

# TECHNICAL INSPECTION OF VEHICLES AND ROAD SAFETY- INTERNATIONAL EXPERIENCE AND EXPERIENCE OF THE REPUBLIC OF SRPSKA

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## INTRODUCTION

Road safety is a problem of modern civilization. The problem has been present ever since motor vehicles appeared on roads. The increasing number of motor vehicles has led to an increase in the number of injuries and fatalities in road accidents.

According to a report of the World Health Organization – WHO, published in 2004, 1.18 million people died in road accidents in the world in 2002 because of motor vehicles. This number included pedestrians and cyclists, as well as vehicle passengers, who were involved in the road accidents. Road traffic injuries are perceived as a price to be paid for mobility and are often neglected. Instead, they should be perceived as an illness that can be prevented to some extent, at least. In 2002, road accidents were the world's 11th most common cause of death, which equals to 2.1% of deaths worldwide and 22.8% of injuries resulting in death. Figure 1 shows the number of deaths caused by road accidents in the world (mortality rate per 100,000 population). It is obvious that Africa, Asia and parts of Eastern Europe have extremely high mortality rates caused by road accidents, [13].

As to Europe, according to data presented by WHO, statistical data show the scope of the road safety problem:

- 120,000 people die on European roads every year,
- 2.4 million people get injured,
- direct and indirect costs induced by traffic accidents in the EU-15 amount to 3% of the EU GDP (gross domestic product),
- there are 375 million road users, 200 million vehicles, and 1.3 million road accidents on EU-15 roads per year.

The preconditions for reducing the number of road accidents are as follows: improved vehicle safety, better road conditions, and maintenance of vehicle technical characteristics during exploitation.

Germany and other European Union member states had implemented many positive measures aimed at improving the level of road safety. To illustrate, in the period between 1970 and 2000, the number of vehicles tripled, whilst the number of fatalities caused by road accidents halved. Many reasons led toward this improvement: vehicles became safer; measures of active and passive safety achieved their goal; critical road sections were made less dangerous; new legislation also contributed to road safety improvement.

EU Action Plan envisaged a large number of measures pertaining to not only the behaviour of road users and improvement of roadworthiness but also to road infrastructure quality improvement. A European Parliament report stated the following: "If every road user fully complied with traffic regulations, the number of fatalities would reduce by 90%." In addition, if every driver wore their seatbelt, obeyed the speed limit, and were not driving

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under the influence of alcohol, the goal to halve the number of fatalities on European roads would be reached.

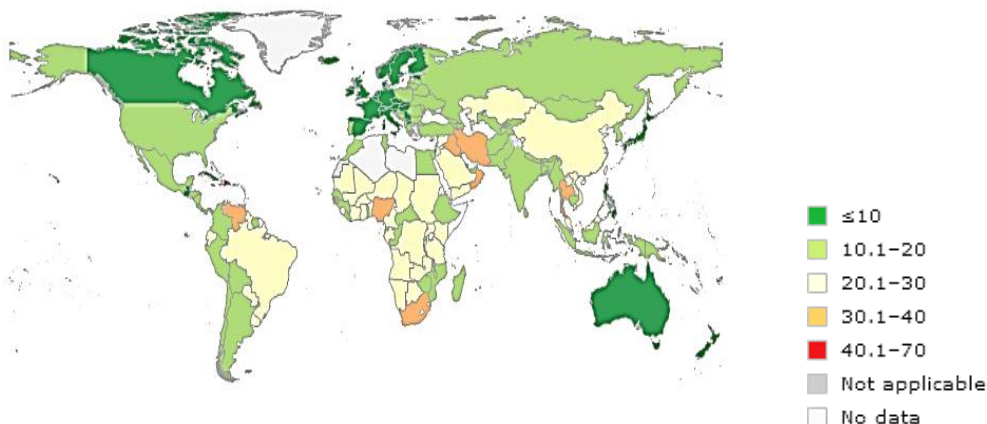


Figure 1 Number of deaths caused by road accidents in the world, 2010, [13]

In the past few years, automobile manufacturers have also contributed to improving automobile safety by introducing the system of active and passive control. The installation of ESP system (electronic stability programme) in every motor vehicle, daytime use of headlights, and better pedestrian safety measures are only some of the measures that improve road safety. If there were options to reduce the average age of vehicles through tax breaks, and to increase the use of safety equipment in every automobile, these technical improvements would produce tangible results.

