SAFETY OF VEHICLES OVER THE WHOLE LIFETIME

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ABSTRACT

The NCAP (New Car Assessment Program) initiatives and most media reports are focussing on new cars. The roads paint a different picture. The average age of passenger cars is e.g. in Germany about 8 years. Only one third of all cars in Europe have an age of 5 years or less.

Little is known about the safety level of cars used for several years. Wear of safety relevant components, more and more rarely inspections, an increasing number of non original spare parts. These few examples make clear that the new cars' safety level cannot be kept over the years.

The decrease in safety leads to increasing risks – the risk of causing an accident due to technical problems like reduced braking power and the risk for the occupants in an accident due to problems like not working airbags.

But how can such problems be solved or at least be minimised? Which starting points are most promising to achieve the best benefit for society and road safety?

According the European harmonization regulation 2010/48/EG every passenger car has to be tested along its lifetime in service after registration and type approval. DEKRA is doing more than 20 Mio vehicle inspections every year in Europe as well as in other countries outside Europe. The over all results have been evaluated out of these test reports.

Additional results of a special project named SafetyCheck are used to learn more about the technical status of cars of young (inexperienced) drivers. SafetyCheck is a free of charge offer for an inspection of safety relevant components for young drivers.

The third pillar of the study is the DEKRA "technical defects" database (TD) based on in depth investigations. The database contains information of more than 10,000 vehicles involved in accidents caused or influenced by technical defects within the last 10 years.

The combination of the three sources periodical technical inspection (PTI), TD and SafetyCheck is a unique combination to illustrate the influence of the vehicle age against the road safety.

The safety degradation over lifetime is obvious and significant even starting with the 5th year in service and drastically after 7 years. The SafetyCheck initiative confirms the PTI results showing mayor problems of young drivers' cars. There are also indications that some problems of older cars are related to ADAS like ESC. The analysis of the TD database is also confirming the results of the PTI. One striking component mentioned in all three data sets is the braking system.

The final consequence might be an advanced program especially focused on cars with high mileage and on older cars. This program should also include an education of the society to show the need of qualified service to retain the implemented safety level.

Besides a high safety level of new cars the preservation of the safety during the vehicles' lifetime is an important goal. Results of inspections can thus be used to further improve new car testing methods to minimise life time safety losses.

1 INTRODUCTION

The discussion about vehicle safety is normally focussed on new vehicles. What are the safety improvements in relation to the previous model? How good is the safety of this vehicle in relation to other models on the market? Especially for passenger cars the last years include an increasing interest on the NCAP classification. The manufacturers are enjoying to show how good the safety features of a new vehicle model are. Currently there is a big focus on advanced driver assistance systems (ADAS).

Unfortunately (or fortunately?) there are not only new cars on the road. The average age of passenger cars is e.g. in Germany about 8 years. Only one third of all cars in Europe have an age of 5 years or less. How is the situation after the vehicles are used some years? Is the implemented safety in the same condition as at the time of the registration date? The

knowledge of the safety condition of used cars is limited. There are several factors which are influencing the implemented safety level when the first owner is using his car on the road. Some components become less safe because they grow old. Some others abrade because of the normal use. One other influence is resulting from the more and more rarely inspections. Sometimes the worn parts are replaced by not allowed spare parts. The mentioned influence examples show why the new cars' safety level cannot be kept over the years. One way to hold the safety level as close as possible to the origin level could be done by mandatory inspections.

It is not only a question for the single car owner. It is also important for all other road users. They become endangered by an unsafe vehicle used on the road. The more the safety decreases the more the risk to be involved in an accident increases. A reduced braking performance may end in a collision because the driver was not able to reduce the speed of the vehicle as far as necessary.

This paper is concentrating on the vehicle category passenger car (PC).

2 GERMAN ACCIDENT STATISTICS

The German Federal Statistical Office (StBA) is publishing every year several analysis of accident data.

A view to these accident figures shows that there is an influence of the vehicle age to the accidents, **Figure 3**. It is shown by the share of main accident causing party. This share is resulting from the number of main guilty parties and the accident involved parties. The advantage to analyze it in this way is that the different kilometrages or other conditions of use are automatically

One may say that this increasing share for higher cars ages results from the influence of younger drivers. In Figure 4 the share is increasing where young drivers (younger than 25 years) are excluded. A more detailed analysis shows an increasing risk for older PC ages for all driver age groups, Figure 5. The increasing risk has nothing to do with the driver age. Based on these figures it could be said that the sometimes mentioned possible influence of younger drivers is less than the influence of very experienced drivers (> 64 years). The difference between the first share value (PC < 1 year) and the last share value (PC > 11 years) is for younger drivers less than 5 percent points and for experienced drivers more than 6 percent points.

