

**GOVERNMENT STATUS REPORT, 2023
FEDERAL REPUBLIC OF GERMANY**

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27th ESV-Conference

Yokohama, Japan, April 03-06, 2023

1. STATUS AND TRENDS

1.1. Road accidents in Germany

The total number of police registered road crashes has decreased by 4 percent since 2010 – from 2.4 to 2.3 million crashes in 2021. The number increased slightly between 2010 and 2019, with yearly changes between -2 and 5 percent. The highest value was reached in 2019 with 2.7 million road crashes. In 2020 and 2021, during the COVID-19 pandemic, the number of crashes steeply declined. The number of road crashes with personal injury has decreased by more than 10 % since 2010, resulting in 258,987 crashes with personal injury in 2021. Between 2010 and 2019, the number of personal injury crashes were relatively constant and stagnated around 300,000. This figure declined substantially in 2020 and 2021. According to provisional data for the first nine months of 2022, the number increased by more than 12 percent compared to the same period in 2021.

Casualty figures have also decreased since 2010, with lower reductions for slight and severe injuries and higher reductions for fatalities. The total number of casualties has decreased by approximately 13 percent from 374,818 in 2010 to 325,691 in 2021. The trend in casualty numbers is similar to the trend in personal injury crashes: The numbers remained nearly unchanged between 2010 and 2019 and then dropped substantially during the COVID-19 pandemic in 2020 and 2021. According to provisional data for the first nine months of 2022, the number of casualties rose by more than 12 percent compared to the same period in 2021.

Since 2010, the number of serious injuries has been reduced by 12 percent to 55,137 seriously injured road users in 2021 and the number of slight injuries has declined by 13 percent to 267,992 slightly injured road users. Both injury severity groups follow the same pattern: The numbers were quite similar between 2010 and 2019. In the two years after, slight and serious injuries considerably decreased. Fatalities have declined by 30 percent from 3,648 fatalities in 2010 to 2,562 fatalities in 2021. In contrast to the number of injuries, the number of fatalities fell constantly in the considered time period. However, the impact of the COVID-19 pandemic is of course notable: Between 2019 and 2021, the number of fatalities fell by 16 percent. According to provisional data, the number of fatalities increased by about 11 percent in the first nine months of 2022 compared to the same period in the preceding year.

Most COVID-19 restrictions ended in the beginning of 2022 and kilometres driven are nearly as high as 2019. A similar trend can be observed for crash and casualty figures. For 2022, an increase in these numbers is to be expected. (See fig.1 for overview).

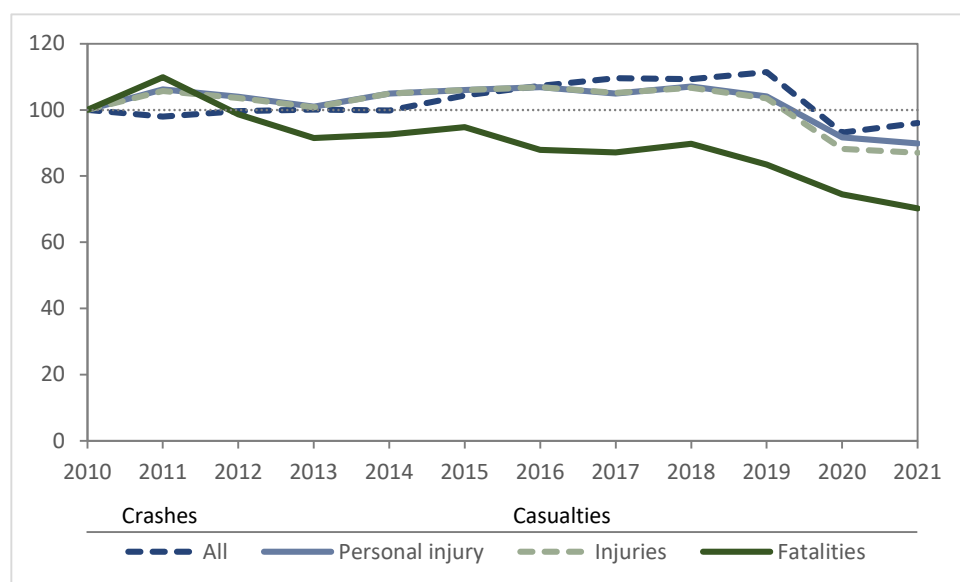


Figure 1: Development of crashes and casualties in Germany (Index 100=2010)

1.2. Socio-economic costs due to road traffic accidents in Germany

The Federal Highway Research Institute (BAST) calculates the costs of traffic accidents on an annual basis. The costs burden of German national economy caused by traffic accidents includes costs of fatalities, injuries and damage to goods.

The socio-economic accident costs include direct costs (e.g. medical treatment, vehicle repair/replacement), indirect costs (police services, legal system, insurance administration, replacement of employees), lost potential output (including the shadow economy), lost added value of housework and voluntary work, humanitarian costs and costs of monetised travel time losses due to traffic jams caused by accidents. The mathematical model developed for the purpose of accident costs assessment enables an analysis of slight, severe and severest injuries and the effect of underreporting on total accident costs.

The total traffic accident costs amounted in 2020 to approximately 31.47 billion Euro. The costs of fatalities and injuries reached 11.79 billion Euro whereas the costs of about 19.68 billion Euro were caused by damage to goods (figure 2). Comparing 2020 data with accident costs occurred 2019 (previous reporting year) we observe an 12% decrease of fatalities costs and injuries costs. However, the decrease of damage to goods by 16% is even stronger and the total amount of accident costs was 2020 about 15% lower than that of 2019. It is assumed that the Covid-19 situation explains the change. The costs per person added up to 1.219 million Euro for a fatality, 119,788 Euro for a severely injured person and 5,391 Euro for a slightly injured person.

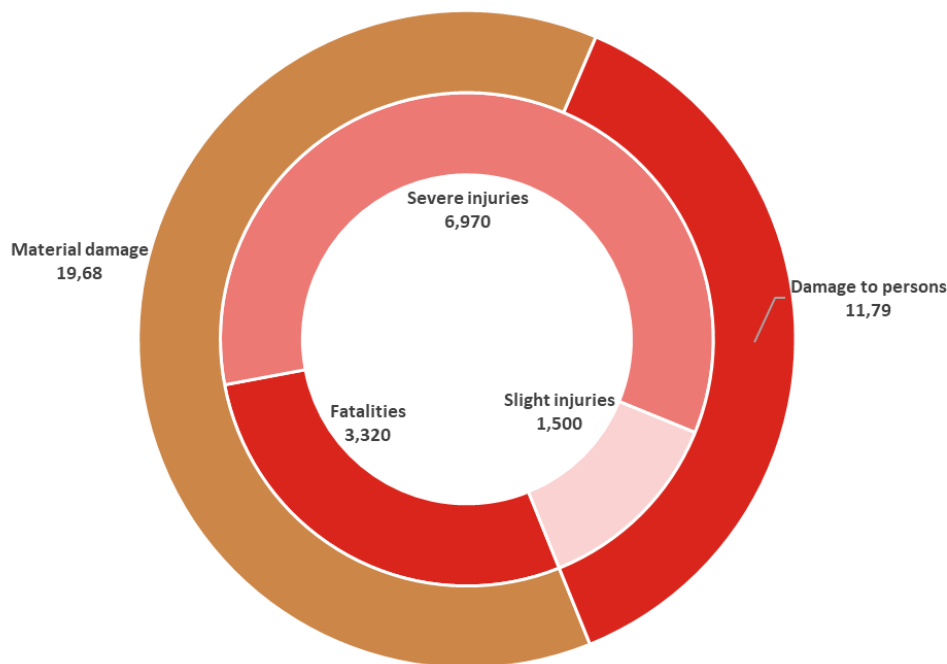


Figure 2: Costs due to road traffic accidents in 2020 (billion Euro)

1.3. German Road Safety Programme

The Federal Government's Road Safety Program 2021 to 2030 is the follow-up to the 2011 Road Safety Program, which expired at the end of 2020. It describes the Federal Government's measures to improve road safety on German roads by 2030. The focus is on commitment to "Vision Zero" - i.e. the reduction of road deaths to zero. The aim is to reduce the number of traffic fatalities by 40% and serious injuries significantly by 2030.