The quality and quantity of road networks is also an important factor of road safety, even though it might not seem obvious at first. Belgium serves as a positive example having introduced lighting on motorways, which provides optimum visibility at all times, including bad weather conditions. Measures of this kind, along with the improvement of road surface, better periodic maintenance, and intelligent management are only some of the positive examples of road safety improvement.

## EFFECT OF UNROADWORTHY VEHICLES ON ROAD ACCIDENTS

It is normal for any vehicle that its features will deteriorate during exploitation. Unfortunately, many vehicle owners do not have their vehicles properly maintained and this results in a large number of unroadworthy vehicles being in use. The key question arises as to what extent unroadworthy vehicles affect road safety and the environment.

Many studies have been conducted in order to estimate the influence of unroadworthy vehicles on road accidents. The results of the studies vary a lot, ranging from some minor percentage to a significant 28%. Such a disparity is due to different work environment conditions (continents, weather conditions, inspectors, local economy, culture, political environment). Despite the differences, a conclusion can be drawn that unroadworthy vehicles have considerable influence on road accidents. It was concluded that the improvement of periodic technical inspections reduces the number of road accidents by approximately 5-10%. Additional improvement of other vehicle inspections, such as extraordinary inspections, significantly increases the above percentage, [12].

It has been noted that even with the introduction of new technical and technological solutions in the automobile industry aimed at improving road safety and ecological

characteristics of vehicles, the number of road accidents in reality is still high and shows no signs of improvement. Therefore, the conclusion is that the need for the improvement of vehicle roadworthiness is now greater than ever.

Greater reliance on advanced technologies when driving has drastically increased the importance of roadworthiness. Any malfunction of these systems results in the loss of advantages that they can offer. Even though the control of mechanical systems within technical inspections is still a priority, a modern approach to roadworthiness must also include the control of new technologies and vehicle systems. Examples of new technologies that have been and are yet to be introduced are shown in Figure 2.

For example, the ESC and ACC systems (Electronic Stability Control and Active Cruise Control) reduce traffic risk by 20-40%. If this system is malfunctioning, it may represent a greater risk than vehicles with traditional braking systems. In fact, drivers will rely on new systems that will help them in critical situations and thus, they will change their driving behaviour. Also, the malfunction of some modern systems can lead to modern vehicles being less safe than traditional vehicles. For example, vehicles with airbags according to ECE94 and ECE95 have stiffer dashboards and interior than vehicles that are not equipped with airbags. It means that injuries will probably be more severe in the vehicles with airbags if the airbags are defective.

