STATUS REPORT, FEDERAL REPUBLIC OF GERMANY

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VEHICLE POPULATION AND ROAD PERFORMANCE

Germany, with its 82.5 million inhabitants, is the most populated country in Europe. The number of passenger cars in Germany on 01.07.2005 was 45.4 million. There was an increase of 0.8% compared to the previous year. A further increase in the number of cars can also be expected in the coming years. Traffic intensities on the approx. 12,000 km of federal motorways in 2005 were about 48,300 vehicles per 24 hours on average. The total driving performance of all vehicles in 2005 was about 684 billion vehicle-km, out of which over 30% took place on the federal motorways alone.

ROAD ACCIDENTS IN GERMANY

The number of road accidents in Germany decreased in 2005 by about 5% compared to 2001 to about 2.25 million. Here, the number of accidents with injuries to persons has declined by 10% to about 336,619. Driving performance remained almost the same.

The number of road accident victims has decreased from 7,503 in 2000 to 5,361 in 2005, i.e. the lowest figure since 1953. The decline in the number of those who were fatally injured was 8% between 2004 and 2005 alone. The occurrence of accidents declined further in 2006 as well. The number of those who died dropped by 5% to approximately 5,100.

SAFETY OF LIGHT GOODS VEHICLES

Accident involvement of light goods vehicles with a permissible total weight of over 2.8 t to 3.5 t has increased dramatically in the past years as has the number of these vehicles. The speed limit applicable for this vehicle group till the end of 1997 was lifted at that point. Since then, it only applies to vehicles with a permissible total weight of above 3.5 t.

As shown in Fig. 1, the development in the number of small transporters above 2.8 t to 3.5 t involved in accidents with injury to persons U(P) is clearly different from the development of small transporters above 2 t to 2.8 t and trucks above 3.5 t to 7.5 t. The number of light goods vehicles above 2.8 t to 3.5 t involved in accidents with injuries to persons increased by 204% to about 5,270 till the year 2002. After a slight decline in the year 2002 the dramatic increase in accident involvement did not continue. In 2004, about 5,670 light goods vehicles above 2.8 t to 3.5 t were involved in accidents with injuries to persons.

Accident involvement of light goods vehicles above 2.8 t to 3.5 t on motorways till 2001 has increased by about 350% to 820 compared to 2001 and the increase on motorways is more intense than on rural roads and roads within city limits. Whereas a decrease in accident involvement to about 750 can be recorded after this in 2004, there was still a slight increase on roads within city limits and rural roads.

Drivers of light goods vehicles above 2.8 t to 3.5 t are the main cause in two out of three accidents (65%). This percentage even increases to about 74% among 18 to 24 year old drivers. The percentage of car drivers who are the main cause of accidents, on the other hand, is more favourable at an average of 54 %.

The percentage of registered light goods vehicles in the N1 category has increased dramatically in Europe. The IMPROVER study spearheaded by BASt in 2005 showed, that in the EU25-countries about 4,000 people die annually in accidents in which at least one light goods vehicle is involved, and about 20,000 road users are seriously injured in the process.

Road safety measures were tested for efficiency within the scope of IMPROVER. Benefit-cost ratios were estimated by introducing road safety measures for small transporters all over Europe within the scope of IMPROVER (see Fig. 2).

The best results were evident in the so called "seat belt reminders" with a cost-benefit ratio of 5.3 and with professional driver's training (benefit-cost: 2.2). As in the case of other vehicle categories, ESP was also assessed positively in the case of small transporters (benefit-cost: 1.0).

Meanwhile, car insurance companies are promoting the equipment of light goods vehicles with safety systems. An insurance offered directly by the vehicle manufacturer reduces the premium by up to 33%, for example, if the vehicles are suitably equipped with an electronic stability program (ESP), parking assistance, accident data recorder and hands-free set.

