identical constellation was chosen for the crash test as described in the crash opposite, although modern vehicles were used. Thanks to the very stable Mazda 6 passenger cell the impacting Ford Fiesta only penetrated it slightly. At the same time the Fiesta's front structure designed for partner protection worked effectively and dissipated the energy. The front area was more deformed than with the comparable older model as a result but the occupants of both vehicles were perfectly protected.

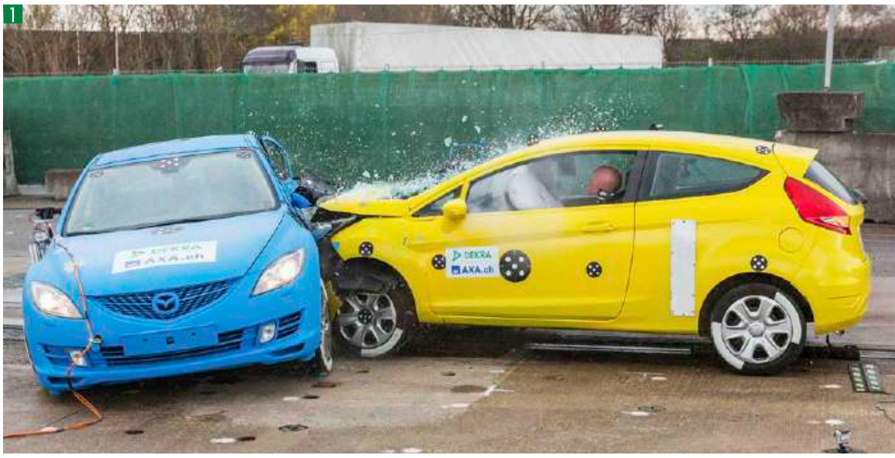
Vehicles:

	Vehicle 1	Vehicle 2
	Ford Fiesta	Mazda 6
Registration date	2009	2009
Speed of collision	50 km/h	0 km/h
Mass	1.110 kg	1.458 kg

Crash outcome:

Despite the fact that both vehicles were signifantly heavier and the much higher crash energy as a result, the risk of injury in both the vehicles involved was significantly lower than in the crash with the two older vehicles. The combination of optimised restraint systems – both vehicles were fitted with effective airbag systems besides seat belts and seat belt tighteners –, high-strength structures in the passenger cells and efficient crumple zones impressively proved the safety potential of modern vehicles. All the dummy load values measured were significantly below the limits. Assuming the occupants were wearing a seat belt, no serious injuries would have been expected with any of the occupants.

1



1 Collision of newer Fiesta with the Mazda 6

2 Triggered side airbags and stable intact sills and B-column protect the Mazda occupants perfectly.

3 The serious deformations to the front of the Fiesta ensure lower occupant decelerations and therefore lower loads.

2

3

1 The almost completely compressed passenger cell of the BMW in the driver's position, mounted and penetrated steering column.

2 Deformation of the Opel body front left into the interior

3 Accident damage to front left wheel

4 Wear to wheel brakes

5 Vehicle front end distorted to the left

Example 5

COLLISION WITH ONCOMING TRAFFIC IN THE PAST

Accident circumstances:

Due to excessive speed the driver of a BMW E12 (525) careered into the lane of oncoming traffic when taking a long right-hand bend. This resulted in a frontal collision with an oncoming Opel Ascona B. The coverage was roughly half of the front of both vehicles. Both vehicles were thrown back several metres as a result of the impact of the collision.

During the technical inspection of the BMW significant faults were identified on the braking system, but they were not classified as having caused the accident. The driver of the oncoming vehicle started to emergency brake before the collision.

Vehicles:

	Vehicle that caused the accident	Parties involved in the accident
	BMW E12	Opel Ascona B
Registration date	1974	1979
Speed of collision	110 – 115 km/h	30 – 35 km/h
Mass	1,400 kg	1,000 kg

Consequences of accident:

	Vehicle that caused the accident	Parties involved in the accident
Occupied with	1 person	1 person
Injuries	Multiple life-threatening injuries to the whole body, freed from being trapped in the vehicle by the fire brigade	Driver died at the accident site

Cause/problem:

The damage to these vehicles led to considerable deformation of the passenger cells. The passenger cell must have as high rigidity as possible to protect occupants in an accident. This ensures adequate residual space. The vehicle parts of the other party involved in the accident should not penetrate this space so that the passive safety elements (seat belt, safety steering column, with modern vehicles airbags) can be fully effective.

In both the vehicles involved in the accident the maximum energy absorption of the affected front areas was exceeded so the passenger cells collapsed.

Example 6

THE POTENTIAL OF TODAY'S ACTIVE AND PASSIVE SAFETY

Crash test:

Two structurally identical BMW models from the current series were crashed to highlight the potential benefit of modern vehicle safety systems. One of the vehicles was fitted with an activated automatic emergency braking system. The impact was against a crash block, which had a so-called deformation element built on the front to simulate an oncoming vehicle. The crash constellation was chosen in line with the EuroNCAP consumer protection tests.

Vehicles:

	BMW 530d	BMW 530d with emergency braking assistant
Year of manufacture	2010	2010
Initial speed	64 km/h	64 km/h
Speed of collision	64 km/h	40.4 km/h
Coverage	40% of the vehicle front	40% of the vehicle front
Mass	2,264 kg	2,264 kg

Crash outcome:

Thanks to the effectively working crumple zone combined with the restraint system, only a low risk of injury resulted for the occupants from the crash at 64 km/h. In the second test the vehicle's sensor technology recognised the inevitability of the collision and automatically triggered emergency braking. The crash speed was reduced as a result to approx. 40 km/h. The kinetic energy therefore dropped by 60 percent. The damage to the vehicle was significantly less and the already low risk of injury was minimised.

As the vehicles were fitted with eCall, emergency calls were automatically placed to the BMW emergency services. All the relevant site and vehicle data as well as information about the triggered airbags and occupied seats were sent correctly.

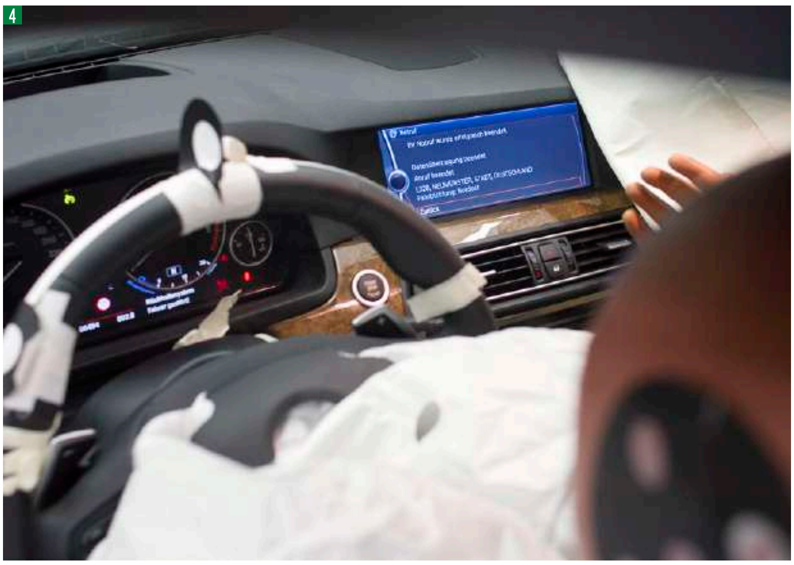
5

1

1 Damage to the vehicle that crashed at 64 km/h
2 Impact against crash block at 40.4 km/h
3 Comparison of the different resulting damage
4+5 An emergency call was automatically placed by eCall with the relevant site and vehicle data.

2


3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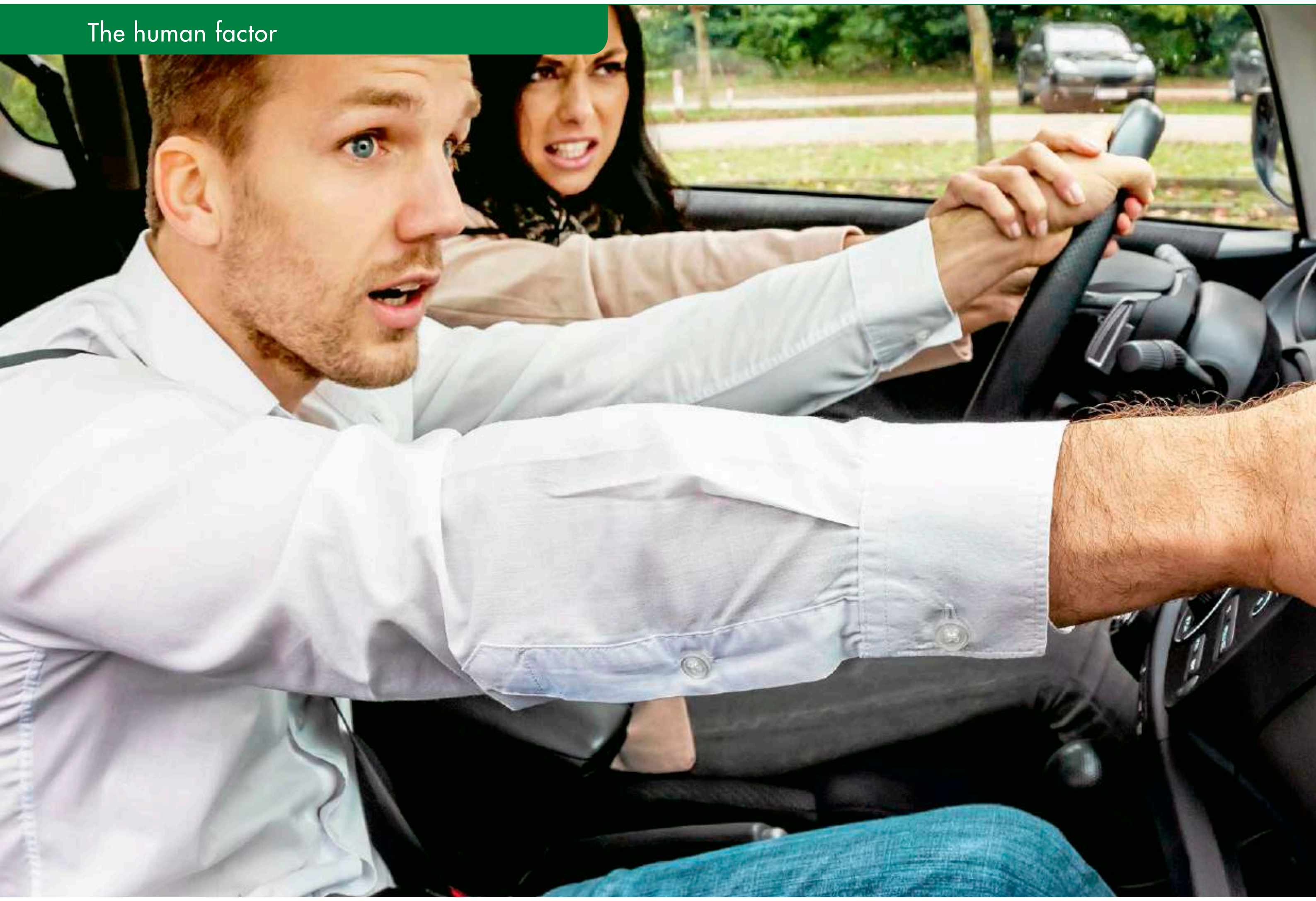


A greater sense of responsibility at the wheel!

Vehicle driver mistakes are still the most common cause of accidents. Besides not adapting their speed, risky overtaking manoeuvres and disregarding the right of way, many accidents also happen due to driving under the influence of alcohol. The use of so-called alcohol interlocks might provide assistance with the latter. Effective public campaigns and last but not least constantly further developing driving licence services are also important contributions to greater safety.

In a complex system like road traffic, which is subject to constant changes, the coordinated actions of various road users are absolutely crucial. We therefore also need to address this seriously to reduce the number of accidents and all their consequences. Whichever means of transport they happen with: road accidents can always have several causes, most notably excessive speed, carelessness or alcohol consumption, but not forgetting external conditions and potential technical vehicle faults.

The history of traffic psychology in Germany

1910 Hugo Münsterberg developed an aptitude test for tram driver candidates

■ and later on also proficiency tests for drivers by the military

1915 First driving simulator in Germany to select military vehicle drivers

1917 Psycho-technical laboratories set up by the railway sector and local authorities in Berlin and Dresden

■ Proficiency test introduced for tram drivers in Hamburg

1925 Publication of the first manual for traffic psychology by Giese

■ Foundation of the Deutsche Verkehrssicherheitswacht (German road safety organisation) to improve driving instruction (road safety education was born)

1937 First methods for retraining problem drivers (for example by Hallbauer)

After 1945 Particular focus on assessing drivers affected by the war and testing opportunities for compensation

1951 Foundation of the first medical and psychological investigation authorities

1900 1920 1940

If we look at the year 2013 more closely, a total of 407,217 accident causes were statistically recorded for the roughly 291,105 accidents with personal injury on Germany's roads. The most common accident cause (approx. 86 percent) was driver error, another 3.7 percent were down to pedestrian error. Other causes, which besides the weather and road conditions also include obstacles, such as game on the road, had a share of approximately ten percent of the recorded accident causes. Even if it is only the police's initial assessments that are included in the respective statistics within a week of the accident, the high percentage of human error definitely shows what a huge risk vehicle drivers pose.

ALCOHOL IN ROAD TRAFFIC

An example for human error in road traffic is the irresponsible willingness to get behind the wheel despite having consumed alcohol. The fact is: alcohol always has an effect on the body, although these may differ from person to person. It depends, among other things, on factors like blood alcohol content, physical condition, how accustomed to alcohol the body is and how full the stomach is. However, it can be summarised that the first deficits are already documented from a BAC of 0.2. Performance is impaired in most people from a BAC of 0.6. Deficits can be evidenced in almost every person consuming alcohol to a socially conventional extent with a blood alcohol content of 1.1 (Gerchow, 2005).

Alcohol directly affects the brain and leads, among other things, to impairments in perception, speed of reaction, concentration and logical thinking. This is also shown in the results of the analysis of 129 international studies on alcohol-induced impairments carried out by Reimann et al. (2014). According to this, 97 percent of the impairments evidenced in the studies analysed already appeared with a blood alcohol content of up to 1.1.

While a person under the influence of alcohol also experiences "pleasant" effects such as a lack of inhibition and increased sociability, they do not realise that at the same time specific information from their surroundings is being perceived in a muted and filtered way. A realistic assessment of the situation is no longer possible for a person under the influence of alcohol (Lindenmeyer, 2010). This leads to the extremely dangerous overestimating of your own abilities in traffic and to risky behaviour that

Passengers also often contribute to dangerous situations and even road accidents through their mistakes.

1973 1st edition of the "Illness and Motorised Traffic" expert report

approx. 1975 Introduction of retraining courses for problem drivers (rehabilitation approach)

1982 "Directive for testing the physical and mental aptitude of driving licence applicants and holders" (Aptitude Directive) by the Federal Ministry of Transport

1995 "Psychological driving aptitude expertise" by Kroj: development of the psychological part of the driving aptitude assessment based on medical criteria

1998/99 Traffic psychology is established in legislative and ordinance procedures for the first time. Namely, in the road traffic regulations and driving licence ordinance.

2000 „Assessment guidelines for driving aptitude" developed by doctors and psychologists

2005 1st edition of the "Assessment criteria": summary of all criteria and indicators as part of the driving aptitude assessment broken down by official reason (alcohol, drugs, traffic offences)

1960 | 1980 | 2000 | 2020

■ *Alcohol checks are important and should take place more often.*

often culminates in accidents. A complex activity like road use, where people can already be out of their depth in normal circumstances, can no longer be carried out without any errors in an intoxicated state. This is clearly shown by the number of road accidents caused by alcohol.

ONE IN ELEVEN ROAD FATALITIES INVOLVES ALCOHOL

In analyses by the Federal Statistics Office, road accidents involving alcohol are understood to be those accidents where at least one person involved in the accident was under the influence of alcohol. At the same time it is noted by the Federal Statistics Office that an estimated number of unrecorded cases must be assumed as alcohol levels are not always recorded for all those involved in the accident. Alcohol levels cannot generally be determined for road users that abscond from accidents. Single vehicle accidents, where nobody else except the driver themselves was under the influence of alcohol, are often not even reported to the police.

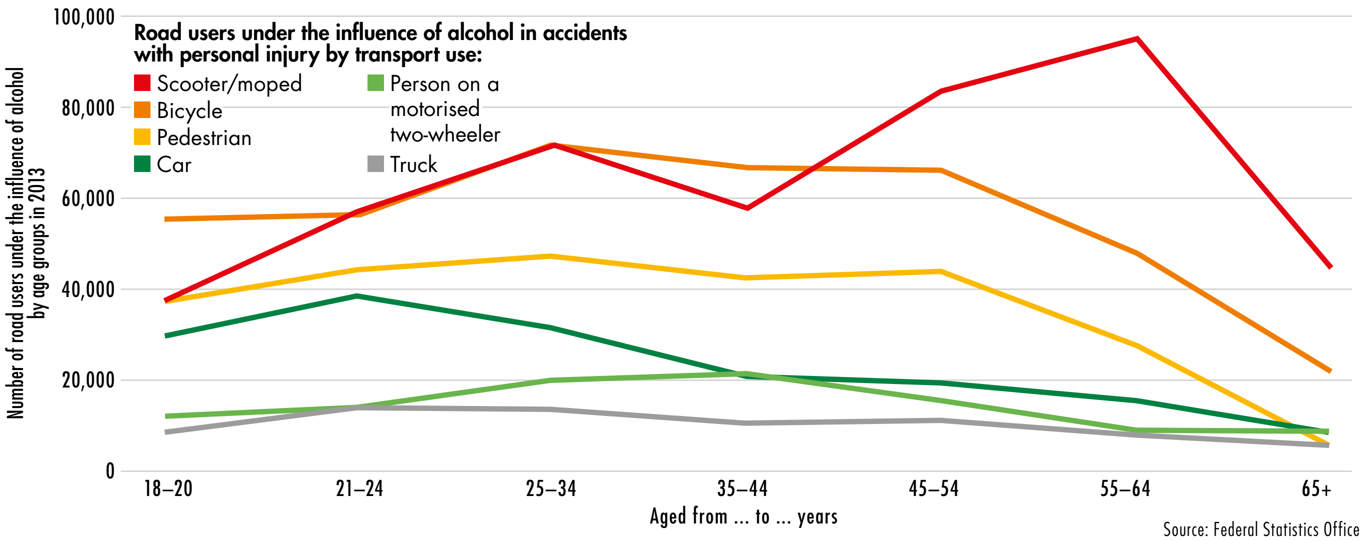
Out of the roughly 2.4 million accidents recorded by the police in Germany in 2013, at least one person involved was recorded as being under the influence of alcohol in just under 40,000 accidents. In 58.3 percent of cases these were car drivers and in 24.4 percent of cases cyclists. Roughly one in eleven road accident fatalities died as a consequence of an alcohol-related accident (314 out of 3,339 fatalities in total = 9.4 percent). Accidents under the influence of alcohol are identified as being of a particularly serious nature: in all accidents with personal injury, 11 fatalities and 220 serious injuries were recorded for every 1,000 accidents. There were 22 fatalities and 346 serious injuries to every 1,000 alcohol-related accidents.

