ROAD SAFETY REPORT 2025

The Changing Face of Mobility

DEKRA


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Safe Mobility Must Be a Given

Jann Fehlauer

Managing Director, DEKRA Automobil GmbH

The world of mobility has been utterly transformed over the past 100 plus years – we have progressed from the first cars to highly automated vehicles; from local traffic to global transport networks. Major progress has been made when it comes to both vehicle technology and road safety. While this evolution has been impressive, it was also critical to meeting the needs of the world's ever-growing population. During this time, it has been demonstrated that technological innovations only succeed when accompanied by a suitable legal framework and societal acceptance.

In Europe, the breakthrough of cars started in the 1920s. Prior to this, horse-drawn carriages had dominated road traffic, but the mass production of affordable vehicles changed the streetscape. The economic boom after World War II led to a sharp rise in private car ownership in many countries. To cope with the growth in traffic – also caused by the increase in road-based freight transportation – countries additionally took measures such as constructing or expanding freeways.

For a long time, the downside was a lack of road safety regulations, which meant a high number of traffic fatalities. In many countries, this trend reached its unenviable high point in the 1970s. Germany, for example, recorded more than 21,000 traffic fatalities in 1972. Improvements in vehicle technology and legislation had started to counteract the trend, with the gradual introduction of seat belts, crumple zones, airbags, electronic driving aids such as ABS and ESP, and numerous driver assistance systems. Similarly, measures such as speed restrictions, blood alcohol limits, and improved training for novice drivers – coupled with stronger sanctions for any violations – led to a reduction in the number of accidents causing fatalities and severe injuries. Of course, we should not forget the many public road safety campaigns either. Above all, however, it was the introduction of periodical technical inspections that helped make our roads safer – and that remains true to this day.

According to preliminary figures from the EU Commission, EU countries recorded 19,800 traffic fatalities in 2024 – a drop of 70 percent from the inglorious record levels seen in the 1970s. However, compared with 2023, the figure was reduced by only 3 percent, which is far too little to achieve the EU's declared goal for 2030 of halving the number of traffic fatalities from the 2019 baseline.

Thus, although progress has undoubtedly been made, many challenges remain before we can ensure safe mobility for everyone at all times. This is particularly true with respect to vulnerable road users such as pedestrians, cyclists, and the occupants of motorized two-wheelers, who remain at greatest risk. When viewed globally, there is still much to do to improve road safety, especially in low-income countries.

In this report, we explain where major progress has been made in recent decades, and where action is needed to achieve further optimization in keeping with “Vision Zero”. This is the 18th consecutive Road Safety Report, in which we continue an impressive success story. The international scope of response to the report, as well as the fact that it is often quoted by politicians, professional bodies, and other organizations, underscores the reputation it has acquired over the years. It is an enduring extension of DEKRA's commitment to road safety, which now dates back 100 years.

The job is far from finished

Kristian Schmidt

European Road Safety Coordinator

Europe's road safety journey is a testament to human ingenuity, collective determination, and an unwavering commitment to protecting human life. The Dekra Road Safety Report 2025 invites us to reflect on a remarkable trajectory of transformation that has fundamentally reshaped our understanding of mobility and safety.

Over the past decades, we have witnessed an extraordinary evolution. From the early days when seatbelts were a revolution and crumple zones just a fantasy, to today's sophisticated ecosystem of advanced driver assistance systems, connected vehicles, smart enforcement systems and intelligent transportation infrastructure, our approach to road safety has been nothing short of revolutionary. The numbers tell a compelling story: despite growing traffic, fatalities on European roads have decreased dramatically, falling from around 50,000 twenty years ago to around 20,000 today. This has been achieved through persistent policy interventions, technological innovations, and a cultural shift towards prioritising safety.

Yet, as we look forward, we recognise that the job is far from finished. The emerging landscape of mobility – with autonomous vehicles, electrification, and increasingly complex urban transportation systems – presents both unprecedented opportunities and challenges. Our policies must be as dynamic and adaptive as the technologies we are developing.

This year's report compels us to look to the future and to do so through a wide, cross-societal lens. Some of the key areas include integrating artificial intelligence and machine learning into impactful predictive safety systems; adapting our approach to safety to encompass the rich variety of our mixed-mobility environments; supporting the transition to zero-emission vehicles without compromising safety standards; and ensuring that safety does not become a privilege of the happy few, but that equitable access to safe mobility solutions is guaranteed for all.

As EU Road Safety Coordinator, I am both humbled by our past achievements and excited by the potential of our future innovations. This report is a call to action and a reminder that behind every statistic is a human life worth protecting.

I invite you to read, reflect, and most importantly, to continue contributing to this critical mission of making our roads safer for everyone.

dekra-roadsafety.com

Stan Zurkiewicz
DEKRA CEO

Dear Readers,

making the world a safer place has been our driving force for 100 years—it is at the very heart of DEKRA. What began in 1925 with the vision of improving road safety through technical vehicle inspections has now become a worldwide mission: DEKRA is the global partner for a safe, secure, and sustainable world: on the road, at work and at home—in physical as well as digital aspects of life.

Year after year, the DEKRA Road Safety Report highlights the crucial importance of safe mobility for our society. Technical vehicle inspections can play an important role in this. Today, in many countries, they are mandatory and an integral part of road safety efforts. And no one in the world inspects as many vehicles as we do: Our colleagues carry out well over 30 million inspections every year—in 24 countries around the world, from the United States to New Zealand, from Sweden to Chile.

It all began 100 years ago with the idea of a few German entrepreneurs: They had more and more motorized vehicles in use—and they wanted to be sure that these vehicles were technically sound. Long before any state-regulated vehicle inspection, the DEKRA founders organized a voluntary periodical inspection. A century later, we still want to be just as responsible and forward-thinking; that is our ambition.

Today, our responsibility extends far beyond the road. Topics such as cyber securi-

100 YEARS SECURING THE FUTURE 1925 – 2025

In 1925, DEKRA's founders established the promotion of road safety as the association's core mission.

In combination with the neighboring DEKRA Technology Center, which opened in 2003, DEKRA's Lausitzring site in Klettwitz (Brandenburg) forms Europe's largest manufacturer-independent testing center for tomorrow's automated and connected mobility.

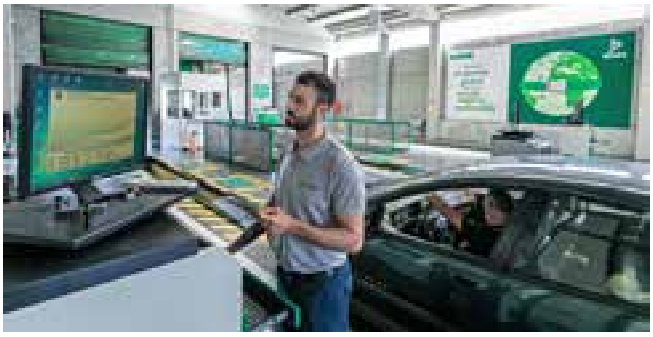
DEKRA has been a partner to the DTM German sports car racing series for many years, guaranteeing not only the safety of the racing vehicles but also a level playing field.

ty, the responsible use of artificial intelligence and our Digital Trust Services shape our work today and in the future. Sustainable solutions are at the heart of everything we do.

This year, we celebrate our 100th anniversary—a milestone not only for our company, but also for everyone committed to safety and sustainability. With a great deal of determination, we have developed and consistently expanded what began on June 30, 1925, as the "Deutscher Kraftfahrzeug-Überwachungsverein e.V." (German Motor Vehicle Inspection Association) into a truly global company. Today, some 48,000 colleagues in 60 countries around the world are committed to our mission – with pride in our history and determination for the future. Our aim is and will remain safety, security, and sustainability. Every day. Worldwide.

On July 1, 1990, the first freely elected government of the former GDR tasked DEKRA with establishing technical testing and inspection centers in eastern Germany.

Today, DEKRA is the world's number 1 for vehicle inspections – this image shows an inspection center in Spain.



DEKRA has been performing crash tests on vehicles since 1978, thus playing a key role in vehicle and road safety throughout Europe.

Every Road Accident Victim Is One Too Many

From the first basic cars to highly automated and connected vehicles, the way we travel from A to B on our roads reflects technological progress, societal change, and global challenges – also in respect of road safety. In any event, the some 1.2 million traffic fatalities worldwide each year underline the fact that there can be no let up in efforts to develop efficient measures to prevent accidents and reduce their impact.

The date is August 17, 1896; the scene is near to Crystal Palace in south London. Bridget Driscoll, a woman in her mid-forties, is crossing the road on foot when a car suddenly approaches and runs her over. As reported by eye-witnesses, the car was being driven at "a reckless pace, almost like a fire engine." Bridget Driscoll's head injuries were so severe that she died on the spot, likely making her the very first victim of an accident involving a car. At the subsequent trial, the driver who caused the accident claimed, among other things, that he had only been traveling a little over 6 km/h (~4 mph) – the Roger-Benz, as his vehicle was called, had a top speed of only 8 km/h (~5 mph). The judge showed clemency and acquitted the defendant, reportedly stating that he hoped such a tragic accident would never happen again. A noble aspiration, as things would soon turn out, as to this day the history of mobility is not only linked with development and progress, but also with high victim statistics.

For example, as reported in a 2006 publication from the German Federal Statistical Office, even the government of what was then the German Reich found it necessary to introduce "Statistics of harmful events occurring when operating motor vehicles" as from April 1, 1906. In January 1907, the number of vehicles on the roads was also recorded for the first time. As at the first reporting date, the statistics determined there were 27,026 registered motor vehicles – 15,954 motorbikes,

»

Milestones in Mobility and Road Safety

1820 · 1900 · 1910

1817

- *In Mannheim, Karl Freiherr von Drais invents his dandy horse, also named the **draisine** after him. It is regarded as the first bicycle.*

1823

- *Scotsman John Loudon McAdam becomes a pioneer of modern road construction when he invents **crushed stone roads** with a hard surface.*

1839

- *The first horse-drawn **streetcar** in Europe enters service between Montbrison and Montrond in France.*

1868

- *The world's first **traffic light system** is installed in London – it was operated by gas light and exploded after just a short time.*

1881

- *The "Wiener Freiwillige Rettungsgesellschaft" (Vienna voluntary rescue service) is founded as one of the first **civil rescue organizations**.*

1885

- *Gottlieb Daimler presents his riding car – the world's first **motorbike**.*

1886

- *With the Benz Patent Motor Car Model 1, Carl Benz ushers in the era of the **modern automobile** powered by a combustion engine.*

1896

- *Gottlieb Daimler sells his first **motorized truck**, designed by Wilhelm Maybach.*

1899

- *The world's first **traffic circle** is inaugurated at Brautwiesenplatz in Görlitz. It is followed by the Columbia Circle in New York in 1904, and the traffic circle around the Arc de Triomphe in Paris in 1907.*

1902

- *British engineer Frederick W. Lanchester invents and patents the **disk brake**.*

1909

- *The **International Convention with respect to the Circulation of Motor Vehicles** is signed in Paris – the first cross-border regulation governing automobile traffic.*

1911

- *In Wayne County, Michigan, USA, white **lane markings** are used for the first time to separate road lanes. Today, they are the basis for lane keeping systems.*

1912

- *The first **electric traffic signal** with red and green lights is installed in Salt Lake City, USA.*

STATEMENT

Financing at national level is also essential for creating and maintaining safe transportation systems

Antonio Avenoso
Executive Director of the European Transport Safety Council

Europe's approach to tackling road safety is in trouble. The EU, and its Member States, have agreed on targets to cut road deaths by half in the decade to 2030. But, according to the current trend, deaths are set to fall by only a quarter. There were 20,400 road deaths in the EU in 2023 – down just 1% on the previous year. While this was a 10% reduction since 2019 - the baseline for the 2030 target - the downward trend has flat-lined in several Member States and risen in others.
In March last year, the European Court of Auditors issued its first ever report on road safety saying that the EU and its Member States will need to "move their efforts up a gear" to reach the 2030 targets.

In its 2021 report on road safety, the European Parliament called for "strong EU leadership to ensure that road safety remains a priority in road transport to help close the road safety gap between Member States and ensure that the EU remains a global leader in this domain".

The European Union is not solely responsible for this underwhelming performance. Member States have a leading role to play in most aspects of road safety and a review of their road safety strategies is underway.

Notwithstanding the role of Member States, the importance of European Union legislation and road safety initiatives should not be underestimated. Unfortunately, recent progress was not what it should have been.

During the last European Commission and Parliament mandate 2019-2024, the ambition of new EU vehicle safety regulation was undermined by weak technical requirements for some key technologies. That will lead to fewer lives saved.

Over the next five years, it is vitally important that vehicle safety regulations are reviewed and updated again to take account of the latest technological advances. While doing so it is important to remember that Europe has been a world leader in vehicle safety, and as well as saving lives, investment in these technologies creates high-quality jobs in the vehicle supplier sector.

Preventing road deaths also brings economic benefits. ETSC estimates that the total value of the human losses avoided by reductions in road deaths in the years 2013-2022 is around €104 billion. While for the families of road victims, no price can be put on their loss, policymakers do have to weigh up the costs and benefits of competing policies that must be paid for from limited resources. ETSC argues for measures that are cost-effective as well as lifesaving.

Financing at national level is also essential for creating and maintaining safe transportation systems that protect lives, promote economic prosperity and enhance overall quality of life. Governments must allocate and invest sufficient resources to address the complex challenges of road safety effectively.

Around 100 young people (aged 15-30) die on Europe's roads every single week. The vast majority of these deaths could be avoided using measures already proven to be effective. ETSC urges policymakers to end this epidemic, starting with a new commitment to achieving the EU's existing target of halving road deaths by 2030. The goal is achievable, but it will take urgency and leadership.

1915 • 1920 • 1925 • 1930 • 1945

1914

- *British doctor Eric Gardner commissions the first **crash helmet for motorcyclists**, made from shellac and canvas.*

1921

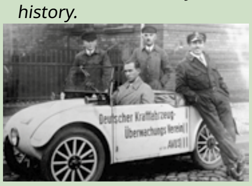
- *The Duesenberg Model A is the first vehicle to be equipped with a **hydraulic braking system**.*

1924

- *The **German Road Safety Volunteer Organization** is established to provide prevention activities.*

1925

- *The organization **Deutscher Kraftfahrzeug-Überwachungsverein e.V.** is founded in Berlin. It aims to conduct voluntary technical inspections on its members' vehicles. The registration of the association marks the start of DEKRA's 100-year history.*



1926

- *In the United Kingdom, **traffic accident statistics** are published for the first time.*

1931

- *The League of Nations in Geneva adopts the Convention concerning the **Unification of Road Signs**. It is ratified by 18 countries.*

1934

- *British businessman Percy Shaw invents the **reflective road stud** ("cat's eye").*

1938

- *The US magazine Popular Science reports for the first time on the **automation of traffic** in the future.*

1946

- *French tire manufacturer Michelin patents the **radial tire**.*
- *After World War II, former **DEKRA engineers** resume the organization's work. Stuttgart becomes the new location of the head office.*

1949

- *The pedestrian crosswalk or **zebra crossing** appears internationally for the first time in the Geneva Protocol on Road Signs and Signals.*

1951

- *In Germany, the **periodical technical inspection** becomes mandatory for motor vehicles and trailers; the inspection sticker on license plates is introduced ten years later. The goal of the periodical technical inspection is to minimize the number of vehicles with technical safety defects on the road.*
- *In collaboration with the Indiana State Police, a team of accident researchers led by engineer Hugh de Haven in the USA starts the first comprehensive **analysis of car accidents**.*
- *German engineer Walter Linderer files a patent for an **airbag**.*
- *Hungarian engineer Béla Barényi files a patent for his concept of a rigid **passenger cell** with crumple zones at the front and rear.*


DEKRA

ZEITSCHRIFT

DES VERBANDES DER DEUTSCHEN KRAFTFAHRZEUG-ÜBERWACHUNGS-VEREINE E.V. SITZ BERLIN

1. Jahrgang | Hannover-Berlin, 15. August 1928. | Heft 8.

Inhalt:

1. Vorbeugen! Von Oberingenieur Wehr (Berlin).
2. Ein neuer 27/30 P. S. Dieselschlepper.
3. Ein neuer Bosch-Magnetzünder für Flugzeugmotoren. Von F. Seitz (Stuttgart).
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. Warnung vor Neugründungen.
10. Aus der Praxis unserer Juristen.
11. Spanien entwickelt eine nationale Automobilindustrie.
12. Deutsche Wirtschaftszahlen.
13. Das Aufkommen aus der Kraftfahrzeugsteuer.
14. Besprechung eingegangener Bücher.
15. Amtliche Mitteilungen des Verbandes der Deutschen Kraftfahrzeug-Ueberwachungs-Vereine, e. V., und des Deutschen Kraftfahrzeug-Ueberwachungs-Vereins, e. V.

mit

Markt für gebrauchte Wagen

957 trucks, and 10,115 cars. In the first year of reporting road traffic accident statistics (October 1906 to September 1907), 4,864 accidents were recorded, in which 145 people died and 2,419 were injured. In 1906/1907, 85 percent of traffic fatalities were caused by accidents with cars, despite the fact that cars accounted for only 37 percent of the vehicles on the roads at that time. On July 1, 1928, the statistics showed that there were already some 933,312 motor vehicles – 351,380 cars, 334,314 motorbikes, and 121,765 trucks. That year, 3,447 people lost their lives in a car accident, and 1,516 in a motorbike accident. Considering the number of vehicles on the roads, driving was therefore much more dangerous in the early days than it is today.

DEKRA Emphasizes the Importance of Road Safety at an Early Stage

Even back then, many of these accidents were likely caused by technical defects. It was not for nothing that DEKRA's magazine dated August 15, 1928, dedicated an article entitled "Vorbeugen!" (Prevention) to the importance of vehicle inspections. As the article stated (translated freely here): "Many collisions, particularly in city traffic, are caused by defective brakes and steering systems. And even if the preventative work carried out by inspection mechanics only remedied these defects to make the vehicles roadworthy again, this work would have already paid for itself, human lives would be at less risk, and important national assets would be preserved. [...] Therefore, objective, properly performed motor vehicle inspections support the healthy ongoing development of the road transport economy; this benefits not only the vehicle owner but also the insurance sector, industry, and road safety; it is an effective preventive in the best sense of the word and should, therefore, also be promoted by those groups that have so far held back."

Alongside its vehicle inspections, DEKRA has generally also always provided its members with extensive information on how to safely operate motor vehicles. On this point, there is an interesting article in the DEKRA magazine dated July 15, 1929, entitled (translated freely here) "The increase in car accidents," covering aspects such as "Observations on how accidents unfold and their causes" and "Suggestions for preventing and limiting accidents." Many of the points raised there remain as valid as ever. The main causes of accidents were listed as technical defects on vehicles, human error such as fatigue or alcohol consumption, inadequate driver training "outside the framework of driving lessons," poor traffic control, poor road conditions, and careless behavior by pedestrians. It put alcohol-related accidents on the same level as accidents "caused by reckless driving, particularly by younger drivers, and speeding on rural roads and city streets." As for pedestrians, the author noted that "they are adapting only reluctantly and grudgingly to the rules of the road." He wrote that from time immemorial, pedestrians had considered themselves to be the "true masters of the road" and would "resist being forced to relinquish this position." Once again, the article highlighted that older vehicles and poor maintenance increase the risk of accidents. DEKRA's suggested improvements at the time included things like stricter checks, improved driver training, optimized traffic control, and preventative measures such as warning signs in hazardous locations. »

Even in the early days of automotive history, the main causes of traffic accidents were largely the same as those today

1955 • • • • 1960 • • • • 1965 • • • • 1970 • •

1955

- *The first section of **traffic barriers** is installed in Germany.*

1959

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

- *Mercedes-Benz launches the first car equipped with a **safety passenger cell**.*

1960

- *Certified **safety cabs** for trucks are launched in Sweden.*

1961

- *DEKRA becomes an officially recognized **vehicle inspection organization** in Germany. From this point on, the accredited experts no longer restrict their periodical technical inspections to members' vehicles.*

1963

- *Béla Barényi files a patent for the **safety steering shaft** for motor vehicles.*

- *Storchenmühle launches a **child safety seat for cars**. Britax Römer enters this market in 1966 (photo).*

1964

- *Luigi Locati presents an overview of motor vehicle safety, making a distinction between **active and passive safety** for the first time.*

1968

- *The US Department of Transportation (DOT) launches a program to develop experimental safety vehicles and initiates the international Technical Conference on the **Enhanced Safety of Vehicles (ESV)**.*

1969

- *The **German Road Safety Council** is founded.*
- *Honda launches the first **motorbike with disk brakes fitted as standard**.*

1970

- *The **European Enhanced Vehicle-Safety Committee (EEVC)** is founded as a European counterpart to the ESV program in the USA, focusing on regulations-related research. For example, it subsequently*

STATEMENT

Handling Transformation Responsibly

Kirsten Lühmann
President of the German Road Safety Volunteer Organization

One-by-one, major towns and cities in Europe are realizing that when motor vehicles share space with people walking and cycling, the only sensible speed limit is 30 km/h (~19 mph). Brussels, Madrid, Paris, and Amsterdam ... these four capitals have all, in recent months and years, switched to 30 km/h as the default speed limit. Spain, and Wales in the United Kingdom have gone as far as making it the default for urban roads nationwide. Bologna in Italy is the latest major city to join the 30 km/h club, with the new limit enforced since the beginning of the year.

There are very many benefits from lower speeds. They include lower noise pollution, air pollution, and of course improved safety. If there are concerns over negative impacts, they tend to be unfounded or overblown. Journey times, for example, hardly change for typical journeys in cities after the introduction of 30 km/h.

Some look at the headline speed reductions that take place, and question the benefits. In Wales, the latest analysis shows that average speeds dropped by 2.4 mph (3.9 km/h) after urban roads were switched from 30 mph (48 km/h) to 20 mph (32 km/h). But the science shows that even small reductions in average speed can bring dramatic road safety benefits. An ETSC report once found that an average speed reduction of just 1 km/h across the EU could result in 2,100 lives saved each year. Such is the critical importance of speed in reducing the frequency and severity of crashes.

Of course, 30 km/h limits are not new. Graz in Austria made the shift more than three decades ago. However, the more recent trend away from small 30 km/h zones or applying the lower limit only in a central area is now evolving into a much simpler city-wide or even nationwide default for urban areas. This may reduce the possibility of traffic being displaced outside of the zone, but another obvious additional benefit is the sheer simplicity. Drivers do not need to be constantly on the lookout for speed signs. In Brussels, speed signs are now only placed on roads with a higher limit of 50 km/h (~31 mph). Everywhere else, drivers are expected to know 30 is the default.

What should be the next steps? Firstly, towns and cities should be given the power to implement 30 km/h default limits without national governments making that difficult. In Germany, hundreds of cities have clubbed together to ask the government in Berlin to get rid of bureaucracy that makes it tricky to lower limits from the current default of 50 km/h anywhere apart from streets with schools or similar.

It would be naive to think that 30 km/h limits will end road death and injuries in cities. But it should be seen as a simple, cost-effective move that has benefits beyond safety. It also clearly signals loud and clear the acceptance of a reality that has been forgotten in many corners of Europe: that cities should be designed for the benefit all citizens, not just those that choose to travel by car.

1975 · 1980 · 1985

develops the testing methods for ensuring occupant protection in the event of a head-on or side collision, and the component tests to ensure pedestrian protection.

1971

- *Daimler-Benz AG files a patent for a viable **driver's airbag**.*

1973

- *The German Federal Highway Research Institute (BASt) starts the "Data collection at accident sites" project at the Hanover Medical School (precursor to the **"German In-Depth Accident Study" or GIDAS)**.*

1974

- *The **DEKRA Akademie** is launched, initially focusing on driver training.*

1977

- *The first **DEKRA journal** "Technische Mängel an Kraftfahrzeugen" (Technical Defects in Motor Vehicles) is published.*

1978

- ***DEKRA Accident Research** is established. The work of the experts builds on the accident reconstruction and includes a database for evaluating traffic accidents, as well as carrying out crash tests.*

- *The first Mercedes-Benz vehicles are fitted with the **ABS anti-lock braking system** as standard. The S-Class is the first model to feature it.*

- *An experimental safety vehicle is developed at four German universities (until 1982). This concept is designed explicitly for the **safety of pedestrians and cyclists**. The vehicle has a "soft face" across its entire front end. If the vehicle hits a pedestrian up to a collision speed of 45 km/h (~28 mph), this "soft face" is designed to keep the loads exerted on them below tolerable biomechanical limits.*

1981

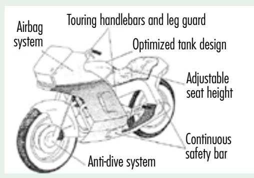
- *The Mercedes-Benz S-Class is the **first German car to feature an airbag**. General Motors had introduced an airbag system a few years earlier, but withdrew it from the market.*

1982

- *With his e-bike study, German inventor Egon Gelhard lays the foundations for the **pedelec principle**.*

1985

- *German insurance association HUK-Verband and DEKRA present a **safety motorbike**.*



A Systematic Commitment to Road Safety

DEKRA Accident Research was established in 1978. Its initial remit included devising and improving methods to reconstruct road traffic accidents, which were largely still inadequate at the time. However, as time passed, the DEKRA experts' knowledge and expertise were increasingly in demand for measures to improve vehicle and road safety as well. For example, since the 1980s, DEKRA Accident Research has worked on several national and international projects to improve the safety of trucks, tanker vehicles, cars, buses, motorbikes, pedestrians, and cyclists, and to enhance safety installations on the roads. For some years now, an increasing aspect of the department's work has been its collaboration in research projects funded by the European Commission. These have included the "APROSYS" project to improve passive safety, the "Safety in Motion" project to improve motorbike safety, and the "SafetyCube" project aimed at enabling the systematic comparisons of the costs and benefits of road safety measures across Europe.

DEKRA Accident Research is currently a partner in the "REALLOCATE" project, which aims to transform inner-city roads into integrated, green, safe, and future-proof urban spaces. The project is focusing particularly on sustainability, innovative urban design, measures designed to influence people's behavior, and smart technological and data-driven solutions for reducing the actual and perceived risks for road safety. The DEKRA experts' remit includes analyzing the pilot projects planned as part of "REALLOCATE" in several European cities to determine the level of road safety, and reviewing the measures taken to determine how successful they were.

"SOTERIA" is another project in which DEKRA is currently involved. This aims to achieve the EU's goal of "Vision Zero" for vulnerable road users sooner by implementing a holistic framework of innovative models, tools, and services; enable data-driven information about urban safety; make it easier for vulnerable road users to travel safely; and promote the safe integration of micromobility services in complex environments.

The core mission of DEKRA Accident Research remains unchanged: to identify risks and potential in the field of road safety and develop solutions, by analyzing daily accident statistics, conducting crash tests and road tests, and fostering an in-depth dialog across different disciplines.

1985 • • • • 1990 • • • • 1995

1986

- *The European EUREKA research project PROMETHEUS (PROgraMme for a European Traffic with Highest Efficiency and Unprecedented Safety) conducts the first research into the possibilities afforded by **automated driving**.*

1988

- *Through DEKRA France SAS, DEKRA offers **vehicle inspections outside Germany for the first time**.*

- *BMW presents the first **series-production motorbike equipped with ABS**.*

- *The International Traffic Safety Data and Analysis Group (**IRTAD** – originally the International Road Traffic and Accident Database) is established.*

irtad
International Traffic Safety Data and Analysis Group

1990

- *In the **new German federal states**, the technical testing and inspection center for motor traffic at DEKRA e.V. Dresden performs official vehicle inspection and personnel certification tasks at 27 new branches.*

1991

- *The standardized **emergency phone numer 112** is introduced in Europe.*

1991

- *DEKRA commissions its **Crash Test Center** in Neumünster.*

1992

- *France introduces the **contrôle technique**; new vehicles must be inspected for the first time after four years, and then every two years thereafter.*

1994

- *A **navigation system** is fitted as standard for the first time in the new BMW 7 Series.*

1996

- *Honda presents the first **motorbike with a combined braking system** featuring ABV and traction control.*

The Ever-Changing World of Mobility

The mass production of cars in the 1920s marked the start of motorized mobility's triumphant advance across the globe. The car became a new symbol of technological progress and a more modern society, particularly in Europe and North America. However, the road infrastructure was still in the early stages of development, and vehicles only had basic braking and lighting systems. In the decades after World War II, the car evolved from a luxury item to become a means of mass transportation, with many countries launching infrastructure programs to build and expand roads. As globalization stepped up a gear from the 1980s onward, numerous emerging countries such as China and India also saw an increase in motor traffic, while industrialized nations experienced the first problems caused by the mass use of cars. Congestion, air pollution, and

STATEMENT

Road Safety Begins With an Awareness of Sustainable Mobility

Juan Carlos Jerez Antequera
First Vice-President of the Committee for Road Safety of the Congress of Deputies in the Spanish Parliament

Before a person's knowledge of the rules of the road and traffic signs, and before their ability to drive a vehicle, comes their ability to internalize learned values and respect all road users. Yet these conditions are trumped in turn by something else: a person's awareness of the need for safe, sustainable mobility. Every time we decide to walk or cycle somewhere instead of driving, and every time we opt for public transport over our own vehicle, we make a major contribution to improving road safety.

This is because there are two important aspects to consider when it comes to road safety. The first is that the use of motor vehicles means that mobility is coupled with risk. It is precisely because motor vehicles pose a risk to road users that vehicle liability insurance is mandatory. The second aspect is that every motor vehicle we take off the roads of our towns and cities means one less risk for road safety.

We are all aware of the difficulties associated with this new approach to sustainable mobility and road safety. Many of our day-to-day activities require us to take part in road traffic. Indeed, the map of most countries is a road map. Reducing the use of motor vehicles must be the top priority in improving road safety.

For this reason, public authorities not only need to promote the energy revolution in the mobility sector by encouraging people to switch from combustion engines to electric vehicles, they also need to address the challenge of reducing the enforced reliance on motorized forms of transport. How? By designing cities to be more pedestrian-friendly; keeping motor vehicles away from schools; installing cycle paths and bus lanes; promoting sustainable public transport; shifting freight transport to the railways; promoting ride sharing; regulating urban distribution traffic caused by online shopping deliveries; and making it easier to work remotely – alongside numerous other measures aimed at achieving the same thing: less motorized traffic, more road safety.

2000 · 2005

1997

- *__Vision Zero__ is applied to road traffic for the first time in Sweden. The aim is zero traffic fatalities and serious injuries. The vision is based on the basic idea that people make mistakes – so the traffic system must allow for mistakes without endangering people's lives.*
- *The "elk test" results for the Mercedes-Benz A-Class lead to the breakthrough of the __electronic stability program (ESP)__.*
- ***Euro NCAP** publishes its first crash test results – with ratings for the tested cars to assess the level of occupant and pedestrian protection they provide.*

1999

- *By the end of the 1990s, __DEKRA is present in most EU countries__ – with vehicle inspections, as well as appraisals, claims settlement, and quality assurance.*

2000

- *Sweden begins to __expand rural roads__ with a central (steel cable) barrier according to the 2+1 principle.*

2003

- *DEKRA opens its __Technology Center__ with a state-of-the-art measurement and testing laboratory at the EuroSpeedway Lausitz in Brandenburg.*

- *The Euskirchen __traffic barrier system__ is approved in Germany; it provides better protection for motorcyclists in the event of an impact. Building on this design, DEKRA later develops the Euskirchen Plus system on behalf of the German Federal Highway Research Institute (BASt). It further improves the level of protection, also for the occupants of cars in the event of a high-speed impact.*
- *In The European Union, Directive 2003/102/EC governs the __protection of pedestrians and other vulnerable road users__. For new car models, frontal impact tests must be conducted to prove that certain biomechanical limit values are not exceeded in the event of an impact.*

2004

- *On April 6, the EU Commission launches the __European Road Safety Charter__ in Dublin. Its declared goal is to halve the number of traffic fatalities by 2010 compared with 2001 figures. DEKRA is among the first signatories to the charter.*
- *The European and Japanese car industries commit to equipping all __cars with ABS as standard__.*

accidents led to a growing awareness of the social and environmental costs of automobility.