The police is fixing the obviously existing accident causes shortly after the accident happened. These statements are the basis of the accident statistics. It is interesting to have a look to those accidents where a technical defect (TD) was mentioned as an accident cause. The analysis of the published German accident data of 2011 is showing that the accident cause TD is existing more often in older cars, Figure 6. A half (50.6%) of the 1012 TDs was found at PCs which were older than 11 years (70.9% older than 7 years). A special analysis of the StBA shown in **Figure 7** gives a more detailed information to the single ages. It is shown that passenger cars with an age of 11 until 16 years have the highest absolute frequency of an accident cause TD. This result is remarkable in relation to the less driven kilometrage of older cars.

So one can say the technical defects are one influencing factor why older cars have a higher risk to be responsible for an accident.

GIDAS is the German In-depth Accident Study which is collecting accident data in two areas of Germany. An examination of GIDAS data allows similar analysis which are shown in this contribution based on the German general accident data coming from the StBA. The additional information coming from GIDAS is showing the influence from the remaining time until next PTI. It is visible, that the share of the main guilty party is increasing when then time until next PTI is decreasing, **Figure 8**. There is also a difference between older (=> 7 years) and younger (< 7 years) PCs. The observed share is at a higher level for older cars.

3 PERIODICAL TECHNICAL INSPECTIONS (PTI)

DEKRA is a private company which is also acting in the area of mandatory inspections on behalf of the government. DEKRA is doing approximately 22 million inspections per year worldwide including 10 million inspections in Germany.

The periodical inspections (PTI) show for passenger cars a share of 54.6% without any defects, Figure 9. Roughly every fourth PC (26.4%) has slight defects. The remaining 19.0% offer serious defects. A separation of the categorisations slight and serious to the vehicle age shows increasing shares for older PCs. Only 14.4% of all PCs with an age of less than 4 years have defects (9.8% slight + 4.6% serious), Figure 10. These values increase step by step by the listed age groups. PCs with an age of more than 9 years include more than 75% with defects (36.5% slight + 29.8% serious). The three most important of detected assemblies with defects are lights (28.9%),

braking system (24.7%) and axle/wheel/suspension (19.5%), **Figure 11**.

A view of the vehicle age in the PTI area shows an increasing share of serious defects for older PCs up to an age of 18 years, **Figure 12**. An analysis of the PTI location shows a higher share of serious defects for the non-workshop locations. This is independent from the vehicle age. The explanation is that PCs which were inspected in a workshop have often got a repairing in front of the PTI. The PTIs done at locations which are no workshops show the results which are more close to the situation which is on the road. The PCs inspected at the non-workshops have a minor share of repairing.

4 SAFETYCHECK

Since the year 2000 DEKRA is doing a special yearly action called SafetyCheck. This action is focused on young drivers. The background is that younger less experienced drivers drive often with older PCs with a minor safety standard and a not perfect maintenance condition. DEKRA wants to show the young drivers where their PCs have defects. The offer of DEKRA is an inspection free of charge for the target group young drivers. This inspection includes some parts of the usual PTI (in Germany named §29 inspection). The driver gets after the inspection the information about the defects. The results of this action are coming from PCs which were not prepared for an inspection (like PTI). The drivers do have an interest on safety. Otherwise they would not spend some time to come to the inspection centre.

In 2012 this action was done at 14.700 PCs, Table 1. This PCs include 55.6% drivers between 18 and 24 years (average age 23.74 years). Roughly one third (32.4%) of the drivers were female. Most of the PCs (71%) were older than 7 years (average age 11.3 years) and the mileage was more than 130,000km. The PCs with an age of 8 years or older include 86.1% with defects. In average were 3.3 defects detected per PC. Defects at the assemblies suspension, tyres or body were found at 49.9 of all cars. These assemblies show a very high increasing share with the increasing vehicle age. The inspected PCs show also 11% of inoperable ESP/ASR systems (ASR – traction control).

5 DEKRA DATABASE REGARDING TECHNICAL DEFECTS

DEKRA has published since 1977 more than 25 reports regarding technical defects (TD) which influenced accidents. These influence by TD could the only accident cause or it could act together with at least one other cause. These causes together are named as accident relevant causes. The DEKRA accident relevant causes correlate to the accident causes TD found by the police. The database contains results of 42,000 examined vehicles with roughly 200,000 technical defects.