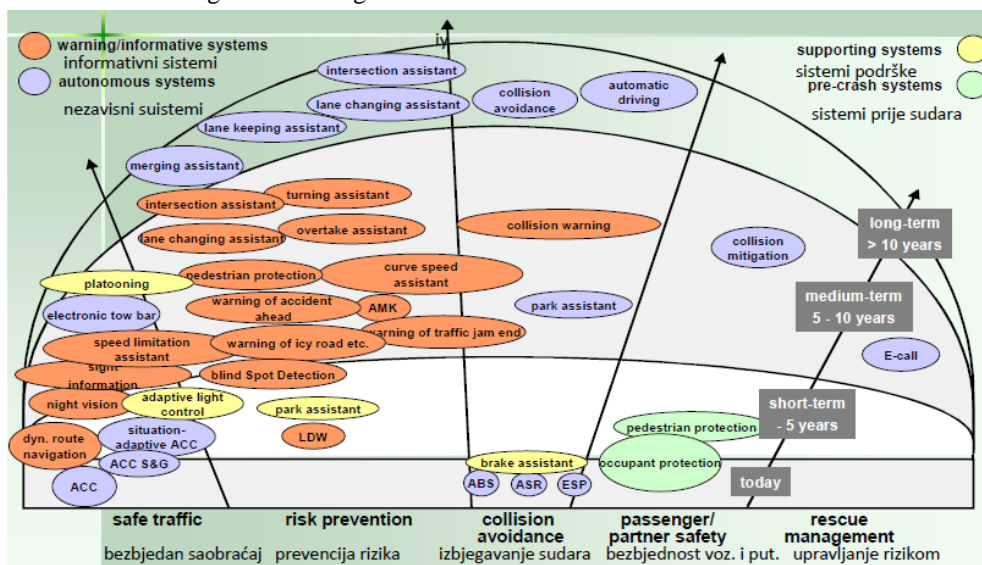


Figure 2 New vehicle technologies [12]

## SITUATION IN EU REGARDING VEHICLE INSPECTION

There is no systematic research in EU member states on vehicle roadworthiness in the time period between periodic technical inspections. Data obtained from extraordinary vehicle inspections lead to a conclusion that there is a considerably large number of unroadworthy vehicles in use.

As to freight vehicles in particular, one should take into consideration the high rate of cancellations between periodic technical inspections. Figure 3 shows intervals for freight vehicle inspections, as recommended by the British Department for Transport in cooperation with freight vehicle operators' associations, and they are similar to those as recommended by vehicle manufacturers. Many freight vehicles reach between 50,000 and 200,000 km per

year and thus need to be checked every 4 to 8 weeks, in addition to the mandatory annual technical inspection. Safety inspection intervals for all vehicles should fall between lines A and C or A and D as appropriate [3].

If the vehicle or trailer is 12 years or older then the SI interval should be no more than 6 weeks. The chart is only a guide and it is the responsibility of the operator, to increase the number of safety inspections should the operating conditions demand it. The actual inspection interval chosen should be determined by taking into account:

- the age of vehicle/trailer;
- the conditions under which a vehicle will be operated;
- the expected annual mileage;
- the recommendations of the vehicle manufacturer; and
- other factors that may increase the risk of vehicles becoming unroadworthy.

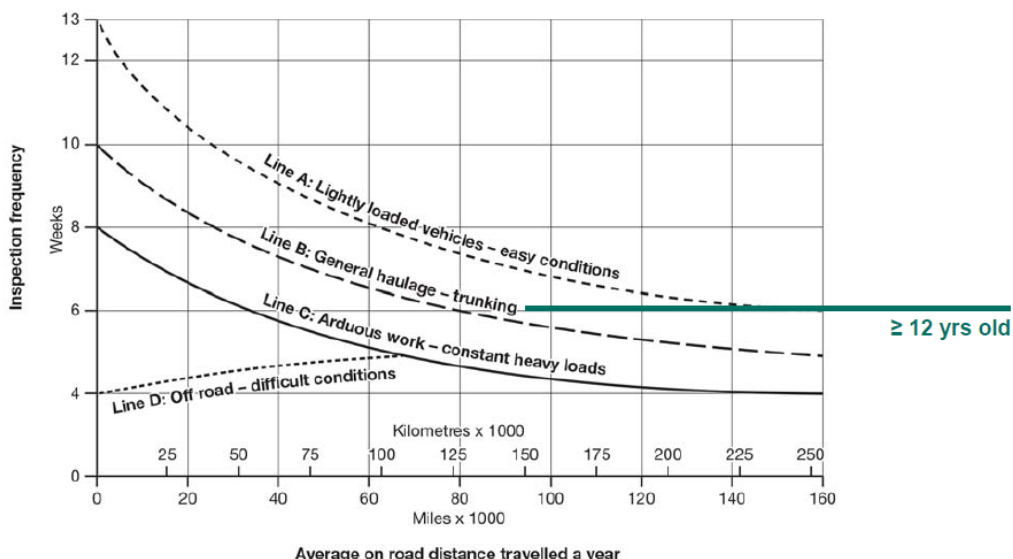


Figure 3 Recommended frequency of freight vehicle inspections in Great Britain [3]

Figure 4 shows the overall rate of unroadworthy vehicles in Germany over the period 1987-2005. It is obvious that the rate did not reduce considerably over the period.