The majority of accidents caused by alcohol (roughly 66 percent) happened in built-up areas, followed by just under 30 percent on rural roads. What was striking about this kind of accident was that alcohol-related accidents were more frequently accidents where the driver lost control of their vehicle, whereas so-called “turning off” or “turning in/crossing” accidents took up a smaller share than average with 12 percent, although these kinds of accidents usually average 36 percent overall. It can be concluded from this that drivers under the

18

Drink driving

Driving under the influence of alcohol was identified very frequently among 45- to 64-year-old scooter/moped riders in accidents with personal injury in Germany in 2013. Cyclists under the influence of alcohol also attracted negative attention in the middle age groups.



Source: Federal Statistics Office

influence of alcohol are obviously extremely careful at known hazard spots such as junctions but tend to overestimate their abilities on stretches of road without any obvious danger.

A clear trend can be identified in terms of the age and gender of parties involved in accidents under the influence of alcohol: they tend to be young and male. 21.9 percent were aged between 18 and 24, another 24.4 percent were between 25 and 34. Women make up a just a small share at only under 13 percent of parties involved in accidents under the influence of alcohol.

HIGH BLOOD ALCOHOL CONTENT MULTIPLIES THE RISK OF AN ACCIDENT

The following figures in particular should give us food for thought: 70.6 percent of car drivers who were involved in an accident with personal injury under the influence of alcohol, had a blood alcohol content (BAC) of at least 1.1 at the time of their blood test. In terms of legislation they were therefore totally unfit to drive. Roughly one in five of the car drivers under the influence of alcohol even had a blood alcohol content of more than 2.0. The recorded BAC values also differ according to age: for example, "only" 11.2 percent of the 18- to 24-year-old car drivers under the influence of alcohol had a blood alcohol content of at least 2.0, this was 33 percent with 45 to 54-year old car drivers involved in accidents under the influence of alcohol.

The devastating effect of alcohol on performance and thus also on road safety is shown in the calculations on accident risk depending on the blood alcohol content. The risk of driver injuries depending on the blood alcohol level was calculated as part of the EU project DRUID (Driving under the Influence of Drugs, Alcohol and Medicines) using data from Belgium, Denmark, Lithuania and the Netherlands. The result clearly showed that there is a roughly 3.5 times higher risk of injury with a blood alcohol content of 0.5 to 0.8. The risk of injury is thirteen times higher with an increase in blood alcohol content up to 1.2. An increased risk of 60 times higher was calculated at over 1.2 (Hargutt, Krüger & Knoche, 2011).

As part of this DRUID study, the risk of having a fatal road accident was also ascertained. This is based on Polish, Finnish and Norwegian data. The result:

- The risk increases three to nine times with a BAC of 0.1 to 0.5.

Magnus Klintbäck
Managing Director of TaxiKurir
Stockholm, Sweden

Alcolocs in everyone of our vehicles

TaxiKurir is the largest taxi company in Sweden and Scandinavia. The company was founded in 1987 and very soon after was entrusted with publicly financed travel. In Sweden, this involves driving school children as well as disabled and elderly persons who have difficulty walking or with their mobility. The requirements set out by the county councils on the transportation of these customers are stringent. One such requirement is that drivers are sober while on duty.

When we were entrusted with publicly financed travel, we thought a lot about how we could really make sure that our drivers are truly sober. The solution: alcolocks in every one of our 2,000 vehicles. Using this option, the driver is required to blow into the hand device before the vehicle can be started. If it shows that the driver is sober, he or she can start the car. When drivers take a break for more than 30 minutes, they must blow into the hand device again in order to be able to start the car.

As part of our safety measures, all alcolocks are calibrated once a year. TaxiKurir also has its vehicles inspected twice a year. During this inspection, the vehicles are examined on the inside and outside, the brakes are checked and the taximeter is calibrated.

Vehicles with integrated computers will be part of the future, with aeroplanes acting as the role model. This means that a driver will always be required to drive and steer the vehicle but that the vehicle itself will determine, for example, the speed, the road conditions or the distance to be kept to other vehicles. In order to have really safe cars and drivers, it will likely take longer to "log in" and start the vehicle, and the vehicle will also save each driver's track record and journeys.

- The risk increases eighteen to forty times with a BAC of 0.5 to 1.2.
- The risk increases 137 to 2,123 times with a BAC of over 1.2.

These figures show that alcohol in road traffic is still a major source of danger. One possibility for counteracting this danger, alongside many other measures such as media campaigns, is the use of alcohol interlocks. An alcohol interlock combines a breathalyser with an immobiliser. After an abnormal breathalyser reading, the person under the influence of alcohol is therefore prevented from starting the vehicle engine.

AREAS OF USE FOR ALCOHOL INTERLOCKS AND ADJUSTABLE PARAMETERS*

An alcohol interlock consists of two important components: the breathalyser with measuring system and mouthpiece, which is located inside the vehicle and the control device that is generally installed under the dashboard. The power

* = This text is an extract from the publication Nickel, W.-R. & Schubert, W. (Ed., 2012), authors J. Lagois and B. Velten. The BASt research report on "Alcohol interlocks for drivers who have committed an alcohol-related offence" also came to the same conclusions in the meantime (2012).

■ *Although alcohol interlocks are still in the test phase, they certainly can counteract alcohol-related accidents.*

supply between the vehicle's ignition switch or button (starter position) and the starter system is disconnected for installation. The alcohol interlock is inserted into the disconnected line, it only releases the starter relay's power supply once the vehicle driver has given a normal breath test. This kind of installation ensures that an alcohol interlock can always only influence the engine's start process but does not have any effect on a running car or truck. This is an important measure for the operational safety of a vehicle that is fitted with this kind of system.

Different areas of use must always be differentiated for alcohol interlocks: general preventative voluntary use, statutory general preventative use and statutory secondary preventative use as a requirement within the law on driving licences. The annual international alcohol interlock symposium provides a very good summary of the current situation with the use of alcohol interlocks and experience in various areas. The presentations delivered there are published on the www.interlock-symposium.com website.

Adjustable parameters are being defined for the respective application and correspondingly the statutory provisions in countries where alcohol interlocks are being used. It is possible to adjust more than 100 parameters in total. The important parameters are the alcohol limit from which the engine can no longer be started, the test result display with "Ok" or "Not ok" instead of the measured blood alcohol content, the activation of the memory, setting the service interval and requesting repeat tests during the trip (for example 15 to 30 minutes after starting the engine).

BLOOD ALCOHOL CONTENT LIMIT, RESTART PERIOD AND REPEAT TESTS

There is a lower detection limit of alcohol content in the breath for technical and physiological reasons. The lower limit for a reliable statement about the conscious intake of alcohol is in fact a breath alcohol content of 0.1 mg/l (equals a blood alcohol content of approx. 0.2). That is why the European standards EN 50436-1 (2005) and EN 50436-2 (2007) specify that the nominal limit must be at least 0.09 mg/l. This also corresponds to the recommendation by the Alcohol Commission of the German Society of Legal Medicine for alcohol limits for new drivers during the probationary period of 0.1 mg/l in the breath and 0.2 in the blood,

1 *Turn on ignition*
2 *Request to blow into alcohol interlock*
3 *Measuring the breath alcohol content*
4 *Accepted breath test: starter released*
5 *Start engine*

which was introduced into the relevant legislative procedure in Germany in 2007.

The vehicle cannot be started again without another breath test being required for a period of for example up to five minutes after switching off the engine. The Federal Motor Transport Authority and two European standards mentioned require that this restart period must be at least one minute long. This is in the interest of road safety to be able to restart the vehicle immediately, for example after a brief stop or if the engine stalled in a critical situation.

To ensure that a driver also remains under the legal alcohol limit during longer trips, alcohol interlocks can be set so that they request repeated breath tests at random intervals after successfully completing the initial test and starting the vehicle's engine. If the repeat test is not carried out or if the measured breath alcohol content is over the limit, a visual and/ or acoustic warning can be issued for example to prompt the driver to follow the respective request or stop the vehicle. Even if the breath test is not taken or the alcohol content is too high, the running engine is not stopped though, so the proper operation of the vehicle is not impaired at all. Instead a note is made about this in the alcohol interlock's memory, which allows the data to be analysed later and these kinds of incidents to be identified.

MANIPULATIONS CAN USUALLY BE DETECTED

Alcohol interlocks often have to be used by people who have not chosen to install this kind of system themselves and may possibly get into trouble as they cannot start the vehicle with higher blood levels. It must be assumed that some of these users will try to bypass the alcohol interlock, manipulate the breath test or unreliably influence the device's function.

The use of aids to bypass the alcohol interlock is detected by modern devices that meet the European standards EN 50436-1 (2005) or EN 50436-2 (2007) for alcohol interlocks. These devices are able to detect breath tests that are taken at a different time or by a different person. For example, the engine starter cannot be released by using an air pump.

Technical solutions for detecting manipulation vary in alcohol interlocks from different manufacturers. With most devices it is necessary for the driver to make a humming sound at the same time

Best practice recommendations for an alcohol interlock programme for drivers who have committed an alcohol-related offence

- Alcohol interlocks prevent a driver under the influence of alcohol from road use.
- The effective use of alcohol interlocks requires an unambiguous legislative regulation.
- It must be checked that alcohol interlocks are installed correctly in a vehicle.
- Participants in an alcohol interlock programme need a contact person who monitors the recorded data and how the programme is running.
- Psychological intervention measures are required alongside the programme to change the behaviour of an alcohol interlock user in the long-term.

as taking the breath test. As this is difficult and also found to be unpleasant there are also manufacturers who have found a different technical solution. The use of these devices is considerably more pleasant as a result, which is also leading to greater acceptance of the devices among users.

With modern interlock devices it is also possible to install a camera, which firstly ensures that the breath test can only be taken from the driver's seat. Secondly, a photo is taken of the person who took the breath test and compared with the driver. Biometric data is used for this. It is also possible to install a GPRS device that with certain pre-defined events, for example attempting to start the engine under the influence of alcohol, sends this data to the responsible agency. The attempt, for example, to operate a vehicle by pushing it without submitting a normal acceptable breath test beforehand is also detected and registered in the memory. Experiences using alcohol interlocks, in the USA among others, show that manipulation happens very rarely though.

The easiest way to bypass using an alcohol interlock is to drive another vehicle without this kind of system. However, if a person has received the use of an alcohol interlock as a constraint to their driving licence, this can be classified as driving a vehicle without a driving licence and punished accordingly. In the contractual regulations for participating in an alcohol interlock programme, it must therefore be clearly defined what is considered to be manipulation or evasion and what the consequences of this are. Notwithstanding this, there is no guarantee that alcohol interlocks cannot be bypassed. However, alcohol interlocks are just one part of preventing drink driving in prevention projects and must be used together with other actions such as training and rehabilitation.

THE INTERNATIONAL STATUS IN ALCOHOL INTERLOCK RESEARCH

47 studies, reviews and theoretical considerations on the topic of alcohol interlocks between the years 1992 and 2011 were evaluated in an analysis of literature (Nickel & Schubert, 2012). The reoffending rate with and without the support of alcohol interlocks was mainly analysed in the studies. During alcohol interlock use the reoffending rate ranged from 0 to 25 percent, after use of the alcohol interlock from 1 to 19 percent. In addition, a two-year alcohol interlock programme in the US state of Maryland showed that the risk of driving under the influence of alcohol again could be reduced by 36 percent with the use of alcohol interlocks. Two years after the programme, the reduction in the risk was still 26 percent and four years later it was 32 percent (Rauch, Ahlin, Zador, Howard & Duncan, 2011).

Antonio Avenoso

Executive Director of the European Transport Safety Council ETSC

Highly efficient alcohol interlocks

It is estimated that alcohol is linked to around 6,500 deaths each year on European roads. And while progress has been made in recent years, the figures are still far too high – especially considering that drink-driving is a totally avoidable risk factor.

In-car technology that can help already exists. Several European countries have laws that require 'alcohol interlocks' to be installed in specific cases, such as school buses, or to prevent convicted drink-drivers from re-offending. Finland was the first to introduce them, back in 2008, and now has a well-established rehabilitation programme. In neighbouring Sweden, it is estimated that there are now close to 100,000 such devices in use. France requires new school buses to be equipped with alcohol interlocks, with the rest of the fleet set to be fully retrofitted this year.

Several studies have already shown that alcohol interlocks are very effective in cutting repeat drink-driving offences. A Finnish report published last year, and based on four years of data, showed a recidivism rate of 6% in Finland when interlocks were used, compared to the usual 30% rate.

A recent report carried out on behalf of the European Commission found that if, in future, the devices were to become less intrusive and costs were to come down due to economies of scale in production or technological development, the option of making fitment compulsory would become feasible.

In fact, bold EU legislation would, in itself, drive innovation and cost reductions in the market for these devices. If, for example, the EU made installation mandatory in all commercial vehicles and required their use for all drink-driving offenders, then we would see a rush of innovation and new players entering the market to deliver reliable, unobtrusive devices at low cost.

We know that alcohol interlock devices work because we have evidence from several EU countries showing reduced re-offending rates. We hope the new Commission and Parliament will take a bolder approach to the deadly, and completely avoidable, problem of drink-driving.

The lower number of drink driving incidents with an alcohol interlock installed is also reflected in the number of accidents. For example, in a Canadian study drivers with alcohol interlocks were involved less often in accidents with personal injury than former drunk drivers without alcohol interlocks. In Sweden, accident rates involving drunk drivers reported to the police proved to be five times higher than with the total Swedish population (Bjerre, 2005). The number of road accidents dropped significantly during the alcohol interlock programme. This picture is also revealed in hospital data. Drivers spent significantly less time in hospital due to road accidents during the alcohol interlock phase, than before the device was installed.

According to an EU report however, the positive effect of most alcohol interlock programmes tails off once the device is removed again (Bax, Kärki, Evers, Bernhoft & Mathijssen, 2001). That's why the EU project group recommends using accompanying psychological, educational and/or medical rehabilitation programmes.

RISK PERCEPTION IN TRAFFIC

The quality of road safety work is generally measured by lower "risk". But what exactly is meant by risk? The risk of an accident surely. But the question then arises what the term "accident" refers to in this context. Is the risk meant of causing an accident under certain conditions? Or being involved in one, whether you caused it or not? The question about what the accident risk refers to becomes even more important if you look at the available data even more closely.

For example, it is well-known from reporting in the media that an older age appears to go hand in hand with a higher accident risk. But what is important here is the accident data reference. Older people travel shorter distances in vehicles. If you consider accidents per million kilometres travelled, then far less people over 65 have accidents than those under 25. An important risk research question becomes clear using this example: What information do people need to be able to assess the risk more accurately?

HISTORICAL RISK RESEARCH

Early risk research started in the 1960s in the USA with the emergence of the first "environmental scandals", for example the use of nuclear power or the fertiliser DDT. The probability of natural disasters was partly massively underestimated by people compared to the statistical frequency of occurrence. This was called "unrealistic optimism". The question was therefore asked how this poor correlation of risk assessment by laypeople and scientific experts comes about.

Tversky and Kahnemann (1974) approached this question first. As a result of their research work on cognitive heuristics and mistakes they came to the conclusion that risk assessment is so difficult for a layperson due to the lack of information and cognitive limitation. Tversky and Kahnemann were also able to prove in their research work that risks, which are more etched on our memories, i.e. airplane crashes, are assessed as being more risky than other more risky but less memorable events, for example dying in a road accident. As a result, many Americans refused to use airplanes after the September 11 attacks and preferred to travel by car. But as car driving is generally more risky than flying, significantly more US-Americans died in road accidents during that subsequent period. There were even more deaths caused by road accidents than victims of the attacks (Gigerenzer, 2006).

People also tend to resolve so-called cognitive dissonance, i.e. the unpleasant feeling that arises when you have two opinions or feelings that don't go together, by playing down certain risks. A heavy smoker might point out that their grandfather lived to a ripe old age despite smoking heavily.

The majority of car drivers neglect further driving training

77 percent of car drivers in Germany have not completed any more driving training since their driving test. This was the result of a survey recently carried out on behalf of the German Road Safety Council. One in two (57 percent) have not been on a course so far because they feel safe in traffic without any additional training. Most car drivers also trust their own assessment when it comes to health: 71 percent of those surveyed are of the opinion that a health check is only essential if the driver notices any physical impairments themselves, an attitude that can increase the risk of an accident. Driver assistant systems can help if impairments occur. However, many car drivers know far too little about these technical aids. Those surveyed aged 65 and over are particularly sceptical about these systems: in this age group one in four (22 percent) is unsure whether light, emergency brake or lane keeping assistants can increase driver safety.

RISKS SUCH AS DRIVING WITHOUT A SEAT BELT ARE UNDERESTIMATED

Probably the most well-known theory on risk perception, the psychometric paradigm, originates from Slovic and colleagues (1977). Slovic and colleagues assumed that personal risk perception is influenced by many psychological, social, institutional and cultural factors. Their research results showed that risk assessments can mainly be traced back to two key factors: on the one hand the "dread factor", which describes the extent of a risk, for example the catastrophic consequences of an

Accidents due to distraction (mobile phone, MP3 players, etc.) are increasing.

"Masters wear the belt" – One of the earliest poster motifs from the 1970s "Real drivers series" for the German Road Safety Council's "Hallo Partner – danke schön" campaign.

uncontrolled nuclear meltdown. The more "dreadful" the risk and its potential consequences appear to be the more risky the technology is assessed to be. The other factor of "familiarity" is how familiar you are with the risk. Unfamiliar risks such as gene technology and nanotechnology are in principle assessed as being more dangerous than they "objectively" are, while familiar risks, such as smoking and driving without a seat belt, are underestimated (Slovic, 2000).