An analysis of 2,267 PCs examined in the period from 2007 until 2011 includes 772 PC with TD. These 772 PC with TD contain 166 PC with accident relevant TDs. The most often accident relevant TD were found for PC between 9 and 17 years, **Figure 13** + **Figure 14**. This result is very similar to the adequate analysis from the PTI and the accident statistics from Germany.

6 SUMMARY

It was shown that older passenger cars do have more often technical defects than newer PCs. The most frequent vehicle age groups with technical problems are in the vehicle age area from 10 until 17 years. This is shown from analysis of general German accident statistics, periodical technical inspections and DEKRA investigations done after an accident happened. It is known that there is a difference between a defect found in a PTI and a defect found in a inspection done after an accident. A PTI is always a visual inspection without demount any parts of the vehicle, whereby an inspection done after an accident is normally including the demounting of parts. The results of both investigations show an age related dependency.

The results of safety check show the technical condition of older unprepared PCs. The results show a higher frequency of PCs with technical problems. This third perspective is giving an impression how high is the share of vehicles with defects on the road. Many PCs will be prepared in front of an expected mandatory inspection. The vehicles on the road do have more defects as vehicles which come to a PTI. The frequency of vehicle with defects will increase from the PTI until the preparation in front of the next PTI.

7 CONCLUSIONS

The fix the vehicle implemented safety level as far as possible over the whole lifetime is in interest of every road user. The results show that there are more problems of older cars concerning technical defects. One reason for this higher share of defects is coming from the minor attendance of those vehicle owners pay for the inspections foreseen from the manufacturers.

In the year 2012 there was a discussion in the European Union to reduce the PTI steps for older PCs to one year steps. This may balance the reduced number of inspections in the workshops. The analysis results shown in this report seem to support this proposal. The open question what is a vehicle age where this changed PTI steps should start. Is it the best point to start after the PC finished the 7th year of vehicle age? It would be a good idea to start a research project to get more detailed results.

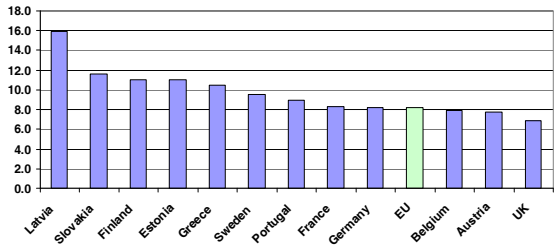

Figure 1 Average age of passenger cars in different European countries, source ANFAC [1]

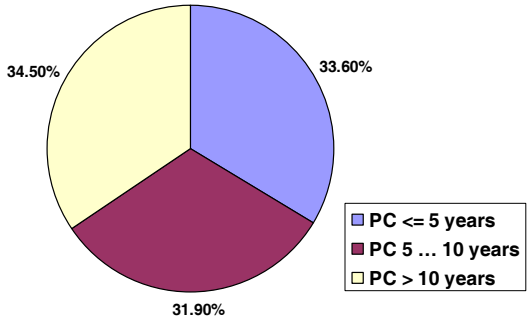

Figure 2 Passenger car (PC) fleet by age for available countries as listed in Figure 1, source ANFAC [1]

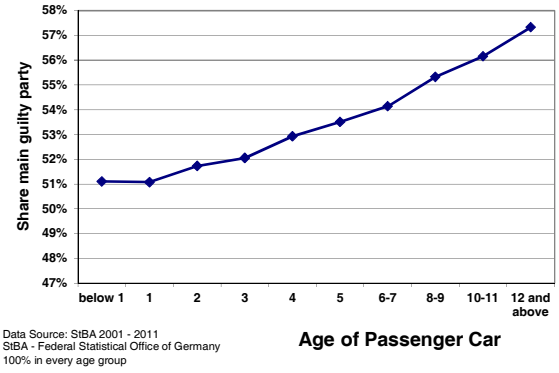

Figure 3 Share of main accident causing party by age of passenger car, [2]

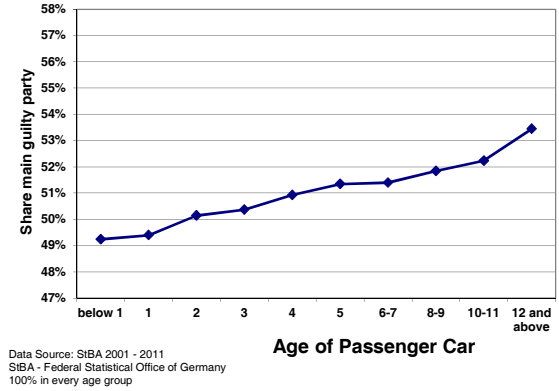

Figure 4 Share of main accident causing party by age of passenger car excluding young drivers (18 … 24 years), [2]