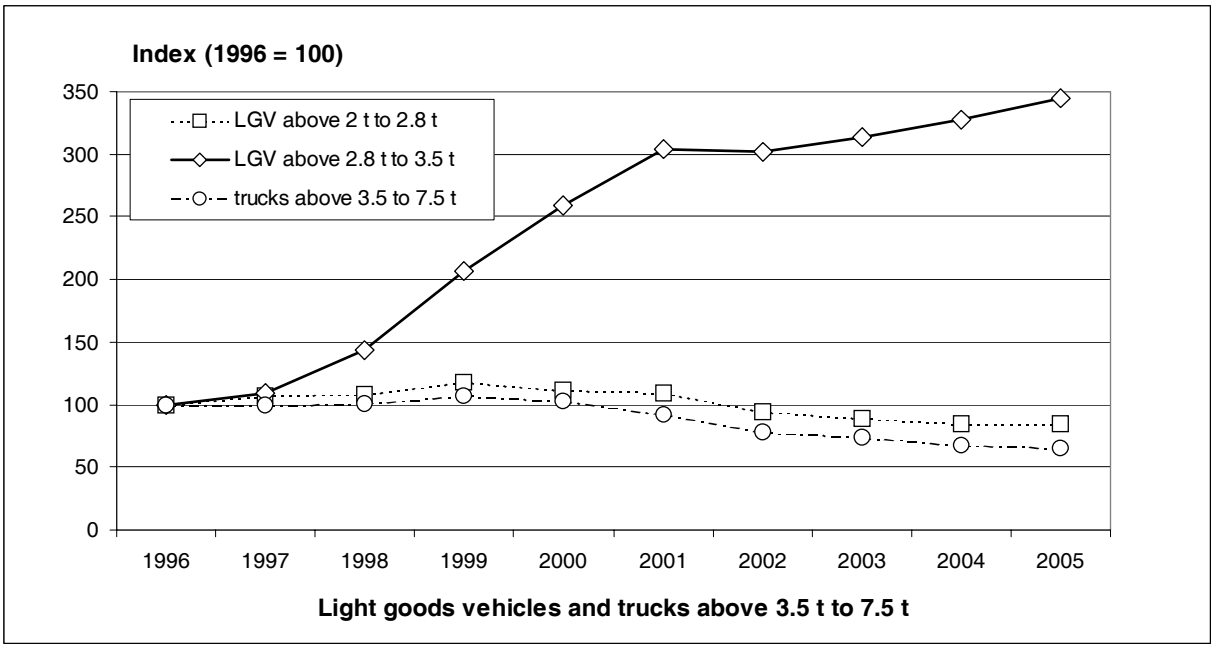

Fig. 1: Development in the number of light goods vehicles up to 3.5 t involved in accidents with injuries to persons and trucks above 3.5 t to 7.5 t

In 2006, BASt investigated the problem of whether aquaplaning plays a role in causing accidents in which small transporters are involved. Aquaplaning is a well known phenomenon in the case of cars, if high speeds, a low tread profile and high water film height coincide. Truck drivers are not familiar with aquaplaning due to the high front axle loads and the comparatively low driving speed. What about small transporters? Reply: Yes, they can enter a state of aquaplaning, and here again – dependent on water film height and tread depth – even from 100 km/h onwards. This was evident from the tests in BASt's interior drum testing facility, which can be watered.

HEAVY GOODS VEHICLES

One of the priorities of the German "Program for more safety in road traffic" consists in reducing the risk potential of heavy goods vehicles (see: Proceedings 19th International Technical Conference on ESV, Government Status Report of Germany, June 2005). It is precisely in the case of heavy goods vehicles that control and driver assistance systems that help in avoiding accidents offer great potential due to the high crash energies of these vehicles. The German vehicle industry offers systems for electronic stability control (ESC), safe lane keeping, headway control or automatic emergency braking in the case of threatening tailgating when confronted with an obstacle. When these systems interact with each other they cover a large part of the accident configurations that can take place with heavy trucks. Rear-end accidents, coming off the carriageway and accidents with oncoming traffic comprise about 45% of all accidents in which trucks are involved.

Studies prove the great potential of ESC, adaptive cruise control and lane guard in avoiding accidents on motorways, on which the majority of goods vehicles drive.

A vehicle insurance in Germany honours the optimisation of technical safety measures within the scope of a three year test run with more favourable conditions in the case of liability insurance and comprehensive vehicle insurance premiums for tractors.

A further technical measure, emphasising the visibility of goods vehicles at night, is the application of contour markings, which Germany has been trying to enforce as obligatory in the case of heavy goods vehicles. In future all newly registered vehicles above 7.5 t (including trailers), that are wider than 2.10 m, must have contour markings on them.