Slovic already started thinking about why people did not wear a seat belt in vehicles, despite the known risks, in 1978. One explanation for this is that people take their experiential knowledge as the basis for such decisions. The large majority of trips with a motorised vehicle are accident-free. As a result, every accident-free trip not wearing a seat belt reinforces this behaviour. Other factors too may contribute to a lack of seat belt: the belief that the seat belt does not offer 100% safety or the driv-

Identify critical personality traits early on

The traffic psychology/medicine department at DEKRA Automobil GmbH carried out a six year long-term study in cooperation with the Social Psychology and Legal Psychology department at the University of Bonn to conduct research into the correlations between personality traits relevant to traffic (for example aggression), attitudes towards driving and traffic regulations (acceptance of rules, showing off) and behaviour on the roads. The research project titled "Personality, Attitudes and Driving Behaviour in Young Car Drivers" is a contribution from DEKRA towards implementing the "European Road Safety Charter" from Dublin in 2004.

This study is a prospective longitudinal study as predictors for future behaviour on the roads were collected first and behaviour on the roads was documented at a later time. Behaviour on the roads was analysed using entries in the Federal Motor Transport Authority's (KBA) central traffic register and the participants' self-evaluation reports on their behaviour on the roads in the last observation year (six years after passing the practical driving test) to draw conclusions about the unrecorded cases of traffic violations.

486 people in total took part in this study, which made it possible to compare correlations between the official figures and unrecorded field data on disorderly behaviour on the roads. All the traffic violations registered in VZR every year and all the driving bans could be surveyed by collecting the official figures (central traffic register information). The disadvantage of this kind of data collection is the low control density where only part of the problematic behaviour on the roads is recorded by the KBA. That is why unofficial data was collected about behaviour on the roads as well as other aspects of behaviour that do not constitute a traffic violation (for example, driving style) by surveying the study participants.

During the six-year phase of data collection it was revealed that 43 percent of men and 19 percent of women were entered in the central traffic register with at least one traffic offence, 12 percent of the men and three percent of the women had at least one driving ban or disqualification. The study results were able to prove numerous correlations between personality traits relevant to traffic and the attitudes of young road users relating to traffic and their behaviour on the roads over the following six years.

Various aspects of aggression, showing off in traffic and a range of traffic-related attitudes, such as the acceptance of road traffic regulations and the psychological importance of the driving licence, had the highest predictive value for traffic violations. The personality trait of seeking risks did not predict a traffic violation but was associated with the self-reported causing of road accidents. It was also proved that certain demographic factors (male, low level of education) increased the risk for traffic offences. In addition, a change in the number of traffic violations was revealed over time. In the first two years, the probationary period for the driving licence, significantly less traffic offences were recorded than in the following four years. A trend towards a decrease in the number of offences was only identified again in the sixth year. This suggests that an increase in traffic offences after the probationary period is due less to a lack of skills but more to not being as afraid of losing their driving licence.

As a result, this study's results also confirm that the measure of a probationary period for the driving licence increases road safety. The authors therefore recommend identifying new drivers with certain critical personality traits and attitudes (for example, non-acceptance of traffic regulations, showing off, high psychological importance of driving licence) early on using a test process still to be developed and supporting them in a primary preventative measure using suitable educational and psychological traffic interventions.

er's conviction that they have the risk under control combined with the feeling of self-confidence produced by this and ultimately the fact that the majority of drivers think they are better than average. Whatever the reason may be, the incorrectly drawn conclusions for not wearing a seat belt are a danger to life.

EFFECTIVE PUBLICITY CAMPAIGNS WITH MEMORABLE SLOGANS

Over the last few years of road safety work, quite a bit has been done particularly in terms of working on road user attitudes towards certain measures, like the mandatory wearing of seat belts or use of child seats. Information campaigns about risks in road traffic have contributed considerably to greater safety. With all the efforts to improve road safety it is of crucial importance to convince road users about the benefits of a measure.

For example, the educational road safety programme "Der 7. Sinn" (The 7th Sense) broadcast on German television for the first time in February 1966 was virtually legendary in its day. In cooperation with the Deutsche Verkehrswacht road safety organisation, tips were presented on correct road safety behaviour every week. The films that demonstrated how you should not behave were particularly popular. Discarded cars were always used for the reconstructed accidents so as not to blow the production budget.

In light of the figure already mentioned in this report of 21,332 road fatalities in Germany in 1970, the German Road Safety Council (DVR) already created the first nationwide campaign at that time under the title "Hallo Partner – danke schön" (Hello Partner – thanks a lot). One major concern of this successful campaign was to influence the basic attitude of road users to have a greater sense of responsibility and a more collaborative approach. Psychological studies had also revealed at that time that the seat belt provoked subconscious fears in car drivers and this hindered its habitual use. From this the DVR and its partners derived strategies for promoting safety, which were integrated into the concept for advertising campaigns. The image of the seat belt had to be positively enhanced and it had to be made clear to car drivers that using a seat belt and driving pleasure were not mutually exclusive. In 1973 the slogan "Könner tragen Gurt" (Masters wear the belt) became the first motto for the DVR's seat belt campaign.

Werner De Dobbeleer
Press spokesman, Vlaamse Stichting Verkeerskunde (VSV)

Practice-oriented road safety and mobility education: the example of Flanders (Belgium)

To be effective, road safety education should be practical, active and at the roadside, rather than classroom teaching. That is why VSV, the Flemish Foundation for Traffic Knowledge, focuses on practice-oriented educational projects. Since 1997, the official 'attainment targets' for primary schools in Flanders state that pupils must be able to walk or cycle independently and safely along a familiar route by the end of the sixth grade. In the following years, VSV has established a gradual learning process that helps schools reach these targets, eventually leading to the development of three evaluation moments:

- The Big Pedestrian Exam, a practical test of basic pedestrian skills in real traffic for fourth-grade children (e.g. crossing the street at a zebra crossing), introduced in 2013;
- The Great Traffic Test, an online test on risk awareness and traffic behaviour for fifth-grade children (multiple choice questions on e.g. priority rules and defensive behaviour, illustrated with realistic photos and video footage), introduced in 2010;
- The Big Bicycle Exam, a practical test of basic cycling skills in real traffic for sixth-grade children (e.g. cycling alongside an obstacle on the road), introduced in 2012.

The results of these tests are important to both teachers and parents, because they indicate possible lacks in skills or knowledge that need improvement. It is our aim to introduce a similar approach for secondary schools in the near future. Furthermore, since 2004, VSV has been backing up traffic education in schools with a network of 1,800 Traffic Parents, keeping them updated with best practices and creative ideas to set up projects.

The number of children and youngsters injured or killed in traffic has decreased more strongly than the average for the total population in Flanders over the past two decades. This positive evolution is even more perceptible among vulnerable road users and is probably influenced by improvements in road infrastructure, vehicles, safety equipment, enforcement, and, last but not least, road user education and awareness-raising.

Once mandatory seat belt installation in new vehicles came into force, the use of seat belts was even more intensively propagated. The slogan "Klick. Erst gurten – dann starten" (Click. Belt up first – then start) became the campaign's trademark in 1974. The DVR also reached a wide public by using its seat belt sled. These are devices that can simulate an impact at 11 km/h. A platform rolls down a sloping surface and impacts against an obstacle. The user who travels with it in a vehicle seat on the platform wearing a seat belt can experience the forces released by an impact even at this low speed on their own body. More than half a million road users ventured a trip on the seat belt sled back then.

■ *"One tailgates, three die" – The German Federal Ministry of Transport and Digital Infrastructure and the DVR have been raising awareness about the dangers on our roads since 2008 with the "Slow down" campaign.*

The high numbers of road accident victims also led to creative campaigns in other European countries and in the USA. Particular attention was also paid to the seat belt there as an essential road safety element. The topic of drink driving had similarly high priority. For example, the first broadcast of a TV ad about the seat belt in Great Britain turned 50 in 2014. The Royal Society for the Prevention of Accidents started printing educational posters in the middle of the 20th century, many of them are still topical today. But it wasn't just classic organisations and associations campaigning for better road safety. For example, the introduction of mandatory seat belts was pointed out by a tobacco corporation in Belgium using stickers in 1975.

At the end of the 1990s the seat belt was once again the focus of a major campaign, this time with a new target group. Traffic monitoring had shown that less than ten percent of occupants wore seat belts in heavy trucks. Mercedes-Benz and DEKRA therefore carried out a public crash test using an Actros truck at the 1st International DEKRA "Safety for Commercial Vehicles" symposium on 1st October 1998. The driver dummy was wearing a seat belt impacting at 30 km/h into a trailer bar, the passenger dummy on the other hand was not. The passenger not wearing a seat

Edmund King
AA President, Visiting Professor of Transport, Newcastle University

Initiatives for the preservation and protection of human life and health

At its heart, the Automobile Association is, first and foremost, a motoring organisation, committed to representing drivers and their interests. But that is not to the exclusion of all others, particularly given that the majority of drivers use the roads in more than one way: as drivers, but also as pedestrians, cyclists, in commercial vehicles, and more.

Our roads are not just filled with a variety of different types of traffic – but also an increasing volume. In 2013, the overall motor vehicle traffic volume was over 10 times higher than in 1949. In recent years, we have also experienced an increase in the number of people cycling on the roads. This combination of more vehicles and a greater mix of modes on our roads means that the need for all road users to be able to share that space harmoniously has become ever more apparent. Improvements in the safety of vehicles, road design, technology, education and legislation have all helped progress this over the years.

One of the most influential pieces of legislation that has shaped our road system in the UK celebrated its 80th anniversary last year: the 1934 Road Traffic Act. The Act was brought in as a direct response to a peak in road casualties with 7,343 deaths, which was the highest figure recorded until that point. When you compare this with the 1,754 people who died on UK roads in 2012, particularly considering there were around 34 million vehicles on the roads compared to just 2.5 million in 1934, you can see how far we have come – although, of course, there is still much to be done to prevent these tragedies.

The 1934 act was fairly wide-ranging, which means we are celebrating the 80th anniversary of a number of key moments last year. For example, February was the 80th anniversary of driving licences for lorry drivers. The safety of trucks and the standard of training that commercial drivers are required to undertake has improved significantly since those licences were first brought in. But they often attract negative headlines and attention from the public for the way they interact with vulnerable road users, particularly cyclists and bikers.

In 2014, the AA Charitable Trust launched a new safety campaign called Think Bikes. The main purpose of the campaign is to remind all drivers to do a double take in their mirrors for cyclists and bikers. To encourage them to do this, we created small line drawing stickers that can be placed in their mirrors to give them a visual prompt to double check for those on two wheels.

I believe the success of the campaign is in large part due to the simplicity of the stickers and the message. This is certainly why it is possible for other countries to replicate something that has worked so well here in the UK. Of course, not everyone will be able to run their own similar campaign, but at the least I hope it gives food for thought for how they try to educate road users about sharing our roads more safely. This is just one small initiative amongst many that have been promoted in the UK over the last few decades to improve the safety of our roads.

belt was thrown against the windscreen upon impact, smashing it with the head and upper body, while the driver wearing a seat belt would not have had any risk of injury. The "Belt Up" campaign led by DVR was initiated by DEKRA. It started at the International Motor Show for Commercial Vehicles on 11th September 2002 and still continues today.

Current campaigns deal with almost every problem area for road traffic. Besides the still topical issues of seat belt, alcohol and speed they are aimed today at risk groups such as young novice drivers, senior citizens or motorcyclists, they focus on the safety of children in vehicles or distraction by making calls or writing text messages while driving or generally appeal to common sense. They range from humorous approaches, to dramatic images, to statements that make you stop and think.

CONTINUOUS IMPROVEMENT OF DRIVING TESTS

Mistakes in road traffic can take a whole range of different forms. For example, the form of us not sticking to traffic regulations. Or not showing enough consideration to other road users. Or incorrectly assessing the traffic situation and our driving skills. The important foundations for ensuring that all of this does not in fact happen are laid during driving instruction. It is therefore even more important to design this training so that novice drivers are adequately qualified to participate in motorised traffic.

While the driving test was still taken as one package comprising a theory and practical test in the 1950s in Germany, these test sections were split up over the years. The content was subsequently expanded and both the theoretical and practical methodology was constantly improved. The content focus of the theory exam also changed over the years from vehicle engineering to behaviour in road traffic and the associated risks. The exam requirements were also permanently stepped up and standardised for the practical driving test and minimum requirements were defined to manage them successfully. At the heart of these changes was the introduction of driving tasks that had to be mastered during the test. These were added to over the years and given clear criteria for assessment from 1970. Right from the start the aim of driving licence services was to permanently adapt the proficiency tests to the changing challenges of traffic and improve road safety as a result.

Gerhard von Bressensdorf
Chairman of the German
Driving Instructors' Association

Driving instruction of the future

What does driving instruction have to deliver today? Modern driving instruction not only teaches our learner drivers sound basic knowledge about the physical and technical context of driving a car, about regulations and environmental aspects. It also provides intensive knowledge about the need to put their responsibility towards people and the environment above their own emotions. In addition, it teaches the operation of a motor vehicle already largely controlled by automatic mechanisms so that the necessary observation tasks do not have to be neglected. As a result, the basic prerequisite is provided to survive their first experiences on the roads without any accidents and to build on these in a continuous lifelong learning process.

However, what learner drivers come across after their driving instruction is unfortunately a not insignificant amount of intolerance and lack of consideration by other road users towards the efforts of young new drivers who are practising what they have learnt during driving instruction on the roads. Added to this, is the hesitant attitude by politics to give new drivers the chance to have their good achievements confirmed, their less good achievements identified and errors corrected under professional instruction during a "second phase" after driving instruction.

Preparing new drivers and offering them follow-up support must be a public policy approach! It is no longer appropriate in road traffic nowadays to believe that a learner driver can already master car driving in a relatively short learning phase at driving school. They are a well qualified apprentice who like any skilled craftsman in other occupations can only become a master through continuous guided learning.

This also describes the way forward for the future. Regardless of all future autonomous or existing semi-autonomous driving options and the vehicle engineering's other technical automations, it will still come down to people in traffic whose actions are influenced by their basic ethical attitudes and knowledge and skills. The whole of society is required to be a role model here.

One successful measure to reduce the frequency of accidents specifically with new drivers was the "accompanied driving at 17" pilot project launched in Germany in 2004. Here youngsters can already start driving lessons at the age of sixteen and a half, pass the test at 17 and drive a car all over Germany accompanied by a named adult before they turn 18. The advantage is that the accident risk drops considerably during the accompanied phase. An evaluation was able to evidence that the accident risk drops by 22 percent and the number of traffic offences by 20 percent in the first year of independent driving. As a result of this "accompanied driving at 17" was adopted into standard procedures from 2011.

One important step in improving the theory driving test was to introduce the computer-based test. This improved the objectivity of testing and

The truck driving simulator from DEKRA has been used to practically train professional drivers for several years.

assessment and considerably restricted the possibility of manipulation. DEKRA started to introduce this in the federal states of Berlin and Brandenburg as early as 2008. From 2010 the nationwide computer-based theory driving test provided the conditions to take accident causes typical for new drivers more into account in the test content with new task formats.

Together with other technical test centres, driving instructors and scientists, DEKRA also works on further developing the practical driving test. First and foremost the test should be more transparently and closely interwoven with driving instruction and give driving licence applicants better feedback on their driving skills. At the same time nationwide standardised test documentation is being produced and analysable data material is being created for test organisations and authorities to be able to continuously adapt the driving tasks and test criteria to current developments. The improved practical driving test was tried out in pilot regions as part of a BASt project, with DEKRA from September to December 2014 in the Oranienburg region.

When the EU Driving Licence Directive came into force on 1st July 1996, the foundation was laid for the EU-wide standardisation of driving licence classes and mutual recognition. Transposition into national law dragged on over several years though. Further amendments were also made by the EU resulting in the European Parliament and Council Directive 2006/126/EC dated 20th December 2006 on the driving licence – the so-called 3rd EC Driving Licence Directive.

Today the same driving licence classes apply all over Europe and a driving licence obtained in one European country is also recognised in every other member state. However, a driving licence can only be obtained in the country where your main resi-

Oliver Schmerold
Director of the Austrian Automobile, Motorcycle and Touring Club (ÖAMTC)

Multi-phase training as a valuable contribution to improving road safety

The risk of being injured or killed in road traffic is higher for young drivers due to a lack of routine and experience. This was particularly noticeable at the end of the 1990s and the start of the new millennium: the figures for young driver casualties and in particular fatalities were exorbitant. As a consequence of this, the so-called multi-phase driving licence was introduced in Austria on 1st January 2003. One of the pioneers of this new type of training was the ÖAMTC Fahrtechnik, which has been focusing on practical driving instruction for more than 25 years since its foundation. The multi-phase driving licence obligates novice drivers to complete a second training phase within a year of the driving licence being issued. This includes two perfection drives, driving technique training and a psychological group discussion in addition to the standard first training stage, which consists of a theory and practical test.

Looking back, the multi-phase driving licence can be identified as an important contributor to improving road safety. As an evaluation of accident figures shows that the number of accidents with young drivers has significantly dropped, considerably more than the total number of accidents, since it was introduced. While the total number of accidents between 2000 and 2011 decreased by 16 percent, accidents involving young drivers dropped by 32 percent. The number of young drivers killed was even reduced by 50 percent.

Novice drivers are familiarised with road traffic risks and at the same time preventing risks through the approach always practiced by the ÖAMTC to teach more practical relevance and raise awareness as part of driving instruction. The success of this is proven statistically. It is therefore hardly surprising that the Austrian multi-phase model has received international acclaim and has been copied.

However, even if the trend is pleasing, there is still a need for action. Young drivers are still involved in accidents disproportionately often. That is why constant investment in road safety is necessary in this sensitive age group. Besides stricter quality checks during multi-phase driving instruction there is also still great potential to improve safety in preventative, awareness-raising road safety work.

dence has been for at least 182 days. Even the driving licence itself was standardised. The more than 100 different national driving licences were turned into one standard European driving licence in credit card format.

With all these simplifications and improvements, one problem remains unsolved: the obviously different standards in driving instruction. Very high standards have been produced in particular in the Scandinavian countries, Britain and Ireland, the Netherlands and Germany thanks to regular revisions and adaptations to national training requirements. By contrast, there are very low standards in some eastern and southern European countries. The discrepancies can even be seen in the prices for driving instruction. You can't get a driving licence for under EUR 100 almost anywhere nowadays but the low three-figure sum also marks the bottom end of the scale. Prices of more than EUR 3,000, like for example in Norway, are the upper end of the scale.

The different training standards are also reflected in the number of road accident victims in the individual states. States where road safety is taken seriously as a political objective and is implemented as an essential part of good driving instruction, have significantly better values than states where driving instruction is not given any special significance.

Regardless of this, all efforts to improve the testing system must be committed to the aim of reducing the number of fatalities and serious injuries caused by road accidents, especially among new drivers. An aim that must be resolutely pursued in the future too.