The 21st century has brought profound upheaval to the world of mobility – the spotlight is now increasingly on topics such as digitalization, climate protection, and new usage concepts. Sharing programs, micromobility, and digital traffic management are playing an ever-growing role. However, while industrialized countries in particular are moving toward fully automated and connected mobility concepts, many countries in the global South still face quite different challenges, including a lack of infrastructure, outdated vehicles, and high accident rates, leading to a lower level of road safety.

Primary Goals of the United Nations

In order to halve the number of traffic fatalities in the period 2021 through 2030, the United Nations agreed on twelve voluntary performance targets back in November 2017. In this form, they are more or less also considered part of the "Global Plan for the Second Decade of Action for Road Safety 2021-2030." By 2030, for example,

- all new roads should achieve technical standards for all road users that take into account road safety or achieve a three-star rating or better;
- more than 75 percent of travel on existing roads should be on roads that meet technical standards for all road users and take into account road safety;
- all new – defined as manufactured, sold, or imported – and used vehicles should meet high quality assurance standards, such as the recommended UN regulations, global technical regulations, or equivalent recognized national performance requirements;
- the proportion of vehicles exceeding the specified speed limit should be halved and speed-related injuries and fatalities should be reduced;
- the proportion of motorbike occupants who correctly use standard helmets should increase to almost 100 percent;
- the proportion of vehicle occupants who use seat belts or standard child restraint systems should increase to almost 100 percent;
- the number of road traffic injuries and fatalities associated with drivers under the influence of alcohol should be halved and/or the number of injuries and fatalities associated with other psychoactive substances should be reduced;
- national legislation should exist in all countries to restrict or ban the use of cell phones while driving;
- all countries should enact regulations for driving and rest periods for professional drivers and/or implement the international/regional regulations in this regard;
- national targets should be defined and achieved in all countries to minimize the time between a traffic accident occurring and the first professional emergency care being provided.

It is clear that, based on what we have seen time and time again in past decades, our work to improve road safety cannot simply be a short-term campaign – it must be an ongoing process. The key is to ensure that preventative technical, organizational, and infrastructure measures are all coordinated to prevent accidents and reduce their impacts.

2005 *2010*

2006

- *Jaguar presents the first **series-produced vehicle with an active hood** to protect pedestrians.*

2008

- *The first **DEKRA Road Safety Report** is published. Each year since then, the report focuses on one main topic and issues specific recommendations.*

2009

- *In the EU, Regulation (EC) No. 661/2009 governs the **type-approval requirements** for the general safety of motor vehicles, trailers, and the related systems, components, and separate technical units. In 2020, this evolves into the General Safety Regulation.*
- *Newly registered commercial vehicles in the EU must be equipped with **retroreflective contour markings**.*

2011

- *In its **Road safety: Policy orientations on road safety 2011–2020** document, the European Commission sets the goal of halving the number of annual traffic fatalities by 2020 compared with 2010 figures.*

- *The installation of **daytime driving lights** becomes mandatory for all new passenger cars and trucks in the EU.*

- *In the EU, all new vehicle models coming onto the market (cars and light commercial vehicles) must be equipped with **ESP as standard**. ESP becomes mandatory for all newly registered vehicles from 2014.*

2012

- *Volvo introduces the first **pedestrian airbag** in the V40.*

2013

- *DEKRA **further expands** its motor vehicle inspection business internationally and acquires shares in VTNZ, the market leader in **New Zealand**.*
- *In the EU, new heavy truck and bus models must be equipped with an **advanced emergency braking system (AEBS)** and a **lane departure warning system (LDWS)**. This becomes mandatory for all newly registered vehicles from 2015.*

2014

- *Internet company Google presents a **prototype of a self-driving car**.*

- *Daimler presents the Mercedes-Benz **Future Truck 2025**. Thanks to the intelligent Highway Pilot system, the truck is capable of fully automated driving at freeway speeds of up to 85 km/h (~53 mph).*

Young People's Mobility Needs and Their Changing Values

In principle, having a driver's license is still considered very important in our society – especially by young people. A driver's license means that a person can travel as they please, gives them independence, and plays a big role in them "flying the nest." This is also reflected in the strategy paper "Youth on the Move: Young People and Transport in the 21st Century" published by the International Transport Forum of 2024, which outlines current and future mobility trends among young people.

The group analyzed in the strategy paper – 15 to 24-year-olds – currently make up around 16 percent of the world's population and primarily travel for education and training, work, and leisure activities. However, due to their limited financial means, young people do not have access to all modes of transport. Their individual circumstances and the availability of transport options also play a role. In the global North (Europe and North America = higher-income countries), the modes of transport most commonly used by young people – other than the car – are public transport and cycling, or they walk. In the global South (Africa and Asia = lower- and middle-income countries), young people mainly walk, cycle, and use shared transport options, but generally aspire to their own motorized means of transport.

The fact that fewer young people have a driver's license or a car nowadays, and that on the whole they use a car less often for their day-to-day travel needs, is mainly due to the economic factors associated with cars. These include, for example, the high costs of driving lessons and for buying and maintaining a vehicle. Additionally, many young people no longer see a car as a symbol of autonomy.

Another important factor is the change in values. These days, young people are less likely to prioritize the instrumental values associated with driving a car (e.g., convenience and flexibility), symbolic values (e.g., expression of status), and affective values (e.g., the enjoyment of driving). By contrast, Generation Z tends to expect more of a "smartphone on four wheels." Moreover, their attitude toward sustainable mobility influences whether they choose these modes of transport. An environmental stance and concerns about climate change correlate with the use of public transport and active modes of transport, and are associated with reduced car usage.

2015 • • • • 2020 • • • •

- *KTM and Bosch present the **electronic stability control system for motorbikes** (Motorcycle Stability Control).*

2015

- *DEKRA celebrates its 90th anniversary with a **vision** for the next ten years to become the global partner for a safe world – on the road, at work, and at home.*

- *A section of the A9 freeway in Germany becomes an official **test track for automated and connected driving**.*

2017

- *DEKRA signs the purchase contract for the **Lausitzring**. Together with the DEKRA Technology Center in Klettwitz, an innovation center for testing the mobility of the future is created there.*

- *In Germany, the **Act on Automated Driving** enters into force. It permits automated systems (Level 3) to take over the task of driving if certain conditions are met. A person must still be behind the wheel, but when the vehicle is in automated mode, they are permitted to turn their attention away from what is happening on the road and controlling the vehicle.*

2018

- *Launch of the Bosch **eBike ABS***

2020

- *The United Nations declares that 2021–2030 will be the **Second Decade of Action for Road Safety**.*

DECADE OF ACTION FOR ROAD SAFETY 2021 - 2030

2021

- *In Germany, the **Act on Autonomous Driving** enters into force. This enables fully automated motor vehicles (Level 4) to be used on regular public roads within defined operational areas.*

2022

- *All new vehicle models in the EU must be equipped with an **intelligent speed assistant, fatigue warning system, automated emergency braking system, emergency lane keeping assistant, reversing assistant**, and **tire pressure monitoring system**. This requirement has applied to all new vehicles since July 2024.*

2025

- ***DEKRA celebrates its 100th anniversary.** Deutscher Kraftfahrzeug-Überwachungsverein e.V. has now become the world's largest independent, non-listed expert organization for testing, inspection, and certification. Around 48,000 employees in 60 countries are committed to ensuring a safe and sustainable world.*

DEKRA 100 YEARS

Much Work Still Needs to Be Done

Road safety is a key concern across the globe. While some countries have significantly reduced the number of traffic fatalities, many others are still struggling with high figures. However, the goals set under "Vision Zero" – i.e., no fatalities or serious injuries in road accidents where possible – are still far from being achieved. Nevertheless, the DEKRA Vision Zero Map does show that there are already many cities across the globe which recorded no traffic fatalities in at least one year or even several successive years.

At the 4th Global Ministerial Conference on Road Safety, held in mid-February 2025 by the Kingdom of Morocco and the World Health Organization (WHO) in Marrakech, heads of state and government together with ministers and officials from over 100 countries once again urgently called for an intensification of commitments and measures to reduce the number of road traffic victims. This is not without good reason, as according to WHO figures almost 1.2 million people still die on our roads every year – equivalent to more than two deaths per minute.

As stated in the "Marrakech Declaration on Global Road Safety", among others, road safety must become a political priority if we are to succeed in halving the number of traffic fatalities worldwide by 2030. This aim is set out in the "Global Plan for the Decade of Action for Road Safety 2021–2030" from the WHO and the "Sustainable Development Goals" from the United Nations.

It is a very ambitious goal. According to the WHO's latest "Global Status Report on Road Safety" from 2023, by the end of 2021 only ten countries from four different regions managed to reduce the number of traffic fatalities by at least 50 percent since 2010: Belarus, Brunei, Denmark, Japan, Lithuania, Norway, Russia, Trinidad and Tobago, the United Arab Emirates, and Venezuela. In 15 countries the figure fell by 40 to 49 percent, in 20 countries it fell by 30 to 39 percent, in 33 countries it fell by 20 to 29 percent, and in 19 countries it fell by 10 to 19 percent. In a further eleven countries the figure fell by two to nine percent.

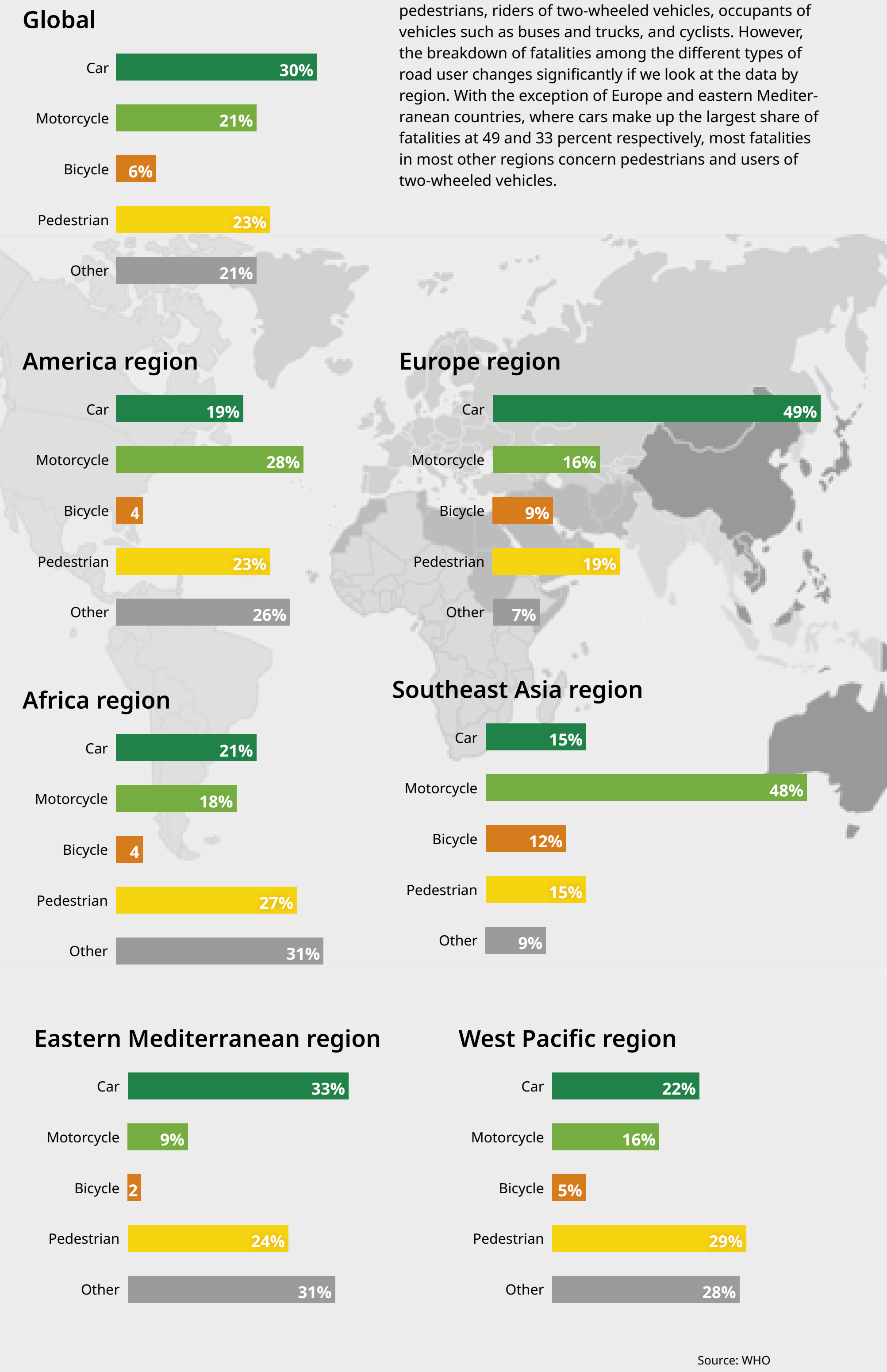
However, when viewed globally, the number of traffic fatalities fell by just five percent between 2010 and 2021. The discrepancy in the figures based on income status remains as high as ever: at 21 traffic fatalities per 100,000 inhabitants annually, the fatality rate is the highest in low-income countries – whereas in high-income countries it is "just" eight fatalities per 100,000 inhabitants and year.

If we look at the absolute fatality figures, they always need to be considered in relation to the population, the number of people with a driver's license, and the number of registered vehicles. Take the USA, for example: according to NHTSA figures almost 50,900 people lost their lives in a traffic accident in the USA in 1966. In 2022 this figure was around 42,500. This equates to a drop of 16.5 percent, which at first glance does not seem that impressive over this comparatively long period. On the other hand, the population increased by over 70 percent during this period, from around 195.6 million to around 333.3 million. The number of people with a driver's license more than doubled from 100.1 million to 235 million, and the number of registered vehicles more than tripled from 95.7 million to 303.5 million. When considered per 100,000 inhabitants the number of traffic fatalities fell between 1966 and 2022 from 25.9 to 12.76 (= a drop of roughly 50 percent), per 100,000 driver's license holders it fell from 50.4 to 18.1 (= a drop of roughly 64 percent), and per 100,000 registered vehicles it fell from 53.2 to 14 (= a drop of roughly 74 percent).

»

Percentage Breakdown of Fatalities Reported Nationwide by Type of Road User and WHO Region in 2021

As stated in the WHO's "Global Status Report on Road Safety 2023", the occupants of cars and car-like vehicles make up 30 percent of fatalities worldwide – followed by pedestrians, riders of two-wheeled vehicles, occupants of vehicles such as buses and trucks, and cyclists. However, the breakdown of fatalities among the different types of road user changes significantly if we look at the data by region. With the exception of Europe and eastern Mediterranean countries, where cars make up the largest share of fatalities at 49 and 33 percent respectively, most fatalities in most other regions concern pedestrians and users of two-wheeled vehicles.



Source: WHO

Road Safety Milestones in Selected Countries

In many countries the number of traffic fatalities rose steadily until the 1970s or even beyond. Road safety was not a major consideration before then. Since then, the number of road accident victims has been on a more or less constant and clear downward trend, in particular in many European countries. A wide range of different measures have contributed to this – notably the compulsory use of seat belts, speed restrictions, the ban on driving under the influence of alcohol and drugs, the ban on using cell phones behind the wheel, the compulsory use of helmets for motorcyclists, and the compulsory use of child restraint systems.

Germany

1956: Inclusion of fitness-to-drive certificates from an examination body in the German vehicle registration regulations (*Straßenverkehrs-Zulassungsordnung*) (known as "MPU" or medical-psychological examinations as from 1960)

1972: Speed limit of 100 km/h (~62 mph) on rural roads

1973: Blood alcohol concentration limit of 0.08% is introduced

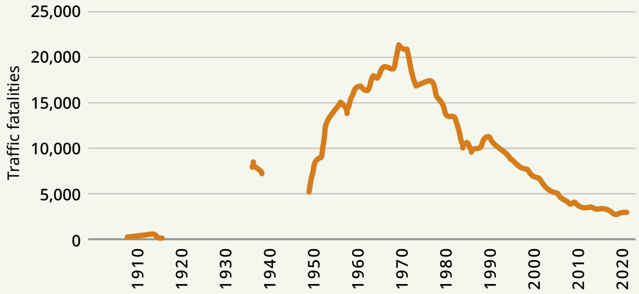
1976: Use of seat belts becomes compulsory for the first time

1976: Compulsory use of helmets for motorcyclists (as from 1978 this also applies to riders mopeds, and as from 1985 for riders of motor-assisted bicycles ("Mofa"))

1993: Introduction of the need to carry children under the age of 12/under 150 cm in height in suitable restraint systems

1998: Blood alcohol concentration limit is lowered to 0.05%

2007: Blood alcohol concentration limit of zero for novice drivers and driving license holders aged under 21



Territory of the German Reich (1906 - 1945), thereafter figures for East and West together

France

1972: Establishment of an Interministerial Road Safety Committee

1974: Speed limit of 130 km/h (~81 mph) on freeways

1975: Compulsory use of helmets and compulsory activation of low beams, even during the day, for motorbikes

1979: Compulsory use of seat belts in the front

1983: Driving with more than 0.08% alcohol in the blood becomes an offense

1985: Introduction of periodical vehicle inspections for cars

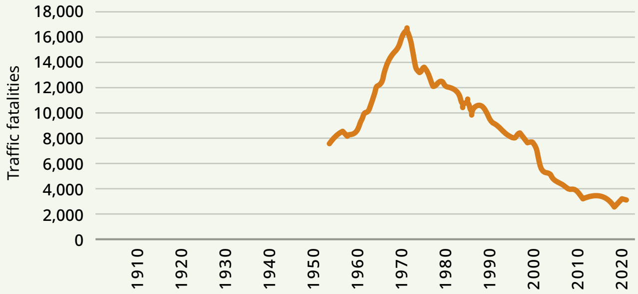
1991: Compulsory use of seat belts in the rear

1992: Reduction in the blood alcohol concentration limit to 0.05%

2003: Ban on making phone calls without a hands-free system while driving

2017: Compulsory use of helmets on bicycles for children under 12 years

2018: Speed limit of 80 km/h (~50 mph) on two-way roads



Poland

1983: Compulsory use of seat belts on front seats (also on rear seats as from 1991)

1997: Compulsory use of helmets for motorbikes and mopeds

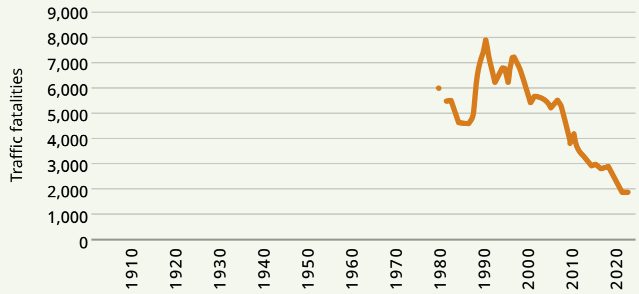
1998: Penalty points system

1998: Compulsory use of child restraint systems

2004: 50 km/h (~31 mph) speed limit in built-up areas

2007: Compulsory daytime running lights

2015: Increased penalties for speeding and severe punishments for drink driving



Sweden

1967: Switch from left-hand to right-hand traffic

Up until 1979: Introduction of various speed restrictions: basic speed of 70 km/h (~43 mph); 50 km/h (~31 mph) in densely populated areas; 30 km/h (~19 mph) in very high-risk areas; 90 km/h (~56 mph) on trunk highways; 110 km/h (~68 mph) on freeways

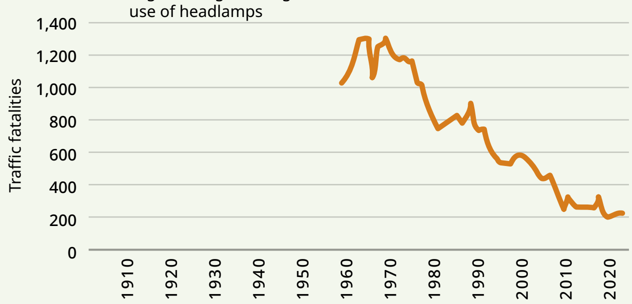
1977: Legislation governing the use of headlamps

1978: Use of helmets becomes compulsory for riders of motorbikes and mopeds

1988: For all children aged up to and including six, special approved safety equipment is prescribed during the journey

1990: Drink driving limit is reduced from 0.05 to 0.02% BAC

2018: Ban on the use of cell phones behind the wheel



Spain

1974: General speed restriction on freeways (130 km/h (~81 mph), later reduced to 120 km/h (~75 mph)

1982: Blood alcohol concentration limit of 0.08% is introduced

1985: Compulsory use of seat belts for the front seats and introduction of periodical vehicle inspections for cars

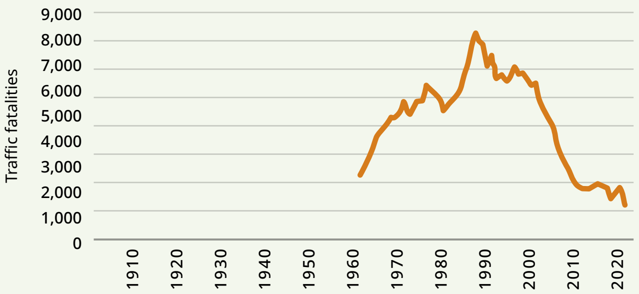
1992: Blood alcohol concentration limit reduced to 0.05% (as from 1999: 0.03% for professional and novice drivers), compulsory use of seat belts now also for the rear seats, and compulsory use of helmets for all motorcyclists on all roads

2006: Introduction of the driving license under the penalty points system, whereby drivers lose points for infringements and lose their license entirely if they reach zero points

From 2010 onward: Promotion of safer roads, more traffic circles, and improved lighting

From 2020 onward: Promotion of pedestrian protection measures and expansion of cycle paths

2022: More points lost for use of cell phone behind the wheel (6 points instead of 3)



United Kingdom

1966: Blood alcohol concentration limit of 0.08% behind the wheel is introduced

1973: Use of helmets becomes compulsory for riders of two-wheeled motor vehicles

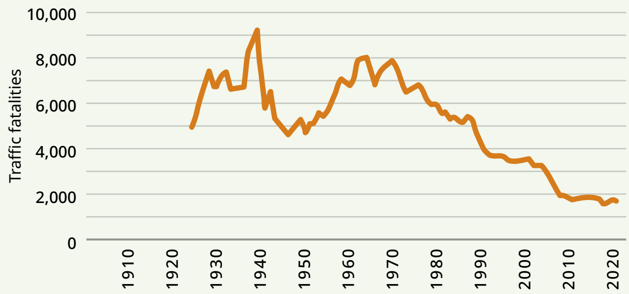
1978: Permanent introduction of national speed restrictions: 70 mph (113 km/h) on freeways and two-lane roads, 60 mph (97 km/h) on single-lane roads, and generally 30 mph (48 km/h) in built-up areas (20 mph (32 km/h) in Wales)

1983: Compulsory use of seat belts on front seats becomes law

1987: All newly registered cars must have seat belts on the rear seats

1989: Increased penalty points for careless driving, driving without insurance, failure to stop after an accident, and failure to report an accident

1991: Use of seat belts for children on the rear seats becomes compulsory in cars that have suitable restraint systems



Japan

1970: Introduction of the “Traffic Safety Policies Basic Act”, which laid the foundation for a long-term road safety strategy

1973: Compulsory use of helmets for motorcyclists

1986: Compulsory use of seat belts on front seats on freeways

1987: Introduction of traffic lights with countdown timer to improve safety for pedestrians and drivers

1989: Stronger enforcement of blood alcohol concentration limit (initially 0.05%, then 0.03% as from 1999)

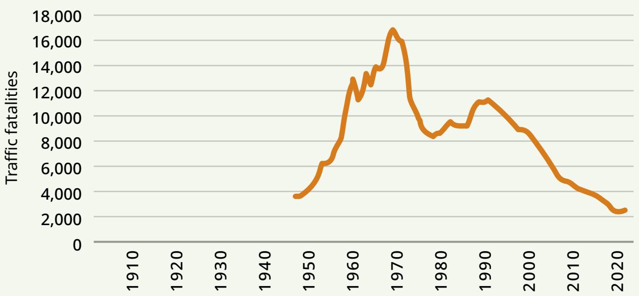
1992: Compulsory use of seat belts on front seats on all roads

2003: Compulsory use of seat belts on rear seats on freeways

2010: Compulsory use of seat belts for rear seats on all roads

2013: Higher penalties for use of cell phone behind the wheel

2022: Stricter penalties for users of e-scooters and cyclists who violate traffic regulations



Australia

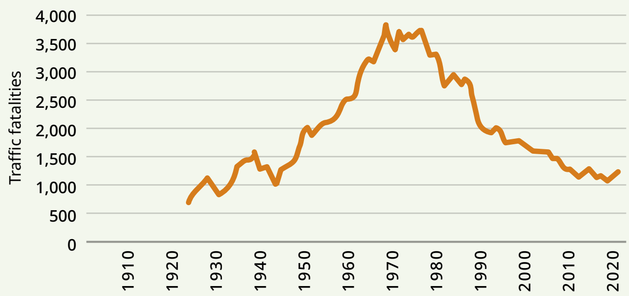
From 1970 onward: It is compulsory for new cars to have seat belts (requirements are then gradually transferred over to other vehicles and expanded to child restraint systems; there are also requirements for improved vehicle brakes, tires, lights, turn signals and glazing, headrests, higher impact resistance for vehicles, higher rollover resistance for buses, occupant protection in buses, and installation of speed limiters in high-speed vehicles)

Up until 1973: Laws on compulsory use of seat belts and use of helmet for motorcyclists

From 1976 onward: Gradual introduction of random breath tests

From 1980 onward: Radar cameras, laser-based speed measuring instruments, and red light cameras; also improved roads (expanded freeways, sealed shoulders at side of road, acoustic edge markings, etc.)

From 1990 onward: Use of helmets becomes compulsory for cyclists (in more and more cities)



Source: IRTAD

Parameters for Greater Road Safety

Back in 2004 the WHO defined five key factors that should be enshrined in law in all countries: speed restrictions, particularly in city traffic (max. 50 kilometers per hour); a maximum permissible blood alcohol level of 0.05%; the compulsory use of helmets for motorcyclists; the compulsory use of seat belts for all vehicle occupants; and the use of child restraint systems. According to the WHO, the countries that achieved success in the field of road safety in recent years are predominantly those that have implemented best practices together with legislative backing. 57 countries now implement WHO best practices in terms of speed restrictions, 48 in terms of the maximum blood alcohol level behind the wheel, 54 in terms of the compulsory use of helmets for motorcyclists, 117 in terms of the compulsory use of seat belts, and 36 in terms of child restraint systems. This means there is still room for improvement here.

Moreover, the latest WHO report states that there are currently only 35 countries – less than a

Use of Seat Belts in Commercial Vehicles

DEKRA Accident Research records the use of seat belts in commercial vehicles at regular intervals. This type of traffic study was most recently performed in 2022 in Germany, the Czech Republic, France, and Denmark. In the four countries, the N1 (under 3.5 metric tons gross vehicle weight), N2 (3.5 to 12 metric tons), and N3 (over 12 metric tons) vehicle classes were evaluated, each at different locations – in built-up areas, non-built-up areas, and on freeways.

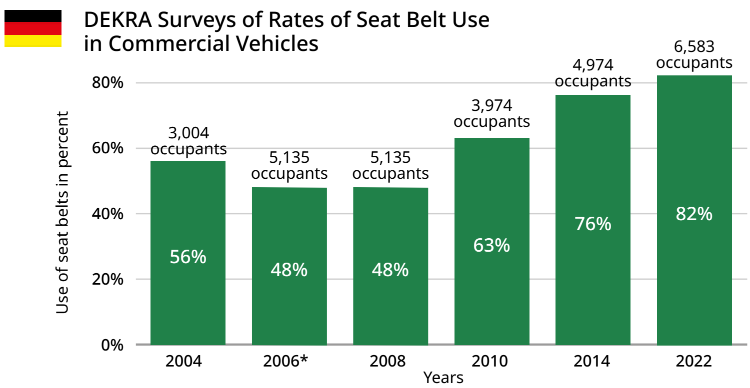
The background to the survey was that, alongside the increasing prevalence of active driver assistance systems, seat belts remain indispensable lifesavers in the event of an accident. Unsurprisingly, studies confirm that the drivers who were severely injured or killed more often are those who had not fastened their seat belt. These studies assume that of all truck occupants killed on the road who did not have their seat belts fastened, between 40 and 50 percent could have survived if they had fastened their seat belt. Seat belts also have an indirect effect here, as in addition to their direct protective function, they can be even more effective when used together with other safety systems – something which also applies to cars.

The traffic study from 2022 showed that of a total of roughly 17,000 people, approximately 14,100 had fastened their seat belt. This equates to an average rate of seat belt use of just 83 percent across all four countries. In other words, almost every fifth occupant had not fastened their seat belt. The overall rate of seat belt use was lowest in the Czech Republic (77 percent) and highest in France (87 percent), with Germany (82 percent) and Denmark (83 percent) falling in between. In all countries, the rate of seat belt use was highest in the van class (N1). The majority of those refusing to wear seat belts were in light trucks (N2) in the Czech Republic and France, and in heavy trucks (N3) in Germany and Denmark. Overall, across all countries and vehicle classes, the seat belt was worn more frequently by those in the driver's seat than by front-seat passengers.

In both built-up and non-built-up areas, the highest rates of seat belt use were seen in vehicle class N1; this applied across all countries. The rates for vehicle classes N2 and N3 were much lower. On freeways, the rates of seat belt use were above average and consistent across all countries and vehicle classes. In Germany specifically, the rate of seat belt use was much higher in 2022 than in earlier studies (absolute low point in 2008 at 48 percent, then rising to 76 percent by 2014).

Overall, the most recent traffic study shows that there is still significant room for improvement. This could be further exploited by additional educational measures, advancements in technology, and corresponding monitoring measures, but also by impactful sanctions.

DEKRA Surveys of Rates of Seat Belt Use in Commercial Vehicles



*Only rates of seat belt use on certain types of roads are available

Source: DEKRA

fifth of UN member states – which have enacted legislation on important vehicle safety features, such as advanced braking systems, ESP, front and side impact protection, and pedestrian protection. Some 134 countries prescribe regular vehicle inspections. However, of these, standards as specified in international agreements governing such inspections are only applied in 38 countries.

Use of Seat Belts Mostly Became Compulsory as From the 1970s

If we look more closely at the key factors, things like restraint systems play a key role in protecting vehicle occupants if an accident can no longer be avoided. We also need to remember that the active safety systems currently installed in vehicles are not fully effective unless the occupant's seat belt is also fastened and they are sitting in the correct position. Based on the statistics, we cannot determine when exactly legal guidelines prescribed the installation of restraint systems in vehicles, as the systems first needed to become more widespread in vehicles. Many countries made the use of seat belts compulsory in the 1970s – but in many cases this was initially only for the front seats.