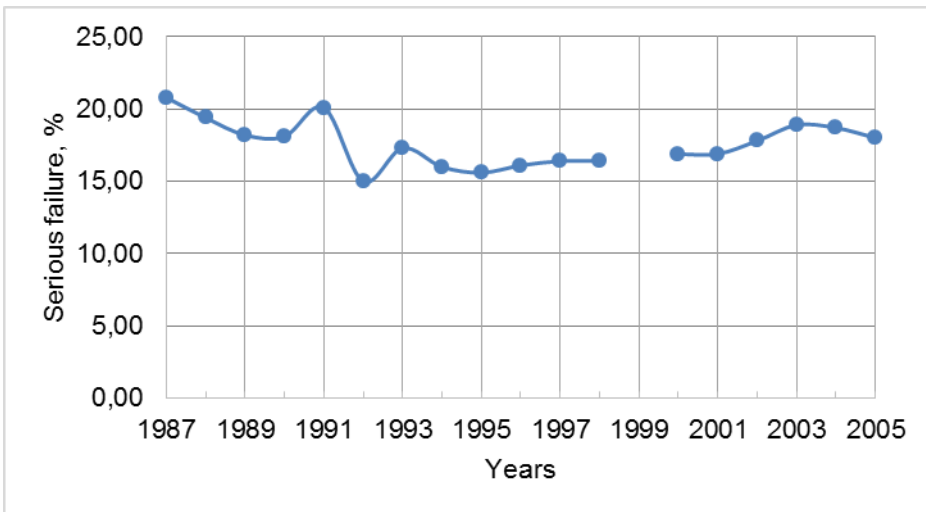


Figure 4 Average rate of unroadworthy vehicles in Germany between 1987 and 2005, [12]

Figure 5 shows the percentage of unroadworthy vehicles based on the total number of inspected vehicles in Great Britain, and it is over 50% for freight vehicles older than 10 years.

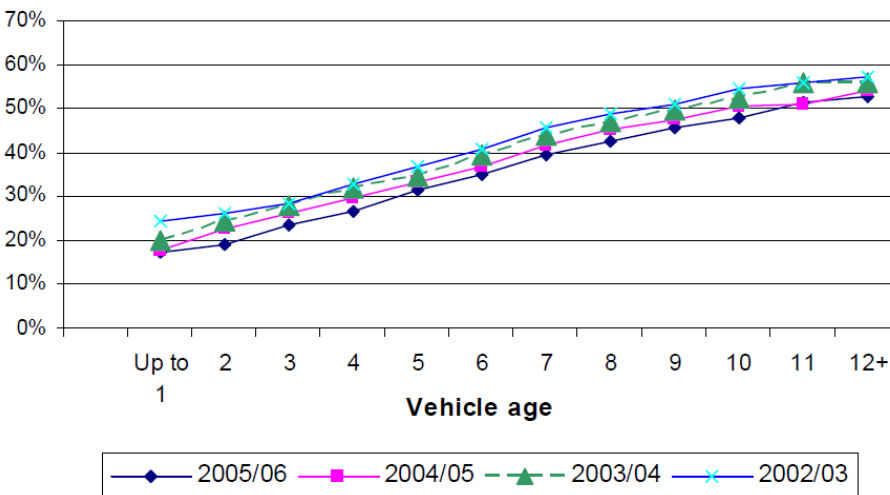


Figure 5 Percentage of unroadworthy freight vehicles out of total number of inspected freight vehicles in Great Britain, [12]

In 2004, 3.9% of freight vehicles and 4.1% of freight trailers were prohibited from movement due to heavy damage, whilst 7.4% of freight vehicles and 8.8% of freight trailers were prohibited from movement due to other faults. The most frequent problem was with faulty brakes and braking system, especially in case of older vehicles.

### TECHNICAL MALFUNCTION AS A CAUSE OF ROAD ACCIDENTS

Technical malfunctions are certainly not the most common cause of road accidents. It is the human factor that has a much greater influence rather than technical malfunctions.