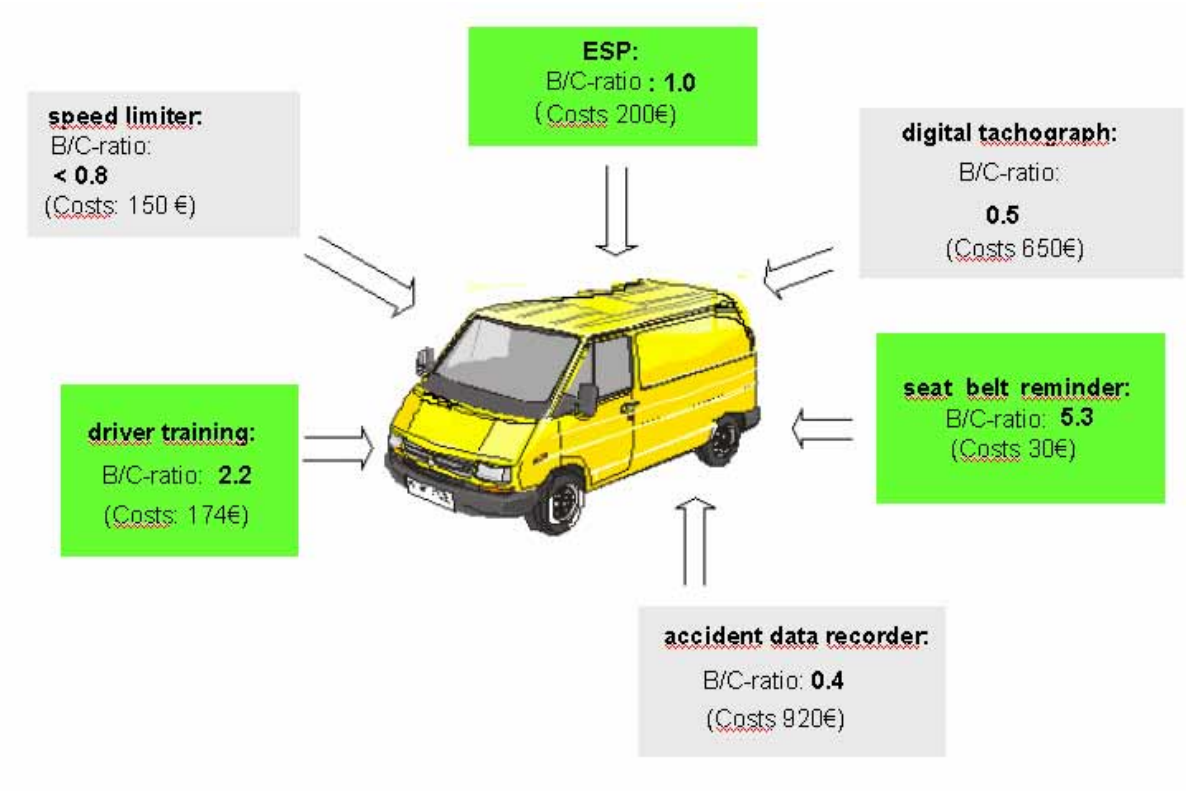

Fig. 2: Estimate of the benefit-cost ratio of road safety measures for light goods vehicles introduced all over Europe [EU research project: IMPROVER sub-project 2: Impact assessment of measures concerning the improvement of road safety of light goods vehicles (LGV)]

Fig. 3: Heavy goods vehicle equipped with an automatic emergency braking system

DAYTIME RUNNING LIGHTS

The suggestion that all vehicles should drive with lights during the day as well, is being discussed both nationally and internationally for many years. This is why the Federal Ministry of Transport, Building and Urban Affairs has assigned the Federal Highway Research Institute with the task of investigating its effects on road safety in Germany more precisely. This research project was completed in July 2005. Based on the results a recommendation for driving with lights during the day was announced by the transport minister. Driving with dipped-beam headlights and the use of dedicated daytime running lights are the variations that appear most sensible out of all the technical solutions for Germany. Dedicated daytime running lights are seen as most suitable. Compared to dipped-beam headlights they stand out due to the obviously lower additional fuel consumption and clearly lower CO_2-emissions. The additional fuel consumption when using daytime running lights corresponds to a percentage of a maximum of 0.3% of the total consumption. On the whole, driving with lights during the day can help in avoiding somewhat more than 3% of all accidents in Germany per year. This corresponds to a potential savings of approx. 1 billion €. Irrespective of the technical model of the daytime running light (dipped-beam headlights, daytime running lights based on light bulb technology or LED technology), the benefit for driving with lights during the day lies at a minimum of 1.6 times the cost. Driving with lights during the day can thus be seen as an efficient measure for a lasting improvement of road safety.

Fig. 4: Different variations of daytime running lights (Fog lights, dedicated daytime running lights (retrofitted), series-wise dedicated daytime running lights, dipped-beam headlights) [BASt 2006]

A German insurance already grants financial support for equipping vehicles with daytime running lights and 10% discount on the vehicle liability insurance for appropriately equipped vehicles. A further insurance gives up to 20% insurance bonus for drivers who do not have any points for traffic offences and who always drive with lights in the daytime as well.

Apart from improved creation of awareness about four wheeled vehicles, attention must now be paid to the visibility of motorcycles, although it has already been obligatory for them to have daytime running lights in Germany since 1988. Meanwhile, 16% of those meeting with fatal accidents are motorcyclists so that measures for their safety are particularly necessary. The Federal Highway Research Institute is presently working on a research project dealing with the optimisation of the signal at the front of motorcycles and is investigating different solutions and alternatives for this purpose.

ACOUSTICS OF MOTORCYCLE HELMETS

The tested motorcycle helmets presently on the market show considerable differences with respect to the development of noise under the helmet. 12 helmet models of various designs, manufacturers and price ranges with differences of more than 20dB(A) were found in a BASt research project. This is the same as an increase in the sound level under the helmet that is four times higher. The loudest helmet reached a sound pressure level of 111 dB(A) at a driving speed of 160 km/h. A long standing decline in hearing as a preliminary stage of hearing damages can already occur at a sound pressure level of 94 dB(A) over a duration of effect of one hour. This value is already clearly exceeded in many helmets at 120 km/h. It has therefore been suggested to divide up helmet quality into four acoustics classes (see Fig. 5). Thus the buyer of a motorcycle helmet would have the possibility of consciously deciding to buy a “silent” helmet and could prevent hearing damages in this way.