If we look at Germany, we can see that the introduction of the seat belt requirement, together with other measures, led to statistically relevant positive effects. This can also be seen clearly in a number of other countries, such as Sweden (1975). In Japan the use of seat belts became compulsory at the same time as a variety of other measures designed to increase road safety, which had a positive impact overall. In the former East Bloc countries and in emerging nations, the use of seat belts often did not become compulsory until the end of the 1990s – for example 1996 for Latvia and 1999 for India. Although in India it only applied to the driver at that time, a slight downward trend can be seen in the statistics. In South Africa the use of seat belts did not become compulsory until 2005, but it applied to all occupants (including children) and came with a fine for non-compliance. The statistics show a fall in the number of fatalities, albeit with a delay.

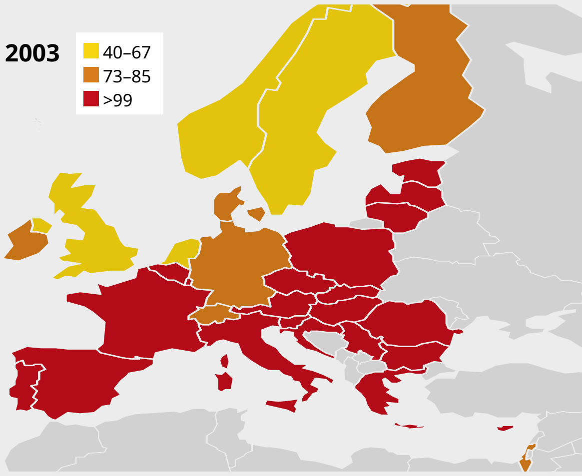
Speed Restrictions and the Compulsory Use of Helmets

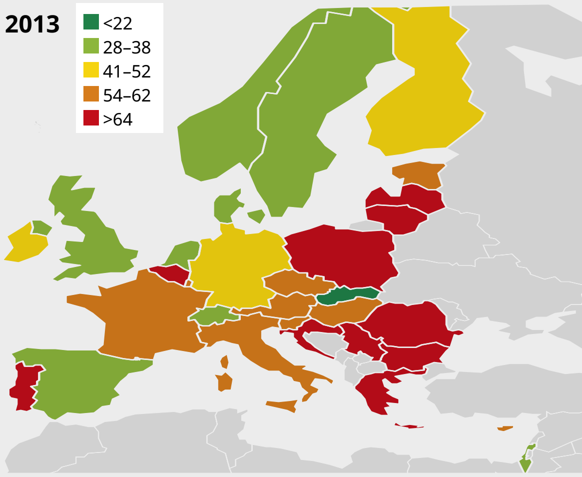
Speed limits are another useful means of improving road safety, provided they are accompanied »

Positive Overall Trend in Europe

In 2003 most European countries recorded well over 100 traffic fatalities per one million inhabitants in some cases. Bringing up the rear was Latvia, with 231 traffic fatalities per one million inhabitants. In 2013 Romania came out the worst with 93 traffic fatalities per one million inhabitants. In 2023 Norway and Sweden recorded the best results, with 20 and 22 traffic fatalities per one million inhabitants respectively. Bringing up the rear were Bulgaria and Romania with 82 and 81 traffic fatalities per one million inhabitants respectively.

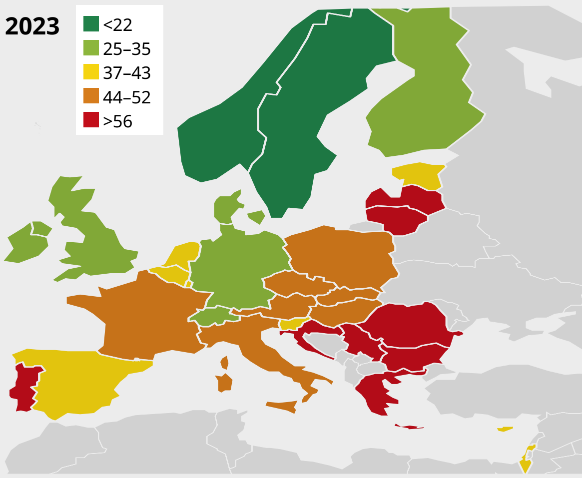
Traffic Fatalities per Million Inhabitants





The different scales used for 2003, 2013, and 2023 also underscore the marked improvements in road safety seen in Europe over the last 20 years.

While in 2003 most countries were still in the red range with more than 99 traffic fatalities per one million inhabitants, in 2013 and 2023 the smallest number of countries fell into the red range, despite the fact that it had been redefined each time and already started at 64 and 56 traffic fatalities per one million inhabitants respectively.



Source: ETSC

STATEMENT

The Automotive Story Is Still Young With Many Miles to Go

Saul Billingsley
Executive Director, FIA Foundation

What will our mobility look like 100 years from now? Perhaps we'll be booking air traffic control slots for our personal hydrogen-powered hovercraft, dodging those ubiquitous and irritating Bezos drones on our way to the office. Perhaps we won't leave home much at all, permanently plugged in to our work+leisure units awaiting the latest Tok shots from our AI supervisors. Or maybe we'll be in deep cryo-sleep halfway through our journey to Planet Elon, dreaming of the burnt cities and flooded streets we sadly abandoned.

Whatever the future holds, could it be more radical than the changes experienced over the last century? In 1925 automobiles were still a minority mode in richer countries, although rising fast. They had evolved from aristocratic plaything to general workhorse – for farmers, taxi drivers, salesmen, doctors. Real horses were being slowly phased out. Railways and trams carried much of the burden. Children still walked and played in the street, just about, but thousands paid the ultimate price for not adjusting to the new automotive realities. Even then, it was clear that this wouldn't be a bloodless revolution.

The motor industry responded to the Great Depression by building cheaper cars, primed for expansion. Post-war ownership boomed, popular culture amplified, teenagers made out, and advertisers honed their talents for technicolor TV. The automobile dominated because it was popular, aspirational, and, with financing, affordable. It also dominated because alternatives were starved of funding, streetcars ripped up, local train lines closed down. The auto, oil, and asphalt industries have looked after many fine lobbyists. Lewis Mumford warned against 'monotechnic' policymaking, and he wasn't wrong.

While few cities went full Le Corbusier – hello Brasilia – most were radically transformed by the car. Freeways, expressways, flyovers, parking lots, out-of-town shopping malls, spaghetti junctions: we have lived so long with auto-oriented planning and architecture that we lose sight of how strange it is. Much like smartphones today, cars just took us over and changed us. We like to think we're in charge of the machines but it's never true. We adapt, like good servants do. AI is taking notes.

Most addictions start out enjoyable. Jazz Age fun for the few morphed so quickly into 1970s oil shocks for the many, by which time we were fully hooked up to the gasoline, dependent. Lines of station wagons queuing at petrol stations was never part of the dream. Nor was climate change. Nor a million plus annual dead in road traffic collisions. Yet even in the worst traffic jam there's something comforting about the leather upholstery, the air conditioning, the excellent sound-proofing, the latest podcast on the stereo system, and the soft purr of the engine. Sure beats standing in the rain waiting for an overcrowded bus.

People want cars, or motorbikes, and increasingly, these days, they're getting them. It is worth remembering that for most people owning a car is a recent experience. While U.S. car ownership raced ahead, followed by Western Europe and Japan, much of the world remained firmly in the nineteenth century, bicycling along. China only reached America's 1920 levels of car ownership per capita in 2002, and now leads in electric vehicle production. Brazil hit America's 1925 ratio in 2012. Even Eastern Europe, held back by communism, only entered the American 1930s at the Millennium. A century on, the automotive story is still young with many miles to go.

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by corresponding monitoring measures and punishments if they are breached. Nowadays, most countries have speed restrictions on the different types of road. In Germany a speed limit of 50 kilometers per hour has applied in built-up areas since 1957. The introduction of this limit can also be positively identified in the accident statistics. In contrast, the introduction of the 100 km/h (~62 mph) limit on rural roads in 1972 came at the same time as the oil crisis, meaning it cannot be considered the sole factor behind the positive trend. In South Africa speed restrictions were introduced in 1989, and this can also be seen in the statistics, albeit with a delay. Japan has more complex requirements for speed limits, based not only on the type of road, but also the number of lanes, the way in which oncoming traffic is segregated, and above all how many pedestrians there are. In 2016 the speed limit was raised from from 100 km/h (~62 mph) to 120 km/h (~75 mph) on a number of well-developed freeways; this did not have a negative impact on the statistics.

A Look at the USA

Road safety in the United States is influenced by a wide range of legal and regulatory interventions at state level. While some states have implemented stricter regulations and safety standards, others have less restrictive rules.

Speed restrictions

The speed limits in the USA vary from state to state and are set by local authorities.

Driving under the influence of alcohol and drugs

In almost all states, driving with a blood alcohol concentration of 0.08% or more is an offense. Utah has already lowered the limit to 0.05%. In addition, all states have zero-tolerance legislation for drink driving by drivers aged under 21. Driving under the influence of drugs is also banned throughout the USA, although the regulations for the limit values differ for different substances.

Use of cell phones

27 states as well as Washington D.C., Puerto Rico, Guam, and the U.S. Virgin Islands have banned the use of cell phones (held in the hand) for all drivers. In 37 states a ban applies for novice drivers, and 23 states ban the use of cell phones for school bus drivers. Writing text messages while driving is banned in 48 states and the aforementioned territories.

Seat belts

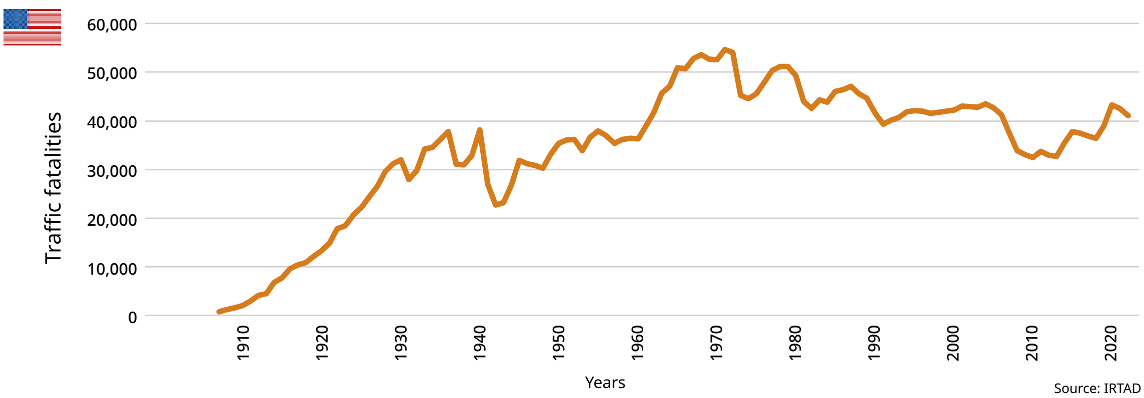
The regulations governing the compulsory use of seat belts are split into two categories: primary and secondary legislation. Primary legislation: the police can stop and penalize a driver just for failing to fasten their seat belt (applies in 35 states). Secondary legislation: a penalty is only imposed if another traffic offense has been committed (applies in 15 states). In terms of the rear seats, 39 states have issued legal regulations on the compulsory use of seat belts, while 10 states do not have such regulations. New Hampshire is the only state that has not made the use of seat belts compulsory for adults in general.

Child restraint systems

All 50 states plus Washington D.C. and Puerto Rico prescribe the use of suitable child seat or booster seat systems for children who are too small to use a normal seat belt. The exact regulations are based on the child's age, weight, and height.

Compulsory use of helmets

Depending on which state is concerned, different regulations apply regarding the compulsory use of helmets for motorcyclists: 21 states as well as Washington D.C. and some other U.S. territories have made the use of helmets compulsory in general. 28 states only prescribe the use of a helmet for certain groups, such as young or inexperienced riders. New Hampshire has not made the use of helmets compulsory for motorcyclists. With respect to cyclists, the use of helmets has not been mandated at national level.



Source: IRTAD

France recently changed the speed limits in non-built-up areas. After lowering the limit to 80 km/h (~50 mph) on rural roads, it was increased to 90 km/h (~56 mph) in some departments. Since 2024 a speed limit of 80 km/h has applied again on rural roads throughout France. Since speed monitoring measures also increased, putting drivers under greater pressure, improvements in road safety cannot be attributed exclusively to this measure. However, we can see a positive trend.

Although almost all countries have made helmets compulsory for motorcyclists, the situation is different for riders of (electric) bicycles. For this group, the requirements often only apply to children or young people. In South Africa, for example, helmets have been compulsory since 2004; in Japan they were made compulsory for cyclists of all ages in 2023. In most countries that have made helmets compulsory for motorcyclists, the compliance rate is almost 100 percent. However, it's a different story for cyclists. Despite there being corresponding rules in place, this group wears helmets less. If we look at the general statistics, we cannot determine when exactly helmet legislation was introduced as the effect is too small. Previous regulations in parts of India on the compulsory use of helmets for motorcyclists seem a little odd, as women were exempted for some time. However, they are now also required to wear a helmet. One particular exemption remains in force throughout India – members of the Sikh religious community are exempted from having to wear a helmet if they wear a turban.

Alcohol and Drugs Behind the Wheel

In addition, almost all countries have defined limit values for the consumption of alcohol and intoxicating substances for road users. In terms of alcohol limits, many countries distinguish between professional drivers, drivers with many years of driving experience, and novice drivers. In the USA, New York was the first state to enact corresponding legislation, done in 1910. It was not until 1988 that all states had a limit of 0.08%, with some states stipulating lower limits.

In Germany the first limit value of 0.15% was introduced in 1953, gradually reducing to 0.08% (1973) and then 0.05% in 2001. However, accidents involving alcohol or intoxicating substances were not recorded separately in the statistics until 1975, so we do not have any detailed findings about the impact of the reduction in 1973. When viewed over a longer period of time, the various measures to combat alcohol as a cause of accidents are not just reflected in the accident statistics with car drivers as the main culprit – the success of these measures is also impressively reflected in the fall in all road users killed in alcohol-related accidents. Whereas 2,229 people were killed in alcohol-related accidents in 1991, this figure dropped to 198 by 2023.

A statistical analysis of accidents in connection with intoxicating substances shows that the topic was not considered hugely important in Germany until 1975. However, in the 1990s there was a huge rise in the number of recorded accidents involving the influence of intoxicating substances. The use of drugs became increasingly widespread across all layers of society. At the same time, the availability of rapid drug tests improved – they were not only easier to access, but also much simpler to use. These developments led to more tests being performed and, in turn, to a higher number of positive results. The rising trend has continued to this day.

In particular, when it comes to road safety we need to take a special look at the legalization of cannabis in different countries. A study from Colorado shows the changes seen since it was legalized in 2013. Since the legalization of marijuana for recreational use in this U.S. state, the number of people killed in accidents involving drivers who had tested positive for marijuana, increased by 138 percent by 2020 – from 55 to 131. The number of traffic fatalities overall only increased by 29 percent in the same period.

Speed restrictions have a clear positive effect on accident statistics

High Risk of Accidents From Driver Distraction When Driving

In addition to the aforementioned factors, there is also a high risk of accidents from drivers being distracted behind the wheel. Over the past few years, the spotlight has increasingly been on people texting, reading messages, and making calls while holding a telephone. Depending on how fast they are traveling, even just a brief glance at a smartphone will cause the driver to travel relatively large distances while “flying blind.” For example, when traveling at 50 km/h (~31 mph), just two seconds of distraction will mean the driver flies blind for

STATEMENT

Joining Forces to Achieve “Vision Zero”

Manfred Wirsch
President of the German Road Safety Council

I’d like to warmly congratulate DEKRA on its 100-year anniversary. This year’s Road Safety Report – “The Changing Face of Mobility” – not only looks back at how our traffic system has evolved dynamically over time, it also looks forward at what is yet to come. It underlines that our efforts to improve road safety must always be geared toward technical, infrastructure, and social factors.

The history of road safety is characterized by ongoing adaptation to meet new challenges. Our society has undergone a remarkable transformation, from the time of the first traffic signaling systems (traffic lights) which were introduced in 1924, to the first road traffic regulations of the German Reich in the 1930s and post-war period, to today’s mass car ownership. In the 1960s we were still pursuing the idea of a car-friendly city. Today we are striving for sustainable and safe mobility concepts that accommodate all road users.

This paradigm shift is also reflected in our commitment to achieving Vision Zero – i.e., eliminating fatalities and serious injuries on our roads. This goal unites both of our organizations. DEKRA is a partner and longstanding member of the German Road Safety Council (DVR) and contributes its impressive expertise to our work. Moreover, it takes a very practical approach in order to improve road safety in many areas. In addition to the essential technical inspection of vehicles, this also includes high-profile contributions such as this Road Safety Report. It is important that political decision-makers and the public are constantly presented with facts, figures, and the results of surveys. For many years now, the Road Safety Report has been a tried-and-tested means of measuring progress and identifying new challenges. The authors highlight success stories, but also indicate clearly where there is still work to do to improve road safety. Correct communications can also save lives.

The collaboration between the DVR and DEKRA is hugely important. Despite a sharp increase in the amount of traffic on our roads, over the years we have managed to steadily reduce the number of fatalities and life-threatening injuries by focusing on things such as active and passive vehicle safety. After achieving a historic low in the number of traffic fatalities in 2020, we are now unfortunately seeing that the trend is stagnating. This probably also reflects our changing mobility habits. The increase in cycling and walking in recent years is a positive development in many respects. However, if we are to improve road safety, this must be accompanied by the construction of “forgiving” infrastructure. In addition to safer infrastructure, it is also important to integrate modern technologies such as driver assistance systems. This is a key area where we need practical answers, in order to ensure technical safety over the entire life cycle of the systems – which includes rules to govern data access.

Our primary task is to shape the future of mobility such that there are no fatalities or life-threatening injuries. Let us join forces to ensure that technological progress goes hand in hand with road safety. This is the only way to design a world of mobility that is efficient, sustainable, and, above all, safe for everyone.

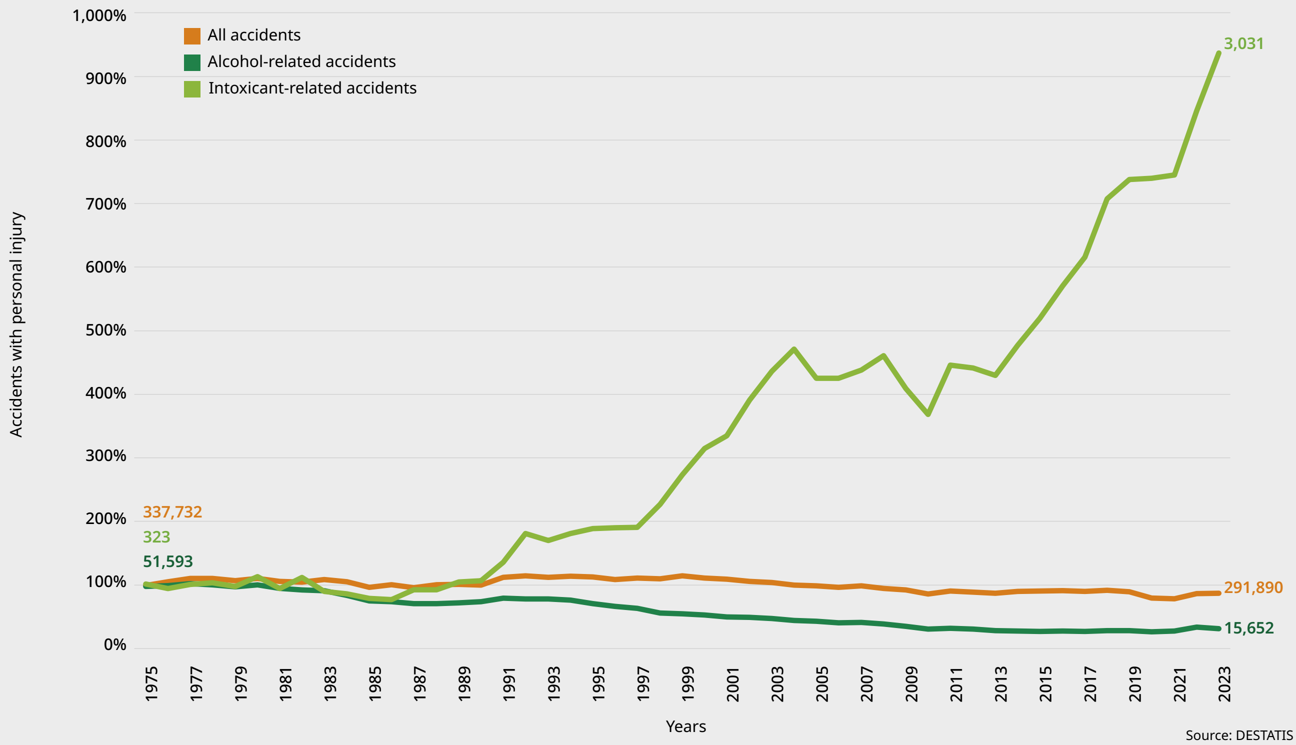
some 28 meters. Most countries have banned people from holding a telephone while driving. In contrast, making calls with hands-free systems is almost always allowed. However, if we look at individual country-specific statistics, we cannot tell when exactly bans were introduced as the use of cell phones has skyrocketed ever since and has counteracted the effects that the bans could have achieved.

Distractions behind the wheel are not just restricted to the use of smartphones or the driver occasionally reaching for a drinking bottle. Modern vehicles are becoming increasingly challenging to operate. This concerns not only basic functions such as operating the windshield wipers, using the lights, or adjusting the temperature, it also relates to the infotainment systems. Large screens distract the driver from what is happening on the road, and unlike knobs or buttons it is now almost impossible to use touch functions without the driver diverting their attention. These new types of distraction (which, in the case of smartphones, affect all types of road user) are also a reason why accident figures have stopped falling in many countries since 2012 and 2013.

The official German statistics did not record the criteria of “Distraction by electronics” and “Other distraction” separately until 2021, and in many cases they are very difficult to determine after an accident. The number of unrecorded cases is therefore correspondingly high. In this context, we also refer to a study published in 2023 by the Allianz Center for Technology entitled “*Ablenkung und moderne Technik*” (Driver Distraction and Modern Technology). One of its findings was that the risk of accidents increased by around half for many technology-related distractions. For example, it in- »

Comparison of Accidents With Personal Injury

In Germany the total number of accidents resulting in personal injury and the number of alcohol-related accidents have remained more or less constant for years. However, the number of intoxicant-related accidents has skyrocketed over the decades. Since 1975 the number of accidents resulting in personal injury which were caused by the influence of intoxicating substances (other than alcohol) has increased nine-fold. The diagram shows the relative changes in percent since the 1975 baseline. In contrast, the absolute figures for all accidents and for alcohol-related accidents are naturally much higher, as can be seen from the numbers at the beginning and end of the respective curves.



Source: DESTATIS

STATEMENT

Road Safety Policy Must Support Changes in Mobility

Florence Guillaume
Interministerial Delegate – Directorate for Road Traffic Safety

When it comes to road safety, the legacy that we are passing down is a set of rules that we have continuously built up over time, layer by layer. This road safety policy always reflects its time and the world of mobility as people are experiencing it. However, it also always looks ahead to further developments. Ultimately, it is a witness to the very world of mobility that it is influencing – while also helping to shape it.

For example, the very first regulations at the time of the Ancien Régime focused on the new idea that roads needed to be maintained and pedestrians needed to be protected. Work then continued to flesh out the regulations more (the first fitness-to-drive certificate, the first traffic lights, etc), before culminating in 1921 in the German Road Traffic Act (***Straßenverkehrsordnung***). The aim was to regulate car traffic, which had become denser, faster, and riskier for road users.

When road safety came onto the scene at the start of the 1970s, the car was already a firm fixture of our society, both socially and culturally – it represented freedom, speed, and convenience. The comprehensive and coordinated political measures which were then taken – focusing particularly on cars – revolved around three levers: the road (spatial planning and "error-tolerant" infrastructure), behavior (vehicle drivers acting responsibly), and vehicle (equipment and driver assistance systems). In some cases, people initially did not understand the measures that were introduced as they were individually considered restrictive and people did not see that they aimed to provide collective safety. However, they ultimately bore fruit as 50 years later, the number of people killed on the roads of France every year has dropped to one sixth of what it was.

The accident statistics in France have changed over the years. In the 21st Century, we are seeing that the world of mobility is becoming increasingly diverse. It is a time characterized by the sustainable use of public spaces and the need for a green transformation. Since 2022 car drivers have made up less than half of traffic fatalities. More than ever, road safety means championing the safety of all modes of transportation on our roads. This policy area is closely following new transport modes to ensure the weakest road users are protected.

The biggest challenges we currently face are ensuring we divide up the traffic space correctly, the fact that there are so many different modes of mass transportation, and the speed of the traffic – and in providing a very diverse group of road users with protective equipment. The triad of road/behavior/vehicle still applies, but its starting points have now been reconsidered to better accommodate active travel concepts, thereby ensuring they find their place in the traffic mix and in our traffic spaces. This is a key area for road safety authorities. This is also evident from the stronger focus on regulatory activity, the development of special infrastructure, the priority given to prevention measures, targeted awareness-raising campaigns for employers focusing on risk prevention when out on the road in a professional context, and the stronger focus on continuous information and continuing education campaigns.

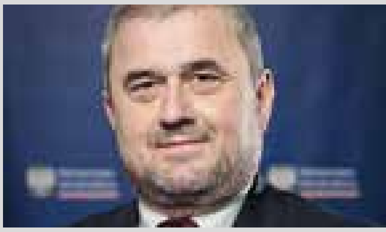
It was and remains the case that road safety policy supports further developments in mobility, always with the goal of saving lives. To achieve this, the main target group of this policy – the full spectrum of road users – must take ownership of this underlying principle and recognize that it is about serving a common interest. After all, if we think about all the constant change we have seen in the world of mobility, it is clear that following the rules that everyone is subject to is a prerequisite for the freedom to travel from A to B safely – a timeless commandment.

creased by 61 percent for writing a message on a cell phone held in the driver's hand, by 54 percent if an anchored/installed device was being used, by 46 percent when using the navigation system, and by 56 percent when performing other tasks with the assistance system activated. A study into the trend in traffic accidents involving young drivers in the USA also demonstrates that being distracted while driving a car is highly relevant for road safety. According to this study, in the seconds prior to the accident the drivers were distracted by something else in 59 percent of cases. The most common causes were identified as interacting with passengers (14.6 percent), using a cell phone (11.9 percent), and using items of equipment in the cockpit (10.7 percent).

STATEMENT

There Is Still a Lot to Do

Stanisław Marcin Bukowiec
Deputy Minister for Infrastructure



In recent years Poland has taken on a leading role in Europe when it comes to improving road safety. And it has done so despite the fact that the number of traffic fatalities in our country remains above the average for the European Union – in Poland there are 52 fatalities per one million inhabitants, compared against 46 EU-wide. However, we must stress that the number of severe and fatal traffic accidents is steadily decreasing. Over the past decade, the number of people who lost their life in a road traffic accident has fallen by almost 44 percent.

Since 2014 major progress has been made in improving road safety, which is reflected in the following data:

- The number of people killed on the road fell from 3,202 in 2014 to 1,893 in 2023 – a fall of 1,309 fatalities (= 41 percent).
- The number of severely injured casualties fell from 11,696 in 2014 to 7,595 in 2023, equating to a drop of 4,101 (= 35 percent).
- The interim goals of the Polish National Road Safety Program for the years 2021-2030 were clearly achieved in 2023. The program's basic assumption for 2023 was that there would be 2,474 traffic fatalities. However, the actual figure of 1,893 was well below that. It was a similar story when we look at severely injured road users.
- The program assumed there would be 9,040 severely injured people on our roads in 2023, but the actual figure for that year was 7,595.

These measures and figures were subsequently also recognized and commended by the European Transport Safety Council (ETSC), which awarded Poland the prestigious Road Safety Performance Index (PIN) Award in 2023 for its outstanding work to improve road safety.

Despite all the success, we are well aware that there is still a lot to do in this area. In order to achieve the goals of the Polish National Road Safety Program for 2021-2030 (which aims to reduce the number of fatalities and severely injured people on our roads by 50 percent by 2030), it is essential that we intensify our efforts. To do so, we intend to place a particular focus on infrastructure, education, changes to legislation, and monitoring.

In order to protect pedestrians – which also involves providing in-depth road safety training to children and young people at Polish schools – we need to encourage people to take part in road traffic in a considerate and responsible way, based on them having respect for their fellow human beings and observing and complying with legal regulations. Another important aspect is ensuring the safety and protection of other road users – in particular people over the age of 60, whose ability to find their way in road traffic and drive a motor vehicle, as well as their visual and perceptive skills, naturally start to deteriorate as they get older.

We need to strengthen our supervisory and monitoring activities by means of corresponding checks conducted by authorized agencies, with the aim of enforcing existing regulations and preventing violations. Changes to legislation proposed by the Polish Ministries of Infrastructure, Justice, and the Interior and Administration, which propose stricter penalties for speeding and other traffic offenses that often have tragic consequences, are intended to improve road safety. I trust that these and other measures will play their part in making Polish roads safer.

Impact of Other Factors

We can also repeatedly see one-off effects reflected in the statistics for individual countries, and they have a big impact on road safety. For example, during times of economic crisis people drive less and more slowly (i.e., more economically) in order to save money. Other events involved a complete ban on driving motor vehicles, or people were required to stay at home. Both had a positive impact on the accident figures. For instance, the oil crisis of 1973, which preceded an economic crisis, is reflected in the accident figures for Germany, Japan, the USA, and South Africa. The financial crisis of 2007 can be seen in the statistics for the USA and Latvia in particular. During the coronavirus pandemic which

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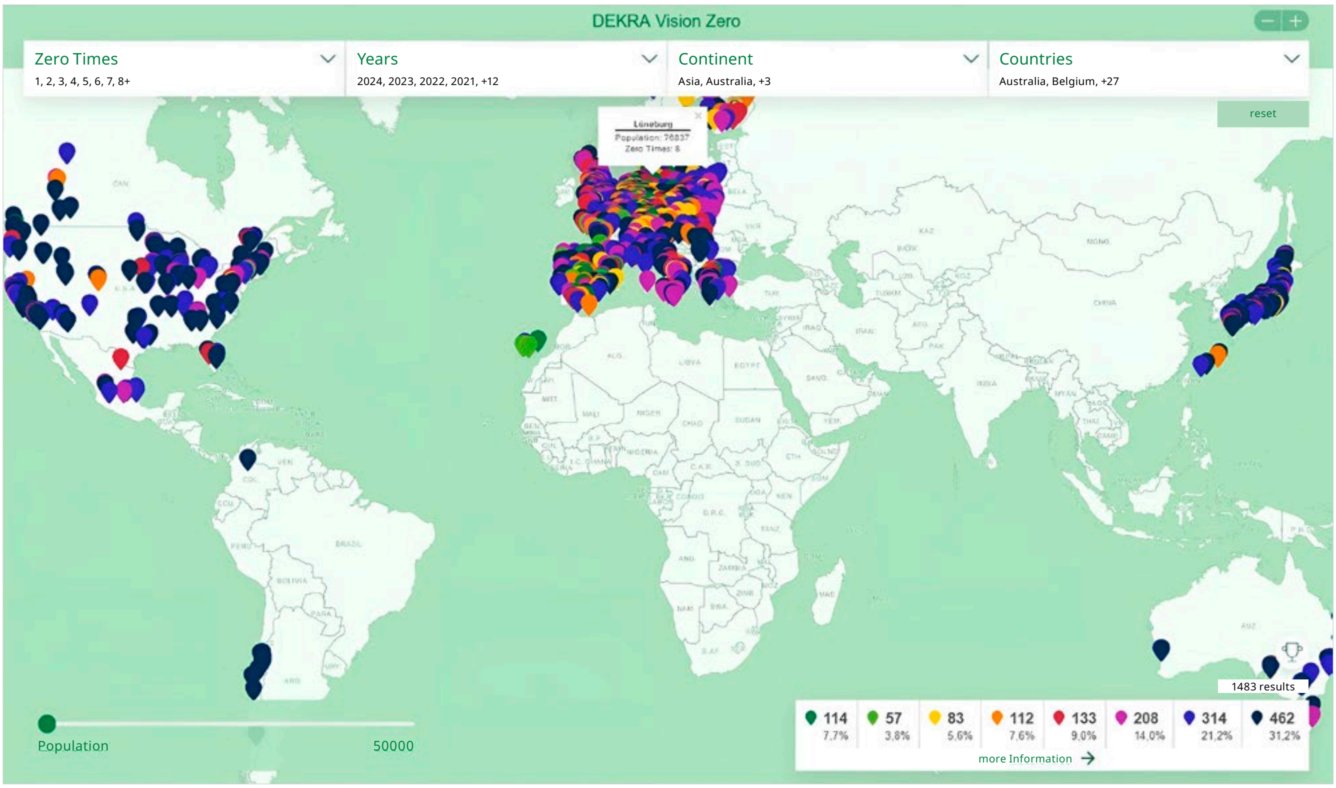
DEKRA Vision Zero Map

A cornerstone of our efforts to improve road safety is "Vision Zero", developed in Sweden in the 1990s. It aims to design road traffic such that no more road users are killed or severely injured. At the beginning the approach was often criticized as a utopia. However, this vision can become a reality if we pursue a strategy of taking lots of small steps to make our roads safer overall for the long term. In order to do so, we need to analyze all measures that relate to road traffic against the goals set under Vision Zero and amend them accordingly if required. In practice, this means that all players must follow this philosophy – from road users to vehicle manufacturers, plus all those responsible for the planning, construction, maintenance, and operation of traffic routes and spaces, all the way through to legislative and executive players. We should not start at national level, but rather focus much more on smaller, manageable units such as regions or cities. Almost 1,500 cities across the globe have now shown that this goal is achievable when it comes to the number of traffic fatalities.