With the "Road Safety Pact", the Federal Government, the federal states and other stakeholders have adopted, for the first time, a joint strategy for road safety work in Germany to reach this goal. Under the slogan "Safe mobility - everybody is responsible, everyone is involved", this strategy combines the efforts of all stakeholders. The measures are assigned to 12 fields of action. At the beginning of the decade, the Federal Government wants to focus e.g. on exploiting the potential of automated, autonomous and connected driving for better road safety, expanding the use of driver assistance systems, improving road infrastructure, as well as on safe cycling.

2. RESEARCH

2.1. Finished projects

2.1.1. Automatic emergency braking systems for heavy goods vehicles

Automatic braking systems for heavy goods vehicles are mandatory across the European Union. While the requirements for pre-accident speed reduction on a moving target with 68 km/h reduction from 80 km/h are quite demanding, the required speed reduction towards a stationary target in the original versions of Regulation (UN) No. 131 (series of amendments 00 and 01) was not so strict (13 or 28 km/h from 80 km/h, depending on truck type). Another major downside of the current technical requirements was the possibility for drivers to switch the systems off (required for rare conditions where the AEBS sensors cannot interpret the environment and thus might act inappropriately) without requiring a mechanism to re-activate the AEBS at a time when the need to switch off has disappeared. The other aspect that could be optimized is that vehicle deceleration is limited during the mandatory warning phase.

All these items had been improved for the new revision 02 of this regulation, developed by an Informal Working Group at UN level, led by Japan and Germany: When deactivated, the systems will reactivate typically after 15 minutes; accidents with stationary vehicles need to be avoided at least up to 70 km/h traveling speed, and braking can commence when needed, even if the warning phase has not yet finished. Additionally, there are requirements foreseen for AEB interventions towards crossing pedestrians.

The revision 02 of Regulation (UN) No. 131 will enter into force approximately in February 2023, it will be mandatory for new vehicle types from September 2025 and for new registrations by September 2028.

2.1.2. Automatic emergency braking systems for passenger cars

Automatic braking systems for passenger cars, designed to address car accidents with other cars, pedestrians and / or (to some extent) bicyclists are state of the art and already available in various production vehicles. It is expected that those systems will have a significant effect in improving traffic safety, so the European Commission has included them in their proposal for the new "General Safety Regulation". The preferred way of setting requirements for technical systems is a broad international discussion on UN level, so the European Commission together with Japan initiated an informal working group with the goal of setting agreed requirements for automatic emergency braking systems for N1/M1 vehicles.

Germany was part of that group and contributed with calculations, simulations as well as experimental data. Finally, the group agreed that AEBS systems should be able to avoid accidents up to a driving speed of 42 km/h on stationary targets, pedestrians and cyclists and deliver a comparable performance for slow moving targets. The results of the Informal Working Group had been already adopted in Regulation 152 with the series of amendments 00, 01 and 02 is already in force. The European Commission currently plans to make these systems mandatory in steps and beginning from 2022 (for new types, car-car accidents) until 2026 (for all registrations, including AEB pedestrians and cyclists).

2.1.3. Driven trailers

Trailers are by definition non-propelled, towed vehicles. They pose resistance forces to the towing vehicle, resulting from e.g. rolling resistance, friction, air resistance. New concepts are proposed where trailers would be able to support the towing vehicle by reduction of the tow ball forces, sometimes even pushing the towing vehicle. This would allow for higher traction of the vehicle combination, possibly even a higher overall energy efficiency when the required energy storage system of electric vehicles would be distributed to both vehicles.

A study conducted by BAST did investigate the possible influence of driven trailers on the driving dynamic properties of the vehicle combinations.

Driving experiments with two prototype trailers (caravans) had been carried out in direct comparisons with active and inactive trailer motors. The experiments focused on possible effects on the handling (double lane change test) and lateral stability (yaw damping test). Additionally, calculations had been carried out to investigate the transferability of the results.

Based on the available data, it was shown that there is no negative impact of the propelled trailer to the stability of the towing vehicle and vehicle combination, provided that there is always a remaining towing force in the tow ball, and no torque vectoring between the trailer wheels. It was also found that handling benefits from a driven trailer. Theoretical calculations show that when these two conditions are met (=no torque vectoring, no pushing), propelled trailers are safe with regards to driving dynamics.

Theoretical calculations also show that torque vectoring has a potential to even further improve handling and stability, however possible faults of the drive system and control strategy could negatively influence handling and stability.

The study had been carried out with only two prototype vehicles. Calculations checked that the results can be transferred to almost all kinds of trailers. Articulated trailers that have a steering of their own, however, need to be excluded from the conclusions without further research. Trailers for single-track vehicles (motorcycles, bicycles) are still under investigation.

As a conclusion, it has been identified that propelled trailers where a towing force in the coupling remains (=the trailers compensate their driving resistance only partially, they do not push the towing vehicle) and without torque vectoring do not have negative effects on the stability of the combination and can have possible effects on the handling. This is true for non-articulated trailers, including semi-trailers and central-axle trailers. Regulations could as a next step be adapted, so that the positive effects towards traction and energy efficiency could be demonstrated. Also as a next step, the benefits and possible issues with torque vectoring should be identified.

2.1.4. Active motorcycle safety

Motorcycle riders are still one of the most endangered groups in modern traffic. Due to the specific driving dynamics of single-track vehicles and the location of the predominantly driven roads, the severity of accidents tends to be considerably above average. Previous analyses of available accident data have shown that the typical cause for accidents with a motorcycle on rural roads is loss of control over the vehicle. Prevention of mistakes by the rider in relation to occurring roll angles and braking while cornering are promising starting points for a reduction in motorcycle accidents on rural roads.

To increase the traffic safety for motorcycle riders, BAST supervised several external research projects on various topics related to motorcycle safety. Potential and limits of autonomous emergency braking (AEB) systems were evaluated. Several studies proved that preparatory partial braking prior to a full emergency braking provides an increase in safety regarding the targeted relevant scenarios. A warning of the rider prior to a brake intervention is considered beneficial. In various studies, the acceptance of those system was high.

In a different project, driven roll angles were studied. In conclusion, a large scattering of the achieved roll angles of individual riders in curves is observed. According to a preliminary survey, the achieved lean angles are smaller for riders who reported to have a high fear of lean angles. However, a clear threshold is not apparent from the data. It also shows that the self-evaluation of the study participants

does not necessarily correspond to the recorded roll angles. Thus, even a participant with a high subjective fear rating can achieve high roll angles.