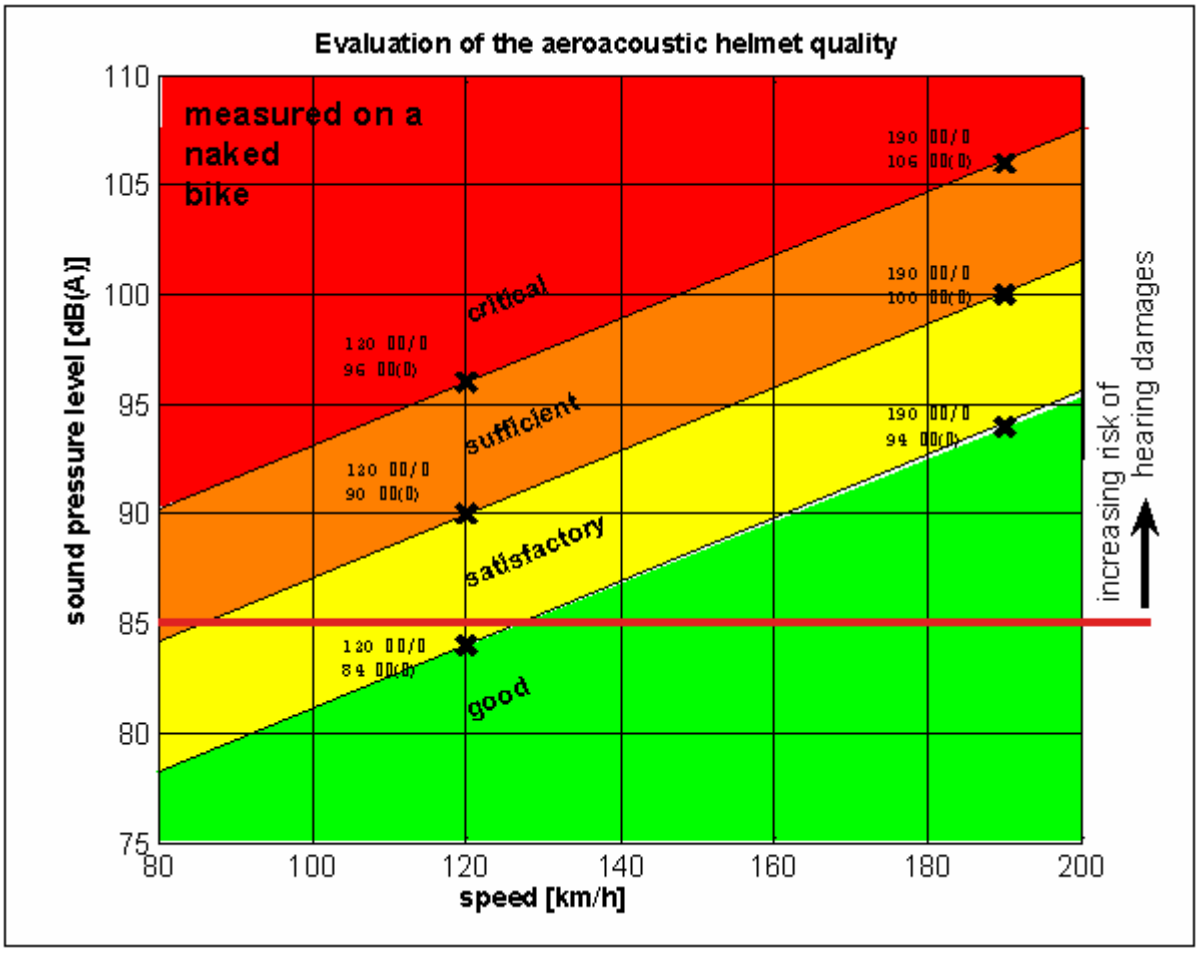

Fig. 5: Division of motorcycle helmets into four classes for assessing aero-acoustics

ACCIDENTS ON RURAL ROADS

Another priority of the German "Program for more road safety" consists of an increase in road safety on rural roads. There has been a particularly positive development in the occurrence of accidents on rural roads in the past few years. In the period between 2000 and 2005, the number of accidents with fatally or seriously injured persons has decreased by about 30% in each case; this trend persisted in 2006 as well. Based on the fact that this number of the total registered accidents on rural roads has only decreased slightly, there is a reduction in serious accidents that is above proportions.

Cars continue to be the most frequently used means of transport. Almost 85% of those involved in an accident were driving a car and 2,698 people were killed in car accidents. It is precisely in the case of cars that the decrease in single vehicle accidents is most prominent. The full effects of electronic stability control is evident here. More than 70% of new vehicles in Germany are equipped with it. But even other improvements to vehicles in the areas of passive safety, brakes (installation of braking assistants) and lighting have contributed to positive developments.

CRASH COMPATIBILITY OF VEHICLES

The EEVC WG 15, under German chairmanship, is investigating the area of compatibility between cars during head-on collisions. In March 2003, the VC-COMPAT project promoted by the EU commission was started. The project was completed in November 2006. The results of this study, in which all members of the EEVC WG 15 have participated, are suggestions for possible testing procedures for evaluating the compatibility of cars in accidents.

Methodical approaches for evaluating accident data from in-depth accident investigations and for evaluating the potential benefits of good vehicle-vehicle compatibility were developed in a work package. The percentage of passengers affected by a good compatibility was estimated. The economic perspectives when implementing compatibility measures in the vehicle fleet for Europe (EU-15) were investigated within the scope of the subsequent cost-benefit analysis. Initial drafts for crash

test procedures and the corresponding evaluation methods were examined in crash tests. The work of the EEVC WG 15 forms an important contribution to the information of the Working Party on Passive Safety (GRSP) of the United Nations.