For eleven years now, DEKRA has been logging these success stories on an interactive world map. The data available from the International Traffic Safety Data and Analysis Group (IRTAD) was evaluated on a large scale for the first time for the DEKRA Road Safety Report 2014 – the focus was on traffic in built-up areas. The results at the time showed that hundreds of cities with more than 50,000 inhabitants had already achieved the goal of achieving zero traffic fatalities in at least one year since 2009. An Internet tool made it possible to present the data clearly. It was presented for the first time at the International Transport Forum (ITF) 2014 in Leipzig. Ever since then, both the data analysis itself and the online portal have been continuously expanded. 17 European countries were logged initially; today there are around 30 countries. The focus remains on Europe, but the USA, Canada, Mexico, Australia, and Japan are now also included.

Even if we look at the major cities with more than 100,000 inhabitants, around 350 have already achieved the goal of "Vision Zero" in at least one year. One of the biggest cities listed is Espoo in Finland with around 305,000 inhabitants.

www.dekra-vision-zero.com



STATEMENT

Policy's Role in Transforming Roadway Safety for All

Mark Chung
Executive Vice President Roadway Practice,
National Safety Council (NSC)

In October of 2024, the Road to Zero Coalition, a group of over 2,000 transportation safety stakeholders led by the National Safety Council and the U.S. Department of Transportation, released a report that demonstrates beyond a doubt the increased safety risks to our roads posed by larger vehicles. Stemming these risks will require changes in vehicle design that cannot be merely voluntary. They must come with effective and firm policies whose primary aim is to protect all road users – whether riding, biking or walking – from harm.

Decades-old regulatory frameworks – such as the Corporate Average Fuel Economy standards – encouraged the move toward bigger and heavier vehicles in the U.S., cultivating a vehicle marketplace in which SUVs, pickups, and vans (collectively, "light trucks") became the dominant models available. Today, light trucks make up roughly 75 percent of new consumer vehicle sales, and they pose risks to pedestrians, bicyclists, and persons in smaller vehicles at unprecedented levels. For years, the proportion of all roadway fatalities for people outside of vehicles (such as pedestrians and bicyclists) has been rising, and this report shows the specific design features relating to height, weight, and direct vision that we believe have contributed to this shift.

Currently, National Highway Traffic Safety Administration's New Car Assessment Program (NCAP) does not include pedestrian nor cyclist safety metrics. Expanding NCAP standards to do so, and to require high scores on those in order to receive a five-star rating, would establish an important precedent that protection for vulnerable road users (VRUs) in vehicle design is prioritized by the manufacturer. One need to look no further for inspiration than international precedents (specifically EURO NCAP), where VRU standards have led to meaningful reductions in road fatalities. By holding manufacturers accountable to these safety benchmarks, we will set a new standard in roadway safety fully informed by the shared nature of public roads.

Besides safety measures, certain life-saving technologies such as Automatic Emergency Braking (AEB) with pedestrian detection and intelligent speed assistance should be required. These systems help drivers avoid preventable crashes or reduce the severity of collisions, especially those involving pedestrians and cyclists. Full deployment of these kinds of technologies would undoubtedly reduce VRU fatalities and improve safety in the U.S. for all road users.

Localities across the country require that their governments be empowered to design roads to accommodate safer transportation options for all users, including active transportation. Empowering municipalities with the statutory freedom to enforce low-speed limits, establish pedestrian-only zones, and implement active transportation infrastructure design enables them to address the safety concerns of their communities with precision and respond to the increasing demands of the population.

With the tools to manage their streets, policymakers can ensure urban infrastructure is aligned with today's mobility needs. These interventions – from protected bike lanes to expanded pedestrian pathways – can greatly reduce the possibility of a serious collision while creating safe, active transportation environments.

But just as policy set us on this course, so too can it steer us onto safer, more inclusive streets. The United States can turbocharge roadway safety by reforming fuel economy standards, revising tax incentives, and empowering local leaders to reshape the streets for all users. We can reclaim roadway safety, reduce deaths, and ensure our streets prioritize the right of all to safe passage, inside a vehicle or not.

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started in 2020, the amount of traffic decreased for various reasons, and this can also be seen clearly in the statistics of different countries such as Germany, South Africa, and India. In Sweden there was a special event in 1967 as the country switched from left-hand to right-hand traffic, and contrary to expectations there was a significant fall in the accident figures for one year.

In addition to these effects, there are, of course, many other factors which have had a positive impact on road safety over the years. However, we cannot pin these down to a specific point in time as they are constantly evolving. Examples include active and passive vehicle safety, improved infrastructure, the legislation, traffic monitoring, prevention measures, the introduction and expansion of the rescue services, and many more. All of these topics will be discussed in more detail in the following sections.

Traffic monitoring cameras can track the flow of traffic and help the emergency services to respond faster following an accident.

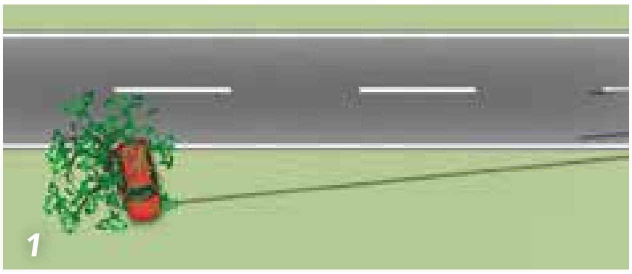
The Facts at a Glance

- **According to the WHO, every year around 1.2 million people die on the road. At a global level there is still some way to go to achieve the goals set under “Vision Zero.” However, at a local level, e.g., individual cities, they have certainly already become a reality.**
- **The WHO aims to at least halve the number of traffic fatalities between 2021 and 2030. Over the last decade only ten countries have reduced the figure by 50 percent.**
- **In low-income countries the fatality rate is 21 traffic fatalities per 100,000 inhabitants, compared against “only” 8 in high-income countries.**
- **In 2003 many European countries recorded over 100 traffic fatalities per one million inhabitants. In 2023 the best countries (Norway, Sweden) recorded 20-23, with Bulgaria and Romania bringing up the rear (over 80).**
- **The WHO recommends the following measures as “key factors” for greater road safety: speed restrictions, alcohol limits, the compulsory use of helmets on motorized two-wheeled vehicles, the compulsory use of seat belts, and child seats. It remains the case that not all countries implement these requirements.**
- **Many countries are seeing a growing number of accidents caused by driver distraction, particularly the use of smartphones and linked technologies while out on the road.**

Compelling Examples of Accidents in Detail

Car Collides Sideways With a Tree

2004



Sequence of events:
At the end of a gentle right-hand bend, a car driver drifted to the right and onto the shoulder at the side of the road. He then steered sharply to the left, causing the vehicle to skid across the road and collide with a tree on the passenger side.

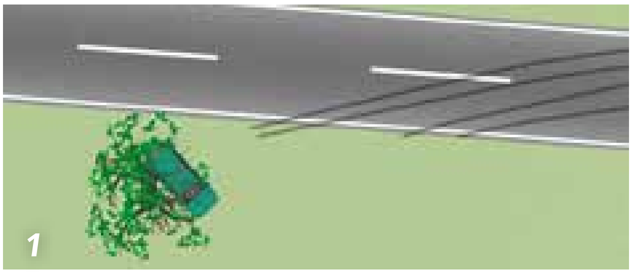
Consequences/injuries:
The car driver was severely injured; the passenger was fatally injured.

Location/lighting conditions/road conditions:
Non-built-up area/daylight/wet

5

1 Sketch of the collision position
2 Scene of accident
3 Damage to car
4 Skid mark
5 Collision speed

2019



Sequence of events:
On a left-hand bend, a car driver drifted into the shoulder on the right-hand side of the road, causing the rear end to swerve to the right. The car skidded across the road and collided with a tree on the passenger side.

Consequences/injuries:
The four occupants of the car were seriously injured.

Location/lighting conditions/road conditions:
Non-built-up area/darkness/dry

1 Sketch of the collision position
2 Scene of accident
3 Damage to car
4 Skid mark
5 Aging-related cracks in the tread

Collisions With Trees – in the Past, in the Present, and in the Future

Causes of accidents:

- Exceeding the speed limit
- Failure to adjust speed
- Technical defect (tire age) contributes to accident

Can be prevented by:

- Adjusting speed
- Ensuring vehicle is in good working order
- Lane departure warning system/lane keeping assistant
- Different response when coming off road
- Driver safety training

The past, the present and the future:

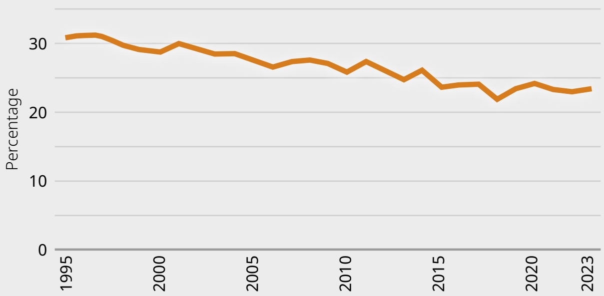
Speed was and remains the number one cause of accidents involving collisions with trees. This applies both when the driver did not adapt their speed to the road conditions, and when they exceeded the speed limit (e.g., for safely navigating a bend in the road). By contrast, technical defects on the vehicle that can contribute to or even cause an accident are becoming increasingly rare.

In many industrialized countries, almost all vehicles are now equipped with ESP. The system can prevent accidents caused by skidding as long as physical constraints are not exceeded. The passive safety provided by vehicles has also improved – alongside fastened seat belts, airbags and energy-absorbing crash elements protect the vehicle's occupants. However, the statistics do not reflect these significant improvements. After initially falling sharply, the figures have now flat-lined or are even rising again slightly.

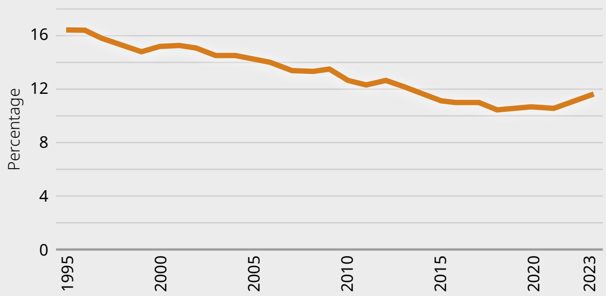
In the future, assistance systems designed to prevent the vehicle leaving its lane can play a bigger role in preventing these accidents. However, this requires lane markings – particularly on narrow roads where the risk is high – to guide lane departure warning systems or lane keeping assistants.

Alongside vehicle technology, infrastructure also plays a key role here. Existing trees must be protected by suitable barriers, and the speed limit should be adjusted if necessary. New trees should be planted far enough away from the road – or not planted at all. In addition, drivers should not be distracted by secondary tasks when traveling along tree-lined stretches of road.

Percentage of fatalities in accidents involving trees relative to the total number of fatalities (excluding pedestrians or cyclists)

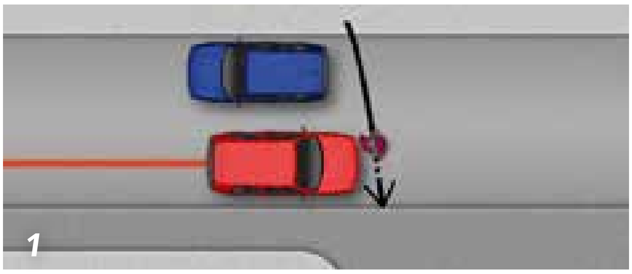


Percentage of people seriously injured in accidents involving trees relative to the total number of people seriously injured (excluding pedestrians or cyclists)



Source: DESTATIS

1998	Pedestrian Is Hit by Car	2023

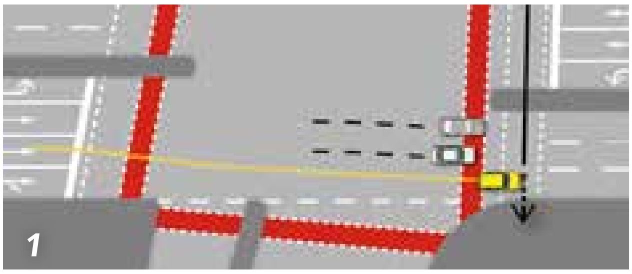


Sequence of events:
In a village, a car driver let his passenger exit the vehicle on the right-hand side of the road. Another car driver was approaching from the opposite direction. The passenger wanted to cross the road behind the car as it moved off and was hit by the approaching second car.

Consequences/injuries:
The pedestrian was fatally injured.

Location/lighting conditions/road conditions:
Built-up area/daylight/dry

1 Sketch of the collision position
2 Scene of accident
3 Damage to car
4 View toward pedestrian



Sequence of events:
When the traffic lights were green, three car drivers in the center lanes drove across an intersection. The first two vehicles slowed down because a pedestrian was crossing the road, although the crossing light was red. The third car driver moved to overtake in the right-hand lane. Upon reaching the pedestrian crossing, he hit the pedestrian coming from the left.

Consequences/injuries:
The pedestrian was seriously injured and later died in hospital.

Location/lighting conditions/road conditions:
Built-up area/darkness/dry

1 Sketch of the collision position
2 Scene of accident
3 Damage to car
4 Car driver’s view

Collisions With Pedestrians – in the Past, in the Present, and in the Future

Causes of accidents:

- Pedestrian was not visible (concealed, contrast)
- Pedestrian crossed the road without paying attention to traffic
- Pedestrian crossed the pedestrian crossing despite red light

Can be prevented by:

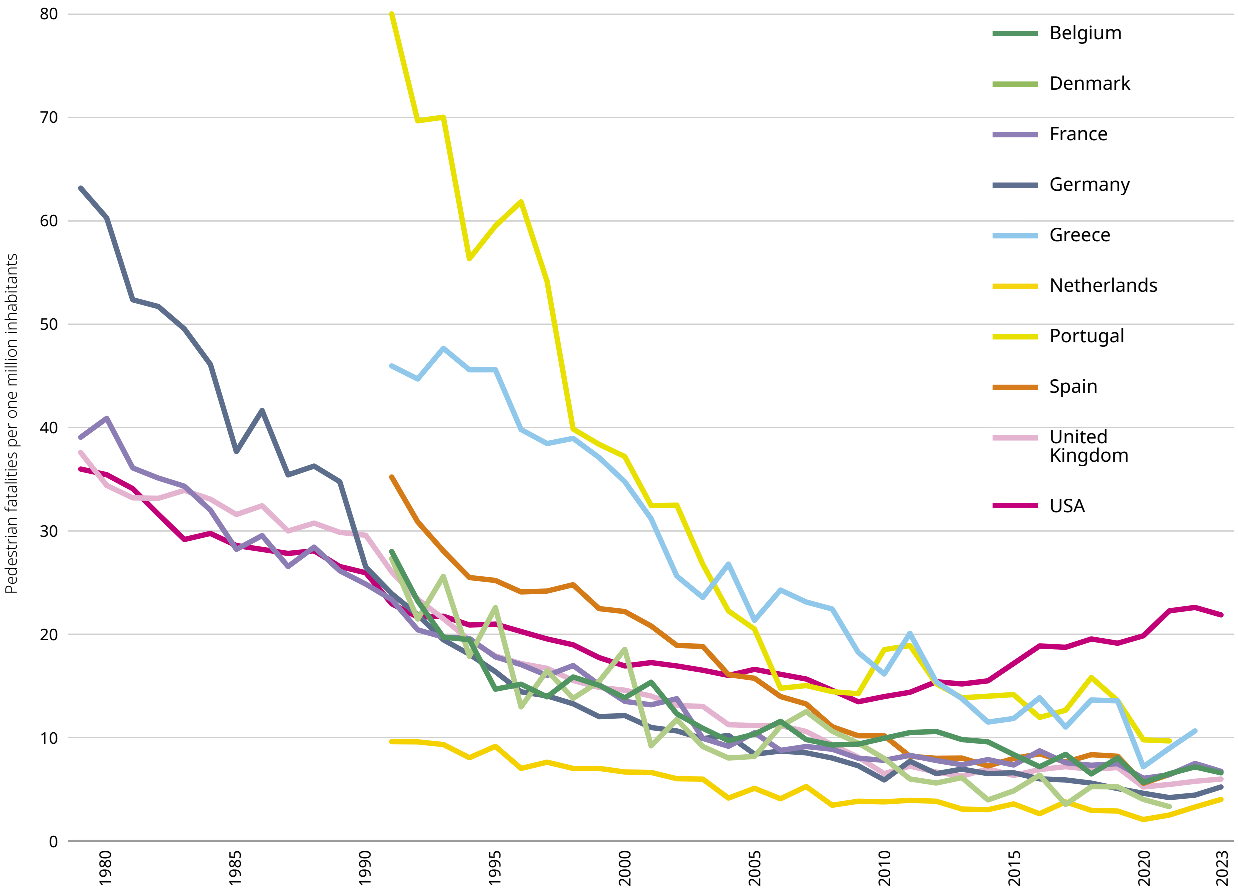
- Paying attention to red light and traffic
- High-contrast clothing
- Different driving style

The past, the present and the future:

It has always been the case that pedestrians have no crumple zone, meaning they are particularly vulnerable. This will not change in the future either, so the primary goal must be to prevent these accidents, or at least reduce the severity of injuries. Many measures have led to a fall in the number of pedestrian fatalities, including making vehicle geometry more pedestrian friendly, lower speed limits in built-up areas, improved headlamps, and public awareness campaigns. However, these figures have flat-lined for some years now, and in a few countries they are even rising again.

Despite the increasing use of and improvements in automated emergency braking systems with a pedestrian detection function in vehicles, this negative trend can only be reversed if technology is coupled with further changes to infrastructure and road user behavior.

Pedestrian Fatalities Per One Million Inhabitants in Selected Countries

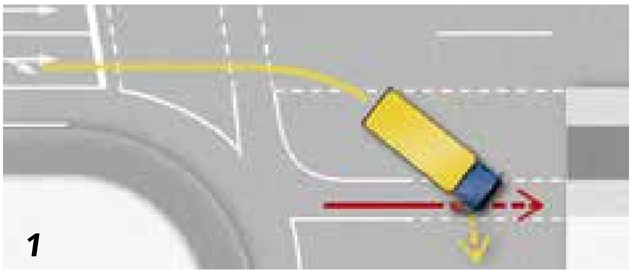


Source: IRTAD

2004

Truck Hits Cyclist When Making a Turn

2021

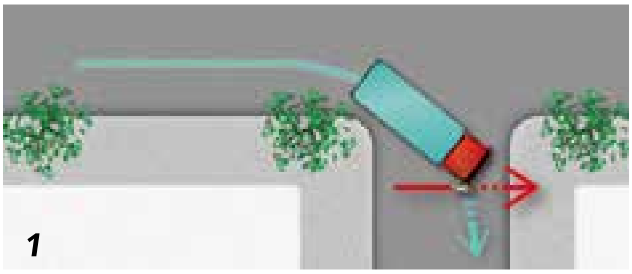


Sequence of events:
At an intersection, a truck driver moved off when the light turned green and wanted to make a turn to the right. At the same time, a cyclist was riding on the bicycle path running parallel to the road and wanted to cross the intersection on the bicycle crossing, also on green. The front right corner of the truck hit the cyclist.

Consequences/injuries:
The cyclist was seriously injured.

Location/lighting conditions/road conditions:
Built-up area/daylight/dry

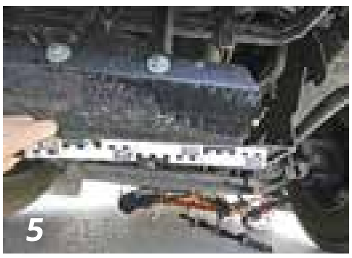
1 Sketch of the collision position
2 Scene of accident
3 Damage to bicycle
4 Truck's view
5 Damage to truck



Sequence of events:
At an intersection, a truck driver wanted to make a turn to the right. At the same time, a cyclist was riding on the sidewalk running parallel to the road and wanted to cross the intersection. The front right corner of the truck hit the cyclist.

Consequences/injuries:
The cyclist was seriously injured.

Location/lighting conditions/road conditions:
Built-up area/daylight/dry



1 Sketch of the collision position
2 Scene of accident
3 Damage to bicycle
4 Truck's view
5 Damage to truck

Accidents Between Cyclists and Turning Trucks – in the Past, in the Present, and in the Future

Causes of accidents:

- Cyclist was (almost) invisible due to blind spot
- Cyclist was riding on the sidewalk

Can be prevented by:

- Turning at walking speed
- Turning assistant
- Not cycling on the sidewalk
- Allowing truck to pass
- Educating cyclists and truck drivers

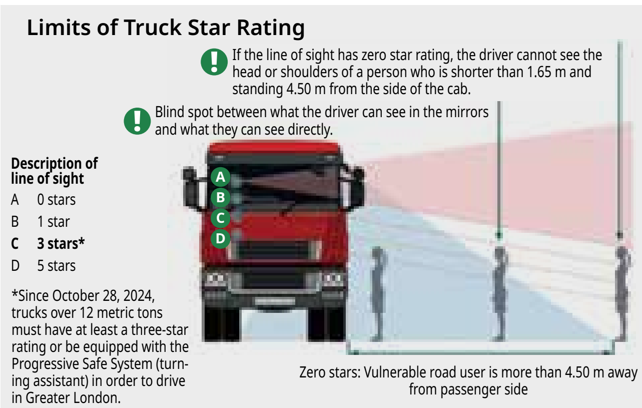
The past, the present and the future:

For years now, accidents between turning heavy goods vehicles and vulnerable road users have been among of the most common accidents in cities. Despite the introduction of turning assistants, these figures are only falling very slowly. Apart from the slow take-up of these systems in vehicles and the rise in the number of cyclists and pedelec users, there are still situations in which neither the truck driver nor the assistance system can detect the vulnerable road user – because they are concealed by an obstacle, for example. Alongside the introduction of assistance systems, different approaches are being taken across the globe to raise awareness of this type of accident and, ideally, prevent it from occurring in the first place:

National/international examples:

Europe: Turning assistants give an acoustic or optical signal to warn the driver of an impending collision, and can initiate emergency braking in some cases.

Germany: Public awareness campaigns aimed at cyclists and truck drivers increase awareness of the imminent dangers and problems faced by road users.



Direct Vision Standard of 3 stars required since 2024

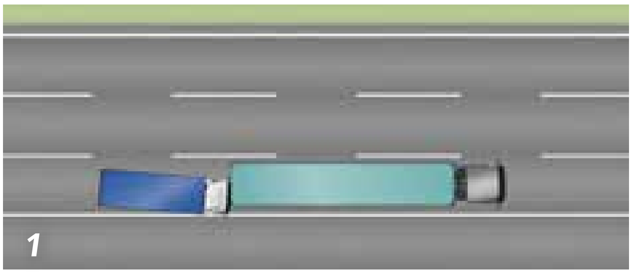
England (far left): London is regulating access permits for trucks based on specific safety standards, also relating to the driver's line of sight.

France (left): Stickers warn vulnerable road users about the dangers of the blind spot.

2004

Truck Collides With Truck In Front

2023



Sequence of events:

The driver of a semitrailer slowly reduced his speed due to slow-moving traffic in the right-hand lane, caused by congestion. The truck driver behind noticed this too late. He reacted by initiating emergency braking but was unable to prevent a collision.

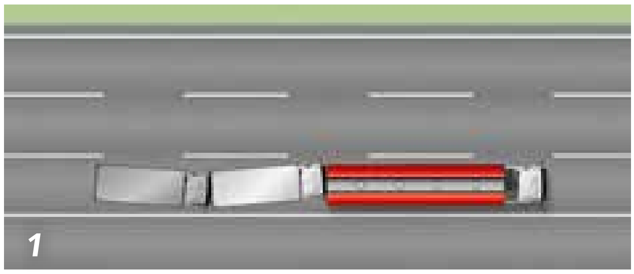
Consequences/injuries:

The truck driver was fatally injured.

Location/lighting conditions/road conditions:

Freeway/daylight/wet

1 Sketch of the collision position
2 Scene of accident
3 Collision between truck and semitrailer
4 Damage to truck



Sequence of events:

The drivers of a semitrailer and a truck slowly reduced their speed due to slow-moving traffic. The driver of a second truck behind them did not react to their slowing down and collided with the rear of the middle truck without braking. The middle truck was pushed into the trailer of the semitrailer.

Consequences/injuries:

The driver of the middle truck was fatally injured; the driver of the colliding second truck was slightly injured.

Location/lighting conditions/road conditions:

Freeway/darkness/dry

1 Sketch of the collision position
2 Scene of accident
3 Collision between truck and semi-trailer
4 Damage to middle truck

Accidents With Trucks in a Linear Flow of Traffic – in the Past, in the Present, and in the Future

Causes of accidents:

- Exceeding the speed limit
- Delayed/no reaction to congestion

Can be prevented by:

- Paying attention
- Adjusting speed
- Fatigue warning system
- Automated emergency braking system
- Keeping a safe distance

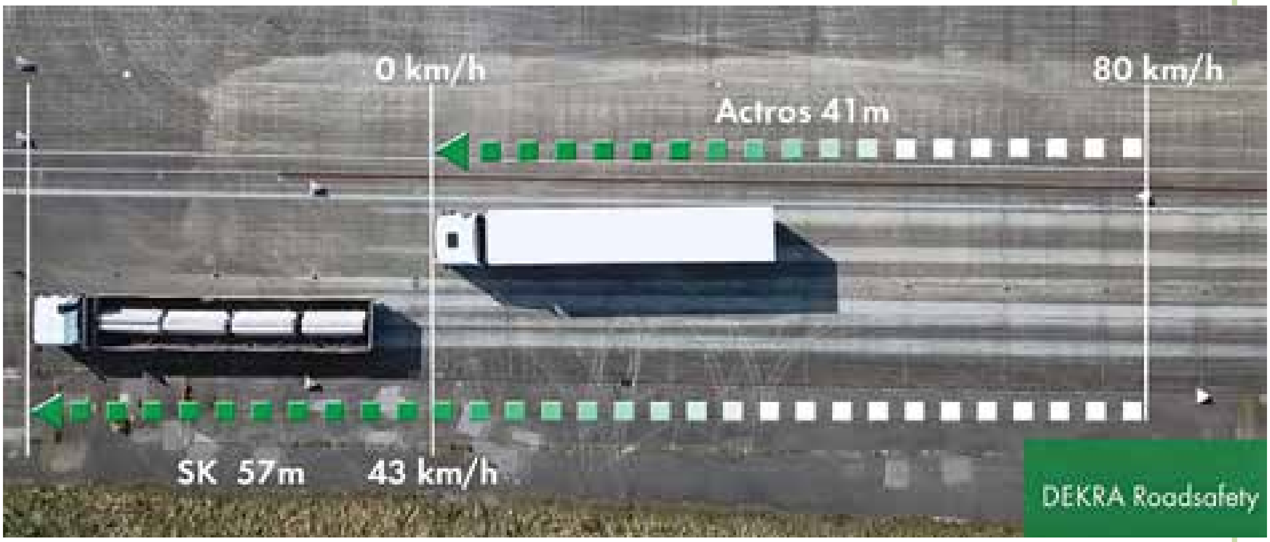
The past, the present and the future:

Rear-end collisions by trucks have always posed a significant potential risk. In the past, the safety standards and technology in the truck industry were limited. To minimize the risk of accidents, legislators and vehicle manufacturers have implemented a range of measures over the years. For example, the introduction of modern braking systems significantly reduced the braking distances.

Today, trucks feature a wide array of assistance systems that help make our roads safer. Automated emergency braking systems detect obstacles and slow-moving or stationary vehicles; in an emergency, they warn the driver and automatically initiate emergency braking. Adaptive cruise control ensures that the driver maintains a safe distance from the vehicle in front, while lane keeping assistants ensure that the vehicle stays in its lane. Despite these technological advances, distraction by smartphones, fatigue, and high time pressure remain major causes of serious rear-end collisions. Moreover, older trucks that are not equipped with modern assistance systems are still in use. If there are roadworks or a traffic jam suddenly builds, all it takes is a momentary lapse of concentration for a serious accident to occur, even if the vehicle is fitted with technical aids.

In the future, the use of automated driving functions, supported by artificial intelligence and connected infrastructure, could help to virtually eliminate rear-end collisions. Self-driving trucks would be able to detect obstacles in real time and react accordingly. Communication between vehicles (car-to-car) and with the infrastructure (car-to-X) can warn of potential dangers at an early stage, further improving road safety.

Comparison of old and new braking systems (Actros 2017, SK 1997): Good brakes underpin any driver assistance system that intervenes in the braking process.



Behaving Responsibly Behind the Wheel Is a Top Priority

In recent decades, countless studies across the globe have shown that around 90 percent of road accidents are caused by human error. Whether it is driving under the influence of alcohol or drugs, speeding, or being distracted by smartphones or other electronic communication systems: there is a long list of offenses that endanger road safety. Although a lot has already been achieved in terms of legislation and traffic psychology, finding an efficient solution remains an urgent task. Another interesting factor is the extent to which highly or fully automated driving can help the people at the wheel of a vehicle.

The way in which people behave on the road has always been a form of social behavior. In order to prevent accidents, road users not only need to have a shared understanding of rules and conventions, they also need to be able to anticipate what other road users will do. Problems become inevitable if road users' "role behavior" is "disrupted" – perhaps through illness, impairment, or even willful misconduct. In a nutshell, people are one of the major risk factors in road traffic – or from an optimistic perspective, they are *the* key factor in improving road safety.

The Legalization of Cannabis and the Resulting Accident Risks

When it comes to misconduct on the road, speeding and being distracted are major factors. However, the consumption of alcohol or drugs such as cannabis also plays a not insignificant role. Cannabis was not a new invention by the flower power movement, but has a long tradition as a cultivated plant, as a medicine and remedy, and also as a psychedelic that induces a euphoric state of mind and heightens perception.