François Bausch
Minister for Sustainable Development and Infrastructure, Luxembourg

„Young Drivers Day" for young novice drivers

One of the most important priorities for the Luxembourg government, which is also documented in the government programme, is safety on our roads. After collecting the accident figures from 2013, young people in the age group 18 to 24 made up 18 percent of the fatalities on our roads. That is why the government wants to use all available means to address young drivers in particular and have as sustainable an effect as possible on their later driving behaviour through appropriate driving instruction.

The necessary funds are therefore also being provided by the government to support promising initiatives like the "Young Drivers' Day" as an outstanding platform to achieve this goal. The "Young Drivers' Day" provides driving training specifically aimed at young new drivers with professional advice on an ideal terrain at the Colmar-Berg driver safety training centre.

The government hopes to improve young drivers' driving skills and raise their awareness of risk situations using initiatives like this. This should sustainably lead to a significant improvement in the accident statistics.

Brief facts

- **Vehicle driver mistakes are still the most common cause of accidents.**
- **Roughly one in eleven road fatalities occured as a consequence of an alcohol-related accident in Germany in 2013.**
- **More than 46 percent of people under the influence of alcohol involved in accidents in Germany in 2013 were aged between 18 and 34.**
- **The first deficits are already recorded with a blood alcohol content of 0.2.**
- **The use of alcohol interlocks is a suitable measure to prevent driving under the influence of alcohol in a car, truck or van.**
- **Personal risk perception in road traffic is influenced by many psychological, social, institutional and cultural factors.**
- **Road safety campaigns contribute to raising awareness of the risks in traffic.**
- **Road safety education and driving instruction have to be constantly adapted to the changing challenges on the roads.**

Driverless cars?

While the potential may appear to be largely exhausted in classic safety areas, modern driver assistant systems still offer a whole range of possibilities to prevent accidents and minimise their consequences. Whether and how the step from semi-automatic to fully autonomous driving could become a reality using such systems in the near future remains to be seen. What it absolutely crucially depends on is drivers trusting their new assistants and knowing their limits, as well as a guarantee that the various systems work throughout the vehicle's whole life. A certain amount of acceptance of false alarms is also always required at the same time with new systems on the market.

Information and assistant systems have already been standard in modern motor vehicles for years to improve comfort and safety. Whether it's the navigation system with recommendations to avoid traffic jams, adaptive cruise control, lane departure warning, blind spot assistant, fatigue warning system, camera-based active light systems, night vision assistant, driving dynamics control and much more. All of these systems contribute to informing and assisting the vehicle's driver and if necessary compensating for their errors to continue to further decrease the number of fatalities and injuries caused by road accidents.

The development is making rapid progress. In May 2014, the presentation of prototype by Google which can transport its occupants from A to B without a driver was quite spectacular. As the vehicle is not fitted with a steering wheel or accelerator and brake pedals, a driver could not even intervene in an emergency. The driving is taken over completely by a computer that receives and processes relevant information from outside the vehicle. Its appearance is characterised by the all-round visibility camera or laser scanner on the vehicle's roof. 100 prototypes that drive at a maximum of 40 km/h are to be built first. As a result their use should be limited to short distances.

Can we really imagine autonomous driving on the roads in the near future? Many developers from the car industry and supplier industry are currently answering this question with a clear no. Neither the available and foreseeable vehicle and infrastructure technology nor the legal framework can make a scenario where vehicles can drive anywhere autonomously all the time a reality over the next 15 to 20 years.

According to the Vienna Convention on Road Traffic, any vehicle and vehicles connected to each other must have a driver when they are moving. The driver must theoretically always be in control of the vehicle under all circumstances to be able to satisfy due diligence obligations and carry out all the driving motions incumbent on them. This regulation agreed internationally by the United Nations since 1968 was recently relaxed slightly to take the current state-of-the-art into account. Accordingly, it is now permissible for the control of a vehicle to be handed over to suitable assistant systems that meet the requirements of relevant international standards. However, the driver must also be able to take control of their vehicle again at any time. It is expected that national legislation will be amended accordingly shortly. But even then self-driving cars cannot be used in all the states that have signed the Vienna Convention.

IDENTIFYING RISKS WITH FORESIGHT

The Daimler research vehicle S 500 Intelligent Drive demonstrated the potential in the technology already available today in the car industry on a trip from Mannheim to Pforzheim in August 2013. Bertha Benz had already proved the practicality of her husband's patent motor car here 125 years ago. The research vehicle based on the current Mercedes S-Class equipped with series-authentic sensors completed the roughly 100 kilometre long route over busy rural roads and through towns and villages along the way totally autonomously. The test driver merely had the job of intervening in an emergency, which was not required though.

BMW has reported that a research prototype completed the first highly automated trip on the A9 motorway from Munich to Ingolstadt in June 2011. In doing so the vehicle carried out 32 automatic lane changes, among other things. The test driver did not have to intervene once. In the meantime the test vehicle has covered several thousand test kilometres in highly automated mode.

It is not just cars but also trucks that can already drive highly automated in test and demonstration trips today. The Mercedes Benz Future Truck 2025 showed this in July 2014 on a section of the A14 motorway near Magdeburg that was not yet opened for traffic. Once the test driver has accelerated to 80 km/h they can hand over to the so-called highway pilot when the truck switches to autonomous driving mode. The driver can then swivel their seat 45 degrees to the right for a more relaxed working or resting position. For example, if there is a complex driving situation ahead at roadworks, the highway pilot detects this in advance. It visually and acoustically indicates to the driver in good time that it is about to deactivate and hand back to the driver. Autonomous overtaking manoeuvres and leaving the motorway are not provided for. In this case too, the system will also turn off and the driver has to take over again.

The Swedish manufacturer Volvo carried out the "Non-Hit Car and Truck" project from September 2010 to December 2014 as part of its ambitious vision for nobody else to be killed or seriously injured in a Volvo car or truck or by one of these vehicles in a road accident by 2020. In this context vehicles are to be enabled to "see" all their surroundings and suggest information and meas-

The driverless car prototype from Google is not fitted with a steering wheel or brake pedal.

■ *Research vehicles with series-authentic technology can already drive autonomously today. Crucial questions include how long the responsible driver may take their hands off the wheel for, how they will cope with their new role as a pure observer (sometimes) and what benefits they have from this.*

ures to avoid accidents to the driver. If the driver does not respond the vehicles are supposed to independently intervene in vehicle guidance. One main component of the newly developed technology is a centralised control unit that enables the efficient exchange of information with data from various cameras, radar sensors, laser sensors or GPS. This results in 360 degree all-round visibility that is updated every 25 milliseconds. When it detects an accident risk, the system searches for and finds collision-free alternative routes, if they exist. This kind of technology is essential for the development of self-driving cars that can automatically brake and steer. Volvo initially focused on identifying different accident scenarios and preventing them with timely countermeasures.

INTERACTIVE LIMITS SET FOR SYSTEMS

If the vehicle is travelling in semi-automated mode, the driver has to constantly monitor the automatic functions and cannot carry out any non-driving activities. In highly automated mode, non-driving activities are possible to a limited extent because the driver no longer has to monitor the system permanently. At the same time the system identifies its technical limits proactively and independently and gives the driving task back to the driver in good time with plenty of reserve time. However, there is a fierce debate on whether the driver fulfills their responsibility stipulated among other things in the Vienna Convention with this and they can take control of their vehicle at any time. The vehicle can only permanently autonomously manage all situations that occur with fully automated driving. With this the driver no longer has to monitor the system all the time and can also carry out a greater number of non-driving activities. Driverless driving would only be possible with this. The driver would then no longer be a constant attentive monitor but a passenger and could, for example, concentrate on work during the journey.

Drivers of modern cars can already be on the roads semi-automated nowadays, for example using the traffic jam assistant at low speeds on motorways. With this the vehicle can automatically accelerate, brake, steer and stay in lane. It is provided with adaptive cruise control with stop-and-go function combined with a steering assistant for this. Cars can also parallel park in certain spaces at the side of the road semi-automatically nowadays. Semi-automatic driving will be possible in more and more clearly definable situations in every day traffic in the near future thanks to advanced functional networking and the enhancement of current comfort and safety systems in vehicles.

There are special challenges in mastering communication with the environment. Extensive experience has already been gathered over several years with so-called car-to-x communication, i.e. the exchange of information from one vehicle to other vehicles and the surroundings relevant to traffic. Vehicles will be able to communicate with each other and their surroundings in the near future. For example, information can be exchanged about the currently travelled routes and the navigation system's data can be added to. Or a traffic light on red can send a radio signal to vehicles nearby. The driver can also be warned about risks and accidents without having to turn on the radio for this.

Reliable communication and understanding of vehicles with other people on the roads as pedestrians, cyclists or drivers of a motor vehicle is still at an early stage though. For example, two vehicle drivers in oncoming traffic can quickly agree who should have priority at a narrow section adapted to the situation. Or a driver can ignore their right of way and let a pedestrian cross the road. An automated vehicle currently reaches its interactive limits far too soon in these kinds of situations.

ONLY LIMITED ACCEPTANCE FOR CERTAIN ASSISTANT SYSTEMS

It will still take many years before the currently realised or technically and legally foreseeable functions of semi-automated and highly automated driving are part of everyday driving. Social acceptance and personal acceptance and trust by the driver play an important role in this too. They are likely to want to maintain constant control of their vehicle for a long time still and then only give it up temporarily when they think it's convenient and comfortable or useful. This includes being able to use the time in a traffic jam with stop and go traffic meaningfully or relaxing and letting the vehicle drive itself for a while on longer motorway journeys. In addition, it would be comfortable and above all time-saving to leave a vehicle to its own devices at the entrance to a car park so that it independently finds a free space and leaves it again, as required. This would already be driverless and therefore fully automated driving, but only at low speeds in a narrowly restricted environment.

The acceptance of new driver assistant functions and automated driving functions may differ considerably in different states and regions of the world. The authors of a study point out that acceptance also depends on whether and to what extent the customer is already familiar with the individual functions. The Germans' reluctance for autonomous motorway driving could drastically change if this kind of system's function, benefit and reliability became much better known, especially through personal experiences.

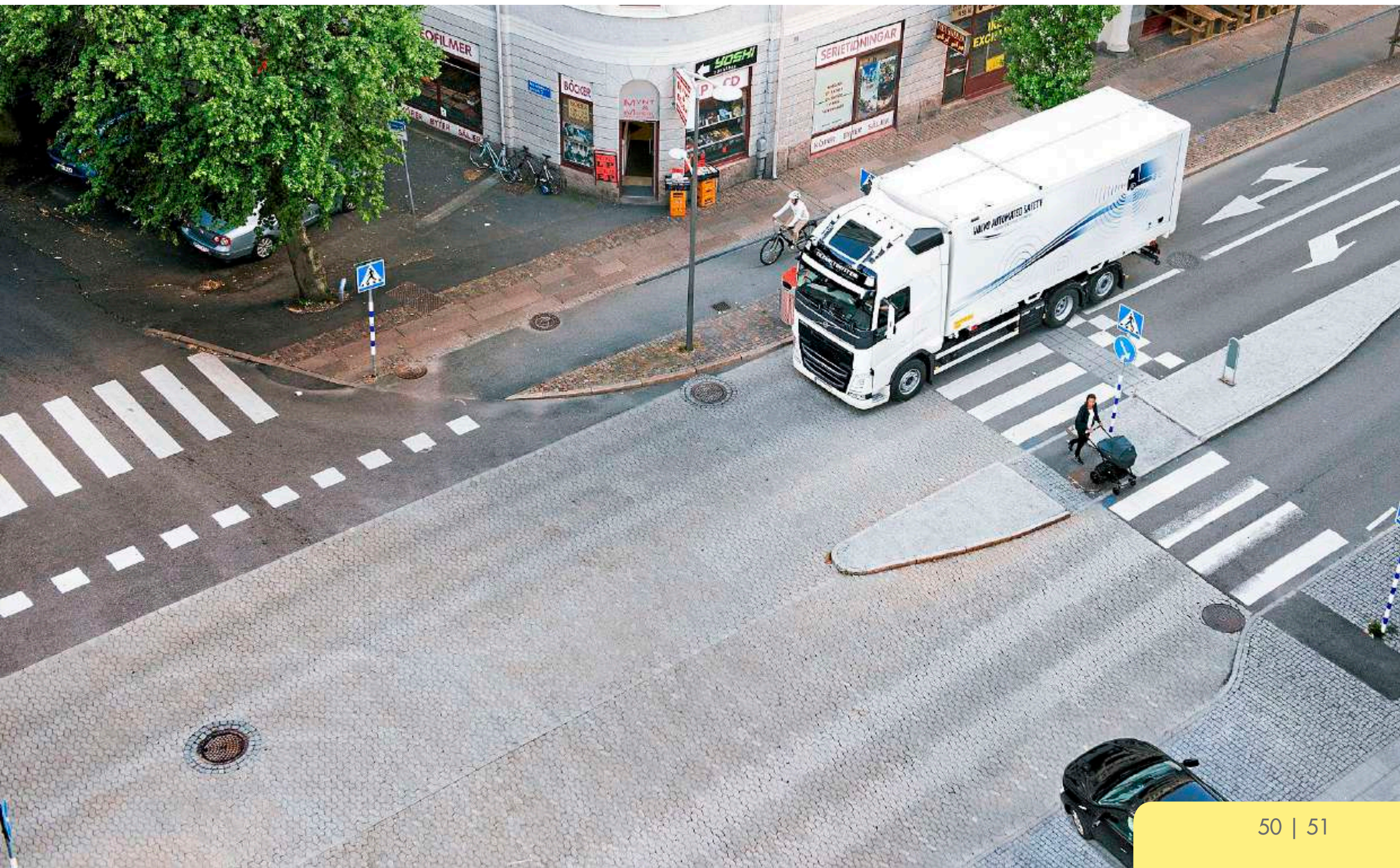
Different degrees of automation

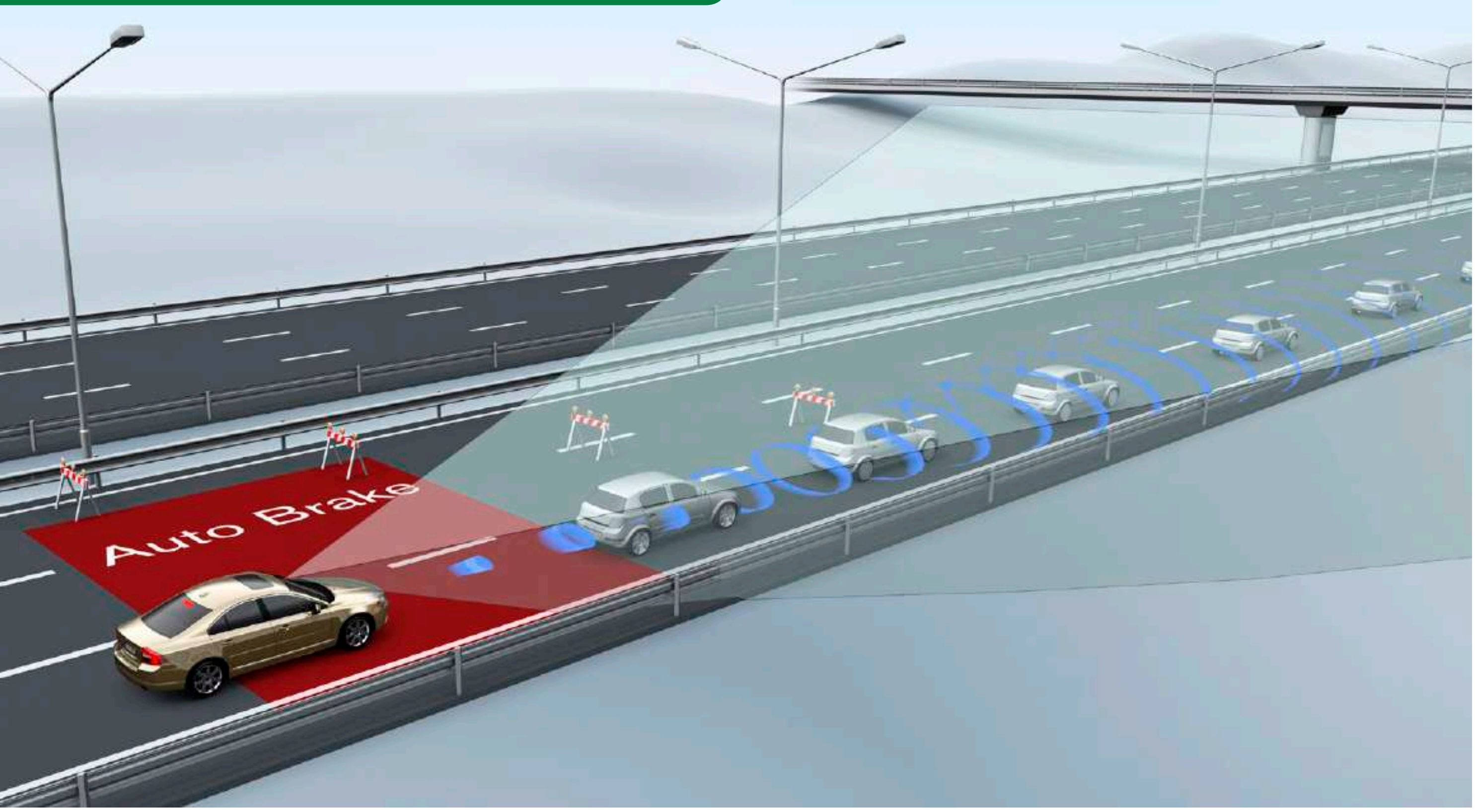
Semi-automated:
When using a semi-automated system the driver has to constantly monitor the system and be ready to take control of the vehicle at any time.

Highly automated:
The driver no longer has to monitor the system but can hand over full control to the system, at least for a certain period of time. If required, the driver is requested to take over the driving task with plenty of reserve time. The system limits are all identified by the system. However, it is not able to produce a minimal risk condition from every initial situation.

Fully automated:
The driver also does not have to monitor the system any more. Before the end of application, the system requests that the driver take over the driving with plenty of reserve time. If they do not do so, it is returned to a minimal risk system condition. The system limits are all identified by the system. It is able to return to the minimal risk system condition in all situations. Source: BASt

A main component of the technology used in Volvo's "Non-Hit Car and Truck" project is a data platform which networks information from all the sensors resulting in a 360 degree scan of the truck's immediate surroundings every 25 milliseconds.





Forward-looking emergency braking systems are based on the adaptive control's radar system and should also contribute to preventing rear-end collisions or at least reducing the collision speed.