In the second area of the VC COMPAT project, test procedures for truck underrun protection were developed. Investigations with currently used vehicles were conducted on energy absorbing front underrun protection systems and on improved rear end underrun protection systems. A recommendation for the adaptation of the current test loads and geometric requirements for rear underrun protection systems in the ECE regulation R-58 was prepared for recommendation to the European Commission.

Fig. 6: Super mini vehicle after a compatibility test against a medium class vehicle

Fig. 7: Medium class vehicle during a collision with the front underrun protection system of a truck

CHILD SAFETY

BASt is involved in the development of an independent consumer protection test procedure for assessing universally applicable child restraint systems (CRS) within the scope of the project NPACS (New Programme for the Assessment of Child restraint Systems), with the objective of a uniform European evaluation of the efficiency of these products. A protocol for the dynamic checking and evaluation of protection in head-on as well as lateral collisions and a protocol for evaluating the manageability/user friendliness of CRS were prepared. The project is presently in the validation phase, in which parallel tests according to the specifications in the protocols are being conducted in the participating laboratories. Q-series dummies are used.

The lateral testing procedure used in NPACS was developed in a BASt research project. This testing procedure has also been introduced internationally in the ISO working group on child safety (ISO/TC22/SC12/WG1 „Child Restraint Systems“) as well as in the relevant sub-group for side impact.

Two new BASt research projects will start in 2007. One project deals with the subject “Misuse of airbag deactivation when transporting children in child restraint systems" The degree of misuse of airbag deactivation is to be determined and moreover the potential for risk of present and future airbag generations will be investigated. A second project is concerned with the “Investigation of changing body sizes and weights in the case of older children with respect to the testing, assessment and use of child restraint systems.” Here, anthropometric data regarding children is evaluated to determine the current size and weight distributions. At the same time, the potential for protection in existing child protection systems for larger or “heavier” children will be determined. The project will illuminate further requirements for action and possibilities for taking action.

As the German representative, BASt is involved in the work of EEVC WG 18 on child safety. This working group deals with the observation of national and international research activities in the area of child safety in vehicles, and compiles the results to demonstrate the required consequences in the area of regulations particularly ECE-R 44, together with nationally and internationally available accident statistics.

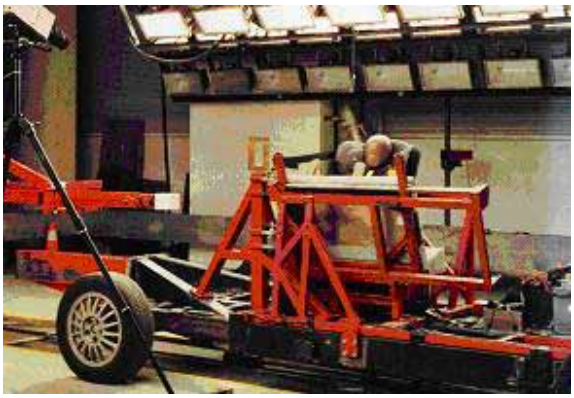

Fig. 8: Q3-Dummy during a side impact / NPACS Logo / Children's seat during lateral impact test

DEMOGRAPHIC CHANGE

The demographic aging of society, the decline in population and its increasingly uneven regional distribution change the image of society in Germany. The percentage of older road users in the total population has increased from 15 % in 1991 to 18.6 % in 2005. This trend will continue, so that in future the occurrence of accidents in this population group will be brought to the forefront. The percentage of senior citizens in the total population will increase up to the year 2020 by 22%. The relevance of road safety problems typical to senior citizens will increase to the same extent so will the necessity for target group and problem oriented road safety measures.

The growing percentage of senior citizens in the total population is relevant both in terms of their involvement in accidents as well as in the cause of accidents. As weaker road users, older road users are particularly at risk. In 2005, 1,162 senior citizens were killed in road traffic (approx. 22 % of all those killed), out of which 471 persons died in car accidents, 336 as pedestrians, 282 on bicycles and 73 in other modes of transport. A further 10,752 senior citizens were seriously injured. Based on their vulnerability due to age alone, senior citizens are basically at a higher risk of being killed in a road accident or being more seriously injured that other road users.

With increasing age, there is also more frequent loss of performance relevant to road safety. The combination of old age and existence of several illnesses increases the individual risk of accidents considerably. As far as the cause of accidents is concerned, older road users form a risk group, because in their case the risk of accident causes specific to age group, which declines continuously form the time of acquiring the drivers' licence in all subsequent age groups, increases again. The group of senior citizens that is older than 75, has an accident cause risk that is only exceeded by the 15-17 year olds. This applies both to car drivers as well as cyclists, but not to pedestrians.

From a perspective of automotive engineering, driver assistance systems, which make driving easier for older drivers in particular, represent a way of countering the increased accident risk for older drivers.