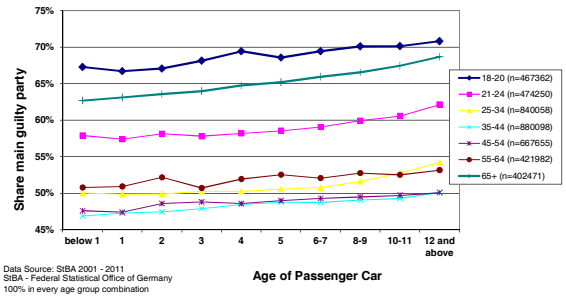

Figure 5 Share of main accident causing party by age of passenger car (parameter driver age), [2]

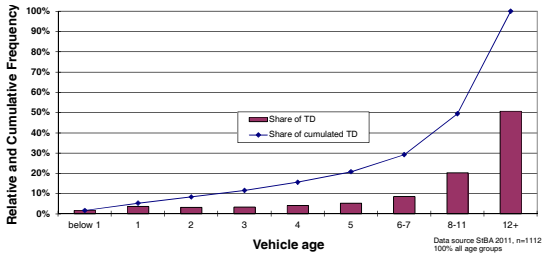

Figure 6 Relative and cumulative Frequency of technical defects (TD) of passenger cars by published vehicle age groups, [2]

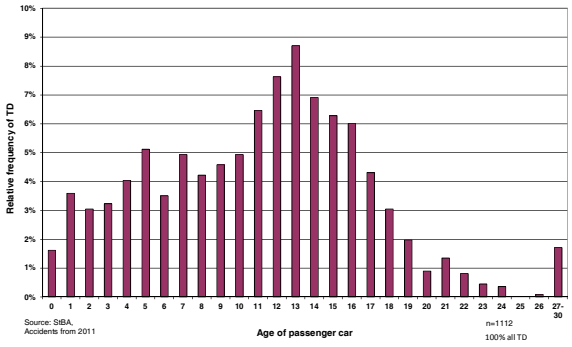

Figure 7 Relative frequency of technical defects (TD) of passenger cars by vehicle age, [3]

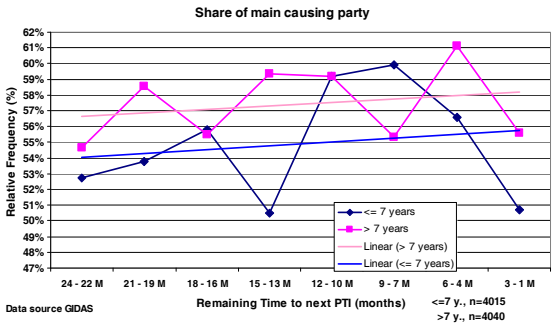

Figure 8 Share of main accident causing party by remaining time until next PTI (parameter age of passenger car), source GIDAS data

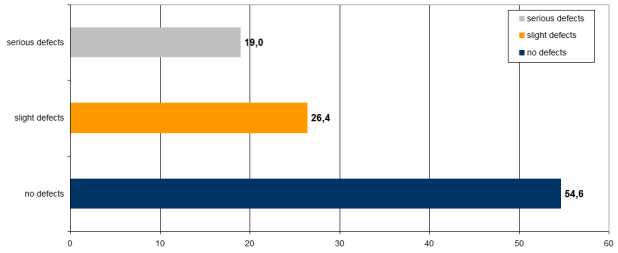

Figure 9 PTI results on passenger cars in Germany (all vehicle ages), data base: DEKRA 2011

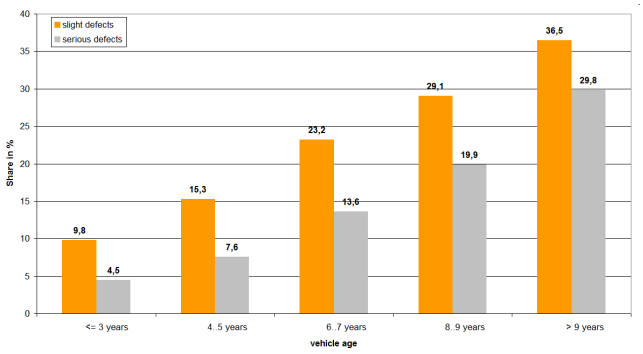

Figure 10 PTI results on passenger cars in Germany by vehicle age, data base: DEKRA 2011