Recently, braking in curves is a challenging scenario addressed by the motorcycle industry. Since there are no public studies available evaluating the benefits of the current systems, BAST claims to provide an overview of the potentials for traffic safety including user acceptance. The results have shown that individual driving behaviour has a huge impact on the effectiveness of cornering ABS systems. In the short, conducted study, no adaption of rider behaviour could be recorded.

2.1.5. Motorcyclist-friendly safety barriers

Road restraint systems, which offer improved protection for motorcyclists in addition to the protection of vehicle occupants, should comply with the Technical Specification CEN/TS 1317-8:2012 (now DIN CEN/TS 17342:2019-10) "Motorcycle road restraint systems" published in 2012. In the beginning of 2000 when the systems for motorcyclist protection have been developed and tested in Germany there was no European standard for testing. Since it was uncertain whether the original systems also meet the requirements of this new specification, this question was investigated in a finished research project.

Aim of this project was to design, assess and modify additional components for a frequently installed vehicle restraint system in Germany (ESP; simple steel guardrail) in regard to pass the Technical Standard.

The nowadays commonly used underride protection of the ESP 4.0 UFS as well as additional components to reduce the impact severity have been tested and designed (Figure 3). Unfortunately, it was not possible to achieve a solution for ESP which passed the tests. Especially the measured neck compression force on the dummy remained a fail criterion for all modifications. However, certain improvements were made on the system as well as further problems and fail criteria were identified which can be used as a basis for further projects. Today, however, alternative protective devices with positive tested underride protection (e.g. Eco Safe) are available for new construction, which can be selected when installing new protective devices.



Figure 3: Impact according CEN/TS 1317-8:2012 (source: BAST)

In the past, the assessment of the sharpness of construction elements in vehicle restraint systems, especially with regard to the impact of motorcyclists, has been rather subjective. The aim of a further research project was to solve this problem by determining specific indications for the definition of system-neutral sharp-edged construction elements of vehicle restraint systems. Here, impact tests were carried out with a new type of biofidelic crash test dummy, modelled on humans, on variants of individual construction parts (Figure 4).

As a result, various criteria for assessing sharpness were identified. Examples are the horizontal offset between two parts of a vehicle restraint system or the minimum tangent angle of a specific part. All criteria were summarized in a flow chart and can be used to evaluate individual design elements with regard to sharpness. Unfortunately, there is no evaluation of the whole system. Nevertheless, the

results can be used by the designers to reduce the sharpness of the vehicle restraint system or by users to choose systems with a reduced sharpness if needed.



Figure 4: Biofidelic crash test dummy at impact point (sigma post covered with a pipe) (source: BAST)

2.1.6. Euro NCAP VRU (Vulnerable Road Users)

Subsequent to the last overhaul of Euro NCAP passive pedestrian test and assessment procedures in 2016, the protocols were revised and transposed into VRU procedures by the technical subgroup for application as from January 2023 onwards.

The headform test area is extended to better account for bicyclists as the second big group of vulnerable road users with the highest portion of killed and seriously injured of all road participants in German urban areas. Headform tests to the roof have been included up to WAD 2500, compare Figure 5 (Zander et al., 2020-2). Grid points in the windscreen area were removed from being defaulted green but, to account for atypical fracture of the windscreen, two repetitions of green predictions will be allowed in case of a colour change of three or more boundaries.

The FlexPLI is replaced by the new advanced pedestrian legform impactor aPLI with upper body surrogate which is, in principle, based on the same concept as the FlexPLI with upper body mass in order to improve biofidelity, to better predict femur injuries, and the idea of a replacement of the upper legform impactor (Zander et al., IRCOBI 2019). However, latter one will continue to be in use for the assessment of pelvis injuries. Finally, a capping is introduced in order to avoid the negligence of any relevant pedestrian body region.



Figure 5. Vehicle corner to bicyclist impact simulation with bicycle speed of 15km/h (orange) and 25km/h (blue) (source: BAST)

2.1.7. Assessment of windscreens as injury-causing vehicle parts for pedestrians and cyclists

Subsequent to the establishment of Regulation (EU) 2019/2144 („General Safety Regulation 2“), UN Regulation No. 127 has been amended to account for head protection of bicyclists, amongst other things by a rearward extension of the head impact zone until wrap around distance 2500 or the rear edge of the windscreen. In a series of tests BAST has found the fracture behaviour of the windscreen being atypical in many, but not repeatable cases, see Figure 6 (Zander et al., 2020). A Task Force under the umbrella of the European Commission developed criteria for atypical windscreen fracture which allow for a maximum of three test repetitions in case of a failed requirement during type approval testing: jerk criterion, acceleration criterion and absence of visible glass breaking. In case of atypical windscreen fracture while the HIC values meeting the requirements, the Technical Services may decide upon a repetition of the corresponding test.



Figure 6. Windscreen behaviour during headform tests: no breakage (upper row, left), typical pattern (upper row, right) and atypical windscreen fracture modes (lower row) (source: BAST)

2.1.8. PPE (Personal Protective Equipment) for bicyclists

The test and assessment procedures according to UN Regulation No. 127 and Euro NCAP are extended in order to better protect bicyclists in the event of a collision with a motor vehicle. However, single accidents or accidents involving bicyclist interaction with areas other than the vehicle front are not addressed. BAST investigated the potential of airbag-based personal protective equipment (head protection system, airbag vest, see fig. 7+8) and found that in a variety of accident constellations head or chest injuries can be mitigated in particular due to the damping effect of the protective system. Nevertheless, in a number of potential use cases the accident was not or not in time detected by the corresponding sensing system, or the total response time (TRT) of the system was greater than the head or chest impact time of the bicyclist. An airbag-based head protection system cannot replace a conventional bicyclist helmet. However, it may altogether contribute to an increased helmet usage rate - especially amongst road users normally not wearing a helmet - and thus to head injury mitigation (Zander, 2019). Furthermore, the airbag vest addresses the upper body / thorax region which is to this point in time not protected by any specific vehicle-based countermeasure (Zander et al., 2020-3).

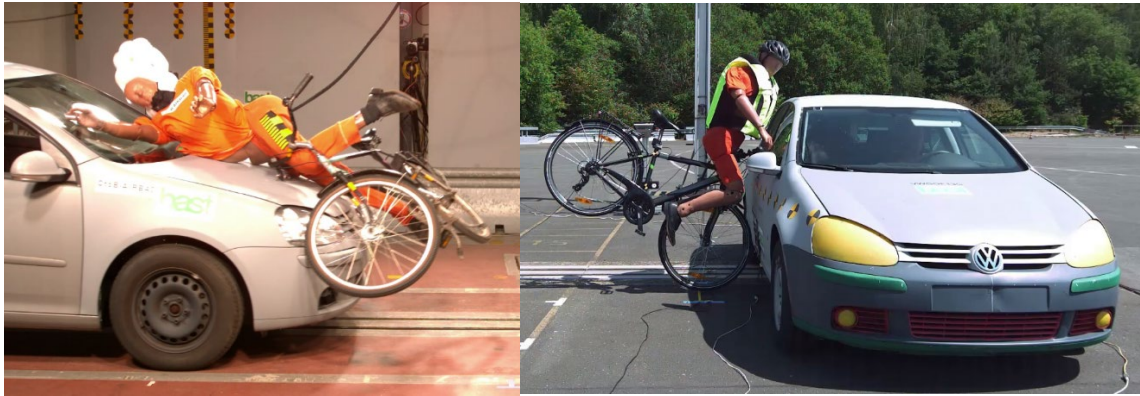


Figure 7 + 8. Vehicle to bicyclist accident simulation with different airbag based personal protective equipment: head protection system (left, fig. 7) and airbag vest (right, fig.8) (source: BAST)