In many countries, cannabis now enjoys a reputation as a lifestyle drug that is widely accepted by and popular among young people in particular. Parts of the plant which can be consumed are hash, marijuana, and hash oil – although the latter is used more rarely. Marijuana refers to the dried flowers and leaf tips of the cannabis plant. These parts of the plant are

The "Aspirin of Ancient Civilizations"

In 2737 BC, cannabis was described as a remedy for the first time in a central Asian book of medicine called "Shen Nung Pen Ts'ao." It is considered the "aspirin of ancient civilizations" and was used to treat pain and muscle cramps and expand a person's mind to improve their personality.

usually smoked, which maximizes the THC content. Marijuana – also known as weed, grass, or pot – contains between seven and eleven percent tetrahydrocannabinol (THC) as the active substance. Greenhouse-grown plants can contain 20 to 25 percent.

Hash is the name given to the resin of the female cannabis plant, which is pressed to form a block. It is also known as dope, shit, or piece. Consuming cannabis resin increases the uptake of THC. These parts of the plant have a THC content of between 11 and 19 percent, but it can be as high as 30 percent. Hash oil can also be smoked by mixing a little oil with tobacco, for example, and has an extremely high THC content of up to 70 percent. As a result, the THC content of a joint can vary greatly and the consumer does not know how much THC they are actually taking in.

Despite this, Germany, for example, felt it necessary to revise its drugs policy, and the German Cannabis Consumption Act (*Konsumcannabisgesetz*) entered into force on April 1, 2024. This act partially legalized cannabis, with the aim of providing better health protection, strengthening canna-

Frequent Encounters With the Police

Studies from Germany and other countries show that drivers with a penchant for cannabis products often turn to harder drugs. According to experts, cannabis opens the door to the co-consumption of illegal narcotics, as described by the gateway hypothesis. These types of consumption patterns demonstrate clear traits of a substance consumption disorder in the clinical sense. In particular, the frequency of substance consumption represents a significant potential hazard for road traffic. The more intensely and frequently cannabis is consumed, the higher the probability of risky driving maneuvers, such as overtaking when prohibited or ignoring speed restrictions. Road users who very often consume cannabis have more frequent encounters with the police for traffic offenses than people who do not, or only occasionally, consume cannabis. The consumption of cannabis is also associated with other risky behaviors, such as taking part in illegal races.

STATEMENT

The Forgotten Pillar

Jesús Monclús
Director of Prevention and Road Safety,
Fundación MAPFRE

Good parents pay attention to the risks that their child is exposed to, and protect them from dangers that could cause irreversible harm. They do this by combining the promotion of play, curiosity, the spirit of discovery, and independence with the prevention of severe or fatal injuries.

The vast majority of fleet vehicles, including the bus fleets operated by public and private transport companies, taxis, rental vehicles with drivers (known as "VTC" in Spain) and without drivers, shared vehicles including e-scooters and rental bikes, the vehicle manufacturers themselves, all modern vehicles which are connected with one another, and even every single one of us with our many navigation and driving assistance apps that we have installed, not to mention the navigation apps themselves: They all know whether we are driving safely or not – however, nobody does anything if we are not. Nobody warns us of the dangers, provides advice, makes us more aware, or encourages us to take more care behind the wheel.

We call all this "data for life" and it represents a major opportunity – an unexplored or "forgotten" pillar of the road safety policies and strategies implemented in various countries, regions, and cities. For example, why do cities or companies not undertake to ensure that all the vehicles in their fleet or the vehicles that they control keep to the speed limit? Bus companies that lead the way in terms of safety already monitor the speed of their drivers and provide coaching if they identify any safety problems.

Data that are still to be published by Fundación MAPFRE show that drivers exceed the speed limit on up to 15 percent of all journeys taken with certain types of vehicle. Speeding, distractions, and alcohol/drugs are the three main causes of fatal accidents on our roads. Should safe driving not be promoted by all possible means, such as the use of technology, apps, on-board sensors, networking, big data, and artificial intelligence?

Instead, we look away and defend the freedom to break the rules, at the expense of the right to life and health. I propose that we put an end to this nonsense and say: "Enough!" If we are in a position to take action, let us be good parents when out on the road – not just for the sake of our children, but for all road users. Let us add a new pillar to the safety strategies and use artificial intelligence across the board in the interests of life. I firmly believe this will pave the way for us to take another major step toward our goal of achieving zero fatalities and serious injuries.

Study Review of the Consequences of Legalizing Cannabis

The legalization of cannabis not only impacts road safety – other unintended consequences for a country's society are also foreseeable. Back in 2024, the German Society for Traffic Psychology (***Deutsche Gesellschaft für Verkehrspsychologie***, DGVP) started to investigate how the legalization of non-medicinal cannabis might affect road safety and other concerns of the population. A systematic review analyzed and assessed 76 international studies to determine risk parameters for road safety and key indicators for the health system. These data were obtained from countries which already have experience with the effects of legalizing cannabis.

The various findings show a mixed picture with more negative than positive effects. For example, the expected drop in prices as a result of economic competition among provider organizations did not occur, and legal retail outlets are still competing with the black market. However, consumers are only switching to the legal market very slowly, which means the black market will persist. The cannabis also has a higher active substance content, and the proportion of synthetic cannabinoids has increased as well.

Among existing consumers, the legalization of cannabis is leading to an increase in marijuana consumption. This applies in particular to adult users, not to adolescents. As a result, the legalization of cannabis is also contributing to a higher frequency of use, and to the formation of habits as part of the consumption pattern. In terms of cannabis-related treatment uptake, hospital stays, and hospitalizations (problematic consumption, dependency), no clear trend can be identified. However, key indicators in Canada and the USA substantiate a doubling of accident-related hospital admissions. There has been a fall in the simultaneous consumption of cannabis and alcohol.

The duration, frequency, and intensity of cannabis consumption are facilitating the occurrence of health risks, which can easily end up compromising a person's fitness to drive, e.g., in the form of addiction or psychological illnesses (psychosis, depression, etc.) and inadequate driving skills. This finding certainly does not relate to all cannabis consumers, rather only to a very small risk group that makes up a low single-digit percentage of active cannabis consumers. This, therefore, sets the framework for future measures to reduce the risk potential of cannabis.

bis-related information and prevention campaigns, curbing the black market, and ensuring the quality of consumer cannabis via controlled channels. Road safety concerns were addressed by accompanying changes to the legislation governing driver's licenses.

However, under no circumstances does decriminalizing cannabis mean this narcotic has lost its dangerous psychoactive properties. Like all psychoactive substances, cannabis affects our nervous system and, in turn, fundamental aspects of our ability to safely drive a vehicle. Unsafe driving observed after cannabis use mainly involves lane keeping, regulating the driving speed, and complying with rules concerning the right of way at traffic lights or intersections. Particularly among young drivers, anomalies such as slower driving, crossing the center line more frequently with increased

Cannabis Consumption and Road Use

Depending on the specific consumption pattern, the experts at the German Society for Traffic Psychology (***Deutsche Gesellschaft für Verkehrspsychologie***) and the German Society for Traffic Medicine (***Deutsche Gesellschaft für Verkehrsmedizin***) suggest different waiting periods before a user drives again. Occasional consumers generally reach a reading below 1 ng THC/ml blood serum after six to seven hours. Readings below 3.5 ng/ml can already be achieved after three to five hours. However, a wait of 12 hours is recommended between consuming cannabis and driving because road safety may also be compromised at readings below 3.5 ng/ml.

In Germany, if a person who is under the influence of THC causes an accident and the court assumes a "relative lack of driving safety" due to the effect of cannabis, that person may be convicted of a criminal offense, even if they are below the applicable threshold of 3.5 ng THC/ml. If the active substance content of the cannabis is not known – which may be the case for an unknown substance that might have a higher THC concentration – and/or if the person consumes a relatively large amount of cannabis, they should ideally wait 24 hours before driving again, even if they only consume cannabis occasionally. If a person consumes cannabis more frequently or regularly, the waiting period is longer. As a general rule of thumb, if a person consumes cannabis daily over several days and intends to drive, they should wait for the same number of days as they consumed cannabis. If only moderate amounts are consumed on individual occasions, then a person's blood serum should be clear of any detectable amounts after three to four days. If there are telltale signs of addiction – such as chronic high consumption over a prolonged period, either daily or almost daily – then in principle the individual is no longer permitted to drive. They should only consider doing so after a long period of abstinence lasting several weeks.

abrupt steering wheel movements, and prolonged reaction times can be observed in connection with the use of cannabis.

Poor Assessment of Safe Driving

We certainly know that there is a slight to moderate increase in the risk of accidents after consuming cannabis – and that this is much lower than when under the influence of alcohol. However, the available figures fluctuate greatly and weaknesses in methodology mean they have only limited validity. As a basic principle, we can assume the risk is around two-and-a-half times higher. It increases even more if we look only at young drivers under 25 years of age (three times the risk) – with the combined effect of cannabis and alcohol being particularly dangerous.

If a person has consumed cannabis, their own assessment of safe driving is made more difficult by two unknown variables. First, they do not know how much of the active substance they have ingested and second, individual metabolism varies greatly. This impairs the necessary ability to gauge how a state of intoxication impacts safe driving. This "self-assessment illusion" and the associated distortion of our self-perception are also highlighted as an unresolved problem in the international specialist literature.

In terms of road traffic, the first step is to reliably identify this high-risk group using appropriate medical and psychological evaluations and trigger a stable and sustainable change process so that, in their role as the active driver of a vehicle, the individual would ideally not consume any substances that impair their fitness to drive before starting a journey. At the very least, cannabis users must be able to comply with applicable road traffic regulations by ensuring that they are always below the relevant threshold – 3.5 ng/ml THC in Germany, for example – when on the road as a driver.

Stronger Prevention Measures Required

In addition to these pressing measures to avert risks, we also cannot ignore the need to focus on prevention. This includes providing funding for high-quality youth protection activities, treatments, targeted and theory-based public information campaigns, advisory services, and school

STATEMENT

We Must Promote a Culture of Road Safety From Childhood

Senator Francesco Paolo Sisto
Deputy Minister for Justice

The current Italian government has never lost sight of the tragic issue of traffic accidents and is focusing on improved prevention measures based on updated standards and infrastructure maintenance. In this context, the new Italian Road Traffic Code is an important response to ensure the safety of everyone. Road safety education – which already starts when children are very young – plays a key role and is intended to foster a stronger sense of responsibility. Here, it is essential to use virtual reality and state-of-the-art technologies such as artificial intelligence.

A culture of road safety means complying with the rules. As soon as they start school, children and adolescents should be given training and education on this topic so that they develop a greater sense of responsibility as road users and we promote a culture of road safety from childhood onward. The information must also be taught in a more engaging way using virtual reality. The technologies can certainly contribute to improving forecast accuracy in respect of accidents. However, it is also necessary to promote the possibility of joint public and private initiatives so we can leverage synergies on an ongoing basis.

With this in mind, the Italian government has decided to intervene in various areas because it firmly believes that these are cross-party issues that must not be used as ideological instruments. Key pillars in this strategy are the reform of the Italian penalty points system to include the suspension of a person's driving license, so they are not permitted to use a vehicle, and the deduction of points if they use a cell phone at the wheel. The new regulations also introduce mandatory road safety education courses in schools, which are run in collaboration with associations and law enforcement agencies. There is also a points bonus for novice drivers who successfully attend these courses – an additional incentive and a very smart decision.

education. There remains an urgent need for research, as well as evaluation of the measures taken. There are indications that men find positive emotional appeals more convincing than fear appeals, and vice versa for women. These findings underline the need to tailor the content and message of a campaign to the specific motivations and needs of the target groups and any identified sub-groups. Essentially, a general and preventive information campaign should promote the rare, controlled, and responsible consumption of cannabis at most.

Drink Driving Can Have Fatal Consequences

We have known for a long time that drink driving in particular is extremely hazardous. In 20 percent of all fatal accidents in high-income countries and 33 to 69 percent of all fatal accidents in low- and middle-income countries, the blood alcohol concentration was found to be above the respective legal limit. Apart from the human suffering caused, the follow-up costs associated with alcohol-related accidents are enormous. For example, they are estimated at 14 million US dollars for South Africa, one billion US dollars for Thailand, and just under 130 billion US dollars for the USA. However, these figures are just the tip of the iceberg; the unrecorded figures are much higher as drink driving is the result of an alcohol-focused culture with intense drinking habits that has become widely accepted in our society.

Looking specifically at certain countries, such as Germany, underlines the potential risk from alcohol in road accidents. Drunk drivers are overrepresented in traffic accident statistics. In 2023, according to the German Federal Statistical Office, 165 road users lost their lives and 4,100 were seriously injured in alcohol-related accidents in Germany, a country with over 80 million inhabitants. At the same time, 37,172 alcohol-re-

MPU as a Special Prevention Measure

In Germany, drivers with alcohol in their blood must undergo a medical-psychological examination (known as an “MPU”) if one of the conditions listed in Article 13 of the German Driving License Ordinance (*Fahrerlaubnis-Verordnung*, FeV) applies, such as a blood alcohol concentration of at least 0.16 percent in connection with drink driving. According to figures from the German Federal Highway Research Institute (BASt), of the roughly 82,000 fitness-to-drive assessments conducted in Germany in 2023, more than one third were the result of an alcohol offense. The effectiveness of the fitness-to-drive assessments, including the special preventive function of an MPU, likely also contributed to the fact that the number of alcohol offenses in road traffic has been falling for years.

Source: German Federal Highway Research Institute (BASt) lated accidents – in which 18,400 people were injured – were recorded in Germany's Central Register of Traffic Offenders (*Verkehrszentralregister*).

According to the German Federal Motor Transport Authority, in 2015 (i.e., shortly after the introduction of the new points-based system), over 8.6 million entries had been recorded in the Register of Driver Fitness (*Fahreignungsregister*), of which around 1.2 million were due to alcohol-related offenses and 125,000 due to alcohol-related misdemeanors. Only speeding ranked higher, making up 61 percent of all entries.

"Drunkards and Moderate Drinkers"

Even before the birth of the car in 1886, the drivers of vehicles such as carriages caused accidents on the road when under the influence of alcohol. Hardy Holte, a long-serving traffic psychologist at the German Federal Highway Research Institute (BASt), described this phenomenon in his book "Rasende Liebe" (Love at a Frantic Speed). He wrote (translated freely here): "Even the ancient Romans were familiar with the problem of alcohol and driving ... The dangerous effect of alcohol on drivers became a topic of debate among experts and the general public just a few years after the car was invented. One of the earliest studies on this topic was mentioned in an American newspaper in 1904. It stated that, in 19 of 25 reported car accidents, the drivers had been drinking alcohol up to an hour before the crash. Drunkards, but also moderate drinkers, as it went on to say, were the most incompetent car drivers of all."

People Still Do Not Properly Reflect on Their Own Wrongdoing

In Germany, many people now no longer consider drink driving to be a trivial offense. However, the situation with cannabis is different, with some sections of the population, and political decision-makers in particular, trivializing its consumption. As mentioned above, following an amendment to German driving license regulations (*Fahrerlaubnisverordnung*), a first offense of driving under the influence of cannabis is not deemed to affect a person's fitness to hold a driving license and is therefore celebrated in certain circles as a kind of "free shot."

Given that social norms relating to alcohol consumption and drink driving have changed

Current Blood Alcohol Concentration Limits in Different European Countries

In most European countries, the blood alcohol concentration limit is 0.05 percent.
The strictest rules – 0.0 percent – can be found in the Czech Republic, Hungary, Romania, and Slovakia.

Country	BAC limit [1]	Fine in euros
Belgium	0.05 [1]	From 180
Bosnia and Herzegovina	0.03 [1]	From 200
Bulgaria	0.05	From 250
Denmark	0.05	Up to 1 month's net earnings
Germany	0.05 [1]	From 500
Estonia	0.02	From 400
Finland	0.05	From 15 day fines
France	0.05 [1]	From 135
Greece	0.05 [1]	From 80
United Kingdom (Scotland	0.08 0.05)	Unlimited
Ireland	0.05 [1]	From 200
Iceland	0.05	From 465
Italy	0.05 [1]	From 545
Croatia	0.05 [1]	From 390
Latvia	0.05[1]	From 430
Lithuania	0.04 [2]	From 290
Luxembourg	0.05 [1]	From 145
Malta	0.05 [1]	From 1,200

Country	BAC limit [1]	Fine in euros
Montenegro	0.03 [1]	From 250
Netherlands	0.05 [1]	From 70
North Macedonia	0.05 [1]	From 300
Norway	0.02	From 570
Austria	0.05 [1]	From 300
Poland	0.02	Up to 1,200 [3]
Portugal	0.05 [1]	From 250
Romania	0.0	From 265
Sweden	0.02	From 40 day fines
Switzerland	0.05 [1]	From 600
Serbia	0.03 [1]	From 40
Slovakia	0.0	From 200
Slovenia	0.05 [1]	From 300
Spain	0.05 [1]	From 500
Czech Republic	0.0	From 110
Turkey	0.05 [4]	From 50
Hungary	0.0	Up to 260 [3]
Cyprus	0.05 [1]	From 100

The fines relate to infringements involving a car.
[1] In some cases, lower BAC limits apply for novice drivers and/or professional drivers.
[2] BAC limit of 0.0 percent for novice drivers and drivers of motor vehicles with a maximum permissible weight over 3.5 metric tons / more than 9 seats
[3] Fine for drink driving with BAC level up to 0.05 percent; if over 0.05 percent an income-based penalty applies of at least 10 day fines (Poland) or a penalty starting at 1,000 euros (Hungary)
[4] BAC level of 0.05 percent applies to drivers of private cars without a trailer, otherwise 0.0 percent; a day fine generally applies (penalty calculated on the basis of monthly income, in Finland: a maximum of 120 day fines). All information subject to change.

Source: ADAC

In summary, it can be said that the recent decline in positive attitudes toward (excessive) alcohol consumption in general and driving under the influence of alcohol in particular is a good signal. However, a person's reduced ability to realistically assess whether their BAC is within the legal limit and the changed perception and decision-making ability under the influence of alcohol of drivers with a higher tolerance for alcohol, even after a drink driving offense, make it more difficult for them to reflect properly on their own wrongdoing, which tends to counteract this positive trend. These factors therefore facilitate relapses. Other risk factors that play a role in a person committing a drink driving offense include an inadequate understanding of the problem of their own drinking habits, a lack of information about the physical and mental effects of alcohol consumption, a lack of awareness about the risks and dangers, an alcohol-focused attitude, the inadequate acceptance of rules, and group influences. For this reason, further action by all stakeholders concerned with road safety is required, both now and in the future.

markedly, we can assume that people who still choose to drink drive fall into a high-risk subgroup, not only accepting stricter sanctions but also social stigmatization as a result of their actions. Although it runs counter to social norms, being unable and/or unwilling to separate drinking from driving is evidence of a much lower level of self-control – something which particularly applies to offenders who are facing prolonged driving bans.

This suggests that alcohol abuse in the clinical sense – i.e., the tendency to consume alcohol to the extent that it endangers or harms health – is very much associated with forming a habit and being highly resistant to change. Therefore, the fact that a person is a drink driving offender could already be considered an indicator that they are very likely to repeat the offense. Against this backdrop, drink drivers, in particular those with high blood alcohol concentrations, can be deemed a high-risk group. Ultimately, the risk of accidents with a blood alcohol concentration (BAC) of 0.11 percent or more is around ten times higher than for sober drivers. The risk of relapse also tends to increase in line with the BAC.

What Behavior Do We Need to See?

In order to reduce the high risk of relapse and protect the general population, offenders need to actively change their behavior. However, this says nothing about the nature or extent of these changes. There are basically two ways to make such changes. The people in question could drink alcohol less frequently and in smaller quantities, so that their alcohol consumption becomes manageable. Alternatively, they could abstain from alcohol altogether and remain teetotal permanently.

In the EU, if a driver is dependent on alcohol, the general need to abstain from alcohol is initially derived from the Driving Licence Directive, which is binding for all 27 EU Member States. When applying for a new license, an extension to include new vehicle classes, or the re-issue of a license after a driving ban, drivers in the EU must meet the minimum requirements for their physical and mental fitness to drive, which are set out in Annex III to the European Driving Licence Directive (EU Directive 2006/126/EC and amendments 2009/113/EC, 2014/85/EU, and 2016/1106).

As the EU merely specifies the framework for the regulations, the specific details are left to the individual Member States, so the situation resembles a patchwork rug. This means that the legal and technical requirements for obtaining a driving license differ greatly between the various EU Member States, as do the procedures for medical examinations, such as those used to diagnose problems with alcohol. Some countries use certified organizations, whereas others utilize the communication channels within the general health system and empower primary care physicians or a health department doctor to transfer the required health data.

Similar differences also exist when it comes to the technical basis for assessment (including the degree of differentiation and binding nature), the verification methods, the time periods for submitting abstinence certificates, and the number of such certificates required. In some countries such as Austria, Belgium, Germany, Sweden, and the United Kingdom, alcohol-dependent drivers are only re-issued their driving license if they have abstained from alcohol for a prolonged period of time – usually six months but up to one year in Germany – evidenced by meaningful biomarkers. Despite all the differences, the countries with regulations that differentiate between alcohol dependency and alcohol abuse agree that a professionally substantiated diagnosis of an individual's alcohol problem is required before they start an alcohol control program. In other countries, people caught driving under the influence of alcohol are only

No drink driving!

permitted to continue driving with an alcohol interlock, regardless of whether or not they are dependent on alcohol.

Need for Innovative Solutions

Based on longstanding experience in Germany, we know that drivers who commit alcohol-related offenses (BAC of 0.11 percent or higher, as well as repeat offenders) are usually suffering from an alcohol consumption disorder with clinical symptoms. Such a consumption disorder can differ in severity and therefore requires a clear diagnosis. This finding is confirmed by a DEKRA study of 840 people who had been caught drink driving for the first time. Around 15 percent were diagnosed as being dependent on alcohol, around 30 percent as severe alcohol abusers, and around 50 percent as people with hazardous alcohol consumption – considering their prolonged risky alcohol consumption before they were caught drink driving. The alcohol consumption of less than 5 percent was deemed to be not clinically relevant. The latter category includes people who have problems accepting and complying with the rules of the road, whereas the first three categories represent "drunk drivers." As a result, there are different approaches for effectively mitigating the potential hazards that drivers pose to

STATEMENT

Thinking Ahead When Driving Is and Remains the Most Important Thing

Bernd Mayländer
DEKRA brand ambassador and
Formula 1 safety car driver

Modern vehicles are equipped with a wide range of assistance systems that can significantly improve road safety. However, it is important to know their limits and to not trust them blindly. After all, even the best safety system is always subject to the laws of physics. If we do not know precisely how the assistance systems in our vehicles work, we cannot make the most of them. All too often we lack the necessary information and training.
In principle, simply handing over the vehicle to the customer when they collect it from a dealer is not enough for them to understand how these systems work.

For this reason, in addition to an in-depth introduction to the vehicle, driver safety training should also become standard practice so that drivers learn how to safely control vehicles equipped with systems such as ABS or ESP in different conditions and what adaptive cruise control, for example, can and cannot do. Driving simulators can also be a valuable tool here – and should ideally already be used in driving schools. Depending on driving style, another important aspect is ensuring that the installed systems are set up correctly. For example, lane keeping assistants can be individually adjusted to set exactly when they should intervene and how sensitive they are. Similarly, the precise pre-warning time can be set for automated emergency braking systems, and the distance to the vehicle in front can be set for adaptive cruise control systems.

But no matter which systems are installed, thinking ahead when driving is and remains the most important thing for preventing accidents in road traffic wherever possible. In critical situations, correctly counter-steering the vehicle and, above all, quickly reducing the speed can also help to prevent an impact or at the very least mitigate the consequences of an accident. Systematic training on emergency braking maneuvers and full braking procedures can save lives as well. As accident analyses show, many car drivers do not react until the last split seconds, and often not as forcefully as they should. This is a mistake. With the ABS fitted in today's vehicles, it is never possible to brake "too hard." Therefore, if the worst should happen, the only response is to slam on the brakes.

Other key considerations are ensuring that the driver's seat is correctly positioned and the driver holds the steering wheel correctly so that they can successfully steer and brake the vehicle when taking evasive action, for example. I recommend sitting relatively upright and holding the wheel with both hands, roughly at the 9 and 3 o'clock position, and angling the arms slightly. In the normal driving position, the legs should also be angled slightly to ensure the application of maximum force in reacting quickly. The visual field is also important when traveling at high speeds in particular, and in critical situations. After all, wherever drivers look is where they will steer their vehicle.

other road users. If a person is dependent on alcohol, rehabilitation is usually required for them to end their dependent drinking behavior or abstain from alcohol altogether. In the case of alcohol abuse, it is essential to end the abuse and bring about stable, lasting changes to the person's drinking behavior.

The draft texts for the 4th EU Driving Licence Directive discuss the use of alcohol interlocks, but they are no substitute for therapeutic interventions as they do not address the causes of the alcohol dependency, nor do they eliminate the individual's psychological compulsion to drink, i.e., their enormous urge to consume alcohol. This means that, as a first priority, alcohol interlocks are not a viable approach for sustainably combating drink driving. However, these alcohol-sensitive immobilizers can certainly be effective and appropriate tools when used in conjunction with targeted and professionally substantiated rehabilitation measures. In addition, if regulations mandate that these devices are installed, the person affected will be

How Different Countries Respond to a Severe Drink Driving Offense

Sweden

In order to get their driving license back, applicants must submit a declaration of physical and mental health to the relevant Swedish Transport Agency (STA). The extent of the alcohol consumption disorder is also a factor in this process. If a person is diagnosed with either alcohol abuse or alcohol dependency, they must remain verifiably sober and abstain from alcohol for at least six months. This can be extended to two years in particularly severe cases. A medical certificate covering the necessary time period documents two biomarkers (blood value and liver function sample), which must be tested at least four times.

Norway

In Norway, too, a certificate of health must be submitted if requested by the police or road traffic authorities. According to the country's national driving license ordinance, people suffering from alcohol dependency, consistently high alcohol consumption, or harmful alcohol consumption must also be examined by a doctor, with support available from the specialist center for persons with drug and abuse problems. In minor cases, the driving license can be withdrawn for up to six months. In severe cases, the person will need to resit their driving test – both the theory and practical parts. A person diagnosed with alcohol abuse and alcohol dependency must document six months of abstinence from alcohol. The applicant must allow different biomarkers to be tested, including blood parameters and liver function samples. The person does not know the exact dates of these tests, meaning they cannot be predicted and are random. Here too, several tests must be performed within a period of six months. The driving license can be issued for a limited time and conditions may be applied, such as the requirement to undergo quarterly biomarker checks and an annual follow-up examination.

United Kingdom (UK)

Specific proof over different periods of time is required, based on the clearly defined stages of an alcohol consumption disorder. As a general rule, independent medical examinations are prescribed for people who have been caught due to excessive alcohol consumption or drink driving offenses. If acute alcohol abuse has been confirmed by medical examinations and/or there are abnormal blood markers that cannot be explained by causes unrelated to alcohol, people in driving license group 1 (e.g., authorized to drive cars or motorbikes) must prove that they have abstained from alcohol for at least six months. The target behavior could be moderate (= controlled) drinking or complete abstinence from alcohol. For applicants from group 2 (e.g., authorized to drive trucks or buses), the monitoring period is one year. If a medical diagnosis has confirmed alcohol dependency, then people from group 1 will have their driving license withdrawn for at least one year. To get it back, they must prove that they have abstained from alcohol for at least one year. People from group 2 must prove this for a period of three years. Once a driving license has been returned, it can be time-limited if this is considered appropriate on a case-by-case basis. After a time-limited driving license has been returned, the monitoring process for ensuring abstinence from alcohol can span six months to three years.

socially stigmatized, incur a not inconsiderable financial cost, and feel like they are constantly under surveillance. This is likely to significantly jeopardize acceptance of this measure and could also provide misguided incentives for tampering.

One innovative solution for treating addiction could start with a mandatory diagnostic examination after a person commits a severe drink driving offense – coupled with recommendations and suggested interventions for reinstating a person's fitness to drive. The second part of the examination could involve what are known as brief intervention techniques which encourage the individual to want to change their drinking behavior as soon as possible.

STATEMENT

Road Safety Concerns Us All

Mar Cogollos
Director of AESLEME (Association for the Study of Spinal Medullary Lesions)

As a trade association dedicated to road safety and a pioneer in the prevention and reduction of traffic accidents and their potential victims, AESLEME has decided to play its part in developing its own direct public information and awareness campaigns. By ensuring that people know the risks and potential consequences of not following the rules, taking into account general values, and focusing on changing careless behavior, we can reduce the accident figures and, in particular, the number of very serious accidents.

Reducing the impact of human error on the road means heightening people's awareness of the responsibility that each individual road user bears, and demonstrating that road safety is not something that is alien to any of us or imposed on us by public authorities.

Here at AESLEME, we are opening the eyes of citizens of all ages to the responsibility we each bear when making decisions in road traffic. It is important that every pedestrian understands that they control whether they cross the street safely and are visible; it is important that car drivers understand that alcohol, drugs, distractions, and speeding put lives at risk; it is important that cyclists and scooter riders are safe and responsible road users. When we are out on the road, we take decisions that can mean someone loses their life or ends up severely and permanently injured.

New forms of mobility, particularly in urban areas, have led to widespread chaos on the roads – and this is synonymous with casualties. It must be made clear that bicycles, e-scooters, and pedelecs may be sustainable ways to get about, but the primary concern must be that they are safe. They are not toys, and using the roads is not a game. These vehicles must also comply with regulations to ensure the safety of their riders and the safety of other road users. In addition, the regulations and infrastructure must be adapted to this new reality because we are talking about vulnerable road users, and we cannot overlook the importance of training them, raising awareness, and issuing recommendations on matters such as wearing helmets and using reflective elements. Mobility must not result in victims.

The Origins of Traffic Psychology Interventions – Background and Developments

Since the 1960s, Germany has increasingly established measures that are based on psychology in order to bring about lasting behavioral changes.

The key feature of all traffic psychology interventions is that they focus on road safety as the core aim and criterion for success, but less on the individual well-being of the people being counseled or treated. Traffic psychology interventions are not based on a stand-alone or "typical" methodology or on underlying psychological disorder patterns. Instead, their aim – preventing (future) traffic infringements – is found at the crossover between law and behavioral science.

From a historical perspective, the first step was to introduce approaches based on the driver improvement model from the USA. This was a kind of "retraining" that continued into the 1970s. To begin with, the interventions were more experimental group discussions, but they quickly developed into highly standardized group programs with the aim of changing the participants' behavior as road users.

Traffic psychology discussion during a medical-psychological examination (MPU)

Following the introduction of retraining courses for convicted drivers, the requirements for change in a person's attitude and behavior were differentiated (a positive prognosis, the possibility of remedying the deficiencies in courses, and a negative prognosis). Today, the courses to reestablish a person's fitness to drive require recognition on the basis of a scientific concept, confirmation of the fitness to drive in the form of an independent expert report, and verification of effectiveness through state-of-the-art scientific evaluation. In Germany, the courses are subject to quality monitoring by the German Federal Highway Research Institute (BASt), which means legislators have chosen independent quality assurance.

The retraining measures developed in the 1970s on the basis of the American model were replaced with therapeutically substantiated methods designed to change the behavior of drivers who had committed traffic offenses. Here, the main impetus came from psychotherapeutically certified course programs. In addition to this field at the interface between traffic psychology and psychotherapy, further approaches and models were established in road safety education, driver training, retraining, reducing penalty points, advice for older drivers, and work with road accident victims. What they all have in common is that they bring together findings and methods from traffic psychology on the one hand and psychotherapy/pedagogy on the other.