TOTALLY ACCIDENT-FREE ROADS STILL A VISION

Research into the possibilities of autonomous driving already started 25 years ago. Early milestones included the European EUREKA research project PROMETHEUS (PROgraMme for European Traffic with Highest Efficiency and Unprecedented Safety) initiated in 1986. As part of this project, the VaMP and VITA-2 robot vehicles based on the former Mercedes 500 SEL 1994 drove more than 1,000 kilometres largely autonomously in normal traffic at speeds up to 130 km/h on multi-lane motorways in the greater area of Paris. In 1995 the route from Munich to Copenhagen was covered using suitable vehicles. Even back then evidence could be provided that automated driving on motorways is technically possible with the manoeuvres found here for maintaining distance, changing lanes and overtaking.

Naturally, safety also played an important part in this project. This is ultimately another criterion that will essentially decide the future of autonomous driving. At the end of the day, the different stages of automated driving are not just to improve comfort but also further improve road safety. People are well-known for being the most unreliable element in the entire system and they frequently make mistakes, which if they can no longer be corrected, often lead to accidents. If people are increasingly relieved or sometimes even absolved of their direct driving tasks by technical assistant systems then it can be expected that the number of accidents caused by human error will also drop. On the other hand, technical systems can also fail and it is also possible to misuse them. A deciding factor will be that the number and severity of accidents caused by the technical failure of new systems or by incorrectly handling these systems is considerably smaller than the

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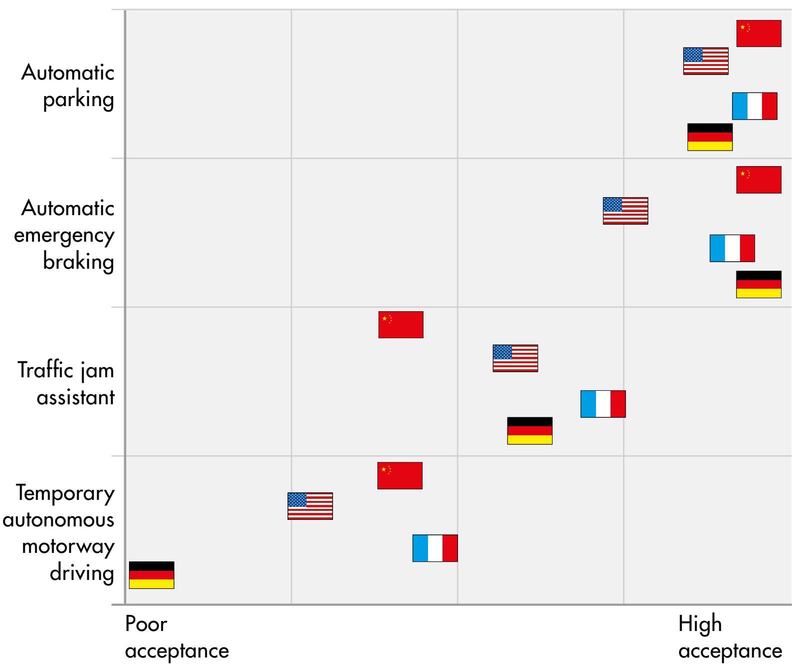
Customer acceptance of assistant functions

Various driver assistant systems are being accepted very differently in Germany, France, the USA and China.



Source: Valeo Study II, Mathes and Bart, 2014 number of accidents prevented by these systems. The aim of totally accident-free roads is likely to still be a vision for decades.

ETHICAL ASPECTS OF DRIVER ASSISTANT AND COLLISION AVOIDANCE SYSTEMS

Even highly automated driving will not always be able to help here. One impressive and thought-provoking example is the often described swerving dilemma. Here a car is approaching a mother with pram suddenly crossing the road and can no longer avoid the collision by just braking. If they swerve to the left, they will collide with an oncoming truck.

However the car driver were to instinctively react, it would ultimately be socially accepted in terms of legal liability too as they cannot accurately weigh up the consequences in the emergency situation. However, with a fully-automated car the algorithms stored in the systems would have to "rationally" compare both alternatives with each other. As a result, the car would decide over the life and death or health of the mother, child and car driver. Based on today's sense of right and wrong, this would not be acceptable and it is also hardly conceivable that a vehicle manufacturer would take responsibility for this.

Using this relatively simple example, obvious conflict situations are predestined where driver assistant systems have to make decisions regarding the "right solution". It will inevitably result in cases where it is impossible to completely avoid conflicts and where decisions are made about which vehicle or road user the car will collide with because this might have the least negative consequences for those involved. Algorithms for this kind of decision might be for example: to give preference to the occupants of a vehicle travelling straight ahead and choose the smallest or lightest collision partner to prioritise self-protection or to protect vulnerable road users as best as possible and take collisions with other vehicles into account in the process, where under circumstances their occupants would benefit from passive safety systems.

Developers of driver assistant systems would have to consider these kinds of decisions and therefore ethical questions. This is a completely new challenge for the technical development of such systems. The problem here is that in the previous reality on roads every single driver reacts in a conflict situation according to their own skills, knowledge and value judgements. This is usually done based on trained behavioural patterns and only allows for the weighing up of different risks if there is enough time to make a decision. Here the question of how a driver has been trained to make a decision between emergency braking and swerving always plays a part and whether they can successfully carry out this kind of operation correctly taking their skills as a driver into account.

In light of all the problems still to be solved on the road towards autonomous driving, it must not be forgotten that this road is not only being taken

Dr Daniela Mielchen

Board Member of the traffic law working group of the German Bar Association (DAV)

Autonomous driving and legal obstacles

Audi boss Rupert Stadler certainly struck a chord with the car industry at the Süddeutsche Zeitung's economic summit at the end of November 2014, when he urged for the go ahead on autonomous driving on pilot routes. If only there weren't the laws so dramatically lagging behind the new technology. Manufacturers could speed up the legal and legislative process though. For example, lawyers would have to know who is to blame when something happens before approving these kinds of breakthrough technologies. However, as long as manufacturers are sitting on data to protect their algorithms, which might for example provide information about the failure of assistant systems and even courts receive hardly or no access to them it will be difficult to keep up legally with progress.

It will also not be very easy to get a handle on traffic offenders if they can appeal a breach of law by the car through no fault of their own. How can and will the state know which assistant system was actually switched on at the time? By getting hold of all the data they can obtain? Cars are networked to each other and their surroundings for the purpose of data communication. Lower Saxony would now like to test the average speed control on roads that has been previously rejected in Germany and the eCall emergency call system makes it a requirement for all new cars to be equipped with a GPS system and transmitting and receiving options next year. We are increasingly facing an infrastructure that also makes monitoring and data abuse possible alongside autonomous driving. Data privacy has to keep up with this! It is not enough to merely freely interpret old laws under the new conditions. A few new laws are urgently required here to take the future into account.

Will vehicles actually be able to travel on German roads without people doing anything by 2020, as the industry would like? Experts are assuming that cars will cause considerably less accidents than human drivers if left to their own driving style. Will people with their too high risk of accident perhaps be banned from sitting behind the wheel from 2025? Or will the driver help the car to recognise that the person standing to the left of the road is dressed in such a way that they actually belong to the group of people to the right of the road and is probably going to cross the road soon so it would be better to slow down. A fully autonomous vehicle might fail in this situation. Life experience can prove its worth in traffic too.

Prof. Dr Wolfgang Schubert
President of the German Society
for Traffic Psychology (DGVP)

Scientific evaluation of driver assistant systems is essential

One of the most prominent technical developments in vehicle equipment over the last few years are certainly driver assistant systems (DAS), which are being installed in ever increasing numbers in new vehicles as standard. However welcome this technical progress is on the one hand, it must also be asked on the other hand whether everything that is technically possible is also reasonable.

For example, DAS can be used to prevent accidents that happen as a result of human error. An intersection assistant, collision avoidance assistant with adaptive cruise control and cross traffic alert system are all examples of this. DAS can be effective with human error in various ways: they can warn, actively assist and intervene. They can also be broken down into comfort or convenience and safety systems though. DAS that have the job of relieving the driver are, for example, cruise control, adaptive cruise control (ACC) and lane keeping assistance. Safety systems include intelligent speed adaption (ISA), emergency braking assistant and lane departure warning.

However a certain amount of caution has to apply with all these totally helpful aspects for road safety. For example, it is well-known from studies of airline pilots that those who often fly on autopilot fail in situations where flying skills are required. The person has to be alert and engaged to be able to make fast, good decisions in complicated situations. However, the more a vehicle does things automatically, the less attentive the person is. The better the DAS become, the more rarely the vehicle driver is also forced to intervene themselves. Two processes therefore play a part. On the one hand, the driver is not required to acquire skills in dealing with difficult driving situations themselves due to the DAS. And on the other hand the driver relies on the DAS' intervention in critical situations and is therefore more willing to take risks when driving.

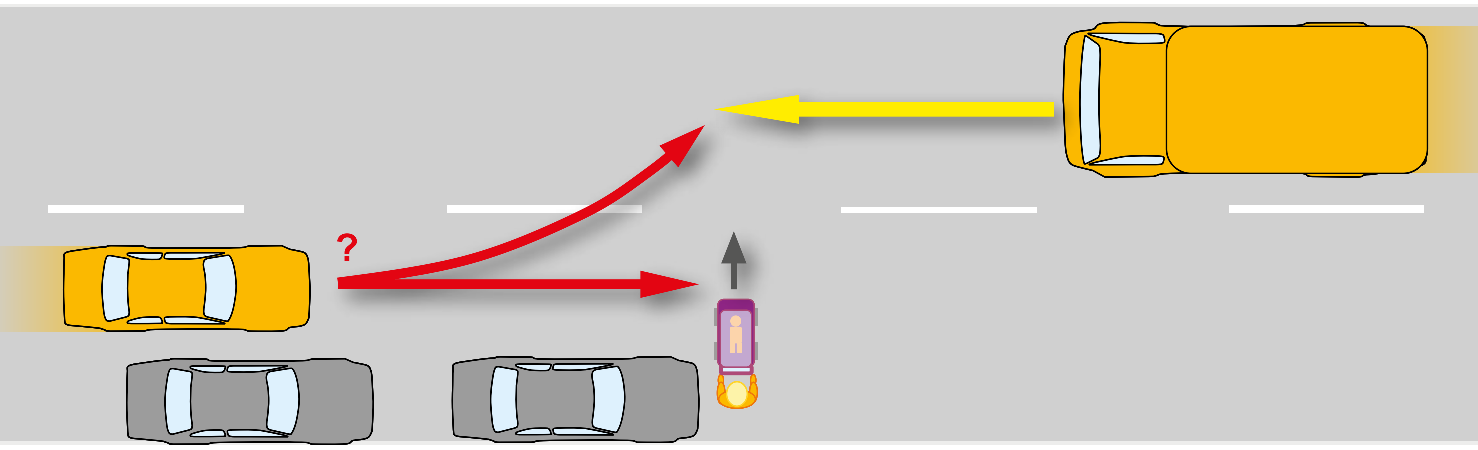
It is therefore not sensible to relieve the driver too much from a psychological perspective. One essential prerequisite for the large-scale use of DAS is the scientific evaluation of them, which should not just be based on technical but on engineering psychology criteria too.

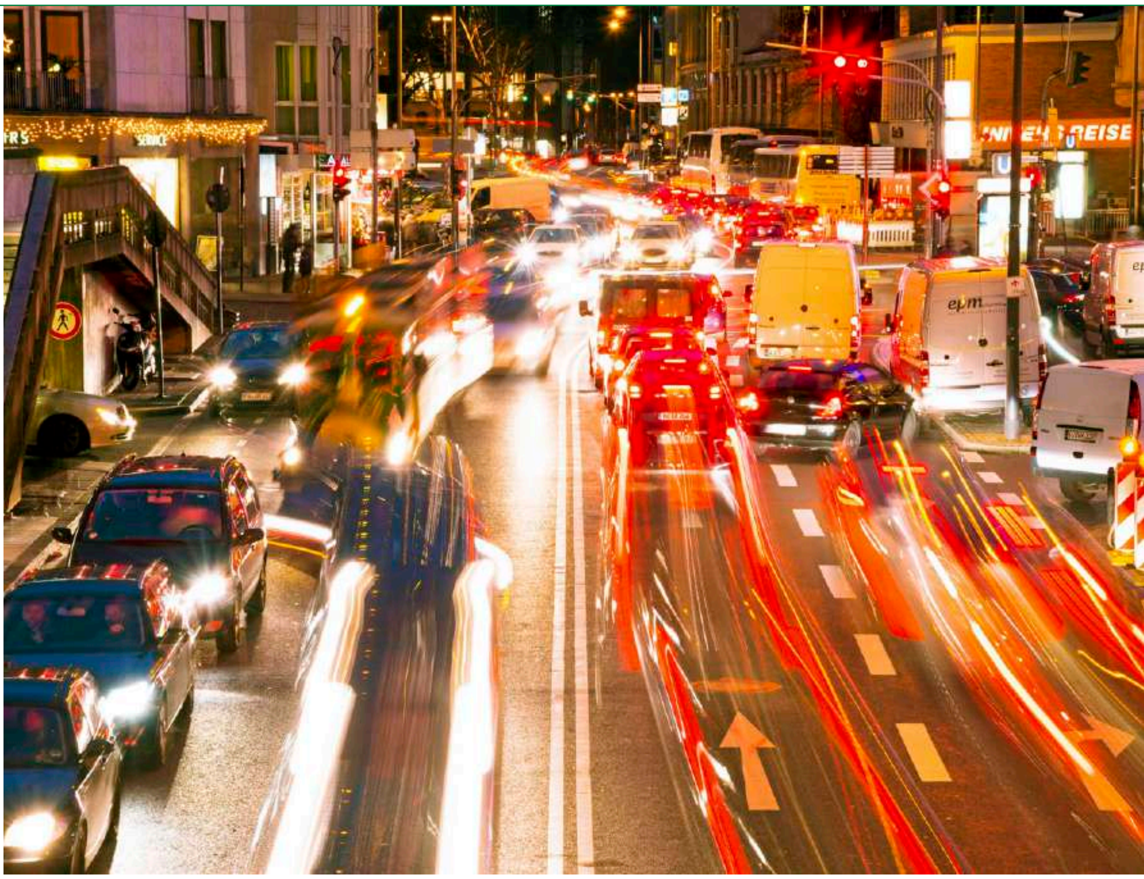
by classic car manufacturers and their suppliers but that society is changing in its attitudes and requirements and solutions for traffic and environmental problems are becoming more and more urgent. While it is difficult to refer to Tesla, the pioneer of mass series production of electric vehicles, as a classic car manufacturer, it is impossible with Google, the Internet corporation. However, these kinds of corporations are also contributing on the road to autonomous driving with innovations and new approaches. Parallel to this, a massive change in values is also taking place in industrial companies. The idea of your own car being a status symbol has become partly obsolete with younger people. Sales arguments are no longer the HP and engine size but connectivity, comfort and low costs. The boom in car sharing also reflects this trend. Having your own car is becoming less and less important when you look at urban regions.

Combining autonomous vehicles and car sharing has many advantages particularly in large cities: far fewer vehicles would be needed to provide the required transport service. This would save on resources, relieve the burden on the environment, reduce the volume of traffic and thus reduce travelling times and minimise the need for parking spaces. These types of mobility would also be available regardless of age and physical restrictions.

The mixture of these advantages and the increasingly urgent problems in urban traffic lead us to believe that the legislator would also be interested in quickly creating a binding and robust legal framework for autonomous driving.

The swerving dilemma gives the car driver the choice of either running over a woman with a pram or putting themselves at risk and steering into oncoming traffic.





Complex traffic situations require maximum attention from every single road user.

Identifying the causes of accidents using event data recorders

It is extremely important for vehicle development to be able to identify the reaction of car drivers in critical situations and derive behaviour or technical solutions from this to mitigate dangerous driving situations. Today's accident analysis is therefore an important foundation for road safety. Researchers and developers can only draw the correct conclusions on how these kinds of accidents can be prevented under circumstances in future if the causes of accidents and how they came about can be explained in detail. The deeper the experts' reliable insight into an accident's circumstances the more valuable the data material. Naturally, accident experts must have access to information for this, which tells them about what exactly happened. A so-called accident data recorder or event data recorder (EDR) may help in the process.

The EDR constantly records driving dynamics data, the systems' condition and their activation or active intervention during the journey. The data is permanently recorded in the event of an accident or at the driver's request and in fact for the time before, during and after the collision. By analysing this kind of data it can be accurately determined how the accident unfolded. So far, a great deal of accident data has only been derived from the complex analysis of predetermined facts or they cannot even be reconstructed using the methods available today.

Added to this, the analysis of road accidents is becoming increasingly more difficult without EDR data: assistant and driver safety systems intervene and influence the position of the marks at the accident site or the intervention leaves no visible marks behind at all. Interventions by ABS, ASR or ESP or a braking assistant can no longer usually be reconstructed with the required accuracy by analysing the marks at the accident site. The pre-crash phase is also usually almost impossible to clarify as there is no objective information about when and how the driver acted and how the vehicle systems intervened. At the same time, the phase before the crash is extremely important for accident research to identify possibilities for preventing accidents or reducing the consequences of accidents.

The status of safety systems such as ESP, lane departure warning systems or emergency braking assistants, which significantly influence driving dynamics and timing, is crucial for the analysis and evaluation of accidents. They are stipulated for certain vehicle classes but should always be able to be "overruled" by the vehicle driver or even be able to be switched off. What kind of working order the systems were in at the time of the accident can therefore be objectively reproduced by comprehensively analysing the confidentially stored data in the control systems after an accident.

It would also be advantageous if EDR data could be read from all vehicles if possible after an accident. However, it would even be progress if just one of the vehicles involved in the accident were to provide the appropriate data. Event data recorders have already been used for a long time, without any legal obligation, by bus companies, hazardous goods carriers, fleet operators, leasing companies, rescue services or as part of accident research projects. Retrofitted event data recorders are often used for this.

Two important criteria must be considered in the discussion on whether and for which vehicles an event data recorder should be obligatory: on the one hand it must be ensured that the EDR is suitable and necessary to improve road safety with regards to the respective vehicle class. On the other hand the regulation must meet the principle of proportionality. The large-scale use of event data recorders is accordingly to be advocated first and foremost for vehicle classes with a high risk potential that results in serious accident consequences from experience. Whether the obligatory introduction of event data recorders is proportionate for "all" road vehicles has to be conditional on how much resulting knowledge is estimated to be gained from the extended possibilities for accident research and therefore what the estimated progress for road safety is.