2.1.9. Automated driving on highways: further development of UN Regulation No. 157

On roads with structurally separated directional lanes, systems that automatically take over the longitudinal and lateral control of the vehicle within its own lane up to a speed of 60 km/h can be type approved since January 2021. Such systems are referred to as ALKS (Automated Lane Keeping Systems, UN Regulation No. 157). An ALKS is thus the first system in a vehicle in which the driving task is temporarily carried out completely by the vehicle itself (Level 3 according to SAE Standard J3016) - for example in a traffic jam on the motorway. Major challenges regarding the technical requirements on the lateral and the longitudinal control of the vehicle by the system without the continuous surveillance of the driving task by the driver have been solved during the development of the UN Regulation No. 157 and reliable safety measures have been installed. Another challenge was to transfer duties of the human driver established in national behaviour laws into dedicated technical requirements on the vehicle system to create the opportunity for the transition of the complete dynamic driving task to the vehicle and also ensure a safe transition back to manual driving to always guarantee a safe and normal behaviour of the vehicle in traffic. The first serial production systems in vehicles received a type approval at the beginning of 2022 and the vehicles can now be regularly driven on the road with an ALKS in these countries where the national laws allow the regular use of self-driving cars.

Since 2020, on the initiative of the German Federal Ministry of Digital and Transport (BMDV) and with extensive support from the associated Federal Highway Research Institute BAST, the work on the regulation UN Regulation No.157 has been expanded in the corresponding expert committee at UN level from the area of application and the necessary technical requirements in such a way that higher maximum speeds of up to 130 km/h and automated lane changes are to be made possible. This enables the possibility for the manufactures to gain a type approval for a complete "motorway chauffeur" for their vehicles. In addition, the regulation will be partly opened up for trucks and buses. This extension of UN Regulation No. 157 was finally put to the vote at the decisive body, WP.29 of the UNECE, in June 2022, was adopted and can thus enter into force at the beginning of 2023. This means that from 2023 onwards, automated driving systems, which for example are able to manage a complete motorway journey, can be type approved for regular vehicles.

2.1.10. EU-Project L3-Pilot

In the EU-project "L3Pilot", 34 partners from research, industry and government agencies cooperated in order to test the safety, efficiency and usability of automated cars (SAE levels 3 and 4). BAST participated with a study on user acceptance and trust, and provided input to the safety impact assessment. The project was co-funded by the European Union under the Horizon 2020 program.

In the study on user acceptance and trust, test participants were given the freedom to hand over driving to an automated system in a test vehicle at speeds of up to 130 kilometres per hour while, for example, using their phones or reading. The automated system did not need to be monitored, but the test participants had to be able to take over control at any time when prompted to do so by an acoustic and optical signal. The test participants drove on a motorway stretch for about 100 kilometres three times

on different days and were free to switch the automated system on and off as they wished. The study's central aim was to determine how often they in fact used the automation, what they were doing when they had it switched on and whether their behaviour and their opinion on automation changed over time. It is crucial to examine trust and acceptance with respect to automated driving: Too much trust can cause misuse, too little trust or acceptance can hinder the use of automated driving functions and thus their anticipated positive effects on road safety and efficiency. Results indicate that the test participants had the automation switched on almost all the time– for between 88 and 99 per cent of the driving time. Only in rare cases did they decide to switch the automation off themselves. Every test participant was successful in taking back control; they needed between 0.78 and 7.76 seconds to do so. However, during many take-overs they did not check their rear-view mirrors, which, depending on the traffic situation, could be evaluated as a critical point.

One important topic within the project was the analysis of how to assess the seemingly very technical topic of road safety as a consequence of increased automation. Using a range of data, for example, from simulations, from L3Pilot test drives and accident data from today's traffic – including the GIDAS and IGLAD data bases – the project estimated how many lives would be saved or how many serious injuries would be prevented across the EU through automated driving on motorways or in urban areas. It is thus encouraging that in urban traffic an overall positive development can be expected in the case of light, medium and severe accidents– regardless of the number of automated vehicles on the streets. Furthermore, at a 30 per cent ratio of automated vehicles in road traffic, accordingly, about 12 per cent of all lethal accidents and about 13 per cent of all severe accidents can be prevented.

2.1.11. OSCCAR

The increasing level of vehicle automatization towards autonomous driving enables new interior concepts with more comfortable seating positions (e.g. swivel seats or reclined seating positions) and allows the driver to engage in non-driving activities. However, crashes with conventional vehicles in mixed traffic scenarios will still occur, thus occupant safety needs to be maintained even in these new interior concepts. From 2018 to 2021 BAST was involved in the EU-funded project OSCCAR (Future Occupant Safety for Crashes in Cars), which focused on the improvement and assessment of vehicle safety for car occupants in future accidents involving highly automated vehicles. The project aimed to protect all passengers in the best possible way by developing innovative occupant restraint systems (belts, airbags and new seating concepts), future accident scenarios and improved vehicle safety assessment methods in a virtual, simulation-based approach.

Within the OSCCAR project several protection principles for possible new interior concepts as well as the corresponding accident scenarios were developed. The protectiveness for some protection principles was assessed with physical tests and the suitability of existing crash test dummies was investigated. The project intended to use human models where no suitable dummies are available – therefore, existing human models were improved and harmonized injury criteria developed. For the future implementation of virtual assessment methods, among others the virtual vehicle models need to be validated. The development of the corresponding validation procedure was led by BAST within the OSCCAR project. Results from the OSCCAR project are available through the homepage (<https://www.osccarproject.eu/>).

2.1.12. EU-Project HADRIAN

The project “HADRIAN – Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs” was funded by the EU Horizon 2020 program and brought together 16 European partners from large industry, SME, academia and research. The HADRIAN project was focused on Human-Systems Integration for the definition of driver roles in automated driving and implemented a novel approach to create automated driving systems that integrated human drivers, vehicles, and road infrastructure. HADRIAN partners designed and validated novel, adaptive, and fluid Human-Systems Interactions that were enabled by advanced driver monitoring to reduce the interaction complexity and increase trust and acceptance of drivers and users. Also, active road Infrastructure Support Levels for Automated Driving (ISAD) were explored to increase the predictability of automated driving as well as support minimum risk manoeuvres. AD level transitions require well-designed human machine interfaces (HMIs) to allow the driver to establish accurate situation awareness. The project

investigated how fluid HMIs improve and allow for appropriate performance of the driver role during active driving automation and transitions. HADRIAN aimed at safe transitions and high trust in automation. In addition to research on human-machine-interaction, BAST also contributed to HADRIAN with analyses regarding infrastructure constraints and opportunities.

2.2. Ongoing and planned research

2.2.1. Personal Light Electric Vehicles PLEV

The scope of the European Type Approval Regulation (EU) No. 168/2013 (for category L vehicles) excludes self-balancing vehicles and vehicles not equipped with at least one seating position. Such vehicles were called Personal Light Electric Vehicles (PLEV). PLEV therefore could be regulated on national level. As a consequence, on June 15th 2019, the German Personal Light Electric Vehicles Regulation went into force with scope on PLEV: Those micro-mobility devices are for instance electronic kick scooters (e-scooters) or self-balancing vehicles. More precisely: In Germany this category subsumes specific electrically powered motor vehicles with a maximum design speed not exceeding 20 km/h, namely such without a seat or self-balancing vehicles with or without a seat.