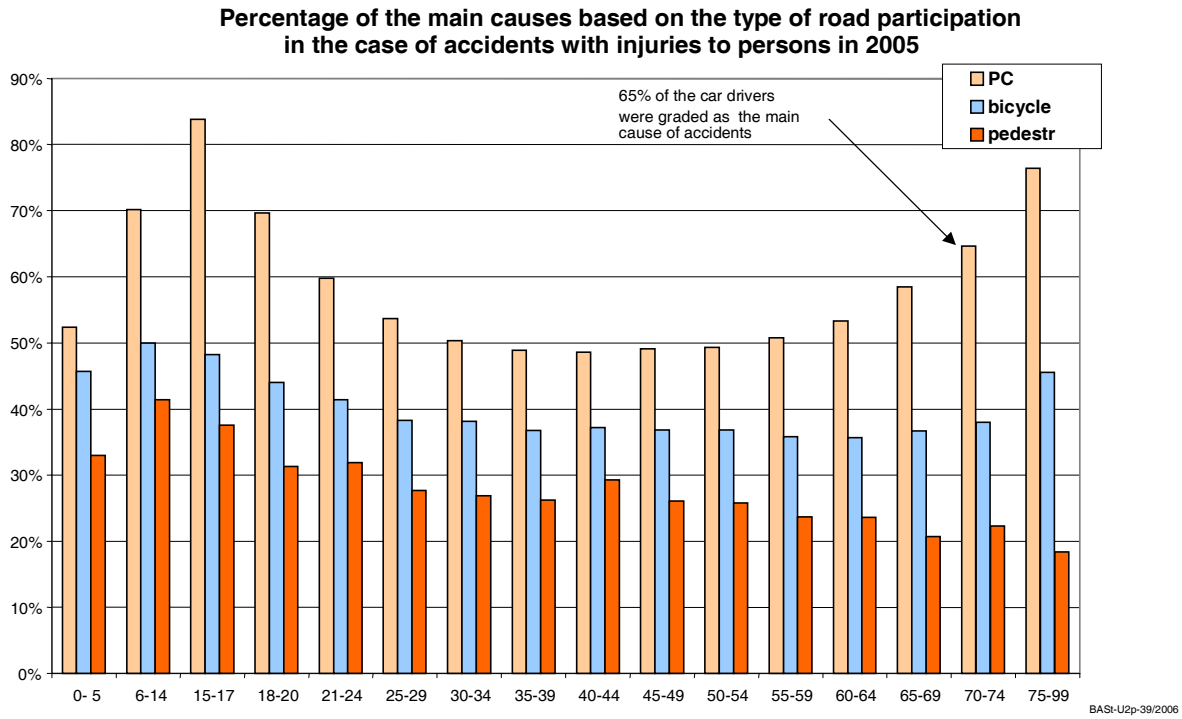

Fig. 9: Percentage of the main causes in accidents with injuries to persons based on the type of road participation

RESEARCH PROJECT "AKTIV"

The acronym "AKTIV" stands for "Adaptive and Cooperative Technologies for Intelligent Traffic." 28 partners are participating in this research initiative – automobile manufacturers and suppliers, electronics, telecommunications and software companies, research institutes as well as road and traffic administrators. The common goal is to make traffic safer and traffic flow smoother in the future, which requires driver assistance systems, information technologies as well as vehicle-vehicle and vehicle-infrastructure communication to be developed by the middle of 2010.

AKTIV consists of three projects – the projects Active Safety and Traffic Management promoted by the German BMWi as well as the project Cooperative Cars promoted by the BMBF.

The development of new types of driver assistance systems for more safety in particularly accident prone traffic situations is the focal point of the vehicle specific project AKTIV-AS (active safety), in which BASt is involved. Thus, an "automatic emergency braking" system is being developed, which intervenes depending on the traffic situation and interferes earlier than existing emergency braking systems. The "integrated lateral guidance" supports the driver when maintaining the lane position and when changing lanes, especially in the case of narrow construction sites. The "intersection assistant" will help the driver in complex traffic situations such as, for example, when turning left. Unprotected road users such as pedestrians and cyclists will be recognised using anticipatory sensors and – as far as possible – a collision will be prevented by introducing effective measures, or protective mechanisms will be activated, which

reduce the consequences of injuries. In the connected sub-project, driving safety and attention, possibilities for compiling data on driver attention will be developed in order to include the degree of attention in the design of the applications to be developed. Long term effects and the potential for use of the driver assistance systems will also be estimated here and the legal framework conditions will be highlighted.

The objective of the traffic specific project AKTIV-VM (traffic management) is the networking of traffic control systems and road users to increase the efficiency of the road network. A common road management system will be developed through cooperation of the automobile industry, the road network operators, data and information services providers and manufacturers of end user equipment.

The project CoCar serves the purpose of fundamental research in the area of vehicle-vehicle and vehicle-infrastructure communication for cooperative driver assistance systems and an efficient road management. The independent CoCar project will thus be conducted in close cooperation with the projects AKTIV-AS (active safety) and AKTIV-VM (traffic management).

CAR-TO-CAR- / CAR-TO-INFRASTRUCTURE-COMMUNICATION (C2C / C2I)

Communication between cars (Car-to-Car) as well as between cars and technical infrastructure on roads (Car-to-Infrastructure) will play an important role in improving road safety and the efficiency of traffic systems in the future. Recently, there have been interesting possibilities for these new cooperative systems in the area of communications technology (keyword: Ad-Hoc networking). However, apart from solving the technical problems, the main challenge will be in creating the basis for introducing economic systems all over the country at a later stage that promise to be most successful. Partnership between manufacturers in the automobile and communications industries and operators responsible for road infrastructure must be intensified in particular for this purpose.