In a nutshell, we can say that a high degree of differentiation has evolved in the field of traffic psychology interventions in recent decades. This process was informed by new findings, as well as legislative requirements. We can assume that further developments in the future will have the potential to help optimize the quality of traffic psychology interventions and more effectively separate "the wheat from the chaff" in terms of the differences in quality.

If we look at how traffic psychology interventions are set to develop in future, there are already initial signs that we could leverage the benefits of virtual reality (VR). For example, VR goggles can depict hazardous traffic situations more clearly and vividly than other methods.

Influential Scientists in the Field of Traffic Psychology and Accident Analysis

Scientific disciplines usually have fathers and pioneers, and the field of traffic psychology is no different. Its origins date back more than 100 years and are closely tied to the work of three individuals from the 19th and early 20th centuries.

Gustav Theodor Fechner (1801-1887) was a prolific physician, physicist, and natural philosopher in various scientific disciplines. Among other things, Fechner is considered the founder of psychophysics, which is concerned with the verifiable relationship between the subjective perceptions and sensations produced by a stimulus on the one hand, and with the quantitatively measurable physical stimuli that trigger the processes of perception on the other hand. Fechner's name is closely linked to the principle of the just noticeable difference as a perceptual phenomenon in psychophysics. According to this principle, a person will only notice a difference between two stimuli if the difference exceeds a minimum level – the just noticeable difference. In particular, the investigations of stimulus thresholds continue to play a key role today, for example, in studies of accident perception in the field of accident research. In this context, we first need to make a distinction based on drivers' perceptual capacity, for example, and actual perceptibility. However, individual limitations such as psychological, health-related, or physical impairments must be considered appropriately to ensure that each case is treated as fairly as possible. We also need to consider that a person's ability to perceive an accident may be impaired by acute internal conditions such as stress or fear, and by external influences such as the complexity of a traffic situation, lighting conditions, or uneven road surfaces.

Wilhelm Maximilian Wundt (1832-1920) was a major German physiologist, psychologist, and philosopher. In 1879 he founded the world's first institute for experimental psychology with a systematic research program at the University of Leipzig. Although Wundt's scientific activities did not make a specific contribution to traffic psychology, his experimental work on human reaction times and the impact of disruptive factors and fatigue laid important foundations for later research in traffic psychology. In this field, experimental studies are an indispensable source of knowledge here for assessing the substance-related problem analyses of convicted drivers, and for individually recording performance parameters during tests to determine a person's reactive capacity when assessing their fitness to drive. Many of Wundt's students later dedicated themselves to this field and became pioneers of traffic psychology research. Among the first of these pioneers attending his lectures was:

Hugo Münsterberg (1863-1916) built on the ideas of Fechner and Wundt. From today's perspective, the idea of placing a stronger focus on drivers' fitness to drive and the causes of delinquent behavior can be considered the roots of traffic psychology. When, in 1910, he developed the first tests for selecting drivers in order to reduce the drastic number of streetcar accidents, Münsterberg realized that the most pressing task was not to make technical improvements to the vehicles or signaling systems, but rather to select and differentiate between suitable and unsuitable motormen. It is now common knowledge – in part thanks to accident research findings – that the people behind the wheel of a motor vehicle are the main cause of accidents. The focus here is on deficiencies in a person's physical and mental condition, as well as in their character. When determining drivers' fitness to drive, there was already a shift toward character assessment in the 1920s. Many of the phenomena we see increasingly on our roads today – such as illegal races – are rooted in the character of the drivers.

The EU's KPI Project

A new and promising path leads us to the European arena: In the future, it should be easier to compare road safety KPIs from the individual Member States.

Under the auspices of the European Union, the EU Baseline project was launched in 2020, involving a total of 18 European countries. It aimed to more effectively define key performance indicators (KPIs) for road safety in Europe and make them easier to compare between the various countries by establishing minimum requirements for the methodology. The KPIs are metrics that are designed to record – and thus quantify – not only conventional accident and casualty figures but also changes in the level of safety provided by the transport system.

Essentially, by recording road safety KPIs, we can measure the progress made over time and assess how effective the implemented measures and initiatives have been. When examining the KPIs on an international level, we can see both positive trends (rate of seat belt use) and areas with significant potential for improvement (transport infrastructure). In particular, it also reveals some major differences between the individual countries, as shown by the following example from the KPIs.

The Eight KPIs of the European Commission for Assessing Road Traffic Safety

- Speeding
- Seat belts and child restraint systems
- Helmets
- Alcohol
- Distraction
- Vehicle safety
- Infrastructure
- Post-crash care

KPI Speeding

Studies commissioned by the European Commission demonstrate that both the rate and severity of accidents grow as the absolute speed of the vehicle increases. This means that compliance with the speed limit is an indicator of how many road users are keeping to a speed that is acceptable in terms of safety. The available data indicate that, when it comes to speed, people's driving behavior varies depending on whether they are driving by day or at night and whether it is a weekday or weekend. The percentage of vehicles keeping to the speed limit on freeways is the lowest in the Czech Republic (40 percent), closely followed by Portugal and Sweden (both 44 percent), Finland (45 percent), and Cyprus (47 percent). The highest percentage can be found in Bulgaria (89 percent), closely followed by Ireland on 88 percent. Since the speed limits vary from country to country, it does not necessarily make sense to compare the percentage of vehicles keeping to the speed limit with the average speed.

KPI Seat Belts and Child Restraint Systems

The KPI figure for the correct use of seat belts by car users ranges from 70 percent in Greece to 99.2 percent in Germany. The figure is 97 percent in Austria, 94 percent in Belgium, 95 percent in the Czech Republic, and 96 percent in Poland. The figure for the correct use of child restraint systems is 99 percent in Germany and Austria, 83 percent in Belgium, 49 percent in the Czech Republic, and 95 percent in Poland. When it comes to fastening seat belts, another relevant factor is where the occupants are sitting in the vehicle – the figure for rear occupants is lower than that for front occupants. If we look at Bulgaria, for example, the figure for rear passengers is 24 percent, compared with over 70 percent for front passengers. Germany achieves a figure of 96 percent for rear occupants.

KPI Helmets

Helmets are the main form of protection for cyclists and riders of mopeds and motorbikes. Head or neck trauma to the riders of two-wheelers is often fatal or results in serious injuries and impairments. If we compare the national figures for this KPI, we see that the highest percentage of cyclists wearing a helmet can be found in Spain (52.6 percent). Latvia has the lowest helmet use (17.9 percent). However, only nine countries collected data on the percentage of cyclists wearing a helmet. The picture is different when we look at motorbikes and mopeds, as all countries that collected figures for this KPI recorded much higher rates of helmet use. Of the eleven countries, Latvia and Austria have the highest percentage of riders wearing a helmet (100 and 99.9 percent, respectively), whereas Greece and Cyprus recorded the lowest figures (80.3 and 87.4 percent, respectively). This is also reflected in the rates of helmet use by passengers.

If we look at children who travel by bike, the figures for the KPIs are generally relatively high in all countries. In Austria, the figure is 78.2 percent for those aged 0 to 14, but only 34.6 percent for those aged over 14. A drastic fall can also be seen in Belgium – while 64.6 percent of those under 14 wear a helmet, this drops to just 22.6 percent for those over 14.

When it comes to helmet use, gender also plays a role in some countries. In Portugal, for example, the KPI is 41.5 percent for women and 49.2 percent for men. In Spain, 26.9 percent of women wear a helmet, versus 47.3 percent of men.

KPI Alcohol

In all countries, more than 97 percent of drivers stay within the relevant legal limits for the blood alcohol concentration (BAC). The KPI figure for Germany was obtained from surveys and is 99.7 percent. Among the participating countries, the lowest figure based on roadside tests was obtained in the Czech Republic, with 96.2 percent. The lowest reported figure comes from Austria, at 91.9 percent.

If we compare the various countries in detail based on road type, Portugal records the highest KPI figure for freeways, at 99.7 percent. Poland (99.5 percent) and Portugal (99.6 percent) record the highest figures for rural roads. When it comes to urban roads, Poland again achieves the highest figure, at 99.8 percent. If we compare the figures based on the time of day, we can say that the figures for all KPIs are lower at night. This trend is particularly evident on the weekends. Germany only achieves a figure of 95.4 percent at night, but 99.7 percent at other times of day.

Men tend to drink drive slightly more often than women. The KPI figure for women who drive cars or motorized two-wheelers is 99.6 percent, versus 99.5 percent for men. However, age appears to play a role in drink driving, as the KPI figure for 18- to 24-year-olds is 97.9 percent, versus 99.3 percent for 25- to 34-year-olds. This figure continues to rise with increasing age, culminating in a figure of 100 percent (rounded) for age 65 and above. Another key factor is whether the driver is a novice or experienced. The KPI figure for novice drivers of a car or motorized two-wheeled vehicle is 92.2 percent, versus 99.8 percent for people aged over 21 or who have completed their probationary period.

KPI Distraction

The increased use of mobile devices, in particular smartphones, is a major cause of accidents as they distract the person behind the wheel. Texting and phoning while driving heighten the risk of endangering other users. For this reason, most EU Member States have banned the use of cell phones while driving, and some countries have extended the ban to include mobile electronic "devices." If we take weekdays and weekends together, the KPI figures fluctuate from 89.3 percent (Cyprus) to 97.3 percent (Czech Republic).

The latest results show that at least 90 percent of drivers do not allow themselves to be distracted by electronic devices because they refrain from using them. Cyprus records the lowest figure (90.6 percent), whereas Finland has the highest (98.3 percent). At 97.9 percent, Germany is in second place toward the top of the rankings.

STATEMENT

How Continuous Improvements to the Driving Test Contribute to Road Safety In Germany

Mathias Rüdel
Managing Director of TÜV I DEKRA arge tp 21

The driving test is an essential part of the overall process of preparing novice drivers as it ensures that only those novice drivers who demonstrate the necessary skills are participate independently in motorized road traffic. In addition, the aspects covered by the test also provide important impetus for shaping the training provided in driving lessons.

2024 marked the first time that more than two million theory tests and around 1.8 million practical tests were conducted. Last year, the number of tests increased across almost all classes, impressively demonstrating the efficiency of Germany's testing system. Around 80 percent of theory tests and some 75 percent of practical tests were for a class B driving license.

In 2024, around a quarter of all class B driving tests were "BF17" tests (***Begleitetes Fahren ab 17 Jahren***, i.e., young people may drive from the age of 17 provided they are accompanied by an experienced driver). The pass rate for BF17 tests was much higher than the average for class B – there was a difference of more than ten percentage points. However, if we look at the trend in the figures for BF17 tests since 2014, we see that the proportion of these tests has fallen by around ten percentage points.

So where do we stand today when it comes to the road safety of young novice drivers in Germany? A look at the accident statistics between 2011 and 2021 shows a clear improvement, as the number of car accidents resulting in personal injury caused primarily by 18- to 21-year-old drivers fell by almost 43 percent compared with the baseline level. Therefore, it can be concluded that the road safety of young drivers improved significantly over this period. This positive trend clearly stands out when compared against drivers from other age groups. Even though young novice drivers remain one of the main risk groups relative to their experience and number, the trend seen in this age group is clearly more positive than that in other age groups. The process of preparing novice drivers has played a key role in this successful outcome, with the improvements implemented in recent years appearing to have been particularly effective.

To ensure that we maintain this high level, driver training and driving tests must both evolve on a continuous basis. Proposals for reforming driver training are currently being discussed. This reform will introduce new curricular management tools, such as competency frameworks and training plans. These changes will inevitably also affect driving tests as they will have to reflect the new structures and content. There is also discussion of increasing the use of digital teaching/learning methods alongside the tried-and-tested methods of in-person teaching/learning.

The European Commission is currently working closely with the EU Member States on a new version of the EU Driving Licence Directive. This will also affect national legal frameworks and, ultimately, test content and methods. Given the increasing use of automated systems in vehicles and the fact that tasks will therefore be shared differently between the driver and vehicle, there will be a more pressing need in the future for the test to cover this aspect as well. To ensure that people continue to drive safely as they get older, TÜV and DEKRA have also offered standardized driving fitness check-ups (***Rückmeldefahrt***) for older drivers since spring 2025, which focus on maintaining and improving their driving skills.

With all of these developments for preparing novice drivers, the test content and methods must be updated continuously to ensure that we meet future requirements for safe road use. Working closely with all parties involved in the driving test process, TÜV | DEKRA arge tp 21 will continue to play a central role in the future and contribute actively to developing and optimizing the theory and practical driving tests to help achieve our goal of "Vision Zero."

Teleoperation – the Challenges Facing the "Hidden Driver" at the Control Station

The technological evolution from manual to fully automated driving is well underway and has reached a new stage.

In the future, the idea is that a human driver sitting at a control station will remotely control or teleoperate automated vehicles under certain conditions. This sounds like science fiction and instinctively reminds us of the 1980s, when the world of cinema began to show interest in the on-board electronics of driverless cars. One such car called KITT (Knight Industries Two Thousand) was the main character of the television series "Knight Rider." This black Pontiac Firebird Trans Am with its red scrolling light bar in the grille could be driven both manually and automatically and received its commands from a wristwatch.

While it might all have seemed like a long way off back then, today it has become a much more feasible option for the near future. Despite all the euphoria, however, there is also some pessimism because teleoperation redefines the human–machine interface and, at the same time, presents new challenges to the way in which humans and technology interact. The core skill of a teleoperator is to rapidly achieve sufficient situational awareness, enabling them to correctly decipher the snapshot of the traffic situation shown in 2D on one or more screen(s) and decide which steps to take. Situational awareness covers perception, comprehension, and projection. The teleoperator will presumably have to apply relatively abstract parameters and infer any missing information and events. As a result, their processing of information tends to be prone to error.

Particularly in the context of fully automated driving, current safeguarding concepts envisage the deployment of a (human) teleoperator in a special work environment (the teleoperator workplace or driver's station).

Such misjudgments could relate to driving speed, for example. If drivers are in the loop and actively involved in what is happening on the road, their assessment of the speed of oncoming vehicles fluctuates greatly and varies between underestimation of 50 percent and overestimation of 13 percent. Depending on whether the observer estimates the distance from their position in the passenger cell of a car or from a chair (comparable to the situation of a teleoperator at a control center), the estimates differ by up to 29 percent, even if all other experimental boundary conditions remain constant. Orientation errors resulting from reduced visibility due to buildings, vehicles, or the weather, and incorrect assessments (e.g., of distance or speed) already cause accidents in manual driving scenarios, as was empirically confirmed by a systematic and structured in-depth analysis of 474 accidents.

Critical Takeover Situations

Alongside sub-optimal context factors for deciphering what is happening on the road, the time required to achieve situational awareness also plays a crucial role. A person who is not physically participating in traffic needs longer to do this than someone who is sitting behind the wheel of a vehicle and therefore fully in the loop. This is confirmed by studies of situational awareness in scenarios where drivers take over control of the vehicle when switching from fully automated to manual driving following a prompt from the system. Whereas situational awareness can be achieved relatively quickly (five to eight seconds) at level 1 (perception), it takes more than 20 seconds at level 2 (comprehension). Studies with drivers located outside the vehicle – similar to a teleoperator – even identified delayed situational awareness ranging from 29 to over 162 seconds, depending on the specific use case. At the same time, the person's reaction speed increases from

one to over three seconds, even for straightforward takeover situations in the vehicle.

Signal transmission latencies tie up further processing time and may compromise the person's monitoring ability and the quality of their control actions. By way of comparison, the aviation sector considers a maximum total delay of 100 milliseconds to be acceptable for time-critical scenarios that require precise control of the aircraft. If the delay exceeds 240 milliseconds, control of the aircraft can no longer be guaranteed.

Another factor is that the lack of haptic feedback following control inputs hampers perceptual processes. As a result, the teleoperator cannot "feel" the significance of their actions. We are familiar with this phenomenon – also known as the embodiment effect – from computer games. It can generate a reduced sense of responsibility and, in particular, result in misunderstandings due to misjudging the significance of certain information.

Given the anticipated range of technologies for fully automated driving, together with different vehicle-specific properties for the teleoperated vehicles (dimensions, weight, contours, equipment, and driving comfort), teleoperators will need to be able to operate many different types of vehicle. Aspects such as the field of vision, steering and braking behavior, and responsiveness to acceleration will all vary depending on the vehicle properties. Given the many different vehicle types, it must be asked how we can ensure that the teleoperator is able to reliably cope with different vehicle types and, for example, familiarize themselves with the features of the teleoperated vehicles before starting their journey at the control station.

Highly Complex Task Elements

What conclusion can we draw? Teleoperation physically and mentally separates the person from the existing structures related to the task of driving. Whereas someone sitting behind the wheel of a vehicle constantly receives and processes information about what is happening on the road, a teleoperator is provided with only selected information – they do not have as much information as the active driver, the information is of inferior quality, and how it changes over time also differs. The extent to which existing technical solutions can adequately simulate the dynamic process of human hazard perception across all distances, driver's views, and associated eye movements has so far not been proven.

If the teleoperator is provided with only selected 2D excerpts of a traffic situation on different screens, there is a risk of error in the heat of the moment. This could be compensated – at least in part – by ensuring that the teleoperator workstation is ergonomically designed and has supporting features that reduce strain. For example, it would make sense to incorporate an indicator showing the distance to the vehicle in front as a mandatory ergonomic feature of a teleoperator workstation.

A teleoperator should be the driver in a legal sense. For this reason, it must be specified precisely when the journey conducted by teleoperation starts and ends. Does the task of remotely controlling the vehicle already start when the teleoperator presses the button on the input device to establish the data transfer between the control station and the teleoperated vehicle, or only once the teleoperator has achieved situational awareness? Which delay times

A teleoperator must be able to operate many different types of vehicle

must be factored in as error tolerances? And when exactly does the remote control process end?

It is possible that teleoperation will become one of the "Ironies of Automation" described by Lisanne Bainbridge more than 40 years ago. Simple driving tasks are being automated, leaving highly complex task elements to be performed in the future by a teleoperator working from a control station, far from the actual traffic on the road. This rather downbeat assessment gives grounds for concern, because the causes of accidents will shift from human error by the driver in the vehicle to human error by the teleoperator and/or the designer of this new human–machine interface.

It will therefore be interesting to see how teleoperation is implemented in practical terms during the trial phase. It could become a successful model, provided that the smart path of theory-led, science-based empirical evidence is not blocked or "creatively" circumvented by political ambition, physical system constraints, an over-reliance on technology, and the financial drive for profit. Ultimately, it is about nothing less than the lives of all road users and the fundamental need to protect them, which the government must guarantee by law.

STATEMENT

The Best Drivers of the Future

Dr. Pedro Miguel Silva
Member of the Board of Directors at IMT
(Institute for Mobility and Transport)

The technological advances in vehicles and road infrastructure create the impression that accidents will decrease or even disappear altogether in the not-too-distant future. Given this scenario, it could be assumed that the people behind the wheel of a vehicle will be relegated to a background role as they are no longer considered to be part of the system. If this were to be the case, why bother investing in training new drivers and ensuring that today's drivers drive safely?

The answer is obvious: Drivers are part of the mobility ecosystem. Even if the challenges we face in the future differ from those we face today, there will still be one lowest common denominator: road safety. The pursuit of a paradigm shift in training – focusing on driver behavior in terms of the ability to predict dangerous situations, concentrate, stay alert, and adapt to using driver assistance systems – is the approach that has been taken in this respect, and that IMT aims to improve and intensify.

We know that not all learner drivers are the same, and that they need learning processes that are tailored as ideally as possible to their lifestyles and needs. The use of e-learning tools and video conferences to communicate driving knowledge, tests with an automatic translation function and sign language avatars, and the incorporation of easy-to-understand theory test content focused on safe conduct will soon be a reality.

We are also planning specific training and assessment methods for motorbikes and trucks as these vehicles come with their own challenges that cannot be overlooked in training. In the case of motorbikes, it is crucial to improve training in the areas of adapting to the vehicle and to critical situations, such as emergency braking.

All these measures are consistent with the recasting of the Driving Licence Directive and with the best practices that IMT tracks and analyzes in conjunction with its national and international partners. The aim is always to ensure that those who are learning to drive now are the best drivers and the most able to adapt to change and technology.

The Use of Artificial Intelligence in Vehicles in Future – A Road to Success or Failure?

Artificial intelligence (AI) is playing a crucial role in the development of highly and fully automated vehicles and, in turn, is revolutionizing our understanding of mobility.

With respect to the five levels of automated driving as defined by the Society of Automotive Engineers (SAE 2018, 2021) – i.e., from level 0 (the drivers control the vehicle entirely by themselves) through level 5 (the vehicle drives from the start point to the destination without any input from the driver whatsoever, i.e., is fully automated or autonomous) – the task of driving the vehicle, and the division of tasks between the driver and the technical vehicle control system, will be redefined in future. The higher the level of automation in the vehicle, the lower the number of tasks left for the human driver.

This technical evolution presents challenges in a number of different areas, such as ethical issues and how to guarantee the fundamental protection of road users. The higher the level of automation, the more the causes of accidents will shift from human error inside the vehicle itself to human error by the IT designer of the human–machine interface. This is because the person who develops the AI software in the vehicle, i.e., the neural networks, must make a large number of decisions about the various parameters of these neural networks. These include decisions about how autonomous vehicles should behave if an accident is unavoidable, and about which party should potentially suffer harm.

The following scenario is a classic example of this type of moral dilemma. Imagine that a pedestrian suddenly steps into the road in front of an autonomous vehicle. Emergency braking alone is not enough to prevent the collision. The vehicle could swerve onto the sidewalk, but it would then hit a person standing there. Swerving into oncoming traffic would result in a collision with a truck and thus endanger all vehicle occupants. At its core, this is an issue about programmed decision-making routines for sharing the risk of potential harm among the various parties involved in an accident. Car manufacturers and political decision-makers alike are addressing this moral dilemma. Ultimately, it is crucial to reach a consensus on the principles underpinning such decisions, particularly for society, because there would otherwise be little acceptance and use of fully automated vehicles.

Experimental Investigation of Moral Dilemmas

A few years ago, in order to quantify society's expectations of the ethical principles for the behavior of autonomous vehicles when faced with a conflict, a group of scientists led by British researcher Edmond Awad developed the Moral Machine experiment. The experiment was a type of game run on a multilingual online experimental platform, which collated data on people's expectations of how to solve moral dilemmas relating to unavoidable accidents. The Moral Machine presented the users with unavoidable accident scenarios with two possible outcomes, depending on whether the autonomous vehicle swerved or remained on its course. The user's task was to select the preferred outcome. To this end, the test subjects were able to view detailed information beforehand explaining the fates of the people in the accident scenario.

Each session covered 13 accidents. After completing a session, the participants could voluntarily complete a questionnaire which collated demographic information such as gender, age, income, education, and religious and political views. Geolocation was also carried out for the participants so that groups of countries with similar moral preferences could be identified at a later stage.

By the end of the experiment, the Moral Machine had recorded just under 40 million decisions in ten languages taken by millions of people in 233 countries and regions. Viewed globally, the results showed that the strongest preference was to protect humans over animals, more lives rather than fewer lives, and younger lives instead of older lives. Geolocation enabled the researchers to identify the participants' countries, which in turn allowed the identification of groups or clusters of countries with similar moral preferences.

STATEMENT

Ensuring the Safety and Reliability of AI Technologies in Road Vehicles

Xavier Valero
Director Artificial Intelligence & Advanced Analytics at DEKRA

As artificial intelligence (AI) becomes more embedded in road vehicles, particularly through Advanced Driver Assistance Systems (ADAS), its potential to enhance driving safety and reduce accidents is evident. However, the risks associated with AI system failures cannot be overlooked, as these technologies directly impact road safety and may endanger lives. For example, decision-making AI systems in ADAS that adjust vehicle speed or activate brakes could cause severe accidents if they fail. As autonomous driving technology evolves, the role of AI will grow, making its safety even more critical.

To effectively manage these risks, AI regulations and standards are essential. Europe's AI Act, which came into effect in August 2024, defines "high-risk AI systems," including those that affect human life and safety. In the automotive sector, AI systems for visual perception (e.g., recognizing traffic signs, pedestrians, and vehicles), vehicle monitoring (e.g., tire pressure, engine temperature), and driving decisions (e.g., automatic braking and ADAS) may be classified as high-risk AI systems, since a malfunction could endanger both driver and pedestrians health and even lives. These systems, crucial to driving safety, must undergo stricter oversight and validation to ensure their reliability and prevent risks.

The AIA also allows for exceptions when existing regulatory frameworks, such as vehicle type approval (Regulation (EU) 2018/858), have already assessed AI systems. This means that safety features like ADAS, though indirectly regulated by the AIA, can be validated through existing type approval procedures without requiring additional third-party evaluations.

While AI system providers are responsible for ensuring their systems comply with AIA requirements, they must also establish a comprehensive AI management system within their organizations. This system should include clear policies, workflows, and roles to ensure AI system safety and navigate regulatory challenges. Moreover, all stakeholders – upstream technology suppliers, downstream integrators, and manufacturers – must contribute to ensuring system safety, data security, and transparency.
A comprehensive quality management system throughout the AI life cycle is necessary for full compliance, as this ensures that all activities remain traceable and verifiable.

ISO/PAS 8800 offers guidelines for the safety of AI systems in the automotive industry. It covers the full AI life cycle, from design to deployment, ensuring systems are both safe and reliable. The standard complements ISO 26262 (functional safety) and ISO 21448 (SOTIF) to address potential risks associated with AI-driven systems. It also emphasizes the importance of data quality control, system validation, and continuous monitoring during operation, ensuring AI systems meet safety requirements at every stage.

DEKRA plays a key role in promoting AI security in road vehicles. We contribute to regulatory discussions, offering expertise to shape best practices, and provide ISO 8800 certification and assessments to help manufacturers ensure their AI systems meet the highest safety standards. Our independent testing and certification services help ensure that AI technologies meet regulatory requirements, promoting safer and more reliable AI applications in vehicles.

The accident scenarios used in the Moral Machine experiment are generated on the basis of a strategy focused on the following nine factors:

- Should we protect people or animals?
- Should the vehicle stay on its course or swerve?
- Should we protect occupants or pedestrians?
- Should we protect many or fewer human lives?
- Should we protect men or women?
- Should we protect young or old people?
- Should we protect pedestrians who cross the road legally, or pedestrians who cross the road on red?
- Should we protect healthy and able-bodied people, or people with health impairments?
- Should we protect people with a higher or lower social status?

Major Differences Worldwide

A total of 130 countries were classified into three rough clusters: the western cluster (comprising North America and many European countries), the eastern cluster (comprising countries such as Japan and Islamic countries), and the southern cluster (comprising countries from Central and South America). These clusters are consistent with the geographic and cultural proximity of the countries they contain. Regarding some preferences, there were clear differences between the three clusters, which presents a challenge in terms of achieving universal machine ethics. For example, the preference for protecting younger people over older people and people with a higher status over people with a lower status was much lower in countries in the eastern cluster, and much higher in countries in the southern cluster than the western cluster. Compared with the other two clusters, countries in the southern cluster exhibited a much weaker preference for protecting people over pets. It was only the (low) preference for protecting pedestrians over passengers and the (moderate) preference for protecting legally compliant driving over unlawful behavior that appeared to apply equally in all clusters. A special feature of

How Cultural Factors Influence Software Engineering Techniques

When developing an AI for fully automated driving, we also need to consider another important aspect. As U.S. software developer Greg Borchers mentioned in a technical article in 2003, when it comes to multicultural teams in particular, it is not just different functions, schedules, and resources that have a major impact on the software engineering work; cultural differences also play a key role. To investigate this further, he looked at two separate software development projects which each involved teams from Japan, India, and the USA. In his analysis, he looked in greater detail at three dimensions from a cultural study published by Dutch academic Geert Hofstede: power distance (the approach to social inequality and the relationship with authorities), individualism versus collectivism (the relationship between the individual and society), and uncertainty avoidance (dealing with conflict and uncertainty).

In cultures with a high power distance, such as India or Japan, the supervisor(s) have more power over their subordinates than in cultures with a lower power distance. Problems can then occur if, for example, the American project manager expects teams in India or Japan to approach problems in the same way as American developer teams would normally do. However, Japanese and Indian teams expect to be subordinate to the American project manager and must follow their instructions directly without challenging them. In terms of developing an AI for fully automated driving, this could mean that people set aside their own concerns about aspects like protecting certain groups of road users, which may endanger the safety of these groups.

We also see the potential for conflict in teams with varying levels of individualism. In the USA, with its high individualism score, the focus is on asserting one's own needs, whereas in countries like Japan or India there is a greater focus on collective thinking. In the case of an AI for fully automated driving, it may thus be the case that teams who tend toward a collective mindset pay greater attention to the needs of more vulnerable road users.

Last but not least, cultures with high uncertainty avoidance scores have more developed coping mechanisms to reduce the feeling of uncertainty. Examples of such mechanisms in software development include restrictive change control systems and sophisticated process models which include the workflows required to deal with all possible events that might arise during the development process.

As a result, this question also shows that, when it comes to the use of AI for fully automated driving, there are still many challenges to overcome, many relevant aspects need to be considered, and comprehensive research is required before this technology can be used across the board.

A highly automated robot taxi in Los Angeles

the southern cluster was the strong preference to protect women and healthy people.

In addition, the research identified four cultural and economic predictors that can explain the differences in moral preferences between the countries and clusters. For example, there are systematic differences between individualistic and collectivist cultures. Participants from individualistic cultures (which stress the importance of each person) demonstrate a stronger preference for protecting large numbers of people, whereas participants from collectivist cultures (which stress respect for older members of the community) show a weaker preference for protecting younger people.

When asked question whether pedestrians who cross the road on red should enjoy the same protection as people who cross the road legally, prosperity and differences in the countries' rules and institutions play an important role. Test subjects from countries which are poorer and have fewer legal regulations are more tolerant of pedestrians who cross the road unlawfully – which is presumably because they have experienced a lower level of regulatory compliance and weaker punishments if regulations are not adhered to. Furthermore, the economic inequality in a country influences how unequally people with a different social status are treated.

People from countries with less economic equality between the poor and rich also treat the rich and the poor less equally in the Moral Machine. This can be explained by their regular encounters with inequality, which become integral to their moral preferences. Moreover, the different treatment of men and women in the Moral Machine is related to a country's gender gap in terms of health and survival. Almost all countries showed a preference for women. This was even more pronounced in countries where women have better health and survival opportunities. In those places which devalue the life of women less in terms of health and childbearing, men are seen as more dispensable in the decisions recorded by the Moral Machine.

The Facts at a Glance

- **Like all psychoactive substances, cannabis influences our nervous system and, therefore, fundamental aspects of our ability to safely drive vehicles.**
- **In 20 percent of all fatal accidents in high-income countries and 33 to 69 percent of all fatal accidents in low- and middle-income countries, the blood alcohol concentration was found to be above the relevant legal limit.**
- **Alcohol interlocks are not viable as a first priority for combating drink driving.**
- **There has been a high degree of differentiation in the field of traffic psychology interventions in recent decades. This process was informed by new findings, as well as legislative requirements.**
- **By recording standardized road safety KPIs, we can essentially compare, measure the progress made over time, and assess how effective the implemented measures and initiatives have been.**
- **The teleoperator at the control station is to be the driver in a legal sense. For this reason, this method of controlling a vehicle requires precise specifications of when the journey conducted by teleoperation starts and ends.**
- **The higher the level of automation, the more the causes of accidents will shift from human error inside the vehicle itself to human error by the IT designers of the human–machine interface.**

Passive and Active Safety Systems Working Smartly Together

Whether you are traveling in a car or commercial vehicle, on a motorized two-wheeled vehicle, by bike, or on foot: The advances made in vehicle technology, particularly since the 1950s, have played a key role in improving road safety for all road users. Continuous innovation, the use of advanced safety systems, and the establishment of corresponding legal frameworks have significantly reduced the risks associated with road traffic.