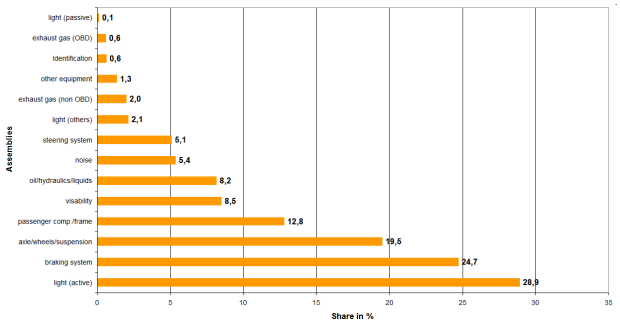

Figure 11 Defects on passenger cars in Germany by assemblies (all vehicle ages), data base: DEKRA 2011

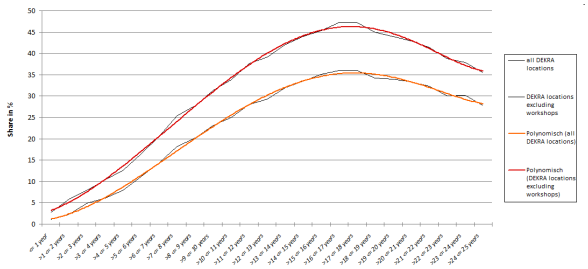

Figure 12 Comparison of PTI results by vehicle age, cars with serious defects in all locations compared with locations excluding workshops, data base: DEKRA 2011

Table 1 Results of safety Check 2007 … 2012, source DEKRA investigation

	2007	2008	2009	2010	2011	2012
period	15 Weeks	6 Weeks	7 Weeks	7 Weeks	7 Weeks	6 Weeks
inspections	> 14.000	>10.000	> 15.000	> 17.500	> 15.600	> 14.700
Defects in total	37.000	25.474	42.687	45.105	43.078	37.956
Ø defects / PC with defect	3,3	3,2	3,4	3,3	3,4	3,3
Ø PC age [years]	10,8	11,1	11	10,9	11,2	11,3
Ø PC mileage [km]	115.000	121.000	126.000	125.888	130.007	130.324
PCs > 8 years	77 %	74 %	72 %	69 %	71 %	71 %
Assemblies with defects						
Braking system	10.910	6.980	10.320	10.886	9.658	8.357
Suspension, Tyre	10.323	6.876	13.356	14.246	13.425	11.753
Lighting	7.943	5.857	8.559	9.223	9.978	9.115
Sight	3.317	3.292	3.597	3.619	3.411	2.828
Safety/Environment	4.815	2.469	6.855	7.131	6.606	5.903

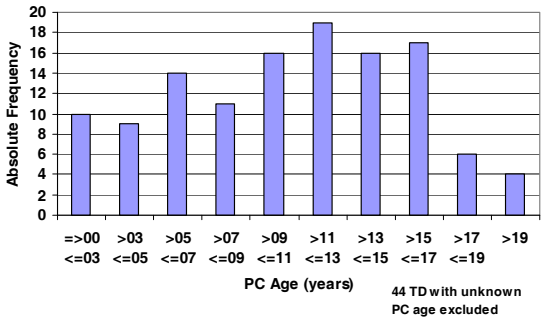

Figure 13 Absolute frequency of accident relevant TDs by PC age, Source DEKRA database

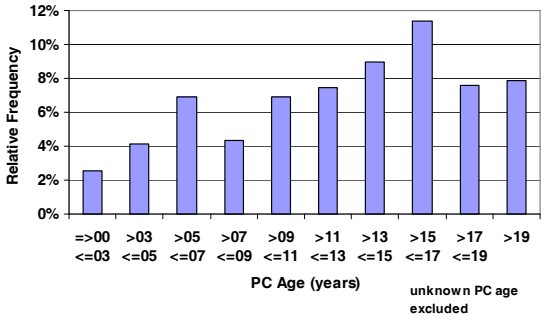

Figure 14 Relative frequency of accident relevant TDs by PC age, Source DEKRA database, (100% all examined PCs of one age group)

REFERENCES

[1] ANFAC, Vehicles in Use, Brussels, ACEA 2010

[2] Federal Statistical Office of Germany, Fachserie 8 Reihe 7, Verkehr Verkehrsunfälle, yearly published analysis of accident data.

[3] Federal Statistical Office of Germany, special data analysis of accident data of 2011, requested by DEKRA