A national testing field for Car-to-Car and Car-to-Infrastructure systems is therefore being built up in real traffic situations in Germany – most predominantly through an initiative for innovations by the federal government – in close cooperation with private industry and public road operators. The prototypical components and functions developed in different national and European research projects will be merged together for the first time in this testing field in large numbers and on a grand scale in an integrated system. The functions to be investigated are, for example, local warnings of risks due to obstacles, accidents, construction sites and ends of traffic jams as well as assistants for complying with the partly dynamically controlled road signs put up in roads.

The testing field will try out the technical feasibility and readiness for the market of the integrated systems – particularly the unobstructed coexistence of different systems. After checking the effectiveness of the applications, a feasible initial scenario with suggestions on sustainable business models to be introduced all over the country will be formed.

TOLL FOR TRUCKS

Positive results can be obtained for the toll system for trucks that has been running smoothly since 1st January 2005. The annual income in 2006 exceeded the three billion Euro limit for the first time. Meanwhile, more than 90% of the journeys are charged automatically through the on-board units installed in the vehicles. The innovative concept of automatic satellite based acquisition of tolls has meanwhile more than passed its test as an established method.

Since the toll for trucks in Germany is only applied on federal motorways, traffic that is possibly avoiding it in the road network not subject to toll was carefully observed. An investigation conducted by BASt to accompany the introduction of the toll showed, that traffic trying to avoid the toll is not a problem of the whole road network. Only individual route sections that are really attractive for trucks larger than 12 tons are concerned. The federal government has therefore absorbed three route sections on the subordinate network into the toll paying area since the beginning of 2007. This results in a reduction in the additional load for those living along the routes concerned.

The main challenge in the coming years will be the achievement of the interoperability of the different toll systems in Europe. Not least based on the directive of the European Commission, users will have the possibility of paying the toll with only one device and one contract throughout Europe in future. The technical, but most of all the organisational and contractual basic conditions required for this purpose are being created at present.

NOISE

As in all densely populated countries with high mobility, noise emission from traffic, particularly road traffic, plays an important role. The possibilities for noise reduction in the areas within cities where most people live, outside city limits in rural areas and for those living near motorways are different in each case. BASt's research work concentrates on tyre-road noise in particular, since this is dominant in the case of cars from 40 km/h onwards

and for trucks from 70 km/h onwards, i.e. when the noise already has to be reduced at the source, a start has to be made with vehicle tyres and road surfaces. BASt has been working with industrial partners for many years in the national project "Silent Road Traffic" but also in EU-financed projects, e.g. SILVIA, ITARI and SILENCE and with France on a bilateral project within the scope of DEU-FRAKO. In the case of tyres it appears that the noise of car tyres can be reduced by 1-2 dB(A), in the case of truck tyres, particularly in the case of the very loud driving axle tyres, the potential for reduction seems to be at 3 dB(A) or even beyond that. Now, the users must be persuaded to buy these silent tyres.

Germany has been gaining experience with so called open pored road surfaces since the eighties, which are particularly silent. These surfaces are now into their fifth generation and their potential for reduction ranges from a considerable 7 to 9 dB(A). However, apart from the increase in construction costs (ca. + 35 €/m²) there is a limited durability. Even closed surfaces still have a potential for reduction of approx. 2-3 dB(A), which must be exhausted. Apart from the optimised texture formation of the road surface, the quality of the execution of the construction work is very important.