As already mentioned at numerous points in this report, the European Commission has set itself the goal of halving the number of traffic fatalities by 2030 compared with the 2019 baseline, and reducing them to virtually zero by 2050 as part of the “Vision Zero” strategy. In order to achieve this ambitious goal, a number of different measures have been defined in the “Strategic Action Plan on Road Safety” and the EU’s Road Safety Policy Framework 2021–2030.

A cornerstone of this strategy is the introduction of new vehicle safety requirements. It is therefore with good reason that the EU Commission has made various safety-relevant driver assistance systems mandatory for new motor vehicles on Europe's roads as part of the General Safety Regulation already adopted in March 2019. This includes systems such as smart speed assistants, automated emergency braking systems that detect pedestrians and cyclists, lane keeping assistants, turning assistants, warning systems for fatigue and if the driver’s attention drops, fixtures for installing an alcohol-sensitive immobilizer, or automatic emergency call systems (eCall).

Pioneers of Safety

However, these modern assistance systems are just the latest innovations in a development process that goes back decades. For example, it was the introduction of the radial tire in the late 1940s that enabled the stable driving characteristics exhibited by today's vehicles – after all, the tire is the only thing that connects the vehicle to the road. The introduction of disk brakes was equally important. They offer more stable braking power than drum brakes, particularly in heavily loaded vehicles. In addition, the excellent control properties of hydraulic disk brakes underpin modern systems such as ABS and ESP. Back in 1902, British engineer Frederick W. Lanchester was awarded a patent for the disk brake and has since been considered its inventor.

Béla Barényi, who worked for Daimler-Benz AG for decades, was behind another ground-breaking development in vehicle safety. In 1951, he filed a patent for his concept of a "rigid passenger cell with crumple zones at the front and rear." This design is the standard today and forms the basis for effectively protecting a vehicle's occupants in the event of a serious accident. In 1963, Barényi also developed the "safety steering shaft," which, combined with a safety steering wheel, minimizes the penetration of the steering column into the passenger cell in the event of a collision.

A further milestone was achieved in 1959 by Swedish Volvo engineer Nils Ivar Bolin, who invented the three-point safety belt. Coupled with a sturdy passenger cell and additional safety features such as belt tensioners and belt force limiters, the seat belt remains one of the most important passive safety systems in use today. This not only applies to frontal collisions, but also to side collisions and rollovers.

In 1971, Daimler-Benz filed a patent for the driver's airbag, which supplements the seat belt in the event of a serious frontal collision. Additional safety systems such as front passenger, side, and knee airbags were introduced in the following years, meaning that today's vehicles are equipped with numerous airbags. In 1978, Daimler-Benz began installing the ABS anti-lock braking system as standard, which ensures that the driver can still steer the vehicle in an emergency braking situation and provides maximum braking power. The system was subsequently expanded to include the traction control system (TCS), which ensures that the vehicle remains stable even when accelerating rapidly.

In 1995, Mercedes-Benz installed the electronic stability program ESP (which had been developed by Bosch) as standard in its S600 model. »

KPI Vehicle Safety

As described in "The Human Factor," the EU's Baseline project launched in 2020 aims to improve Europe's road safety key performance indicators (KPIs) and, at the same time, increase the comparability between the various countries by establishing minimum methodological requirements. These KPIs also include vehicle safety.

The passive and active safety features in a vehicle play a major role in road safety because they reduce the probability of an accident and its severity. Passive safety features such as seat belts, airbags, and rigid passenger cells with a crumple zone protect the vehicle occupants in the event of a collision. Active safety features such as the automated emergency braking system, lane keeping assistant, smart speed controller, and distance warning system support the driver and can prevent traffic accidents or help to reduce their severity.

With the entry into force of the General Safety Regulation on July 6, 2022, many of these driver assistance systems became mandatory in the EU for various vehicle classes undergoing EU type approval for the first time. Since July 7, 2024, these systems must be installed in all newly registered vehicles of the affected categories.

The European New Car Assessment Programme (Euro NCAP) assesses vehicles on the basis of tests that examine occupant protection, the protection of the other road user involved, the protection provided by driver assistance systems, and rescue options following an accident. The star ratings are a good way of assessing vehicle safety – they reflect how well cars perform in the process and therefore provide a transparent and comparable basis for deciding whether to buy a particular vehicle. The test conditions go well beyond legal requirements. In comparable accidents, cars rated with five stars result in a much lower risk of injury than those rated with two stars.

The KPI Vehicle Safety is based on the proportion of newly registered cars with a good Euro NCAP rating of four or five stars in the countries examined in 2019 and 2020. For 2019, the percentage of newly registered cars with a Euro NCAP star rating of four or higher is between 96 percent in Sweden and 64 percent in Lithuania. The percentage is above 80 percent in all but three countries. This means that, in most European countries, 80 percent of newly registered cars in 2019 provided a good level of vehicle safety overall.

People Saved by Safety Systems in the USA

In 1971, the National Highway Traffic Safety Administration (NHTSA) published its first analysis of the potential benefits of Federal Motor Vehicle Safety Standards (FMVSS). This was followed ten years later by the first retrospective assessment of how effective the FMVSS had been, based on statistical analyses of accident data. The FMVSS include a range of technical regulations that set out minimum requirements for components and assembles in motor vehicles. These standards apply in the USA and are comparable with the European UNECE regulations. According to an NHTSA study published in December 2024, the combination of technologies such as seat belts, airbags, electronic stability control, improved brakes, and other safety functions led to a 64-percent reduction in the risk of death for the occupants of cars and small commercial vehicles in 2019 alone. This assessment is based on the assumption that these systems would not have been introduced without the standards. As a result, in 2019, the FMVSS are believed to have prevented around 40,000 fatalities, 1.9 million non-fatal injuries, and damage to 3.8 million vehicles. The ranking is topped by seat belts (20,440 human lives saved), electronic stability control (4,690 human lives saved), front airbags (4,330 human lives saved), protection from side impacts (2,140 human lives saved), and occupant protection in the event of an impact in the interior (2,065 human lives saved). Between 1968 and 2019, the safety standards are believed to have prevented more than 860,000 fatalities on the country's roads, 49 million non-fatal injuries, and damage to 65 million vehicles.

The Most Important Driver Assistance Systems and How They Work

Driver assistance systems help the person behind the wheel by detecting critical situations at an early stage, issuing warnings, or even actively intervening. In this way, they help to prevent accidents, mitigate their consequences, and improve driving comfort.

- **Automated emergency braking system:** Detects obstacles, pedestrians, and cyclists and issues an audible and visible warning to the driver. The vehicle automatically applies the brakes in an emergency.
- **Lane keeping assistant:** Warns the driver if they accidentally stray from their lane and can steer the vehicle back into the lane.
- **Lane change assistant:** Helps the driver to change lanes by intervening in steering if there is no vehicle in the blind spot.
- **Blind spot warning system:** Warns of vehicles in the blind spot, particularly when changing lanes.
- **Adaptive cruise control:** Automatically maintains a safe distance from the vehicle in front.
- **Fatigue warning system:** Detects signs of fatigue and recommends that the driver takes a break.
- **Alertness assistant:** Analyzes how the driver is steering, warns them if there are signs of fatigue or inattentiveness, and thus reduces the risk of accidents caused by the driver momentarily nodding off.
- **Turning assistant:** Detects pedestrians and cyclists when turning and can brake the vehicle if there is an imminent danger. Particularly important for trucks and buses.
- **Intersection assistant:** Detects cross-traffic at intersections and helps to prevent accidents.
- **Congestion assistant:** Combination of adaptive cruise control and lane keeping assistant – enables partially automated driving on freeways.
- **Speed assistant:** Automatically restricts the speed by detecting traffic signs or using GPS data, thus preventing accidental speeding.
- **Predictive cruise control:** Uses GPS and map data to adjust the vehicle's response on inclines and downhill sections.
- **Traffic sign recognition system:** Reads out speed limits and other traffic signs and shows them on the head-up display or dashboard.
- **Night and infrared assistant:** Improves visibility in darkness, detects people or animals, and can warn the driver.
- **High-beam assistant:** Detects vehicles ahead and oncoming vehicles and automatically turns off certain segments of its own high beam or automatically switches from high beam to low beam.
- **Rain and light sensor:** Automatically activates the windshield wipers and lights if it is raining or dark.
- **Parking assistant:** Independently steers the vehicle into a parking space (parallel or perpendicular). The driver only needs to operate the accelerator and brake, or does not need to do anything at all.
- **Vehicle backup camera and 360° camera:** Shows the area around the vehicle to make parking and maneuvering easier.
- **Trailer maneuvering system:** Helps when reversing with a trailer as the system automatically steers the vehicle.
- **Reversing assistant:** Helps the driver when reversing by warning of possible obstacles using acoustic or optical signals.
- **Hill-start assistant:** Makes it easier to move off on inclines by preventing the vehicle rolling back.
- **eCall emergency call system:** Detects accidents via sensors (e.g., sudden deceleration, vehicle tilted) and automatically transmits an emergency call with the GPS position and other relevant data to the rescue services.

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This assistance system helps the driver in critical driving situations by correcting oversteering or understeering. Independent tests show that an ESP can prevent almost half of all serious car accidents involving a single vehicle. This makes it one of the most important safety systems in modern vehicles.

Crash Test – Comparison of the Old Golf with the New Golf

To demonstrate the advances made in the overall passive safety system over the decades, DEKRA conducted a crash test with a VW Golf II (built between August 1983 and December 1992), and compared the results to a Euro NCAP test of the VW Golf VIII (built since October 2019). The crash test with the Golf II at the DEKRA Crash Test Center in Neumünster was based on the offset frontal crash used in the European New Car Assessment Programme (Euro NCAP) until 2020. In this test, the vehicle collides with a barrier at a speed of 64 km/h (~40 mph) and with a coverage of 40 percent. To simulate the energy absorption of the other vehicle in a collision, an aluminum honeycomb structure is fitted to the barrier. The test is therefore equivalent to a frontal collision between two identical vehicles, each traveling at a speed of 50 km/h (~31 mph) and with a coverage of 40 percent. It reconstructs a collision with oncoming traffic, such as when overtaking.

Occupants of the Golf II would have been unlikely to survive this collision with oncoming traffic.

In the Golf VIII, the occupants would have tended to suffer minor injuries in such a collision with oncoming traffic.

Unlike the standard procedure, an older type of dummy in line with the vehicle's age was used. It was not equipped with measurement technology as the risk of serious damage was too high in this case. Several acceleration sensors were fitted inside the passenger cell. Additionally, no child seats from the 1980s or child dummies were used. DEKRA also did not subject to the vehicle to the total mass specified in the test report. Given the lower unladen mass of older vehicles (845 to 1,165 kg for the Golf II versus 1,260 to 1,590 kg for the Golf VIII), this would have negatively affected the comparison to the clear disadvantage of the Golf II.

The driver of the old Golf effectively had no chance of survival due to the collapse of the passenger cell, the fact that vehicle components penetrated deep into the passenger cell, the deceleration, and the collision with the steering wheel. The driver dummy was wedged solidly in place by the crash. The significant deformation of the vehicle meant that it would not have been possible for first aiders to free the driver from the vehicle or provide effective first aid. The likelihood of the front passenger surviving is very low, in particular due to the fact that their head collided with the dashboard and the high deceleration.

In the new Golf, slightly elevated readings were recorded on the driver dummy's the right lower leg and chest. Slightly elevated readings were also recorded on the left lower leg of the front passenger dummy. The occupants may possibly have suffered contusions and bruising in these areas.

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Microcars Offer Scant Protection for Occupants

Small, lightweight vehicles are not just relatively affordable; they can even be driven by the holders of a class AM European driving license, which can already be obtained by 15- and 16-year-olds. As a result, these vehicles enjoy a certain popularity, particularly among young novice drivers. However, these microcars do not offer a particularly high level of safety, as demonstrated by a crash test that DEKRA conducted with a Citroën Ami and Aixam Access on behalf of German TV program "***auto mobil – das VOX Automagazin***." In this test, the vehicles were driven into a stationary obstacle at their maximum speed of 45 km/h (~28 mph) and with 40 percent coverage. The findings showed that in this type of scenario, the driver is subjected to forces which must be classified as potentially fatal. The poor results obtained with the tested vehicles are all the more surprising given that criticism of the inadequate occupant protection provided by lightweight vehicles is nothing new. Back in 2007, the insurance accident research association ***Unfallforschung der Versicherer*** prepared a study on the safety of microcars in collaboration with the ***Allianz Zentrum für Technik*** and criticized that these vehicles (quote translated freely here) "already pose an increased risk of injury in collisions at urban speeds." German automobile association ADAC came to a similar conclusion based on its tests in the Euro NCAP 2016 test consortium.

Superheroes in the Service of Vision Zero

They put their "bones" on the line for us – anthropomorphic test devices, better known as crash test dummies. They contain state-of-the-art, ultra-precise test instruments which are used to measure the risk of injury to humans in vehicle accidents. For many years, they have played an indispensable role in the development of new vehicle models, and in accident research.

However, crash test dummies have their origins in the aircraft industry. Sierra Sam, the first crash test dummy, was developed in the late 1940s and used by the U.S. Air Force to test ejection seats. Colonel John Paul Stapp – a flight surgeon in the U.S. Air Force in the 1950s and a pioneer of passive vehicle safety – noticed that more fighter pilots were dying in car accidents than plane crashes. This led him to launch a comprehensive program of studies in which dummies in cars were catapulted into wooden and concrete barriers. Brave volunteers tested seat belts and were subjected to forces of up to 28 g (28 times the force of gravity).

It quickly became clear that more biofidelic crash test dummies than Sierra Sam were needed. In 1971, GM built the Hybrid I, the first in a series of modern crash test dummies. It turned out to be durable and better suited to obtaining standardized results, but it was not as sophisticated as modern dummies yet and was unable to fully replicate how real people are affected in an accident.

The most widespread of the current crash test dummies is the Hybrid III, a direct successor to the Hybrid I. The Hybrid III was originally built in the 1970s; it is 1.76 meters tall and weighs 78 kg – which corresponded to the dimensions of the average adult man at the time. It is now also available as a 50-percentile and 95-percentile male dummy, and as a 5-percentile female dummy.

In recent years, the U.S. National Highway Traffic Safety Administration has been working on a sophisticated new model called THOR. This model is much better at simulating actual human movements and comes equipped with a whole range of sensors to record detailed information about happens to our body in an accident.

In it efforts to further improve road safety, DEKRA Accident Research has been collaborating for many years with Humanetics, a leading manufacturer of crash test dummies. For example, prototypes of an elderly female dummy and an obese dummy have already been tested at the DEKRA Crash Test Center in Neumünster. The elderly female dummy represents a 70-year-old woman with a height of 1.61 meters and a weight of 73 kg. The obese dummy represents an overweight vehicle occupant weighing 124 kg.

DEKRA experts at the Lausitzring in Klettwitz carried out various tests with the Golf II and Golf VIII, including braking tests on different road surfaces.

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They would have been able to exit the vehicle by themselves. The statistics classified their injuries as "slight." The doors could be opened normally without the need for additional force, and the entire passenger cell area remained intact. The occupants received excellent protection from the front and side airbags, in conjunction with their seat belt, belt tensioner, and belt force limiter.

Insightful Road Tests

In order to demonstrate the impact of technical advances in vehicle construction on road safety, many comparative tests were conducted at the Automobile Test Center, part of the DEKRA Technology Center at the DEKRA Lausitzring. As before, the test vehicles were a VW Golf II that was first registered in 1989 and a VW Golf VIII that was first registered in 2024. Each vehicle was fitted with the standard equipment. The Golf II was given a comprehensive technical inspection before the tests. The vehicle and its tires were found to be in a very good condition.

In the first series of tests, the DEKRA experts examined the braking properties at different speeds, on different surfaces, and under different conditions. In all cases, the braking distance of the new vehicle was around 30 percent shorter than that of the old vehicle. The impact this has on road safety can be seen from the residual speed – i.e., the speed at which the Golf II was traveling at the point when the Golf VIII had come to a standstill.

Another crucial factor when assessing driving safety is the vehicle's cornering stability. This tells us the speed range within which the vehicle can swerve safely or safely navigate a bend in the road. Alongside the tires, chassis, and vehicle type, vehicle assistance systems – especially ESP – also play a key role. To compare the results, DEKRA carried out a standardized double lane change test to simulate the vehicle suddenly swerving before an obstacle, driving around it, and then returning to its original lane. During the test, the vehicle speed was increased in 5 km/h increments.

Comparison of the Braking Distance of the Golf II and Golf VIII

Road surface	Initial speed	Braking distance Golf II	Golf VIII	(difference)	Percentage*	Braking deceleration in m/s² Golf II	Golf VIII	Residual speed Golf II**
Wet basalt	60 km/h (~37 mph)	123.4 m	85.4 m	(38 m)	69.2%	1.13	1.63	33.3 km/h (20.7 mph)
Wet concrete	60 km/h (~37 mph)	24.6 m	17.4 m	(7.2 m)	70.7%	5.65	7.98	32.5 km/h (20.2 mph)
Dry asphalt	80 km/h (~50 mph)	41.4 m	28.5 m	(12.8 m)	69.0%	5.98	8.66	44.5 km/h (27.7 mph)
	100 km/h (~62 mph)	62.2 m	42.6 m	(19.6 m)	68.5%	6.20	9.06	56.1 km/h (34.9 mph)
	130 km/h (~81 mph)	93.6 m	63.3 m	(25.5 m)	73.0%	6.97	9.55	67.6 km/h (42.0 mph)

* Percentage braking distance: Golf VIII versus Golf II
** Residual speed of the Golf II at the point where the Golf VIII comes to a standstill

Source: DEKRA

DEKRA's road tests also showed major improvements in the cornering stability of the Golf VIII compared with the Golf II.

The test is deemed failed if the vehicle is repeatedly unable to keep to the marked route or if the vehicle skids. Professional test drivers were behind the wheel of the vehicles. As a rule, they reached speeds far above those that normal drivers can manage safely in such situations.

The maximum speed achieved for the Golf II was 65 km/h (~40 mph), compared with 75 km/h (~47 mph) for the Golf VIII. The photos clearly show the differences in the vehicles' handling. The Golf II pitched down on the outside of the bend, and the rear wheel on the inside of the bend lifted off the road. The Golf VIII pitched down far less and its wheel did not lift off the road. However, it also became clear during this test that modern technology will also reach its limits at some point, meaning that it is no longer possible to stop the vehicle from swerving.

STATEMENT

Motor Sport as an Innovation Platform for Series-Production Technology

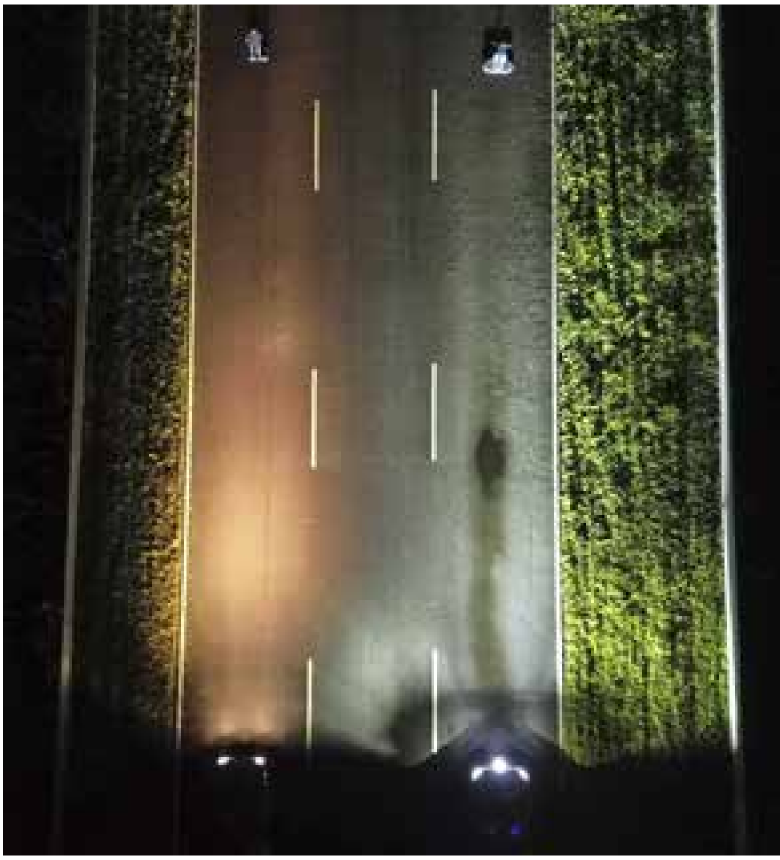
Wolfgang Dammert
DEKRA Motor Sport Coordinator

Motor sport has always played a pivotal role in taking automotive technology to the next level. Not only is it a test field for high-performance vehicles, but also an innovation platform for technologies that are subsequently transferred in series-production vehicles. Many of the technical accomplishments that we consider par for the course today – from safety standards to improved efficiency – have their origins on the racetrack.

A classic example is the development of the carbon ceramic brake. Originally designed for the aviation sector due to its enormous deceleration and low weight, this brake disk material soon became the standard in many top-level motor sport competitions, most notably Formula 1. Based on the experience in motor sport, carbon ceramic braking systems subsequently found their way into high-end sports cars and luxury vehicles. The development of the four-wheel drive is also largely down to motor sport. Another example of the importance of motor sport as an innovation platform is Formula E. The high demands made of battery technologies and charging management systems in Formula E have accelerated the development of more powerful, more efficient batteries. Ultimately, fast charging cycles and high energy densities are not only essential for motor sport, but also for our ability to use electric vehicles in everyday life.

A key advantage of motor sport is its extremely short development cycles. Whereas series production often requires several years to introduce a new technology, racing innovations can be tested and improved within a single season. This not only relates to drives and materials, but also to chassis technology and safety components, and the systematic development of aerodynamic concepts. Especially in the field of simulating computational fluid dynamics (CFD), the rapid development processes in motor sport have played an indisputable role in developing series-production vehicles.

Crash tests are another example of the links between motor sport and series-production vehicles. Whereas the first standardized crash tests were developed for road vehicles, the motor sport industry provided additional impetus by introducing new materials, improved safety structures such as carbon fiber monocoques, and optimized standards and simulations.



Changes in Steering Forces and Noise

Driving has also become a much more comfortable experience over the years. In addition to the haptic properties of surfaces, the convenience of the potential settings, and the comfort of the seats and similar components, measurable and comparable variables like the necessary steering forces, noise, and lighting have also changed. A series of tests measured the necessary steering forces and the turning angle of the steering wheel when parking the vehicle. To achieve full lock, the wheel in the Golf II must be turned 712 degrees, which is almost two complete revolutions. The Golf VIII requires much less effort because full lock is already achieved at 487 degrees. The forces required to turn the steering wheel also differ greatly. The Golf VIII requires around 3 Nm, compared with 13 Nm for the Golf II. A modern power steering system plays a big role in ensuring that the driver can drive the vehicle without getting fatigued – after all, the vehicle is steered constantly, not just when it is being parked.

A similarly clear picture exists for interior noise, i.e., the level of noise at that reaches ear height in the front seats. When driving on asphalt at speeds of 100 km/h (~62 mph) and 130 km/h (~81 mph), the noise generated by the Golf II was 5 dB(A) above that of the Golf VIII. The logarithmic structure of the decibel scale makes it difficult to identify the increases. However, in each case, there was a clear rise in the perceived noise level. This is an important factor, particularly on longer journeys, as it affects the strain on and fatigue experienced by the driver.

Advances in Lighting

The lighting units on the vehicles have also changed over the generations. The Golf II is equipped with halogen headlamps. At the time, these were a major improvement over the predecessor technology as they had a much higher range and improved the asymmetrical illumination of the road. As a result, drivers could detect obstacles and pedestrians in good time. The Golf VIII is equipped with LED headlamps as standard. As well as providing scope for many different designs, these headlamps illuminate the road much better and more evenly. In contrast to halogen headlamps, they give off a bright, almost white light. This roughly corresponds to daylight, meaning the driver is more relaxed and less fatigued when driving in the dark.

Further differences can be found at the rear of the two vehicles. The smaller rear lights of the Golf II are equipped with halogen bulbs and are less visible than the much more prominent rear lights on the Golf VIII. The LED elements have a higher illuminating power, and the fact that the diodes take up little space allows for many more engineering and design options. The third brake light is a safety feature that is not fitted to the old Golf. It makes the vehicle more visible from behind, and not just when it is dark. This third brake light was made a requirement in the USA from 1986. In the wake of very positive experience there, it was legalized in Germany in 1993. It did not become mandatory for newly registered cars until January 1998. It makes it even clearer to the traffic behind that the vehicle is braking.

Modern Operating Concepts Must Not Cause Extra Distraction

Modern Operating Concepts and Their Pitfalls

The vehicles have undergone major changes inside as well as outside. However, unlike the aforementioned changes, these have not all been positive. The cockpit of the Golf II is equipped with physical buttons and (control) dials. The display instruments have analog indicators and most operating controls are self-explanatory. The driver will not encounter any problems changing the temperature or operating the radio. The cockpit in the Golf VIII is dominated by a large central touchscreen. It enables the driver to control a whole host of functions of varying importance for the journey. However, the driver often needs to work through sub-menus to find the option they want, and they do not receive any haptic feedback for the touch functions. This means they must look away from the road to search for and select the desired functions.

Against this backdrop, it is worth remembering the results of a study conducted by DEKRA and published in the Road Safety Report 2023. This showed that, despite the vehicles being stationary during the tests, several of the test subjects were overwhelmed by the operating concept in modern vehicles. Even if they were familiar with a function, many test subjects pressed the touch button for too long, causing it to switch itself on and then off again, or accidentally pressed other touch buttons in the vicinity. Buttons and controllers with haptic feedback proved to be the better options for safety-relevant functions or settings in particular. Due to the fact that touch buttons and touchscreens do not provide this feedback (such as when typing on a smartphone), the user has to look at them for longer, thus increasing the distraction time. They are also associated with more input errors, as the user's fingers can easily miss the small buttons, especially when driving. In the future, the use of voice commands and gestures will help in many cases. However, there is still a lot of work to do to develop and optimize these functions.

Overall, the tests showed the progress that has been made in terms of vehicle safety over the past 30 years. The key challenge will be to ensure that the demands specified by legislators and, above all, by vehicle manufacturers regarding the safety of their own products remain at the same high level and are not downgraded in favor of electronic gadgetry and greater smartphone connectivity.

Periodical Technical Inspection Becomes More Important

If assisted and automated driving systems have been installed in vehicles, it must be ensured that they – like the systems for passive and active/integral safety – function reliably throughout the vehicle's life. Only then are they able to achieve their desired effect. Periodical technical inspection (PTI), which many countries around the world have been conducting for many years now, will therefore become even more important in the future than they already are today – given the higher complexity of vehicle systems and the risk of electronic manipulation. In its 2023 "Global status report on road safety," the World Health Organization therefore also expressly listed (for the first time) periodical technical inspections as one of the main measures for reducing the risk of being injured or killed on the road.

Various studies show that vehicle electronics are also subject to a certain amount of wear. Moreover, they may contain system errors, can be tampered with, switched off, and even removed from the vehicle. Studies conducted by the International Motor Vehicle Inspection Committee (CITA) have shown that electronically controlled systems in vehicles suffer from similar malfunction rates and age-related failures as mechanical systems. The failures increase with vehicle age and mileage. Of course, despite all the advances achieved with electronic components, the mechanical, hydraulic, pneumatic, and electrical systems continue to play a pivotal role in road safety.

For this reason, a periodical technical inspection scrutinizes not only the braking and steering system, but also lighting systems, axles, wheels and tires, suspension, chassis, frame and bodywork, as well as visibility, to name just a few examples. The importance of doing so becomes clear if we look at France. After the mandatory *contrôle technique* was introduced there in 1992, there was a significant improvement in the technical condition of the vehicles on the road. According to statistics from DEKRA France, the defect rate in many components and assemblies dropped by 50 percent or more. The re-inspection rate for cars fell from just under 26 percent in 1992 to around 20 percent in 2001. The most common critical defects include the tires, the

Higher Risk of Injury From SUVs

In the USA, the number of pedestrians killed has risen by 83 percent since its low in 2009, and represents 18 percent of traffic fatalities. In 2022, 7,522 pedestrians were killed in traffic accidents and around 67,000 were injured. In addition to the collision speed, the front design of the vehicle also plays an important role, as shown by various studies. Compared with the standard front design of a car (where the front edge of the hood is no more than 76 centimeters high), the typical front design of large SUVs (where the front edge of the hood is more than 100 centimeters high) increases the risk of fatal injuries by 45 percent. This is also shown by a study published by the Insurance Institute for Highway Safety (IIHS) in December 2024, which developed injury probability curves for the U.S. market. In the past, the standard curves were based on GIDAS data, which means they were based on European vehicles. The study showed that the risk of injury when traveling at the same speed was higher due to the fact that vehicles in the USA are larger and taller.

Even if we cannot apply the findings from the USA in exactly the same way to other markets, it is still clear that increasingly large and heavy vehicles with higher hood front edges pose a greater risk to pedestrians. Another IIHS study also shows that vehicle occupants also do not necessarily benefit from a higher vehicle weight. The study investigated how the protection afforded to the driver and other road users changes as the vehicle weight increases.

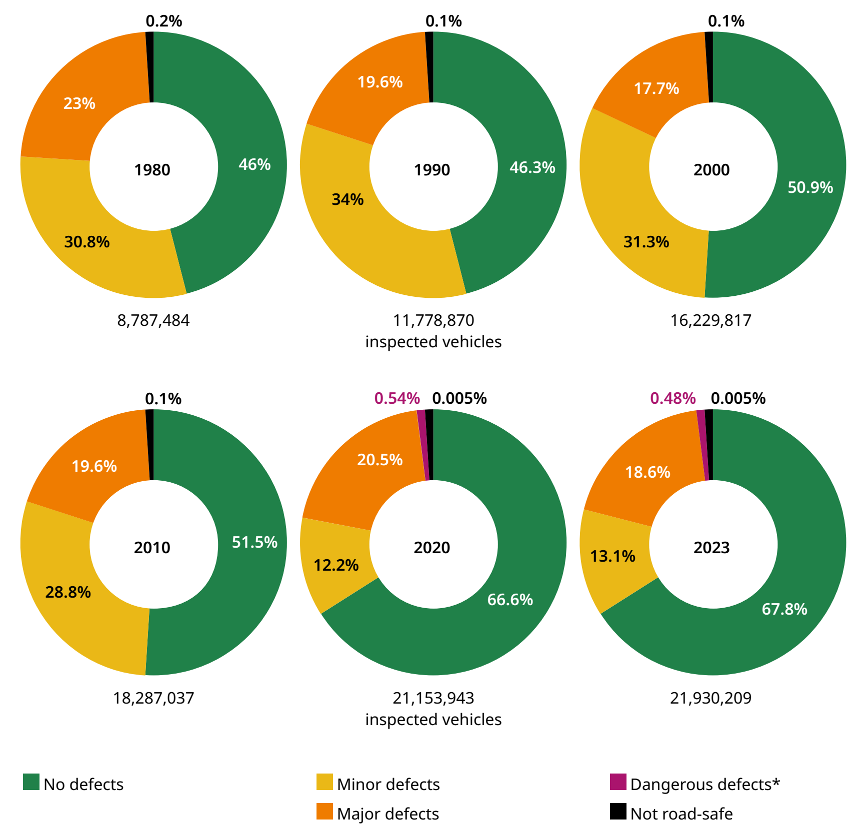
effectiveness of the parking brake, the brake lights, and the brake linings.