Currently, a research project is ongoing for a detailed analysis of the PLEV impact with regard to road safety. This evaluation project places emphasis among others on following aspects: Primarily an in-depth accident analysis focuses on crash causes and injury patterns. In another work page the potential of conflicts with other road users, in particular children, mobility-impaired persons and senior citizens, is assessed. Additionally, the project will answer questions regarding traffic issues as well as user behaviour and user characteristics.

2.2.2. Technical innovations for safe cycling

To ride a bicycle is one of the most sustainable and green transportation modes. Since it is accessible to almost everyone and enables an easy participation in road traffic, it is very popular. However, as the current development of road accident statistics shows, there is potential to make cycling safer: While the total number of accidents involving personal injury in Germany is falling continuously, this trend is not discernible for accidents involving bicycles. The objective of current various projects is to examine how cycling can be made safer and more comfortable by using technical innovations.

One field of activities focuses on technical requirements for lighting devices of bicycles and bicycle-trailers. As new forms of light sources (e.g. LED) have been established on the market, it is necessary to examine how to adopt the test requirements taking the state of the art and possible new solutions into account. For example, cornering light can improve illumination of the path. Therefore, adequate technical requirements have to be developed which also prevent oncoming traffic from being dazzled. With another project the technical requirements for the braking device of bicycles (including electrically power assisted cycles (EPAC) and cargo bicycles) and their trailers (braked and unbraked) are to be developed in a technology-neutral manner. New technical devices like anti-lock braking system, brake force distribution system and overrun brakes for trailers should be considered as well.

2.2.3. Cargo bicycles

Cargo bicycles and cargo bicycle trailers continually gain more popularity, as they offer an environmentally friendly way to transport heavy loads and have a potential in reducing local traffic emissions. They are used for private and commercial purposes, which also provides a wide field of application. Since they are an uprising enrichment to the variety of vehicles found on public roads, it has to be scrutinized if they should be addressed by distinct regulations, e.g. by defining different categories of cargo bicycles with different technical requirements. To ensure a sensible development of design categories with regard of the given road infrastructure which could be used by cargo bicycles and cargo trailers already using public roads, BAST is supervising an external research project. The aim of this project is to evaluate various aspects of cargo bicycles used on public roads with regard to potential modifications of existing regulatory aspects. With completion of the project, scientific-proofed

recommendations that support enhanced traffic safety for cargo bicycles will be available regarding design categories of cargo bicycles and cargo trailers and, if applicable, to the usable infrastructure. Selected categories should fit seamlessly and without contradiction into the categorization of other vehicle classes. In this project, the main focus is on cargo bicycles and cargo trailers for the purpose of transporting goods. In practice, mixed use - simultaneous or exclusive transport of people, especially children - is common and therefore, it is included in the ongoing evaluation.

2.2.4. Urban emergency braking systems

Collisions between Vulnerable Road Users (VRU) and large commercial vehicles that are undertaking low speed manoeuvres, such as turning or moving off from rest, typically occur at low driving speeds. They usually have serious consequences for VRU.

The cause of this type of collision can be contributed to by many factors. The VRU may have been positioned in a place where they were not available to be seen by the driver through either glazed areas or mirrors. Alternatively, they may have been available to be seen during the build-up to the collision, but the driver may have detected their presence too late to avoid collision, or may have failed to detect their presence at all. This late detection, or failure to detect, could be a result of the driver failing to look, looking but failing to see, or seeing but failing to correctly judge the risk.

Elimination of this type of collision may consider action that mitigates many of these different causes. Other regulations have been introduced concurrently to enhance direct visibility, to use electronic sensing systems to detect a VRU in close proximity to the vehicle, to inform the driver of their presence via a low urgency information signal (e.g. light) and to provide a collision warning (e.g. audio-visual) when the situation becomes more critical.

2.2.5. Deployable Pedestrian Protection Systems

The UNECE Informal Working Group on Deployable Pedestrian Protection Systems (IWG DPPS) with significant contributions from BAST has made important steps towards the finalization of the test and assessment procedures as amendments to UN Regulation No. 127 und UN Global Technical Regulation No. 9. The prerequisites to account for the benefits provided by vehicles with DPPS (Figure 9) to the pedestrian's head in case of an accident have been defined: a minimum protection below the deployment threshold must be demonstrated by headform tests at impact velocities equivalent to the vehicle speed. The FlexPLI has been evaluated as appropriate pedestrian surrogate for the sensing system of the DPPS. The boundaries of the area in which a pedestrian must be detected have been defined. A qualification procedure for human body models to be used for the determination of head impact times (HIT) has been evolved. The decisive factors for headform compliance testing of the DPPS, either statically in the deployed or undeployed state, or dynamically during its deployment, have been developed. For Contracting Parties opting to perform tests on the statically deployed system, a procedure for HIT determination by means of numerical simulations on the deployed DPPS has been developed in order to compare HIT with the total response time (TRT) of the system. For all cases where the HIT exceeds the TRT, headform compliance tests have to be performed dynamically. For the correct timing of headform firing and system deployment, additional numerical simulations are performed with the qualified models on the undeployed DPPS.

Since pure passive systems are expected to also provide some protection during accidents with impact speeds higher than 40km/h, and DPPS should provide at least the same level of protection, the deployment of DPPS should be at least initiated, or sufficient clearance be provided for energy absorption during headform tests at impact velocities higher than 35km/h. However, the IWG did not define specific requirements but will address it by including a corresponding wording within the preamble to UN Global Technical Regulation No. 9.

Furthermore, the generated clearance underneath the bonnet may be compromised due to the wrap around and loadings induced by the upper body of the pedestrian prior to head impact. A reasonable bonnet clearance will be required in the preamble to UN Global Technical Regulation No. 9.

The procedure for DPPS accounts for both, vehicle type approval as well as self-certification, providing the corresponding requirements.

A final draft will be submitted to GRSP at its May 2023 session. An adoption of the Global Technical Regulation No. 9 amendment by AC.3 is expected in November 2023. In a subsequent phase, provisions for HIT determination based on the vehicle geometry and using an empirical formula will be developed.



Figure 9. Vehicle with pop up bonnet as deployable pedestrian protection system (source: BAST)

2.2.6. Mitigation of thoracic pedestrian injuries

Current passive pedestrian test and assessment procedures comprise of component tests addressing injuries to head, pelvis and lower extremities of pedestrians during collisions with passenger cars. However, injuries to the upper body, in particular to the thorax which have been found in the German In Depth Accident Study GIDAS (Schick et al., IRCOBI 2021) are not specifically addressed. To account for thoracic pedestrian injuries, BAST has initiated a research project with the aim to establish a test procedure as follow up to the findings of the EU project SENIORS where a thorax injury prediction tool was developed and prototyped, see Figure 10 (Zander et al., ESV 2019). Both, a standalone procedure and an amendment to the existing procedures will be developed. A workshop with stakeholders is foreseen towards the end of the project in the course of 2023.