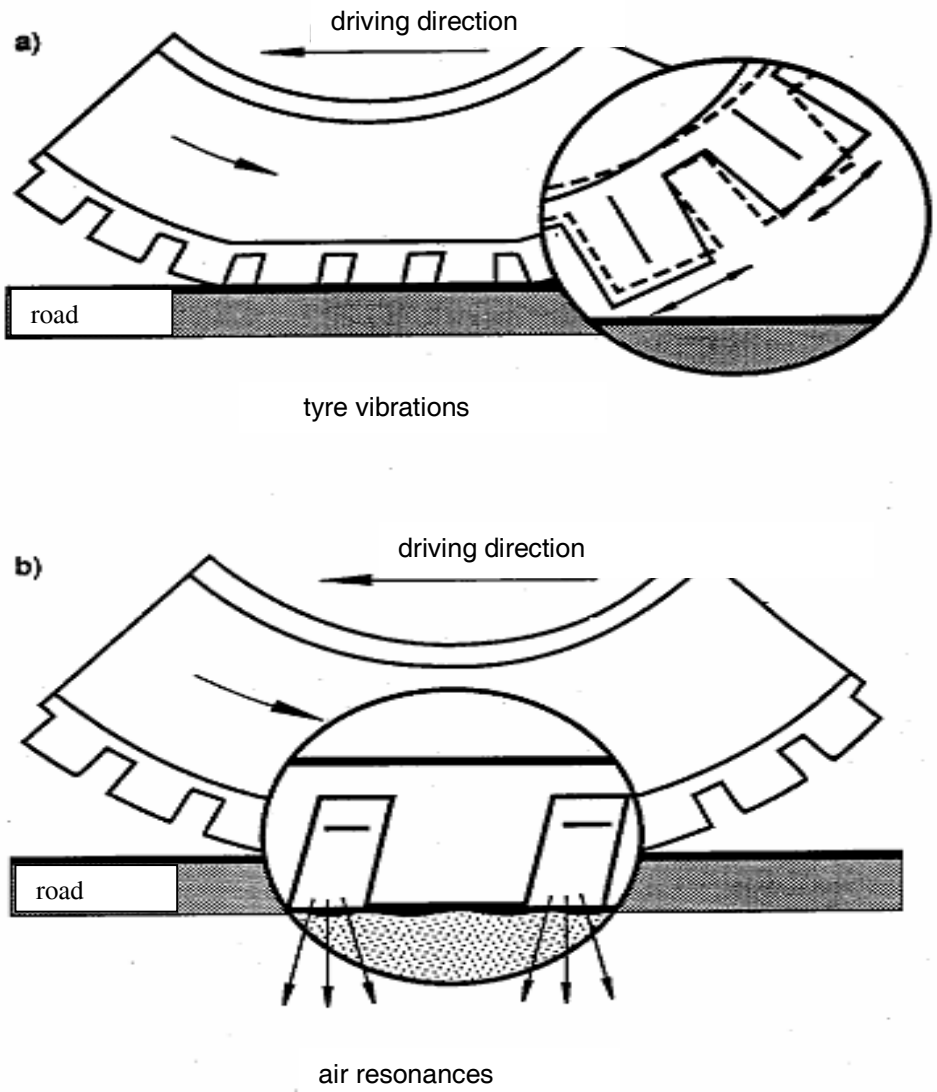

Fig. 10: Tyre vibrations and air resonances as causes for the development of tyre noise

As far as the vehicle itself is concerned, it has been found that the ECE/GRB in Geneva has been working on a new testing procedure for accelerated passing, for some time now. This procedure will represent the real way of driving in cities better, however there are problems in adequately evaluating the noise behaviour of a vehicle driving with high engine speed. Policy makers are still working on this. Moreover, it is not clear, how silencers for retrofitting are to be evaluated, and especially in the case of motorcycles, the (easily made) manipulation of silencer units by motorcyclists and the control and sanctioning by the regulatory bodies poses a problem.

EU-PRESIDENCY AND G8 CHAIRMANSHIP

eSafety-Specialists' conference

The European Commission aims to reduce the number of those fatally injured in road traffic by 50% by the year 2010. This goal is also being strongly supported by the Federal Republic of Germany. The European eSafety Initiative has prepared recommendations for this purpose on how, by using ITS (Intelligent Transport Systems) in particular, important contributions to road safety can be achieved. The following have been particularly emphasised as systems with a good perspective in the analysis of the suggestions:

- Real Time Traffic Information (RTTI)
- Human Machine Interaction (HMI)
- Driver assistance systems as well as
- eCall

These highlights have been structured and prepared further in special working groups of the eSafety Initiative.

Germany will be taking over the EU presidency in the first half of 2007. Specialist conferences are planned within the framework of this presidency, of which the eSafety conference must be particularly emphasised. The objective of this conference, which is directed at the heads of department of road construction authorities of the European Union, is to represent the achieved levels of development and to reach consensus on suggestions for further procedures, for the development of implementation strategies and if necessary the formulation of suggestions for recommendations to the European Commission. BASt is intensively involved in the preparations for this specialists' conference, which includes the selection of suitable speakers on the given topics as well as the preparation of the subject matter.

3. EFV Conference in Dresden

Germany took over the chairmanship of the G8 from Russia on 1st January, 2007. Apart from issues of worldwide trade and finance relations, the reduction in global imbalances as well as climate protection are focal points in the German agenda.

The preparations for the third international EFV (Environmentally Friendly Vehicles) conference must also be seen in the context of the German double presidency. Its aims are to bring forward technologies for environmentally friendly vehicles. This process was started in the two past EFV conferences in Tokyo and Birmingham and will now be continued in the third EFV conference in Dresden from 19th to 20th November 2007. Concrete suggestions will be developed together on how the demanding goal of the environmentally friendly vehicle can be achieved in a cost effective manner. The reduction of exhaust emissions harmful to climate, improvement in air quality, reduction of noise emissions caused by traffic, protection of resources, reduction in the dependency on fossil energy sources and the avoidance of the release of substances harmful to health into the environment are included in this.

An important step in the direction of EFV is the precise and globally applicable definition of what an environmentally friendly vehicle is. This type of definition does not exist till now. All relevant aspects of an environmentally friendly vehicle, from its production to its life duration and its removal must be taken into consideration for an objective description of an EFV. This work can only be taken over in detail by an international group of experts who are experienced in the harmonisation of regulations with respect to vehicles and their environmental aspects. The working groups of the UN-ECE, for example, are pre-destined for this work.

The EFV conference, 2007 in Dresden represents a suitable political platform to bring together representatives of different interests to suggest an appropriate working group, for establishing a definition of EFVs, since high ranking personalities from politics, the (automobile) industry and research from all over the world are expected at the conference.