Turkey is another a good example of how periodical technical inspection (PTI) can have a major benefit for road safety. Until the end of 2007, motor vehicle inspections there were carried out by a national network of state-run inspection centers. This involved a visual inspection to check that the information in the vehicle documents matched the condition of the car. The only decisive factor was whether the car was apparently fit to drive when presented. In 2008, a PTI based on the European model with clearly defined standards was introduced. Within a few years, the number of traffic fatalities decreased by 40 percent.

The example of the US state of Idaho also demonstrates the effectiveness of periodic inspection. In 1997, the state discontinued the PTI program that had been in place until then. Just two years later, the number of mechanically defective or unsafe vehicles had risen significantly. The condition of the brakes on older vehicles was also worse than before PTI was abolished. The condition of steering, suspension, and drive trains also deteriorated noticeably. In contrast, the US state of Texas introduced a PTI program in 1999, and within a very short time, the proportion of accidents caused by vehicle defects fell from 12 percent to 4 percent. Against this backdrop, PTI could also be expected to have positive effects in many emerging and developing countries, for example. »

Periodical Technical Inspections for Cars in Germany

The results of periodical technical inspections on cars from recent decades show a positive trend: The number of vehicles with no defects has risen sharply, and the number of vehicles with major defects has fallen.



* New defect classification since 2018

Source: German Federal Motor Transport Authority

STATEMENT
Safer Together Ahead

Dr. Michiel van Ratingen
Secretary General Euro NCAP

Over the last 25 years, the name Euro NCAP, particularly among new car buyers, has become synonymous with the five-star rating it gives to new cars. Euro NCAP has rated over 1,000 car models since the start, from 20 cars tested in 1997 to nearly 100 to be tested this year. However, while this is a remarkable achievement, the true value and main impact of Euro NCAP has been the tangible reduction in road fatalities across Europe over the same period. Despite rising traffic, there are now on average 25% fewer fatalities per year, thanks in large part to car manufacturers' response to Euro NCAP's initiative and their support for our rating programme.

From the very beginning, Euro NCAP has set out to encourage manufacturers to exceed legal requirements by applying more broad and stringent test conditions. This “push” has proved a significant catalyst in safety design and created a market for safety. With the introduction of the pole test in 2000, the knee mapping sled method in 2007, the Whiplash test protocol in 2009, and the pedestrian and child occupant safety assessments, Euro NCAP focused on areas where fatalities and injuries were frequent, but vehicle countermeasures were not always fitted as standard across car segments or markets. Since 2009, Euro NCAP has leveraged its unique capacity to bring together the automotive industry and testing community to produce the first standard tests and test equipment for the evaluation of driver assistance systems like Intelligent Speed Assist, Autonomous Emergency Braking systems for car and vulnerable road user crashes, and Lane Support systems. These tests were gradually implemented as part of Euro NCAP's overall rating scheme and have now become a global benchmark for regulators and other NCAPs alike.

Looking ahead, Euro NCAP continues to evolve by incorporating new safety innovations, such as Driver Monitoring and Assisted Driving systems. It strives to improve the impact of safety technology in real life, not only by aligning its criteria with current system capabilities and modernising its assessment methods, but also by covering additional vehicle categories, such as commercial vans and heavy trucks. A critical step in this strategy is the implementation of a new rating approach that considers the four stages of a crash: safer driving, crash avoidance, crash protection, and post-crash rescue, and which can be applied to cars, vans, and trucks. The successful launch of the new HGV rating scheme in 2024 underlines Euro NCAP's ongoing significance in the market.

Most car buyers will have no personal experience on how to judge the crash safety of their vehicle. Without objective and clear safety information, they would be unable to make an informed decision about which car best meets their needs. This is why Euro NCAP must continue to do comparative consumer protection testing. Interest in Euro NCAP’s information continues to grow not only in new channels for consumers but also more and more with public and private fleet managers so they can ensure that the safety level of their fleet is adequate to protect their employees. Euro NCAP is a system that is rooted firmly in real-life experience, but which closely follows the technological innovations in the marketplace, so it can therefore deliver the most benefit for society.

However, we don't accomplish this alone, and our growing number of members across national governments, consumer organisations, transportation ministries, road authorities, invested European laboratories, and centres of excellence like DEKRA make this a shared challenge. And I am confident that together we will achieve our major aim of Vision Zero – zero fatalities on our roads.

Regulated Access to Original Safety and Environmental Vehicle Data

Given the increasingly important role played by software, sensors, and control units in vehicle safety, it will soon no longer be sufficient to test the condition of the systems only every two years, for example. In the medium term, there will be a need to inspect vehicles on an event-driven and ad hoc basis, especially because vehicle manufacturers are increasingly set to provide wireless and over-the-air firmware and software updates rather than via a cable in the workshop. A vehicle can become fundamentally different within moments if, as a result of a software update, safety-relevant driving functions relating to assistance systems or automated driving functions are changed.

There are also substantial risks associated with this kind of over-the-air-updates – the risk of hacking being the most significant. Especially after traffic accidents and traffic offenses, it will become increasingly important to establish the causes and who or what was responsible. Was a human doing the driving? Or was the automated system in control of the vehicle? And was there potentially a fault in the automated system? To enable all safety and environmental systems to be independently inspected for damage, malfunctions, and manipulation at any point in the vehicle's life cycle, testing organizations like DEKRA will require direct, unfiltered, and non-discriminatory access to the vehicle's original (i.e., unchanged) safety and environmental data. This will also ensure that the organizations are able to fulfill their statutory duty in accordance with EU Directive 2014/45. The data that is made available should also include the vehicle history.

The Facts at a Glance

- **The radial tire, disk brake, rigid passenger cell, safety steering shaft, three-point safety belt, airbag, ABS, and ESP were important pioneering achievements.**
- **The NCAP star ratings are a good way of assessing vehicle safety – they reflect how well cars perform in the process and therefore provide a transparent and comparable basis for deciding whether to buy a particular vehicle.**
- **Driver assistance systems help the driver by detecting critical situations at an early stage, issuing warnings, or even actively intervening. In this way, they help to prevent accidents, mitigate their consequences, and improve driving comfort.**
- **DEKRA crash tests and road tests underscore the major advances made in vehicle construction over past decades.**
- **For the first time, the World Health Organization's 2023 "Global status report on road safety" listed periodical technical inspections as one of the main measures for reducing the risk of being injured or killed on the road.**

Connected Mobility Can Help Make Our Roads Safer

As already demonstrated in earlier DEKRA Road Safety Reports, when it comes to road safety and our infrastructure, road construction measures and, above all, smart connectivity and digitalization inside and outside vehicles are set to become increasingly important in the future.

If we look at the statistics, we see time and again that accidents are often caused by poor visibility, unpredictable driving maneuvers, or human error. V2X technology can help to minimize these risks. The abbreviation V2X stands for vehicle-to-everything and means that a vehicle communicates continuously, directly, and wirelessly with other vehicles of all types, the road, the infrastructure (such as traffic light or traffic management systems), pedestrians, or the network.

The key advantage of V2X communication is that it can inform and warn the driver about hazards along the route within split seconds, even if these hazards are not yet visible to the driver. In these cases, a highly or fully automated vehicle would actually brake or change lanes independently in order to avoid the hazard area with sufficient clearance, without the need for the driver to intervene.

All road users – but particularly vulnerable people such as pedestrians and cyclists – are likely to benefit from V2X communication. Ultimately, these vulnerable groups are exposed to a much higher risk of accidents – they are harder to detect and have no safety features such as crumple zones or airbags. As mentioned above, V2X enables vehicles to warn of pedestrians crossing the road or cyclists in good time. Cyclists could send signals to approaching cars via a smart system to ensure that they are detected in the blind spot. And pedestrian lights could boost safety at crossings when used in combination with V2X.

Accident Figures Reinforce the Importance of V2X

Although specific quantitative data on the direct impact of V2X on these groups is still limited, some studies allow us to infer the potential for positive effects. For example, a few years ago, the German Road Safety Council (DVR) referenced a study by automotive supplier Continental analyzing data from the German In-Depth Accident Study from 2005 to 2020. According to these figures, 30 percent of cyclists and 37 percent of pedestrians crossing the road at intersections in Germany were hidden before an accident. Conventional sensor-based safety systems did not detect them at all, or too late to prevent a collision. V2X could help in these situations by transferring the relevant information quickly.

The DVR also states that other, less time-critical applications would help to improve safety, such as congestion warnings or information about icy roads. The positive effect increased in line with the number and type (cars, trucks, motorbikes, agricultural machinery, bikes, public buses and streetcars, rescue and emergency vehicles, or electrified micromobility solutions such as pedelecs and e-scooters) of road users and the road infrastructure involved in sharing information.

Another interesting Continental study of accident data from 2020 and 2021 obtained in Germany, the USA, and Japan revealed that crossing/turning accounts for the highest percentage of fatal accidents between vehicles and pedestrians: 74 percent in Japan, 74 percent in Germany, and 63 percent in the USA. Looking at accidents between cars and riders of motorbikes, accidents at intersections/when turning off are equally relevant: 66 percent in Japan, 49 percent in Germany, and 55 percent in the USA. Looking at accidents between cars and bikes, accidents at intersections/when turning account for a significant proportion of fatal accidents in Japan and Germany – 69 and 80 percent, respectively.

The Role of V2X in Smart Cities

As well as improving road safety, V2X is becoming increasingly important in future urban development – to be more precise, for smart cities that use state-of-the-art technologies to improve residents' quality of life and foster sustainable urban landscapes. Digital solutions, connected infrastructure, and smart systems are being deployed in the optimization and smart management of road traffic.

For example, V2X can reduce congestion by networking with traffic lights and other traffic control systems. Adaptive traffic light systems adapt in real time to traffic volumes and improve traffic flow. With the aid of V2X, electric vehicles are directed efficiently to charging stations, and charging times are optimized. Last but not least, V2X can ensure that fully automated vehicles interact safely and efficiently with other road users, thus contributing to the smooth flow of traffic in a city. Moreover, emergency vehicles can be given priority because they are recognized by traffic lights, which are phased to ensure the faster passage of these vehicles. In an emergency, this can greatly improve response times.

Despite the fundamentally promising opportunities, many challenges must still be addressed. For example, connectivity increases the risk of cyber attacks and necessitates stringent security measures. Moreover, uniform protocols and frequency bands must be agreed worldwide to ensure seamless communication. Lastly, it should not be forgotten that an immense amount of investment is required because expanding the V2X-enabled infrastructure is very costly.

STATEMENT

The Development of Road Infrastructure: The Past, Present, and Future of Road Safety

Enrique Miralles Olivar
Technical Director at Asociación Española de la Carretera (Spanish Road Association)

The road infrastructure has been subject to constant change based on technical advances and the growing challenges of road safety. In the past, roads were built along ancient transport routes on the basis of criteria that aimed to ensure better accessibility to a region at minimal cost. The safety of road users was not a priority in planning, but an additional aspect if it became evident that a certain section of the road was dangerous.

Modern road design encompasses active and passive safety systems such as illuminated signs, durable non-skid road surfaces, and vehicle restraint systems. Advanced technologies make it possible to recognize incidents and manage traffic in real time, thus improving the response to accidents and optimizing traffic flow. Moreover, more resistant and sustainable materials are used, such as asphalt mixtures that absorb noise and minimize the risk of hydroplaning.

Looking to the future, the infrastructure must be adapted to the needs of autonomous and connected mobility. The general integration of systems for vehicle-to-infrastructure (V2I) communication that allows real-time data sharing is planned to enable autonomous vehicles to make decisions on the basis of road and traffic conditions. Smart road surfaces that can monitor their own condition and warn of structural problems will be the key to maintaining a high level of safety. In addition, the use of self-repairing and sustainable materials will reduce the need for maintenance and the associated environmental impacts.

In light of the effects of climate change, infrastructure will have to be adapted to minimize its vulnerability to extreme events such as flooding, heat waves, and landslides. New construction techniques such as permeable road surfaces to facilitate the run-off of water and materials that are resistant to extreme heat will increase the resistance of roads and help to reduce the negative impact of these events on infrastructure and the safety of mobility. Climate change adaptation is the key to ensuring the integrity of roads in an increasingly unpredictable environment.

5G networks are substantially more powerful than the preceding generation.

A Question of Technology

In order to best leverage V2X and provide the necessary connectivity, we need corresponding communication technologies. In addition to standardized, general-purpose short distance technologies (Bluetooth, Wi-Fi, wireless power, near-field communication, etc.) and cellular technologies (GSM, UMTS, LTE, and all the associated variants), this also includes technologies developed specifically for vehicle connectivity, such as the WLAN standard IEEE 802.11p or the cellular standard C-V2X (cellular vehicle-to-everything) on the basis of 4G or 5G. However, 5G networks are substantially more powerful than earlier generations. Whereas 4G only enables data transfer rates of up to 100 megabits per second, the 5G standard allows up to ten gigabits per second, with a maximum latency time of one millisecond. This level of ultra-short delay is essential if vehicles are to permanently share data in real time with each other and with the infrastructure, e.g., traffic light or traffic control systems.

IEEE 802.11p, a standard published by the Institute of Electrical and Electronics Engineers (IEEE) in 2010, uses WLAN technology, which is suitable for real-time-capable communication over distances of a few hundred meters. C-V2X is a global vehicle connectivity standard developed by the 3rd Generation Partnership Project (3GPP). The technology enables both direct communications independently of cellular networks and network-based communications. The direct communications mode uses the 5.9 gigahertz frequency band. In Europe, Directive 2010/40/EU permits direct communication using both variants. It remains to be seen which standard will ultimately prevail. »

The KPI Project

As described in "The Human Factor" and "Technology", the EU's Baseline project aims to improve Europe's road safety key performance indicators (KPIs) and, at the same time, increase the comparability between the various countries by establishing minimum methodological requirements. This chapter examines the two KPIs relating to infrastructure and post-crash care.

KPI Infrastructure

Implementing a basic method for this KPI is still at an early stage. With the aid of the Expert Group for Road Infrastructure Safety (EGRIS), the Commission is currently developing a method to analyze the safety of the road network based on the combined assessment of "inherent" road safety and historical accident data. Four further KPIs or areas are specified within this category.

KPI 1 is restricted to that proportion of the road category with a safety ranking above the agreed threshold. KPI 2 concerns the length of the road network, expressed as a percentage. It relates to the roads with a safety ranking above the agreed threshold.
KPI 3 addresses the percentage of roads with traffic separation or speed limits. By contrast, KPI 4 relates to the proportion by length of the road network with traffic separation or speed limits.

As things stand at the moment, values of 100 percent have been recorded for all the KPIs – which relate to freeways. Depending on the KPI and country, different values are recorded for rural roads. Whereas Finland achieves a value of 19 percent for KPI 4, Latvia stands at only 4.4 percent. By contrast, 53.8 percent was measured for Lithuania, the highest value among the countries listed. For the third KPI, Finland achieves a value of 31.3 percent; Spain has the highest value of 64.3 percent.

KPI Post-Crash Care

This specific KPI was chosen because the time required for the emergency medical services to reach the accident site plays a pivotal role in minimizing the consequences of the accident. A meta-analysis of the response times, i.e., the time until the rescue services arrive, in various countries showed that better and faster medical treatment would likely be able to prevent between 10 and 13 percent of road traffic fatalities. Similar percentages are assumed for serious injuries. The values for the KPI vary widely between 18 and 54 minutes. Germany has the shortest response time, whereas the longest was recorded in Greece. The KPI estimates could be distorted by differences between the countries in collecting and recording the data, the availability of ambulances and rescue personnel, road and traffic conditions, and the accuracy in describing the accident location.

The response times depend on the road type where the accident is located. As a rule, it takes longer to reach an accident on a rural road. In Finland, for example, the rescue services take an average of 20:09 minutes to reach the freeway, 31:13 minutes to reach rural roads, and "just" 17:16 minutes to reach urban roads. The response time varies depending on the time of day. It is shorter during the day on weekdays than it is at night at weekends. In Austria, it takes the rescue services 23:48 minutes to reach the accident site during the day on weekdays. During the day at weekends, the response time is 26:18 minutes.
It takes 25:12 minutes at night on weekdays and 26:36 minutes at night at weekends for the rescue services to arrive.

STATEMENT

Transformative technologies and innovative solutions for a safer, more sustainable and inclusive mobility future

Joost Vantomme
CEO of ERTICO ITS Europe

As a trusted and long-standing partner of ERTICO, DEKRA plays a pivotal role in addressing safety-related mobility challenges. Their research, expert analysis, and actionable recommendations on integrating advanced technologies and fostering global collaboration to tackle complex mobility issues reinforce the broader community's commitment to shaping a safer mobility future, a mission ERTICO is proud to share.

In addition to their leadership in safety assessments, ERTICO values DEKRA's active involvement in delivering tangible results from EU-funded projects, one of which is the REALLOCATE project. This initiative aims to transform streets into inclusive, green, safe, and future-proof urban spaces by supporting cities in achieving their net-zero carbon objectives. Alongside, ERTICO is also honored to work with DEKRA on two Innovation Platforms: Enhanced Automated Valet Parking (EAVP) and ADASIS. These initiatives contribute to the advancement of vehicle automation and enhanced road safety solutions, further strengthening Europe's intelligent transport ecosystem.

Amongst other initiatives focusing on road safety, the Data for Road Safety (DFRS) Innovation Platform is a prime example of integrating real-time data from vehicles, physical and digital infrastructure, and traffic management centers. It provides tangible evidence of European regulations on safety-related traffic information under the ITS Directive, showcasing how data-driven solutions improve road safety.

Another key focus for ERTICO is Cooperative Intelligent Transport Systems (C-ITS) which enable real-time communication between vehicles, infrastructure, and road users, facilitating safer and more connected road networks. By sharing critical safety information via V2X communications, this technology enhances driver awareness and supports better decision-making. Advancement of traffic management systems through initiatives like the ERTICO Innovation Platform TM2.0 which exemplify this in practice. By focusing on the deployment of connected vehicles and travelers, and aligning travel behaviors with collective mobility objectives, TM2.0 bridges the gap between vehicle innovation and traffic management, creating value for legacy systems and opening new business opportunities.

In the realm of automated driving, safety is becoming increasingly reliant on advanced systems. ERTICO is actively involved in other influential EU-funded projects that contribute to Europe's Vision Zero goals. V4Safety and EvoRoads are two of many in ERTICO's portfolio of safety-related projects which deliver holistic, predictive safety assessments, defined improvement measures, and integrated safety-related information into automated systems. These initiatives exemplify how ITS technologies drive improvements in safety, resilience, and inclusivity across Europe.

Through ERTICO's unique public-private partnership, we foster cross-sector collaboration to develop and advance transformative technologies and innovative solutions for a safer, more sustainable, and inclusive mobility future for all. DEKRA's annual publication underscores the importance of raising awareness and advancing ITS as a cornerstone for safer and more inclusive mobility. By leveraging the importance role of ITS, from early technology innovations to real-life deployment together with DEKRA and all our partners, ERTICO work to enhance road safety, a cornerstone of future mobility.

»

At present, however, C-V2X with direct 5G communication would seem to be preferred in the medium term. In the USA and China at least, the choice has already fallen on this standard – initially on the basis of 4G (LTE). One important aspect in this context is reliable signal coverage, as most applications relating to connected mobility are, after all, heavily dependent on fully functioning communications. For non-safety-related applications, a drop in signal coverage is not critical, as the user can easily determine whether there is connectivity or not. However, when it comes to safety-relevant services or applications like eCall, warning displays should be triggered to inform the user about any communication outages. Furthermore, the system should be able to independently regain control of the relevant function once the signal is stable again.

Another keyword is cybercrime. In order to protect vehicles as far as possible against external attacks, manufacturers must ensure that any new vehicle types are safe from connectivity and data transfer manipulation – a requirement that has been mandatory since July 2022. Since July 2024, this requirement has applied to all new vehicles in the EU. The basis for this is the set of regulations formulated in 2020 by the UNECE World Forum for Harmonization of Vehicle Regulations (WP.29), which stipulates that manufacturers must maintain a certified management system for cyber security (UN-R 155) and software updates (UN-R 156) throughout the entire development period and life cycle of vehicles. Moreover, from August 2025, the cyber security requirements of the EU Radio Equipment Directive and, from 2027, the new EU Cyber Resilience Act will provide additional security for connected products.

System Developed by DEKRA Protects Motorcyclists in the Event of Impact

Especially when it comes to increasing road safety for the users of motorbikes, traffic barriers have an important role to play in road infrastructure. However, by default, countless numbers of traffic barriers are still built with their primary goal in mind: that the rail should be at the same height as the hood of a car.

While this enables them to offer maximum protection for vehicle occupants, the remaining space between the barrier and the ground represents a huge risk for motorbike users. In the event of a crash, there is a danger that they could slide under the traffic barrier or hit one of its supporting posts. In such situations, severe or even fatal injuries are not unusual.

That is why traffic barriers should be designed to offer optimum protection for motorbike users who crash into them. In many locations, a combination of a standardized large top surface, such as that offered by a box shape, and a secondary rail under the main rail to prevent people from crashing into the posts has proven effective in both crash tests and real-life accidents. The secondary rails used in this design can also be retrofitted to many existing systems. For example, the "Euskirchen Plus" system further developed by DEKRA several years ago on behalf of the German Federal Highway Research Institute (BASt), offers a relatively high level of protection. This system was proven to provide improved protection for motorcyclists both when riding upright and when sliding across the road on their side.

Excessive Differences in National Legislation Still Exist

If accidents are to be prevented in the first place, it is necessary to ensure that road users behave correctly, observe the rules of the road, and drive a roadworthy vehicle. With the increase in cross-border traffic, it became clear at an early stage that it was essential to achieve the international harmonization of the main rules of the road and vehicle registration requirements. The International Convention Relating to Motor Traffic was concluded an October 11, 1909, and amended on April 24, 1926. It covered the main aspects of a vehicle’s equipment, such as a redundant braking system, requirements concerning the vehicle’s steerability and maneuvrability, operational safety, glare-free lighting, license plates, and unpleasant odor and noise emissions. Likewise, it governed the issue of driver’s licenses, their mutual recognition, and harmonized traffic signs. At this time, it was already clearly stipulated that drivers must comply with the rules of the road of the countries in which they are traveling.

In November 1968, the regulations underwent a fundamental revision and new regulations were added. The Convention on Road Traffic and the Convention on Road Signs and Signals were signed in Vienna, thereby establishing an international framework for road traffic. In the years that followed, they were then transposed into national legislation in most countries around the world.

Despite these crucial steps, there are still major differences in national traffic legislation and regulations. Things always become dangerous if identical traffic signs instruct drivers to do different things in different countries. Another aspect that is not particularly driver-friendly, but can at least be considered non-critical, is the fact that every country has its own maximum permitted speed limits depending on the type of vehicle and road category. The same applies for the maximum blood alcohol concentration limits. By contrast, within Europe, the very different rules for using pedestrian crossings (zebra crossings) and governing the rights of way and the use of indicator lights on roundabouts are a source of danger. It is equally incomprehensible that each Member State is currently casting its own rules for carrying hi-vis vests in vehicles. Even most transport ministries do not doubt the potential benefits for these vests. Instead of eliminating borders and creating uniform regulations, new complexities are being created in intra-European transport.

The Facts at a Glance

- **Smart connectivity and digitalization inside and outside of vehicles are set to become increasingly important in the future.**
- **V2X technology can help to reduce the number of accidents caused by poor visibility, unforeseeable driving maneuvers, and human error.**
- **It especially benefits vulnerable road users such as pedestrians and cyclists.**
- **If vehicles are to continuously share data with each other and with the infrastructure in real time, an ultrashort delay time is indispensable.**
- **There are still major differences in national traffic legislation and regulations – with negative consequences for road safety.**

Many Challenges Remain Before We Can Achieve "Vision Zero"

Road traffic has changed radically in the past 100 years. The transformation of mobility is characterized by the increased number of motorized vehicles, the diversification of the way in which roads are used, the adaptation of infrastructure, and technological development. Despite major progress, achieving further reductions in the number of traffic fatalities and serious injuries remains a key task. Therefore, it is now more important than ever for politicians, trade associations, and other organizations to pull together. The ambitious targets of "Vision Zero" can only be achieved by the ongoing commitment of all stakeholders, specific measures, and possibly also a new understanding of what mobility is.

The urgency of this task is highlighted by the persistently high number of traffic fatalities worldwide. According to estimates from the World Health Organization (WHO), almost 1.2 million people are killed in road traffic accidents each year. In its 2023 "Global Status Report on Road Safety," WHO stated that 90 percent of these fatalities occur in low- and middle-income countries. Looking at the distribution of traffic fatalities among the various WHO regions shows that 28 percent are accounted for by Southeast Asia, 25 percent by the Western Pacific, 19 percent by Africa, 12 percent by the Americas, 11 percent by the Eastern Mediterranean, and five percent by Europe.

Moreover, the fact that vulnerable road users such as pedestrians, cyclists, and the occupants of motorbikes and other motorized two- and three-wheeled vehicles make up more than half of road traffic fatalities should give pause for thought. Since 2010, the number of pedestrian fatalities has increased by three percent to around 274,000 in 2021 – accounting for 23 percent of road accident victims worldwide. The number of fatalities among cyclists actually increased by 20 percent to some 71,000. As WHO also admonishes, just 20 percent of the world's roads satisfy the basic safety standards for pedestrians, and only 0.2 percent have a bicycle path. This explains the large number of traffic fatalities in these groups. Added to this is the fact that, especially in many emerging and developing economies, the often tight financial situation means that car ownership rates are still relatively low. Those who cannot afford a car travel by bicycle or motorbike, or walk.

Whatever the future of road traffic, vehicle technology and road infrastructure are and remain important contributors to road safety – with a focus on improving the safety of hazard areas, maintaining road equipment, monitoring speeds at accident hot spots, installing suitable traffic barriers, and increasing the number of bicycle paths. Other factors are legislation and traffic monitoring, emergency services, road safety education, periodical technical inspections, and further measures to prevent accidents and mitigate their impact. In addition, vehicle connectivity facilitating the communication between the vehicles themselves and between vehicles and centralized or decentralized systems can also help to further reduce the number of accident-critical situations and, thus, the number of serious accidents with fatalities and serious injuries.

As a general rule, it should be analyzed in advance whether the chosen optimization measure is actually suitable for addressing the respective problem and for the prevailing regional or local conditions, and whether it can achieve the desired effect. Subsequently, it is also essential to review whether the implemented measures have functioned as expected or whether further improvements are possible.

Irrespective of this, and it cannot be emphasized often enough, the person at the wheel will continue to be the biggest factor in the occurrence of accidents for the foreseeable future. No matter how many driver assistance systems are installed, responsible behavior, paying constant attention to the road, a realistic assessment of one's own abilities, and a high degree of acceptance of the rules by all road users remain essential. And, when it comes to the behavior of drivers and the users of two-wheeled vehicles, the wearing of a seat belt or a helmet should be second nature.

DEKRA's Demands for Greater Road Safety

- **Road traffic should be seen as a form of social cooperation that requires responsible conduct by all road users in accordance with applicable rules and in a spirit of partnership.**
- **The availability of substantiated and largely comparable accident data and statistics must be further improved at both national and international level.**
- **Efforts to improve road safety must be strengthened, especially in low- and middle-income countries.**
- **Road safety work must aim more at reducing the number of serious injuries, as well as cutting the number of traffic fatalities.**
- **Before implementing a traffic safety measure that has proved successful elsewhere, it must be investigated whether it is transferable to the circumstances in question and would thus be equally successful.**
- **Especially dangerous behaviors such as driving under the influence of alcohol and drugs, being distracted by smartphones, and speeding must be strictly prohibited, monitored, and punished effectively.**
- **As the number one lifesaver, seat belts should be used on all journeys where they are provided; children should be secured by the appropriate restraint systems for their size and age.**
- **The occupants of motorized and non-motorized two-wheeled vehicles should always wear a suitable helmet, regardless of whether or not they are required to do so by law.**
- **Before using their vehicle on the road for the first time, e-scooter riders should familiarize themselves with the specific rules of the road and practice how to handle the vehicle safely under controlled conditions.**
- **Users of two-wheeled vehicles should be aware of how important active and passive lighting devices are for their safety, and should equip their vehicles accordingly.**
- **The careful installation, maintenance, and care of bicycle paths and sidewalks are essential to ensuring the safety of bicycle and pedestrian traffic.**
- **Ongoing road safety education is the best form of prevention – it should therefore be started as early as possible, with different approaches used to address all road user groups through to old age.**
- **The use of driver assistance systems and automated driving functions should be taught during driver training, but the limits of these systems should also be made clear. Ideally, confidence in handling these systems would be part of the driving test.**
- **The working order of the mechanical and electronic components of vehicle safety systems must be ensured throughout the life of the vehicle. This also applies to the aspect of cyber security. The scope of the periodical technical inspection of motor vehicles should be adjusted accordingly on a regular basis. In addition, testing organizations require regulated access to original vehicle safety data.**
- **When constructing new roads, especially in rural areas, or when modifying existing roads, the priority must be to ensure that the roads are self-explanatory, with a roadside environment that forgives error. Existing trees in the immediate roadside environment should be fitted with protective systems; new trees should be planted an adequate distance from the edge of the road.**

Any Questions?

Your Contacts at DEKRA

Vehicle Inspections
Florian von Glasner
Tel.: +49 711 78 61-23 28
florian.von.glasner@dekra.com

DEKRA SE
Handwerkstrasse 15
70565 Stuttgart, Germany

Analytical Expertise on Accidents
Michael Krieg
Tel.: +49 711 78 61-23 19
michael.krieg@dekra.com

DEKRA Automobil GmbH
Handwerkstrasse 15
70565 Stuttgart, Germany

Accident Research
Markus Egelhaaf
Tel.: +49 711 78 61-26 10
markus.egelhaaf@dekra.com

Stefanie Ritter
Tel.: +49 711 7861-2032
stefanie.ritter@dekra.com

Andreas Schäuble
Tel.: +49 711 78 61-25 39
andreas.schaeuble@dekra.com

Luis Ancona
Tel.: +49 711 78 61-23 55
luis.ancona@dekra.com

DEKRA Automobil GmbH
Handwerkstrasse 15
70565 Stuttgart, Germany

Basic Principles/Processes
André Skupin
Tel.: +49 357 54 73 44-257
andre.skupin@dekra.com

Hans-Peter David
Tel.: +49 357 54 73 44-0
hans-peter.david@dekra.com

DEKRA Automobil GmbH
Senftenberger Strasse 30
01998 Klettwitz, Germany

Traffic Psychology
Dr. Thomas Wagner
Tel.: +49 357 54 73 44-230
thomas.wagner@dekra.com

DEKRA e.V. Dresden
Senftenberger Strasse 30
01998 Klettwitz, Germany

Corporate Communications
Wolfgang Sigloch
Tel.: +49 711 78 61-23 86
wolfgang.sigloch@dekra.com

DEKRA e.V.
Handwerkstrasse 15
70565 Stuttgart, Germany

Our Services for More Safety

DEKRA ensures the safety and performance of all kinds of vehicles in road traffic. The company offers comprehensive inspection services for cars and motorbikes through to trucks and buses.

DEKRA inspects and certifies products to ensure they operate safely and comply with the relevant standards and regulations for access to global markets.

DEKRA offers comprehensive safety inspections and assessments all over the world for buildings, infrastructure, and industrial facilities.

DEKRA offers compliance, performance improvement, and supply chain services relating to safety and sustainability standards.

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DEKRA
Handwerkstrasse 15
70565 Stuttgart
Germany
Tel. +49.711.7861-0
Fax +49.711.7861-2240
www.dekra.com

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