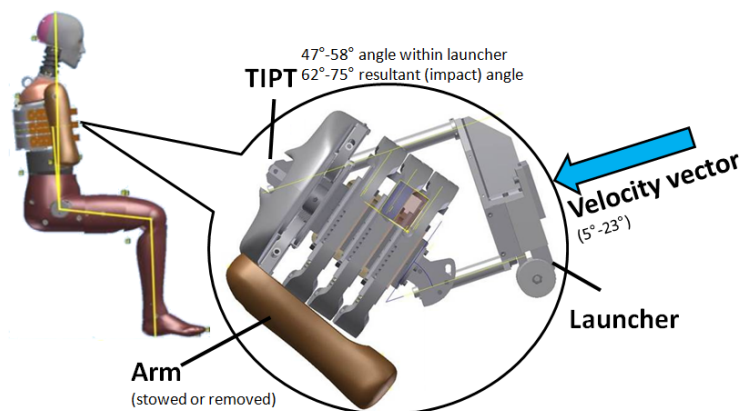


Figure 10. Test parameters for the thorax injury prediction tool (TIPT) (source: BAST).

2.2.7. Virtual Testing for crashworthiness assessment

Virtual Testing (VT) for vehicle safety crashworthiness assessment will be an important method to further improve the robustness of safety. Therefore, BAST is contributing to the development and evaluation of a VT methodology in Euro NCAP for the assessment of crashworthiness in a pilot case. The selected pilot case is the "Far-side" sled test. According to the proposed methodology the vehicle manufacturer will run simulations of additional sled test configurations to improve the level of protection.

Eventually, the rating will be based on a combination of physical and virtual test results. In a first step the method will be based on virtual tests with the WorldSID dummy. Requirements to certify the virtual simulation model of the dummy have been defined. The dummy-based Far-side VT procedure also includes a procedure to check the level of validation of the sled model that is used by the vehicle manufacturer for the VT assessment simulations. Validation acceptance criteria will be specified and evaluated in a pilot case. In a future step the validated sled model might be used for VT with human body models to further improve the robustness of safety assessment. A prerequisite for the potential future use of HBMs in virtual testing procedures will be harmonized HBM validation requirements and application methods. Therefore, BAST continues to support the THUMS User Community (TUC), which continues to work on this topic. In addition to that BAST is also involved in several working groups of an international framework HBM4VT (Human Body Models 4 Virtual Testing), which was initiated by Euro NCAP to bring together international experts to jointly work on the most important questions and issues to be solved to enable a wider application of HBMs in VT based vehicle safety assessment.

2.2.8. Child Dummy Task Force for Mutual Resolution

BAST took the lead of a task force of the GRSP to implement the child dummy series “Q” in the Mutual Resolution 1 (M.R. 1). The M.R.1 defines test tools such as dummies for the use in UN-Regulations and can also be considered in Global Technical Regulations (GTR). The main objective of the Task Force is, to define the dummies of the Q-Series for use in UN Regulation No. 129. This requires a general description of the dummy design according to their specification in UN Regulation No. 129, assembly and disassembly, engineering drawings and certification procedures. All dummies (Q0, Q1, Q1.5, Q3, Q6, Q10) are checked and defined individually, starting with Q0 and Q1.

2.2.9. Improved frontal impact assessment procedures - New rotational brain injury criteria (Euro NCAP)

Brain injury is still one of the predominant injuries in frontal impact car accidents. Therefore, BAST was involved in the evaluation and introduction of a new brain injury criterion. More than 30 years brain injury assessment in all dummy-based vehicle safety assessment procedures was only considering linear head acceleration measurements. The Euro NCAP brain injury group evaluated several proposed alternative kinematic brain injury criteria which also consider rotational effects, because these are assumed to contribute to the risk of brain injury. BAST contributed to the group by evaluation of performance of various candidate criteria in MPDB crash tests as well as by simulation-based accident reconstruction studies using in-depth accident data and human body model simulation. The brain injury criterion DAMAGE was selected as a short-term kinematic criterion to be introduced to the Euro NCAP assessment protocol. BAST will continue to contribute to further research and evaluation to replace this kinematic criterion by a more advanced human model-based brain injury method in the future.

2.2.10. Further development of the in-depth collection of traffic accident data (GIDAS)

Since 1999, the Federal Highway Research Institute of Germany (BAST) and the Research Association of Automotive Technology (FAT) have been conducting a joint project for the interdisciplinary, in-depth investigation and documentation of randomly selected traffic accidents with personal injury (German In-Depth Accident Study – GIDAS; www.gidas.org). The scientific analyses of the reconstructed cases lead to findings on the cause, sequence and consequences of traffic accidents. This provides the opportunity to closely monitor accident occurrences and to identify negative developments at an early stage. Scientific evaluations of this accident data make it possible to identify safety problems and potential. Based on the findings, targeted measures can be derived and regulations can be drawn up or further developed at national and international level. The same applies in particular to investigations that become necessary in connection with the introduction of highly automated and connected vehicles.

Further development of GIDAS is set out in the German Road Safety Program 2021-2030 and is necessary for various reasons. Within the framework of the previous GIDAS project (GIDAS 3.0), possibilities for improving the collection, reconstruction and provision of the data have been discussed for several years. Furthermore, organizational and legal changes and improvements to GIDAS are necessary to ensure the future viability of the in-depth investigation and accident analysis.

Therefore, the current project is to be extended to include new survey content, including additional content from the areas of traffic infrastructure, human behaviour / psychology, and medicine, as well as the integration of sequential data - for example, time series of vehicle dynamics data. To ensure that the collection of new content is in line with the current state of science and technology, the BAST has launched a series of research projects whose results will serve as the basis for the further development of GIDAS leading to GIDAS 4.0. Finally, GIDAS 4.0 is going to be ramped-up in 2023.

2.2.11. Activities in the IWG EDR/DSSAD

By its Terms of References, the UNECE Informal Working Group (IWG) on Event Data Recorder / Data Storage System for Automated Driving (EDR/DSSAD) shall develop draft proposals for Event Data Recorder (EDR) for conventional vehicles and automated/autonomous vehicles and for Data Storage System for Automated Driving (DSSAD) for automated/autonomous vehicles. These categories shall be understood as systems collecting and storing a determined range of vehicle data, including:

- a. Information related to collisions valuable for accident reconstruction (EDR);
- b. The status of the automated/autonomous driving system and the status of the driver (DSSAD).

In particular, the IWG considers defining the categories of data recorded, the events triggering recording, as well as technical specifications in terms of mandatory performances of such systems.

The Federal Highway Research Institute of Germany (BAST) supports the Federal Ministry of Digital and Transport in this IWG since summer 2019 by providing technical and scientific input to the various discussions.

Specifically, current tasks of the IWG include the completion of EDR common performance elements for Contracting Parties to the 1958 and 1998 agreement in EDR Step#1 (UN Regulation No. 160, 01 series of amendments) and the consideration of additional technical provisions in EDR Step#2. Additionally, the IWG develops a document of common technical elements for creation of a UN Regulation on EDR for heavy duty vehicles (trucks and busses) and will develop EDR performance elements for Automated Driving Systems.

Regarding DSSAD, the IWG has provided requirements to Automated Lane Keeping Systems (ALKS) in UN Regulation No. 157, builds up an inventory of best ADS storage practices and will harmonize on DSSAD performance elements for ADS for 1958/1998 Contracting Parties.