■ *Urban traffic in major cities has massively increased over the last few years.*

THE MAJOR CHALLENGE OF CAPTURING THE ENTIRE TRAFFIC SITUATION

ABS and ESP driver assistant systems still follow the early philosophy of solitary accident avoidance systems. ABS is to compensate for the drivers inability to carry out a perfect braking procedure so that the vehicle's steering remains intact at the same time as decelerating as best as possible by providing technical assistance. ESP is to assist the driver to stabilise the vehicle in critical situations to prevent, for example, skidding during swerving manoeuvres. These systems have so far not included consideration of the entire traffic situation but have only identified the start of a locking situation as a result of technical circumstances and avoided it or have detected the start of a skidding movement or excessive understeering early and initiated technical countermeasures through targeted braking intervention on the individual wheels or interventions in engine management.

The future challenge lies in capturing other road users and the entire traffic situation, besides the situation for its own vehicle, and initiating a suitable countermeasure for the identified conflicts. This must be appropriate and proportional and must not give rise to new, under circumstances even greater risks that already exist due to the original conflict situation. Ultimately this still has to be established after the accident, if required and can be assessed by the courts.

These considerations are so important as steps towards automated driving will be influenced over a long period by the fact that vehicles will

Fewer accidents thanks to a personalised ignition key?

The personalised ignition key, as already offered for example by Ford under the name "MyKey", could be a solution for parents who want to help their children as new drivers to drive economically and safely without personally supervising them in the vehicle. This is an ignition key that can be allocated to individual people and can be programmed with additional functions. It is programmed by wireless control using an assigned menu in the vehicle's central display. The main key has to be in the vehicle for programming or deletion, the personalised ignition key's user cannot delete or change the programming independently.

An important function, for example of "MyKey", is the restriction of the maximum speed or recommended motorway speed of 130 km/h. It can also be programmed so that warning sounds and visual cues are issued when a predefined speed is exceeded. The audio system's volume can also be restricted using the personalised ignition key. Other functions are the seat belt warning, the enhanced reserve tank display and the prevention of certain assistant system functions being deactivated.

Ford conducted surveys in the USA to obtain knowledge about user acceptance. As expected, parents have an extremely positive attitude towards this. Their children are much more sceptical. But 42 percent of new drivers would accept this kind of control if they could then drive a car more often on their own.

Young adults aged between 18 and 24 are still a high risk group in traffic as car drivers. Most new drivers also fall within this group. In 2013, 1,588 car occupants were killed in road accidents on Germany's roads. 342 of these (= 22 percent) were people aged between 18 and 24. Young men clearly dominate here with 251 fatalities. The most common cause of accident is not adapting their speed. As a result, personalised ignition keys with the function described have great potential to further reduce the number of road fatalities.

have an ever increasing level of intelligence and driver assistant systems while a considerable number of other vehicles do not have these systems yet. A high completion rate could undoubtedly lead to conflicts being identified early and a suitable solution strategy being automatically guaranteed. At least this applies to systems in vehicles that have this kind of intelligence. It will become critical when road users, be it other vehicles or vulnerable road users like pedestrians and cyclists, have to be involved in traffic without their own intelligent safety systems and have to be taken into account too.

From today's perspective, the hope that all relevant incidents in the entire traffic system can be identified in good time and controlled remains a utopian idea for the time being. Unless traffic policy requirements were to obligate pedestrians, cyclists and also motor vehicle road users to carry appropriate retrofittable systems on them and constantly keep them active to produce a sufficiently networked choice of various traffic control systems.

In what way intelligent and responsible algorithms can be developed for a whole range of traffic situations cannot be clearly defined at the moment. However, it is recommended that research is conducted into which decision-making mechanisms experienced drivers use to successfully cope with conflict situations with the help of an extensive observation of "ideal drivers". The recorded and processed conscious and subconscious information plays an important part here. The aim of analysis must also be to weigh up which of the possible alternative defence mechanisms might be the "right one". It must also be analysed how drivers behave in a vehicle without certain safety systems to compare the risks and assess the risk changes. Very complex naturalistic driving studies have already been carried out on this in Europe and the USA. So far it is largely still open as to how the accumulated flood of data can be analysed in a manageable and purposeful way at reasonable cost and which definitive conclusions must be drawn.

OTHER IMPROVEMENT POTENTIAL FOR HEAVY COMMERCIAL VEHICLES

Besides cars, heavy trucks in particular have been increasingly developing into high tech vehicles too recently. It is not just the structures and safety equipment of cabs and driving characteristics that have been constantly improved in the process. Besides purely mechanical measures for partner protection on the front, rear and sides, more and more modern electronic driver assistant systems are being used that further improve the safety of truck occupants and other road users too. The basic principle still applies here that the greatest potential benefit is in avoiding accidents. As in light of the vehicles' heavy mass, measures to minimise the consequences of accidents (passive safety) only have limited potential. If a 40 ton truck is travelling at 80 km/h this is the equivalent

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Head of the Lighting Technology Department
at the Technical University of Darmstadt

Intelligent light systems for more safety

The car industry's history started around 1886 with the development of the combustion engine. The first electric light sources were used in the car sector in 1908. From that time until now automotive engineering and automotive light technology have made great progress parallel to each other. Technical lighting systems in vehicles have the job of improving visibility conditions for the vehicle driver in the dark to prevent road accidents. Until well into the 1990s, car technical lighting was mainly influenced by the development of light sources for front headlights, such as halogen bulbs and xenon high intensity discharge lamps. The light functions were restricted to dipped beam and full beam. Dipped beam systems achieved a maximum visibility range of roughly 85 metres.

At the start of the 21st century car lighting technology moved over to developing adaptive front lighting systems (AFS). Directional lights, cornering lights, urban lights, motorway lights and poor weather lights are activated depending on the topology of the road, steering angle and speed. The rapid further development of LEDs led to their use in full beam and dipped beam functions from 2006. These systems ultimately provided the same luminous flux on the road as was previously only possible for xenon lamps. Intelligent light-based assistant functions, such as marker lights, dynamic cut-off lines and glare-free full beam were developed parallel to the increased use of LEDs. This was possible by combining the available sensor functions, for example camera, GPS or radar.

Current analysis by TU Dresden proves that systems with glare-free full beam can achieve a visibility range of roughly 130 metres and therefore almost the level of full beam. At the same time, oncoming traffic is no longer exposed to the glare when the full beam is switched on. At a speed of roughly 125 km/h it is therefore still possible to stop safely (emergency braking).

The development of car lighting technology over the next few years includes the design of high resolution multi-pixel LED arrays. As a result of these, other roads users can be dynamically shielded from glare depending on the traffic situation while all the surrounding areas are perfectly illuminated. In addition, high power light sources, such as laser and high-current LEDs, are currently being developed to further increase the visibility range for full beam systems to 220 metres and further improve visibility.

to kinetic energy of roughly 10,000 kilojoules. A 1.7 ton car would have to be travelling at roughly 400 km/h to be on the roads with the same kinetic energy. Nevertheless, passive safety measures are still essential and gain new significance in fact in accidents at low collision speeds from an integrated perspective in combination with the effect of modern driver assistant systems.

One important milestone in improving the active safety of trucks was the automatic anti-lock braking system also called ABS. The statutory requirement for heavy commercial vehicles to be fitted with this system has applied in Germany since October 1991. Light commercial vehicles were also gradually included from 1998. The requirement for trailers with a permissible gross weight of over 3.5 tons to have ABS came into force in March 2001.

REGULATIONS ENSURE GREATER MARKET PENETRATION

Driver assistant systems have already been available as electronic stability control (ESC), automatic emergency braking systems (AEBS) and lane departure warning systems (LDWS) or lane keeping assistance systems (LKA) for heavy and light commercial vehicles as special equipment for several years. From the perspective of accident research there is no doubt that these kinds of driver assistant systems significantly improve the road safety of trucks and not only protect truck occupants but also others involved in the accident. Although experience in real traffic already confirms improved protection, previous installation rates provided on a voluntary basis are still very low.

With the implementation of the European Regulation 661/2009/EC dated 13th July 2009, electronic stability control systems (ESC) have been stipulated for new motor vehicles coming into circulation, i.e. for trucks too, since 1st November 2014. This obligation has already applied for new type approvals since 1st November 2011. New commercial vehicles (buses and class M2, M3, N2 and N3 trucks) coming into circulation must be fitted with lane departure warning systems (LDWS) and automatic emergency braking systems (AEBS) from 1st November 2015. This obligation has already applied to newly approved vehicle types since 1st November 2013. At the same time, there are exceptions and specifications that affect both motor vehicles and trailers that cannot be dealt with in detail here. In special cases, for example, some trucks only have to be fitted with more powerful level 2 advanced emergency braking systems from November 2016 or November 2018. Despite these special transitional periods in individual cases and the different minimum performance, these systems will be found in almost all heavy buses, trucks and trailers and will contribute to further improving the safety of these vehicles. The trend here is also towards fully-automated driving and the first step has already been taken.

EFFICIENT PROTECTION FROM REAR-END COLLISIONS AND TURNING ACCIDENTS

Future active steering assistant systems promise really high potential particularly in commercial vehicles. These kinds of systems have only been

Dr Gerd Neumann
Council Member of the International Motor Vehicle Inspection Committee (CITA)

Further advancements in vehicle monitoring in Europe

An important agenda has been set for greater road safety and further advancements in periodic vehicle monitoring over the last three years by the EU Commission. As part of this, the EU Commission tendered a research project on the testing of electronically controlled vehicle systems during the vehicle inspection in mid-2013. The International Motor Vehicle Inspection Committee (CITA) was commissioned with conducting the study out of the applicants.

Important questions in the study were which new processes could be suggested to integrate the electronic vehicle interface and what the resulting value added would be for the European member states in the process. Experts installed and trialled test methods, for example ABS, ESP and airbags, in the Federal Highway Research Institute's (BASt) research lab. More than 2,000 system tests were then carried out in three European countries to practically trial the test methods during a field test. The applicability of so-called scan tools could also be evidenced in the process and coverage could be determined in the different vehicle fleets.

Thanks to excellent collaboration between testing organisations, testing equipment manufacturers and independent research institutes (TRL United Kingdom, BASt Germany, Zeppelin University Friedrichshafen) results could be achieved that constructively support the European-wide introduction of the testing of electronically controlled vehicle safety systems.

Further implementation steps are already starting in Germany from 1st July 2015 thanks to long-term development work by FSD GmbH. The PTI scan tool will then be introduced for all testing organisations. Functional tests for the individual system groups will then be gradually introduced over the next few years. The testing of all electronically controlled safety systems installed in vehicles will be standardised more and more and consistently implemented within the framework of further implementing the 2014/45/EC Directive.

With ever increasingly networked mobility, the future testing of vehicles is unthinkable without using the appropriate tools and software. The EU Commission has made an important contribution towards this with the ECSS study.

Trucks turning right/left are one of the greatest sources of danger in traffic for cyclists.

available for cars so far. They constantly keep the vehicle roughly in the middle of the lane or close to the edge of the road, depending on the setting. The driver finds this convenient in everyday use and the conventional lane departure warning system will appeal considerably less often in combination with an active steering assistant. Like every assistant system, the driver can also override the steering assistant at any time.

The previously mentioned braking system with integrated emergency braking function (AEBS) delivers another safety improvement. A precursor to these kinds of systems is adaptive cruise control (ACC), which can constantly keep a set distance to the vehicle in front. It is already widespread in vehicles from many manufacturers as a comfort system and can help to avoid rear-end collisions to a certain extent, for example on motorways.

It is also foreseeable that camera monitor systems will replace conventional mirror systems. Combinations with electronic image evaluation as well as radar, LIDAR and ultrasound sensors will open up even more perspectives to relieve, warn and if necessary also actively assist the driver with vehicle guidance with perfect all-round visibility. The problem area of accidents involving pedestrians or cyclists and trucks turning right/left can also be tackled again in a sustainable way here. A turning assistant for trucks could also be an important contributor to accident prevention in this respect.

VEHICLE INSPECTION IS BECOMING EVEN MORE IMPORTANT

Previous statements make it clear that the electronics available now make a completely new dimension of vehicle safety possible today. Just like conventional systems, i.e. technical lighting systems, braking and steering systems, axles, wheels and tyres, suspension, chassis, frame and structure, electronically controlled systems are also subject to a certain amount of aging of course. As the International Motor Vehicle Inspection Committee (CITA) already established a few years ago in various tests, electronics in vehicles have a similarly high failure rate to the mechanics. Failure rates rise with both the vehicle's age and mileage.

Periodic vehicle monitoring will therefore be even more important in future than it already is today. At the end of the day, a driver assistant system can only produce the hoped for effect if it actually works. And that should be throughout the vehicle's entire life if possible. The PTI scan tool being introduced on 1st July 2015 will play a key part in this. Using this tool, experts can enquire about the design of the installed safety systems, monitor all sensor data and test that the vehicle's safety systems work, are effective and in a good condition.

The PTI scan tool ensures even greater efficiency during vehicle inspection.

The "Safety Check" that has been carried out for years by DEKRA, the Deutsche Verkehrswacht and the German Road Safety Council impressively shows how important periodic testing is, especially for electronic systems too. With the campaign launched in 2007, the initiators are pursuing the goal of further reducing the still very high risk of accident for young drivers. 18- to 24-year-olds are still the road users with the highest risk of accident and death. 14.8 percent of all road fatalities belonged to this group in 2013. The reasons for this are on the one hand insufficient driving practice and on the other hand the fact that younger drivers are often on the roads in older vehicles.

Nevertheless, more than half of the vehicles inspected as part of the "Safety Check" (52.4 percent) in 2014 had ESP/ASR on board, nine out of ten vehicles were fitted with ABS (89.6 percent) and airbags (91.6 percent) (Figure 20). Only nine percent of vehicles did not have any of the three systems installed. However, it also revealed that more than seven percent of the ESP/ASR systems, just under three percent of the airbags and 2.3 percent of the ABS systems did not work.

70 percent of the cars inspected during the "Safety Check" in 2014 were aged eight years and older. The average age was 11.7 years and therefore almost three years older than the total car stock in Germany. On average the inspected cars had just under 136,000 kilometres on the clock, which is roughly 10,000 kilometres more than five years ago. The results also show that the percentage of faults rises significantly with increasing vehicle age. With vehicles under three years old a good 28 percent had faults. With vehicles aged 7 to 9 years, it was just under 71 percent and with cars aged 13 to 15 years it reached an all-time high of almost 87 percent. Roughly 46 percent of all vehicles had

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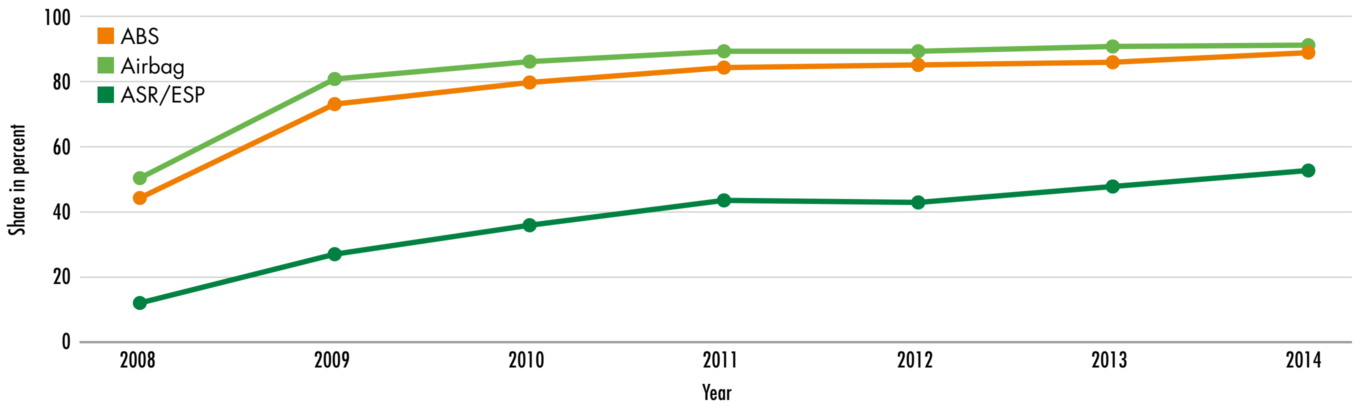
High level of equipment

ABS and airbags have already become almost standard in vehicles tested during the "Safety Check".



Source: DEKRA

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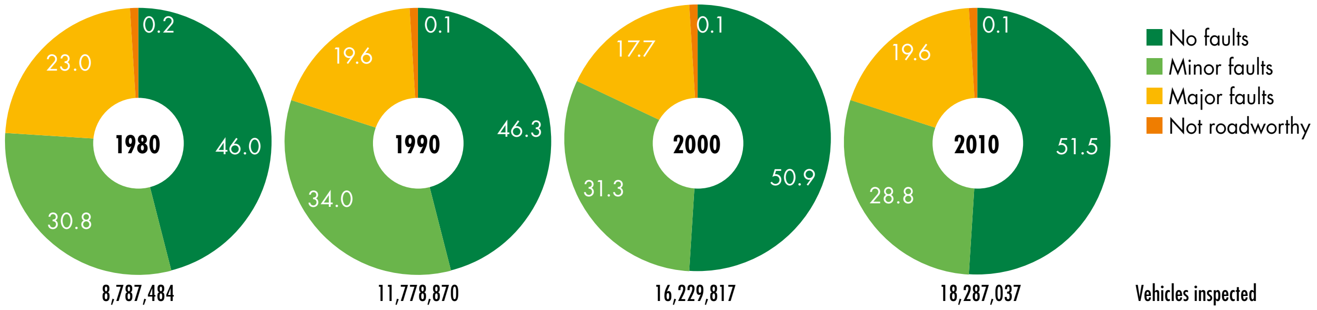
Constant development

Results from vehicle inspections over the last few decades. If you look at the results of vehicle inspections from the years 1980, 1990, 2000 and 2010, it becomes clear that the ratio between vehicles with no, minor and major faults as well as not roadworthy vehicles has only changed slightly but nevertheless positively over the decades. While the number of vehicles with no faults increased by 5.5 percentage points during this period, the number of vehicles with minor and major faults decreased by almost the same margin. The most frequent faults are still in lighting systems, followed by brake faults in second place and wheels and tyres in third place.



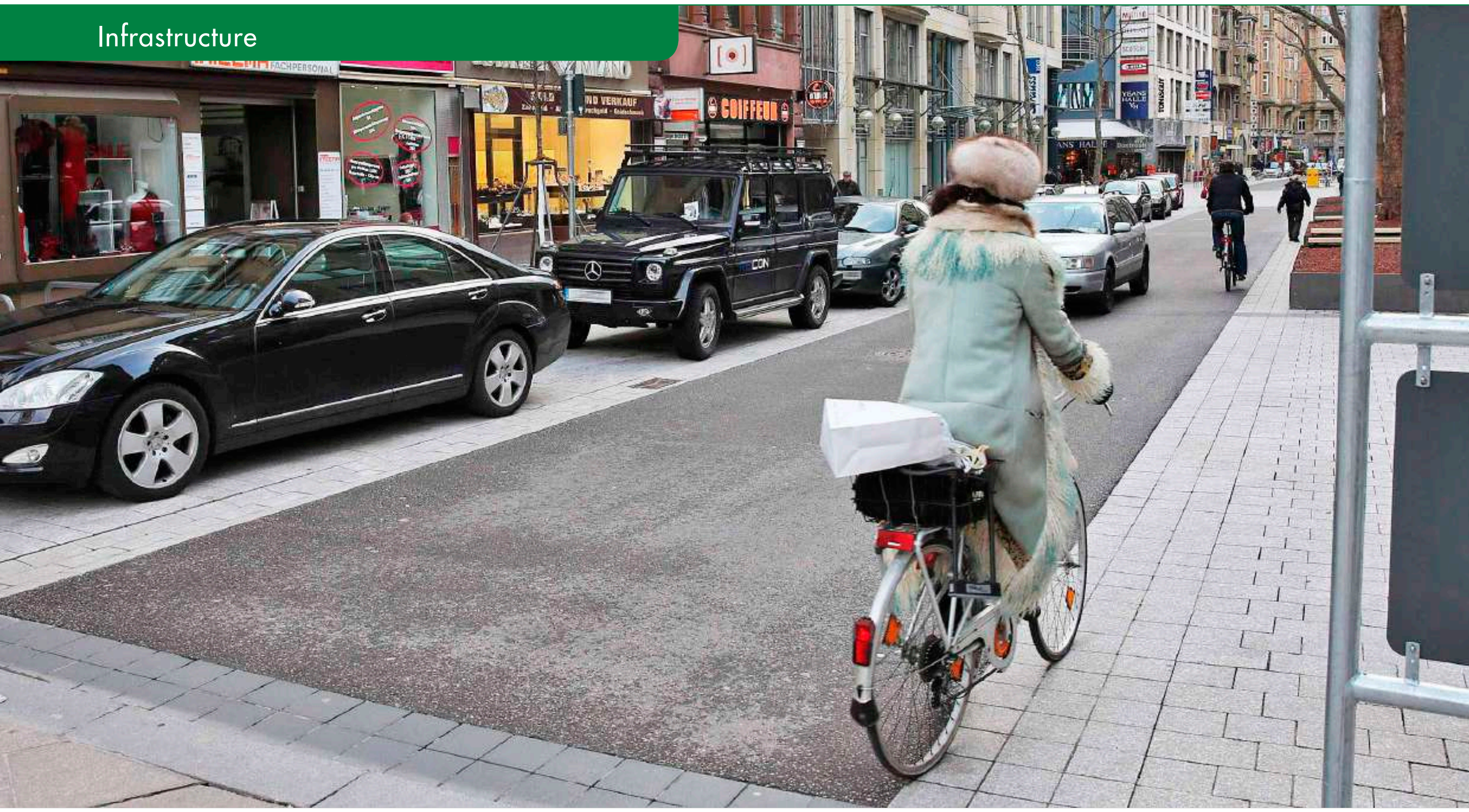
Details in percent

Source: Federal Motor Transport Authority

faults to do with the chassis, wheels/tyres and the car body, 43 percent to do with lights, electrics and electronics, 34 percent to do with braking systems. These figures alone clearly show that there is even more potential to further improve road safety as far as the technical condition of vehicles is concerned.

Brief facts

- **Modern driver assistant systems still offer a whole range of possibilities to prevent accidents and minimise their consequences.**
- **Besides cars, trucks can also already travel highly automated today during test and demonstration journeys.**
- **Drivers of modern cars can already be on the roads semi-automated nowadays, for example using the traffic jam assistant at low speeds on motorways.**
- **The vehicle's reliable communication with the infrastructure and other road users is still at an early stage.**
- **The acceptance of new driver assistant functions and automated driving functions differs considerably internationally.**
- **Developers of driver assistant systems have to also take ethical issues into account when solving conflict situations in traffic.**
- **Protection from rear-end collisions and turning accidents involving trucks must be considerably improved.**
- **Event data recorders provide important information about accident causes and circumstances.**
- **Vehicle inspection is becoming even more important due to the installed electronic systems.**



Rapid assistance and understandable rules

Besides systems specific to vehicles, the infrastructure also plays a crucial role in enhancing road safety. Building and maintaining roads or securing them with appropriate safety barriers is not enough, though. Rescue services and standardisation of traffic regulations across the EU as far as possible also provide potential for improvement.

■ More and more cities in Europe are designing select traffic zones based on the shared space principle. The idea behind this is to redesign inner-city traffic, if possible with no traffic lights, signage and markings. The aim is to achieve a voluntary change in the behaviour of all users of the public space without any restrictive regulations. At the same time, road users are to be treated totally equally within this space.

Be it in the city, on rural roads or on the motorway: rapid assistance is essential to avoid the worst and even save lives after an accident with personal injury. In serious cases every second counts at the end of the day. Today's understanding of the rescue services includes rapid and patient-focused rescue, the best medical care at the accident site and the careful transport of casualties to suitable hospitals. However, obvious differences can be identified in terms of the quality of the rescue services when compared across Europe. Not all systems reflect the importance of preclinical patient care. In England, the National Health Service Act from 1948 stipulated that an ambulance must be available to anyone who needs one at any time. This made the organisation or tendering of the rescue services a municipal task. In 1956, an intensive transport service was set up at the Necker hospital in Paris to be able to move ventilated patients. Other units followed at various French hospitals, which were also used for medical emergencies outside hospitals. These so-called UMH (Unité Mobile Hospitalière) were centrally coordinated from the mid-1960s and are still part of the current SMUR (Service Mobile d'Urgence et de Réanimation) service today. With the increase in personal transport in the 1950s and rapidly growing numbers of road accident victims the call for emergency medical first aid immediately at the accident site also intensified in Germany. The first paramedic car was brought into service in Heidelberg in 1964. The "rendezvous system" with separate arrival of ambulance and paramedic, which is still also used today in many places, was born.

LICENCE PLATE ENQUIRY SPEEDS UP RESCUE CHAIN

The rapidly increasing volume of traffic and associated problems for the fire brigade to quickly get to accident sites with their large vehicles led to the commission of rapid response vehicles in the mid-1970s. These emergency vehicles based on an SUV carried equipment for technical assistance and medical first aid. As a result, trapped vehicle occupants could be freed and given medical care faster. At the same time, they started to more effectively coordinate the technical work by the fire brigade with those of the medical rescue services, if the rescue was not already taken over by the fire brigade.

The use of the fire brigade in the rescue of trapped and locked in vehicle occupants changed drastically. High-strength passenger cell structures, comprehensive equipment with airbags and other safety systems protect occupants in an ideal way. In extreme cases though the fire brigade are faced with enormous challenges.

To guarantee rapid, patient-focused rescue, vehicle manufacturers have developed a scheme for vehicle-specific information cards together with the fire brigade and emergency medics. The fire brigade can use these rescue data sheets on the job. An electronic identification and information system is essential as it is impossible to unambiguously identify all vehicles at the accident site in a damaged condition and then have the right printed version of the rescue data sheet with you too. The rapid introduction of a system across Europe is called for here where the fire brigade can directly access the right data at the accident site, for example using a licence plate enquiry. This would ensure comprehensive information about all the vehicles involved. Appropriate systems are available on the market from various providers; amendments to the legal framework conditions are on the right track. Ultimately the responsible fire brigades are now required to procure these kinds of systems and integrate them into their everyday work.

STILL TOO MUCH DISPARITY BETWEEN NATIONAL LEGISLATION

Besides a roadworthy vehicle, it is above all down to the correct behaviour of all road users or rather their compliance with traffic regulations for accidents to not even happen at all if possible. The reg-

Dr Marco Irzik

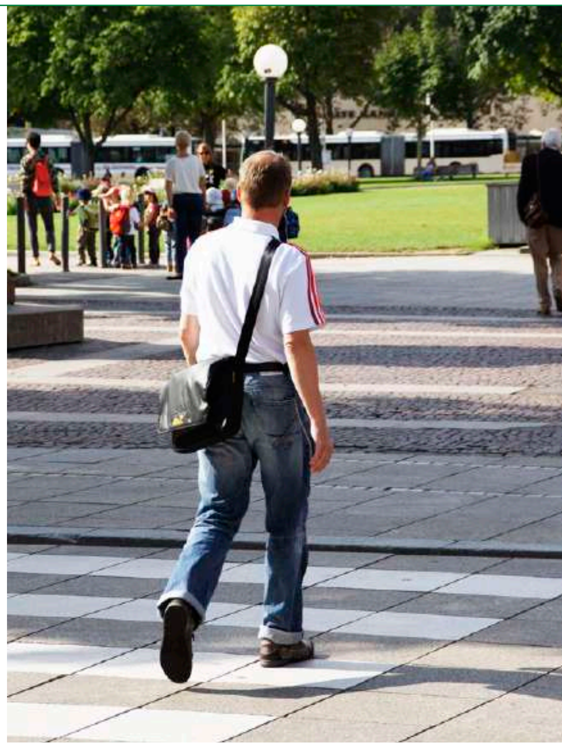
Head of the Long Combination Vehicles working party at the Federal Highway Research Institute of Germany (BASt)

Predominantly positive effects with the use of long combination vehicles

The opportunities and risks of using these kinds of innovative vehicle concepts are being analysed in the ongoing field test being carried out by the federal government with long combination vehicles from 1st January 2012 to 31st December 2016. Long combination vehicles must be up to 6.50 metres longer than standard trucks with up to 25.25 metres but cannot have a total weight heavier than the 40 tons valid already today or 44 tons for the first and last legs of combined transport operations.

At roughly halfway through the field test, the important findings from the test period so far have been summarised and analysed in an interim report by BASt, tasked with providing scientific supervision. On the whole, the remit was to derive what impact the use of long combination vehicles has on the identified issues compared to a situation without long combination vehicles. To sum up, besides the positive effects determined, such as greater efficiency and less truck journeys, considerable problems have not be revealed so far in the boundary conditions given in the field test. The number of identified risks is low measured against the number of issues considered. The identified risks are also classified as manageable with the current number of long combination vehicles in the field test and also assuming the considerably higher share of long combination vehicles in the volume of goods transport. The only factor that a solution would have to be developed for with an increasing number of long combination vehicles is the diagonal parking spaces at service stations, which are generally too short for long combination vehicles. This solution would have to be able to guarantee the parking of long combination vehicles at service stations in compliance with regulations too.

It should be noted that the results achieved are based on the very specific boundary conditions of the field test. Some of these boundary conditions result from the specifications in an exemption regulation for the field test, in individual cases also from the adapted behaviour of the long combination vehicle drivers under test conditions. The long combination vehicles have also mainly been operated with eight axles so far in the field test. Taking the permissible axle loads into account however, six axles may also be sufficient in circumstances, which might have an impact on individual test results. Therefore, if changes are to be introduced to the given boundary conditions, certain issues will have to be looked at again.



Dr-Ing. Achim Kuschefski
Head of the Institute for Motorcycle Safety (ifz)

Motorcycle safety – in the past, now and in the future

When it comes to making travelling on two wheels safer there are basically three components that define moped and motorcycle safety: the vehicle, the traffic infrastructure and the rider.

The vehicle safety of modern motorised two-wheelers has been able to be improved mainly due to "inner values". For example, improved stable handling and better contact with the road surface were achieved through advancements in the chassis and tyres. The introduction of anti-locking systems and traction controls has already prevented numerous crashes. Many improvements were only made reliably possible thanks to modern measuring technology and suitable control systems. Advancing technology will also provide further services in future, for example when looking at networking vehicles or road users with each other.

Besides road users, road construction aspects are particularly important when it comes to the traffic infrastructure. It is generally widely known that the traffic infrastructure was and is primarily designed for two-track vehicles. A rethink has also been taking place here for some time. For example, with guard rails where motorcyclists are often seriously injured. The possible consequences of accidents can be considerably reduced simply by dismantling guard rails that are not necessary and replacing them with motorcyclist-friendly guard rail systems with underride guard. Regulations about motorcyclist-friendly road construction, such as the "MVMOT" instructions have been introduced, recognised and taken to heart by responsible road construction planners in many places. Further research, combined with experience from practice, will also contribute to improving moped and motorcycle safety.

The third component, the rider, was also the focus of the ifz' 10th International Motorcycle Conference in Cologne at the end of September 2014, where the latest findings on moped and motorcycle safety were presented by road safety experts from 20 nations. Current findings from accident research confirm that one of the prime accident scenarios consists of a motorcycle colliding with other road users at junctions. In 80 percent of cases, the other party involved in the accident is a car, and in fact the main cause of the accident. Motorcycle riders are often totally overlooked or the speed at which they are approaching is misjudged. Such simple but crucial findings have to be more intensively integrated into motorcyclist training and also be passed on to other road users, for example car drivers.

Looking at motorcyclists' single vehicle accidents shows that difficulties with braking procedures and a lack of skills in lean angles are particularly evident outside built-up areas. More intensive training at the start might also help to reduce the risk here. One reason why the ifz has launched a quality seal for "motorcycle training" is to be able to offer future learner motorcyclists guidance on good motorcycle training providers. Two-wheeler safety will also continue to be researched and worked on intensively with commitment at all levels in future. The focus will remain on the person as the "upper half of the motorcycle".

ulations are essential but at the same time also often unknown, misunderstood, cursed, flouted and deliberately ignored.

With more and more cross-border traffic it was soon recognised that the international standardisation of important traffic regulations and motor vehicle registration provisions is inevitable. The International Convention on Motor Traffic was agreed in Paris on 11th October 1909, which was then revised on 24th April 1926. This includes important points on vehicle equipment, like a redundant braking system, specifications about the vehicles steering and control, operational safety, glare-free lighting, identification and unpleasant odours and noise emissions. It also included specifications about driving licences and their mutual recognition and standardised road signs. It was already clearly regulated by then that the driver must comply with the regulations in the country where they are travelling.

The regulations were thoroughly revised and supplemented in November 1968: The Convention on Road Traffic and the Convention on Road Signs and Signals were signed in Vienna as the international basis for road traffic and transposed into national law in most countries in the world over subsequent years. Despite these important steps there are still clear differences in national traffic laws and regulations that make international transport considerably difficult. Things get really dangerous when identical road signs demand different driver actions in individual countries.

The fact that every country has its own maximum permissible speed limits depending on the vehicle type and road category is to be considered as not very driver friendly but at least non-critical. The same applies to the maximum limits for the permissible blood alcohol content. By contrast, what are dangerous are the very different rules of behaviour at pedestrian crossings (zebra crossings) within Europe or the give way and indicating regulations at and on roundabouts. It is just as incomprehensible that every member state currently implements its own regulations about carrying a warning vest on you. The major potential benefit of warning vests is undisputed, even with most ministries of transport. Instead of breaking down borders here and creating a standardised law, new complications are being created with intra-European traffic.

Nevertheless, further developments are being made to the legal framework conditions for road traffic to meet technological progress, among other things. This can be clearly seen by the example of changes to vehicle lighting. It was only possible to introduce Xenon, LED and recently also laser lighting systems due to the corresponding amendments. But it's not just motor vehicles that are affected. The legal framework for bicycle lighting has also been adapted to state-of-the-art technology so that certain battery-powered lights and a bright bicycle light are now also permitted in Germany.

A revision of the Vienna International Convention in May 2014 now takes further developments

Ernst Fiala

Austrian car designer (former Professor at the Institute for Motor Vehicles at TU Berlin, developer of the VW Golf and Honorary Professor at TU Vienna)

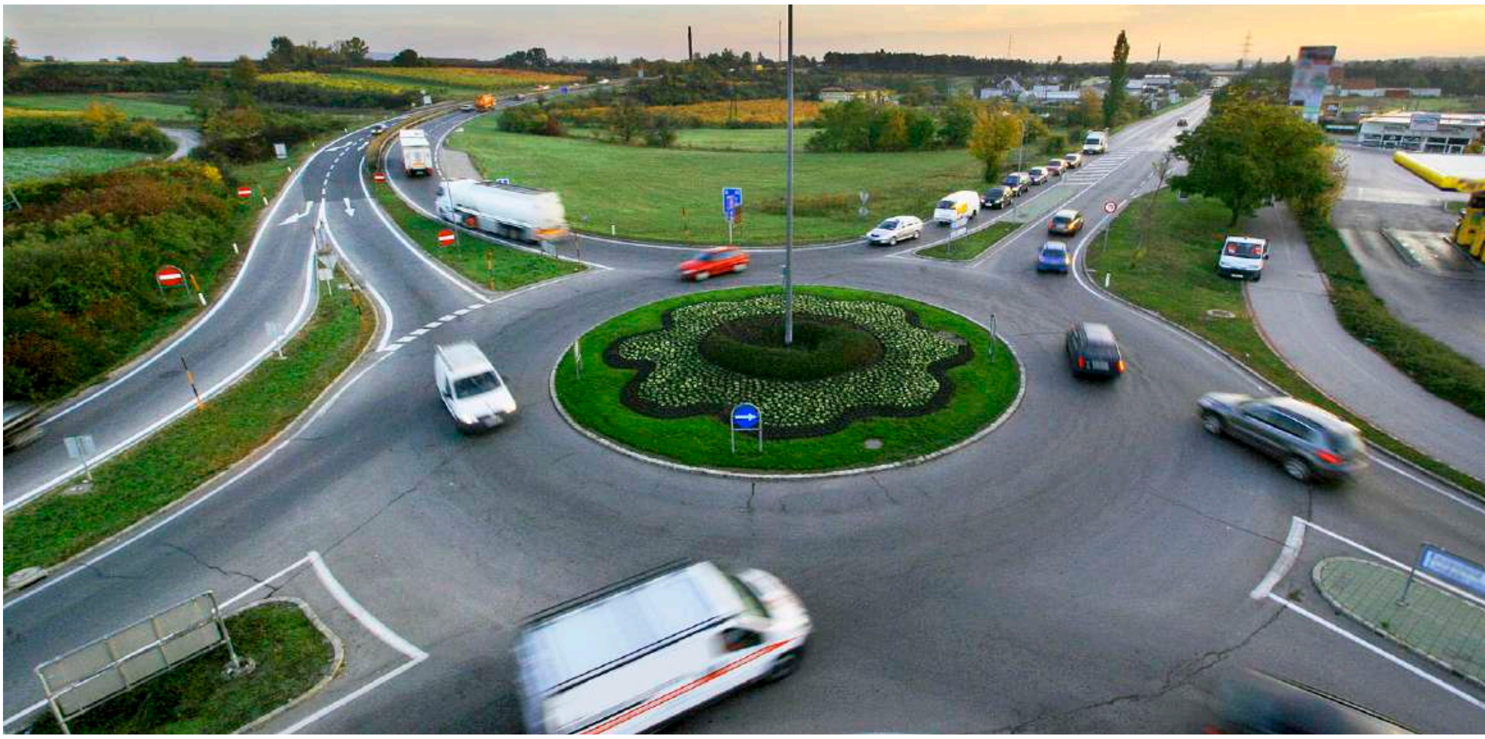
Automation of truck transport on trunk roads appears to be urgently needed

Zero deaths caused by road accidents? A great target, encouraged by the trend over the last few years. The successes with car occupants are significant but motorcyclists have not been able to benefit from this trend. A rapid implementation of fully automated vehicle guidance is not expected across the board. However, the automation of truck transport on trunk roads appears to be urgently needed and could be realised relatively quickly and cost-effectively. Not much effort is required with the infrastructure and vehicle systems. It makes it possible for combinations of vehicles to travel behind one another autonomously with short gaps. After 10 or 20 trailers there is then a bigger gap so that other road users can pull in or out without any danger.