2.2.12. Safety evaluation of driver engagement in assisted and automated driving

Adapting the performance and design of assisted and automated driving systems to human capabilities and safety needs is an important requirement for a safe market introduction of new technologies in this field. A specific challenge is the correct level of engagement of the driver in the driving task. In assisted driving, a high level of driver engagement is necessary to ensure that drivers are able to monitor the system performance and to intervene immediately in system limit situations. In automated driving, it is important that drivers effectively and efficiently redevelop a sufficient driver engagement and situational awareness during takeover situations. One important aspect is that drivers perform as required by their individual role and responsibility, both in assisted and automated driving. However, effectiveness of current driver monitoring technologies to ensure driver engagement is rather limited. Therefore, the aim of the current research project is to go beyond driver monitoring and think about performance-based assessment procedures of driver engagement with a direct link to safety by focusing on concrete driver behaviour in system limit situations. It is assumed, that a system design influences driver behaviour in specific situations and that based on observed driver behaviour conclusions on a safe system design can be drawn. By doing so, design-neutral and innovative requirements on driver engagement can be described and assessed.

2.2.13. EU-Project Hi-Drive

The EU-Project Hi-Drive is co-funded by the European Union under Horizon 2020 research and innovation program and aims on pushing automated driving one step further towards higher automation. The ambition is to considerably extend the operational design domain (ODD) from the present situation, which frequently demands interventions from a human driver. The removal of fragmentation in the ODD is expected to give rise to a gradual transition from a conditional operation towards higher levels of automated driving. Hi-Drive focusses on testing, demonstrating and evaluating robust high automation functions in a large set of traffic environments on motorways, in cities and cross-border scenarios, with a specific attention to demanding, error-prone conditions. On this basis, important objectives of the project are to define and implement enabling technologies as well as targeting defragmentation and extension of the ODDs for different automated driving functions and traffic contexts.

In Hi-Drive, 40 partners from 13 different countries are involved. The consortium consists of OEMs, automotive suppliers, research institutes, associations, traffic engineering, deployment organizations and mobility clubs. BAST will participate with a study on situational awareness in takeover situations of SAE-L3 vehicles on motorways. It is common knowledge that a proper situational awareness of the human driver is highly relevant for traffic safety. Past studies have shown that drivers respond very quickly to take over requests when required to do so, but there are no findings in the special process of re-engaging situational awareness after taking over full vehicle control. The study will provide relevant insights into this process. Furthermore, BAST contributes to the analysis of teleoperator workplaces, the analysis of safety effects of higher levels of automated driving as well as the cooperation of different stakeholders (ITS experts, road operators etc.).

2.2.14. German project Validation and Verification Methods

The German project Validation & Verification Methods (VVM) is co-funded by the German Federal Ministry for Economic Affairs and Climate Action. The project aims to develop testing methods as well as a structured argumentation for the safety case of automated and autonomous vehicles for the use case of an urban intersection. Focus lies on the development of automated driving systems up to the complete automation of entire vehicles for SAE Levels 4 and 5.

VVM is part of the PEGASUS Family and the direct successor of the prolific PEGASUS Project, which delivered the well-known challenger model and the 6-Layer-Model for scenario-based testing. These results are utilized and built upon to extend the safety case and the argumentation for higher levels of automation and for more complex scenarios. An integral part of the project is to incorporate the safety case into the development process of components and subsystems in order to make their separate testability possible. This allows for individual testing of subsystems and for an arbitrary combination of components that meet the functional requirements.

In VVM, 23 different partners are involved ranging from OEMs and automotive suppliers over tech companies and evaluation authorities to science institutions with an overall budget of over 47 million Euros. The BAST contributes to the project as a node to international activities and regulation.

2.2.15. Research needs on Teleoperation

In July, 2022 the kick-off meeting of the working group for research needs on teleoperation took place at BAST. BAST is coordinating this action with experts from different departments. The term teleoperation describes techniques and methods for an external influence on vehicle control from a remote location. A teleoperator can for example remotely command a specific manoeuvre of an autonomous vehicle or even take over full (remote) vehicle control. Teleoperation is fundamentally different from the manual control of a vehicle and teleoperators are confronted with new tasks in a special working environment. Currently, more than 30 experts are part of the working group aiming on analysing the still basic state of research on a safe application of teleoperation and giving recommendations on future research needs.

2.2.16. EU-Project SUNRISE

Safety assurance of Cooperative, Connected, and Automated Mobility (CCAM) technologies and systems is a crucial factor for their successful adoption in society, yet it remains to be a significant challenge. CCAM must prove to be safe and reliable in every possible driving scenario. It is already acknowledged that for higher levels of automation the validation of these systems would be infeasible by conventional methods. Furthermore, certification initiatives worldwide struggle to define a harmonized approach to enable massive deployment of highly automated vehicles.

Building from the Horizon 2020-funded project HEADSTART and other initiatives, the SUNRISE (Safety Assurance Framework for connected, automated mobility Systems) project, funded in the Horizon Europe framework program, will develop and demonstrate a commonly accepted, extensible Safety Assurance Framework for the test and safety validation of a varied scope of CCAM systems.

The project will define, implement and demonstrate the building blocks of this Safety Assurance Framework: harmonized and scalable safety assessment methodologies, procedures and metrics tailored for use cases, a European Scenario Database framework and its necessary data interfaces, a commonly agreed simulation framework including tools and interfaces. SUNRISE will work closely with CCAM stakeholders, such as policy makers, regulators, consumer testing, user associations.

BASt is responsible for the communication to vehicle safety bodies and contributes to the development of track testing methods and the scenario database framework. The project with more than 20 international partners is led by IDIADA and started on the 1st of September 2022 for a duration of 36 months.

2.2.17. V4SAFETY - Vehicles and VRU Virtual eValuation of Road Safety

The EU project “V4SAFETY - Vehicles and VRU Virtual eValuation of Road Safety“ is dedicated to the development of a harmonized framework for the assessment of safety measures for all kinds of road users. Such a framework has to deal with the rapidly changing road traffic system, including new technologies such as automated and connected vehicles, or a changing transport behaviour with an increase in cycling or the growing participation of older road users.

Therefore, V4SAFETY will use a Safe System approach and provide a prospective safety assessment framework that can handle a large variety of safety measures. This includes in-vehicle safety technology, new vehicle types, infrastructure solutions, and new regulations as well as a change in road user behaviour. To encourage intensive use of the framework, guidelines and examples will be provided on the use of the various simulation methods, driver and VRU models, and projection methods. A demonstration of use cases and a description of the validation and verification process aim to enhance broad acceptance of and trust in the framework. Thus, simulation-based safety assessment becomes more transparent and consistent, which leads to much-improved comparability and reliability of assessment conclusions. BASt is involved in the development of the framework, leading the task on the elaboration of the validation and verification process, there also physical testing of in-vehicle safety solutions will be performed. Further, BASt will analyse accident data on different aggregation levels – ranging from in-depth data of the GIDAS database to high-level databases like CARE – that will be used for modelling simulation baseline cases and the projection of the results on different areas of interest.

2.2.18. EU-Project MODI

The European Commission, through the Horizon Europe framework program, is funding a project to test and validate the implementation of CCAM solutions for real-logistics operations. The MODI project will demonstrate automated heavy-haul vehicles without safety drivers use cases on the motorway corridor from Rotterdam in the Netherlands to Moss in Norway, crossing four national borders and demonstrating terminal operations at four different harbours and terminals en route.

Automated transport will significantly contribute to improving European transport and logistic chains. The MODI research project will make substantial steps toward identifying and resolving barriers preventing this from coming true.