Much greater safety is achieved by avoiding accidents caused by falling asleep at the wheel and lane departure as well as very small speed differences to the vehicle in front in the event of problems or an accident. The road capacity is also considerably improved with a reduction in emissions and fuel consumption (slipstream driving). Experiences with automated truck guidance can then also be applied directly to cars.

The hybrid drive is attractive despite its heavier vehicle weight because it can be driven electrically in town and kinetic and potential energy are sometimes recoverable. An additional electric drive is available at any time without any delay making long, consumption-saving passages possible. The prerequisite though is that it has to pay off. The cheap hybrid drive is a challenge in this respect.

Communication and data processing are becoming extremely important for road safety. They are a requirement for various driver assistant systems and are therefore elements of progress over the next few years.



in active driver assistant systems to the level of autonomous driving into account. Transposition into national law is still pending though. At the same time however, the complexity of legislation and problems for vehicle developers are becoming clear. Even if the legal framework for system permissibility is being extended and presented more clearly, questions of liability still remain unanswered. Other national laws generally apply here. This indicates a change in the development of future vehicles and mobility concepts: it is to a lesser extent the technical engineering and computer aspects that define the pace of progress in vehicle and mobility development and more the legal framework conditions. However, at this point, we are still far away from global and even European-wide standardised regulations due to ever increasing more complex contexts.

INTENSIFY CONSTRUCTION AND MAINTENANCE MEASURES

When it comes to improving the infrastructure, one topic must not be neglected: the condition of roads, bridges and tunnels. Aspects such as the condition of the road surface, the predictability of the road layout, the recognisability of lanes, roadside design, lane markings, the design of junctions and intersections and creating possibilities for passing and overtaking and the general building structure, specifically with bridges, play an important part in this context.

The European Union published the “2009/96/EC Directive on Safety Management for the Road Infrastructure” in November 2008. According to this, the EU Commission sees infrastructure as being an important area of its policy to improve road safety. In doing so, it is not just about new building projects but specifically about the targeted increase in the safety level of existing roads. Germany’s “Road Safety Programme 2011” also pursues this aim. It specifies: “The provision of a functional and efficient infrastructure is an important foundation to pave the way for safe road traffic. Factors that contribute to accidents must be eliminated by road construction and traffic regulating measures and danger spots must also be defused to the extent that the consequences are as minor as possible in the event of an accident.”

Of course it is not possible to rebuild every dilapidated road or modernise it from scratch. However, significant safety benefits can be expected if all construction and maintenance works are planned, prioritised and implemented in terms of maximum safety.

In Germany, bridges for example, are considered to be a major weakness in the road network, among other things. It is not without reason that the Federal Minister of Transport Alexander Dobrindt published a special bridge modernisation programme in May 2014 which is to have no less than EUR 1 billion invested in it by 2017. Naturally,

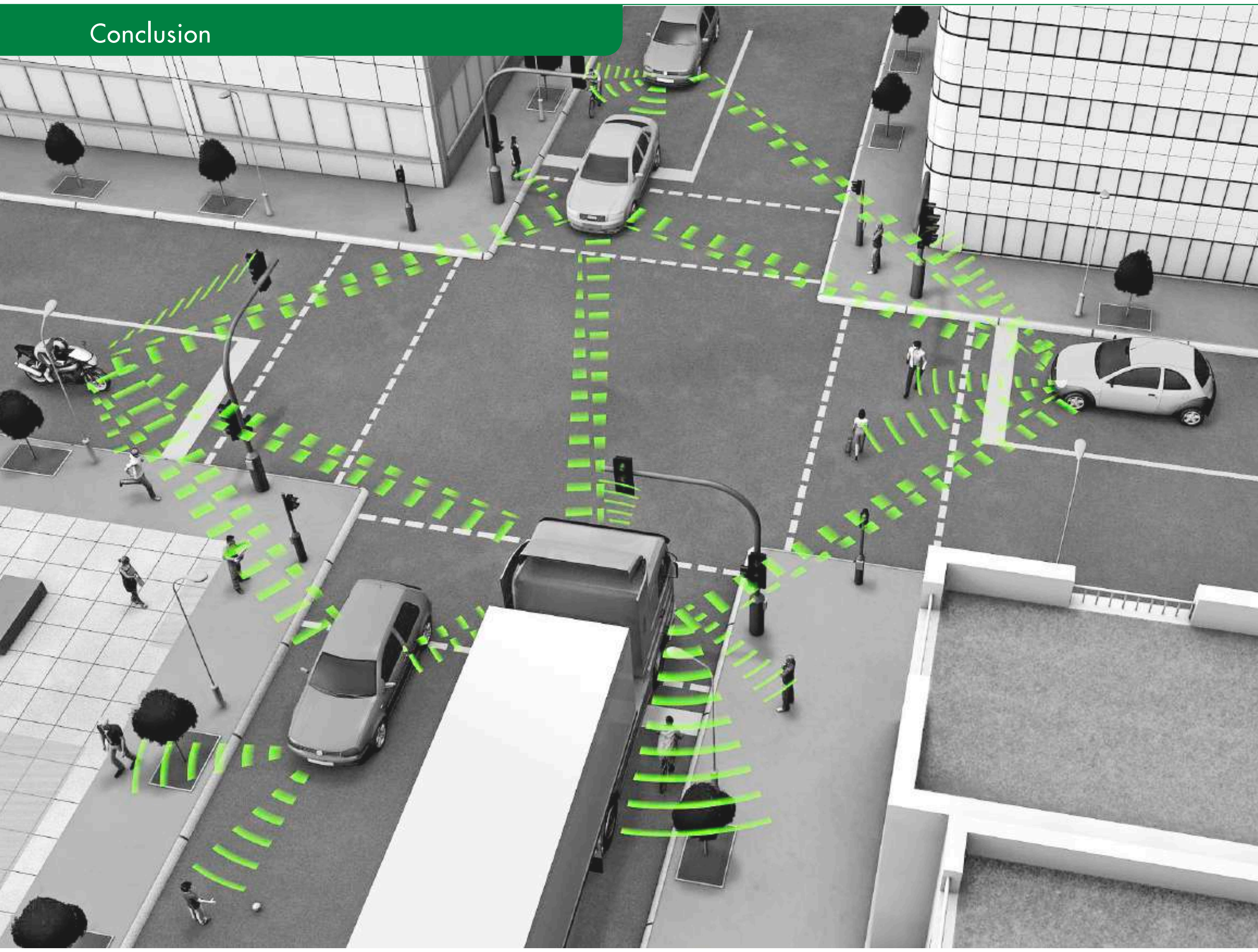
The German federal government, federal states and municipalities are meeting their duty to monitor road safety, static stability and the durability of, for example, road bridges using neutral building inspections.

this money is only available to modernise bridges over motorways and federal roads. However, municipal roads also must not be forgotten. According to a study by the German Institute for Urban Studies many of these bridges have to be either modernised or even completely rebuilt by 2030. The institute puts the investment required to replace the bridges at roughly EUR 11 billion by 2030, added to this are another roughly estimated EUR 6 billion to replace parts of bridges.

One problem with these structures is material fatigue, which is on the one hand sometimes disproportionate to the structure's age and on the other hand due to the traffic load that has massively increased over the years. The huge increase in heavy goods transport in particular causes bridges a lot of trouble. For these reasons, the structural tests prescribed pursuant to DIN 1076 also must not be neglected in future as part of measures for improving the road traffic infrastructure. Regular inspection by an expert contributes to identifying structural faults early on and providing assistance and is therefore also an important cornerstone in improving road safety.

Brief facts

- **The best medical care must be guaranteed at the accident site.**
- **High-strength passenger cell structures present the fire brigade with huge challenges in extreme cases.**
- **An electronic information system is essential for the unambiguous identification of vehicles involved in accidents.**
- **There are still clear differences in national traffic laws and regulations that make international and intra-European transport considerably difficult.**
- **Further developments have to be made to the legal framework conditions for road traffic to keep up with technological progress.**
- **Sufficient funds and investments are required for an intact road infrastructure (maintenance, expansion and rebuilding of roads or bridges). Speed limits because of poor road conditions can only be a temporary emergency measure.**
- **When building new roads or modernising roads, a preventative and interdisciplinary approach is essential in order to not allow accident black spots to arise in the first place.**



Creating road safety for the future

The different chapters in this report have clearly shown that sustainable road safety work is not a nine day wonder but an ongoing process that has to be managed over decades and constantly adapted. The status we have achieved so far in terms of vehicle and road safety is ultimately thanks to further development consistently driven over the generations with sometimes ground-breaking ideas from individual pioneers. We have to now build on this so that the number of accident victims on Europe's roads continues to constantly decline even more in future.

There cannot be relevant progress in the future without knowledge gained from the past: this wisdom can be applied to many different aspects of life. It is particularly valid though when it comes to technical achievements. Many of the road safety milestones highlighted in this report can be labelled as such. Often, as for example in the case of radial tyres, disc brakes, rigid passenger cells with crumple zone or safety steering shafts, they were just the prerequisite for today's occupant and partner protection systems to be able to yield their full effectiveness in serious accidents.

In terms of technology, the journey is taking us in the direction of fully-automated or autonomous driving. What is interesting and exciting in the process is that it's not just classic car manufacturers and their suppliers who want to go down this road but powerful new players are increasingly getting involved in shaping the future mobility market. The Internet corporation Google and the electric vehicle manufacturer Tesla are the best examples of this.

EVEN MORE ATTENTION IS SHIFTING TO THE "MAN-MACHINE INTERFACE"

In light of further technical developments it is to be expected that legislative authorities would also be interested in quickly creating a binding and robust legal framework for semi-automated or autonomous driving, also because an even greater degree of road safety appears to be possible here as respective systems are taking over more and more tasks from the driver. However, there are also cautionary voices: will people in an autonomous driving vehicle lose important skills for safe driving over time? In the transition period with different automated and semi-automated vehicles, can they take over driving tasks again quickly and safely enough whenever they themselves have to intervene as necessary? More and more attention is shifting to the human factor and so-called man-machine interface as a result.

A glance at the figures shows how urgent the need for improved road safety is. According to the "Guidelines on Road Safety 2011–2020" published by the EU Commission, the target is to halve the number of annual road fatalities again compared to 2010 and to significantly reduce the number of serious injuries. Major efforts are still required from everyone involved to achieve these targets. This is particularly true in light of the fact that the positive trend of the last few years has possibly suffered a slight setback. As a result, the number of road fatalities in Germany in 2014 will be roughly the same as the year before based on a provisional forecast by the Federal Statistics Office or will increase by roughly one percent based on a current estimate by BASt. An increase of 3.7 percent is being assumed in France. According to information from the police, a drop of 3.6 percent is being reckoned with in Italy at least. All in all this is not enough though. A reminder: 31,484 people died on the EU's roads in 2010, therefore it should be "only" 15,742 at the most in 2020. The official figures in the CARE database (EU road accident database) show a total of 26,073 road fatalities for 2013. This is a 7.3 percent decrease compared to 2012. In the remaining years the decrease would have to at least be level with this to achieve the target being strived for in 2020.

THE ACCEPTANCE OF REGULATIONS IS AND REMAINS INDISPENSABLE

The fact is: Vehicle engineering as well as infrastructure and road construction, legislation and traffic monitoring, the rescue services, road safety education and other measures to prevent accidents and minimise their consequences can undoubtedly make even more important contributions to greater road safety. Periodic vehicle testing also must not be forgotten in order to guarantee that mechanical and electronic vehicle safety system components work properly. With all the measures though, the person at the wheel is always the one who has the greatest influence on an accident happening. And however many driver assistant systems are installed: responsible behaviour, constant focus on the surrounding traffic, correct judgement of their own abilities and a high degree of acceptance of rules by all road users are also essential.

DEKRA's demands

- **Road safety work not just to focus on reducing the number of fatalities caused by road accidents but also of people seriously injured.**
- **Even greater focus on risk groups, for example young drivers, senior citizens, motorcyclists, drivers under the influence of alcohol and/or drugs and irresponsible, aggressive road users.**
- **Evaluation of previous measures for improved road safety using real accidents and the consistent application and further development of tried and tested instruments.**
- **Identification and implementation of effective national measures in individual EU member states (specific potential for improvement, learning from other countries).**
- **Promotion of the systematic use of event data recorders to improve research into accident causes.**
- **Even more intensive promotion of safety-conscious and responsible behaviour by all road users (for example with driver training courses to get to know their own limits; educational campaigns regarding distraction by smartphones).**
- **Standardisation of traffic regulations in Europe, as far as possible and reasonable.**
- **More educational campaigns on traffic regulations: rules only work if they are generally known and understood (for example, with new infrastructure models like "shared spaces").**
- **Compliance with all traffic regulations; targeted, effective punishment of dangerous violations (for example, alcohol, using a smartphone, excessive speeds).**
- **More research and preparation for use of alcohol interlocks to prevent drink driving, for example for repeat offenders.**
- **Information campaigns about the existence, function and limits of driver assistant systems, clarification of the driver's responsibility at all times.**
- **Preparation and creation of an ideally global standardised legal framework for electronically assisted and also autonomous driving in future.**
- **Further improvement of protection from rear-end collisions and turning accidents involving trucks (greater market penetration of assistant systems).**
- **Improvement of intelligent traffic concepts to network more modes of transport.**
- **Transmission of relevant traffic and safety information to the vehicle: understandable information for driver without major distraction.**
- **Constant further development of technical vehicle monitoring with regards to new components (electronic systems, safety communication technology).**
- **Further development of scientific basis for driving aptitude assessment.**
- **General exhaustion of all potential to prevent and avoid accidents.**

Any questions?

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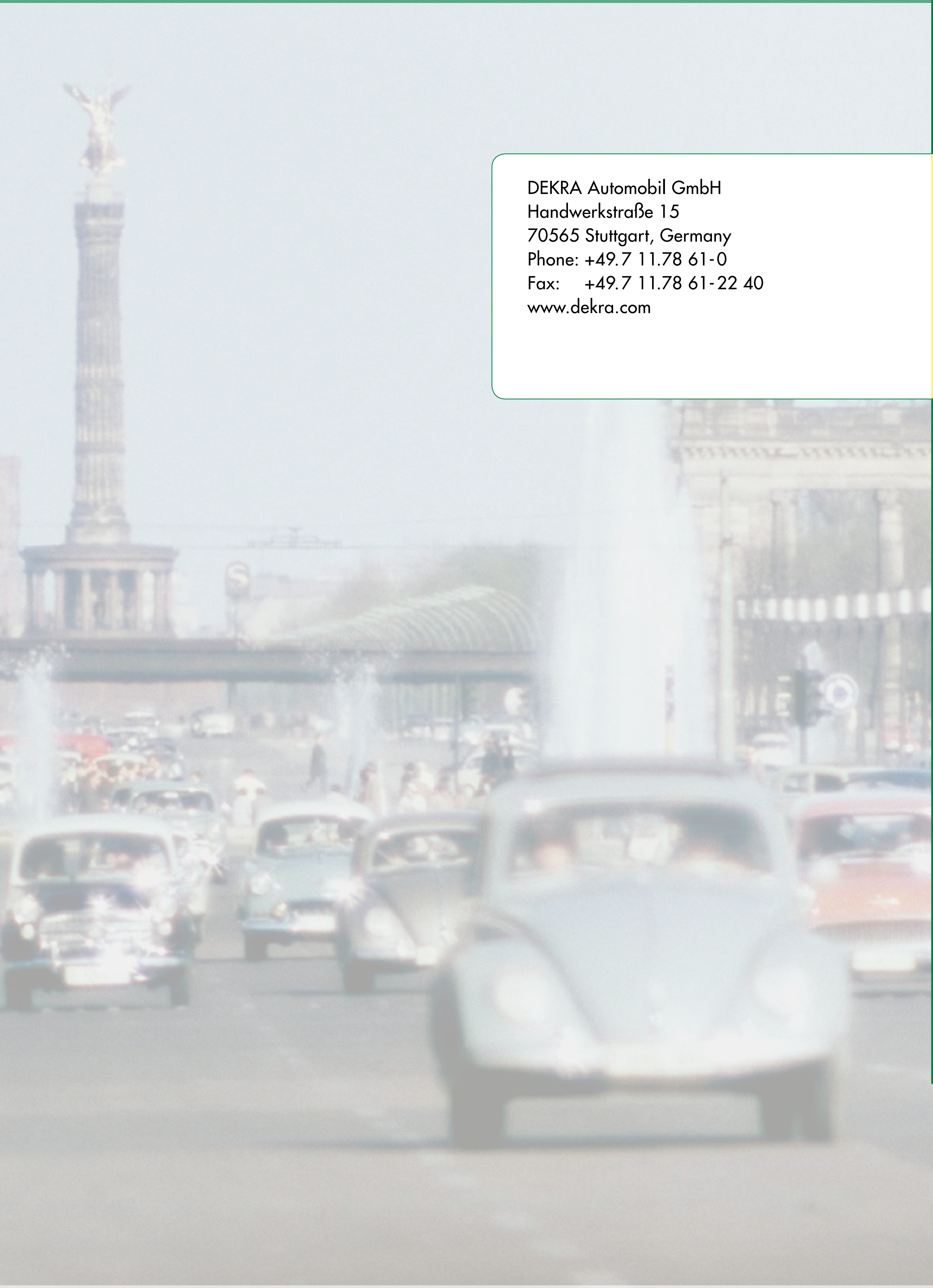

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