Even though the development of automated transport is accelerating, there are still many hindrances to overcome before we see a full-scale introduction of such transportation. These are related to the maturity of the technology itself but also to regulations, harmonisations, and social acceptance. The hindrances escalate when considering border-crossing transport. The project comprises five use cases, each describing a part of the logistics chain. It identifies what is required for automated driving level without human interaction (known as SAE level 4), and what is not possible yet.

BASt has an important role first in developing the safety requirements for the SAE L4 vehicles to be used in the project, and second to verify this during development and on-site in the Hamburg use case, where L4 heavy vehicles are set to travel from the surrounding highways through small city areas into the harbour, with special emphasis on ensuring the safety for vulnerable road users (section F1). BASt also contributes to the impact analysis for the project (F5) and to the definition of the required physical/digital infrastructure including (cooperative) intelligent transport systems (C-)ITS (V5). The project will be rolled out from October 2022 for 3.5 years.

2.2.19. Data for Road Safety (DFRS)

Data for Road Safety (DFRS) is a public-private partnership to improve road safety across the European Union by making vehicle-generated data on road safety related events and situations available for the creation of road hazard warnings.

European Transport Ministers of participating Member States, the European Commission, automotive industry partners as well as mobility data service providers established Data for Road Safety on the 15th of February 2017 in Amsterdam. In October 2020 a Multi-Party Agreement was signed, establishing the legal, organisational and partly also technical foundation. Since then, more partners have joined and more data is being made available via the DFRS data ecosystem: nine European States or their national road operators (Germany, Austria, Belgium, Denmark, Spain, Finland, Luxemburg, the Netherlands and England), five automotive manufacturers (BMW, Daimler, Volkswagen, Ford and Volvo) and five data service providers (GeoTab, INRIX, HERE, TomTom and NiraDynamics) are signatories of DFRS.

The Data Task Force was structured around 3 core principles:

- a) Working together to make driving safer. Safer driving is a shared vision amongst government and industry stakeholders and is a key founding for this public-private partnership.
- b) Safety without compromise. Vehicle-generated data has the potential to save lives. By making vehicle-generated data relevant for traffic safety a priority and share data across brands and across borders, we can maximize its usefulness and enhance road safety.
- c) A fair and trusted partnership. The Data Task Force is a trusted partnership of government and industry stakeholders that enables trusted discussion and fair competition.

BASt has been supporting the Federal Ministry of Digital and Transport from the beginning of the initiative. From 2018 to 2021 BASt has led the Technical Group.

In 2023 BASt will manage the procurement, development and operation of a system that takes data from the DFRS data ecosystem and creates road hazard warnings for Germany, also using data from the legacy road traffic safety service (set up and run by the police in Germany together with traffic management centres of the main road operator and public broadcasting services). This additional and new data source has a proven potential to improve the quality of road hazard warnings: more data covering the whole road network is available, latency can be reduced compared to traditional data sources and additional data validation is possible. The created road hazard warnings will be made available at the National Access Point for traffic data in Germany (Mobilithek) so that service providers can inform road users via various end-user channels.

2.2.20. C-Roads Germany

C-Roads represents a European flagship initiative (co-funded by the Connecting Europe Facility) for piloting and deploying C-ITS services (<https://www.c-roads.eu>). It comprises of Member States driven

pilots from 18 European countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden and UK). The key result of C-Roads is a catalogue of harmonised and tested specifications for C-ITS use cases and services (consisting of a bundle of use cases). C-Roads does not require institutions to deploy (although strongly encouraged) but to follow the agreed specifications when services are deployed. The specifications are harmonised across sectors (among road authorities/operators and with industry communication profile custodians such as the Basic System Profile of the Car2Car Communication Consortium). The catalogue gradually expands over time, driven by releases, so that the functionality of the services increases while at the same also extending the scope of the services. The first wave of pilots (with a focus on services for the motorway network) has ended in 2021. The achievements have been presented at the C-ITS roadshow (#saferoadstoday) in Brno in June 2021. The current state-of-play with regard to deployment is available at the European Commission's TENtec portal (C-ITS stations, <https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html>). On national basis, Autobahn hosted an event with the Federal Minister for Digital and Transport in October 2022. The nationwide roll-out of the Road Works Warning service – the special fleet of 1,500 fully equipped roadworks safety trailers – will be completed until end 2023.

The second wave of C-ITS pilots which has started 2019 is targeting 50 European cities, aiming at providing the basis for urban C-ITS deployment. C-Roads Germany Urban Nodes extends the pilot locations to Hamburg, Kassel and Dresden, focussing on services such as Traffic Signal Priority, Emergency Vehicle Approaching, Green Light Optimal Speed Advisory and Vulnerable Road User Advise. The three cities have deployed until now 170 ITS stations (Road Side Units) and most of the services are already operational. In October 2022, the German cities have hosted a series of cross tests with pilot cities from other C-Roads countries and industry actors. The second wave comes to an end in 2023, or 2024 respectively. It is planned to broaden the wave of urban deployment with additional co-funding provided by the Connecting Europe Facility (project end: 2026).

The BAST roles are devoted to the national technical coordination of C-Roads and the provision of coordinated expert input into the various expert groups (addressing issues to be solved for deployment, i.e. organisational issues, security, service harmonisation, infrastructure communication, hybrid communication, cross-testing and validation, evaluation and assessment of the pilots, urban C-ITS) of the C-Roads Platform. Especially, BAST chairs the task force on security aspects (Public Key Infrastructure) and co-chairs the task force on cross-testing and validation. BAST also supports the Federal Ministry for Digital and Transport at the Steering Committee.

2.2.21. FAME

FAME is a 23 partner-project coordinated by ERTICO, addressing the research and innovation needs as identified in the research coordination cluster of the CCAM Partnership. It has started in July 2022 and will run for three years, making use of a budget amounting to 5.7 MEUR. FAME will implement three key recommendations from the CCAM Platform (COM Expert Group, Final Report 2021), maintaining and enhancing the EU wide Knowledge Base on Connected and Automated Driving (which has been established by the predecessor project ARCADE), establishing an EU Common Evaluation Methodology (CEM) for CCAM testing and to provide a framework for sharing test data. A taxonomy tool as well as a legal and ethical framework will complement the European framework for CCAM testing. Besides that, FAME will foster the stakeholder engagement and organise key events such as the EU CAD Conference in Brussels (next forthcoming in May 2023).

BAST contributes to FAME with the following mission: to include the facts and findings from the BAST-hosted monitoring of CAD test fields (<https://www.testfeldmonitor.de>) in the EU wide Knowledge Base, to bring in methodological contributions for HMI research in the context of large scale demonstrations, to extend and accompany the Common Evaluation Methodology with a branch of impacts which are not directly based on test data but receive increasingly larger public attention (e.g. wider economic impacts, distributional impacts, land use) and to pilot CEM in synergy with large scale demo projects such as HiDrive and MODI. More information on FAME is available at <https://www.connectedautomateddriving.eu/>

2.2.22. Research program road safety

BASSt has the task to carry out target-oriented planning and coordination of research in the area of road safety and to examine traffic safety improvements. Therefore, BASSt elaborates research programs, addressing current and future road safety issues in order to provide scientifically proven information as a base for advice and support to the Federal Ministry of Digital and Transport (BMDV).

Among other topics, programs currently ongoing are dealing with the further development of the German In-Depth Accident Study (GIDAS) and with safe cycling on shared roads. A program dealing with cargo bikes is currently under development.