Nonetheless, road accidents caused by technical malfunctions can be avoided if the malfunctions are registered on time and removed within proper maintenance. Even so, over 26% of vehicles that participated in road accidents and were consequently examined by DEKRA experts in the period between 2001 and 2004, did have some technical malfunctions, sometimes very serious ones. These malfunctions were not always relevant for the accident, however almost one quarter of the examined automobiles that participated in accidents showed some malfunctions, either causal or non-causal, and therefore, they were malfunctions relevant for the accident, Figure 6.

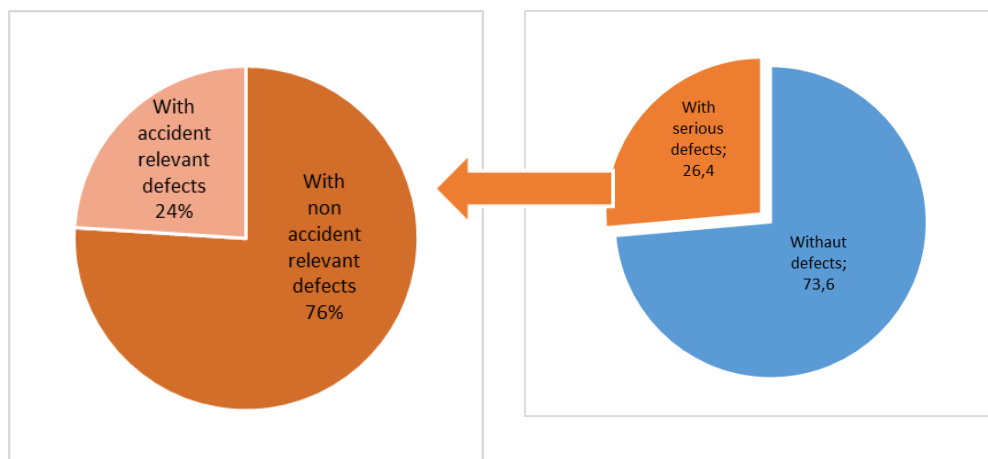


Figure 6 Defects in cars inspected after an accident (2001-2004), [6]

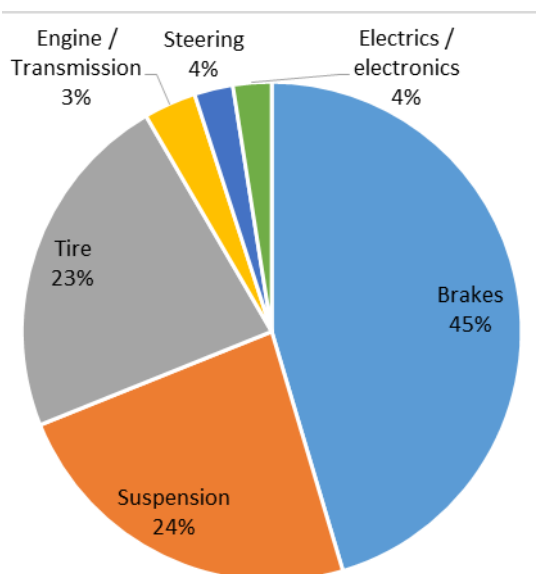


Figure 7 Malfunctions relevant for accidents grouped by assemblies, [6]

A more detailed analysis of malfunctions that cause road accidents showed that a malfunction in the braking system is the most common cause of accidents (45%), followed

by a running gear malfunction – wheels, axles, suspension (23.5%) and defective pneumatics (22%), Figure 7.

It is therefore very likely that malfunctioning or inadequately repaired components of the braking system or old, worn-out and damaged pneumatics will cause accidents. The most obvious malfunctions can be detected by the driver or within automobile service checks or periodic technical inspections.

## **OVERVIEW OF PRESENT SITUATION AND WORK IMPROVEMENT IN TECHNICAL INSPECTION STATIONS IN REPUBLIC OF SRPSKA**

The Law on the basics of traffic safety on roads in Bosnia and Herzegovina and the Regulation on technical inspection of vehicles regulate in a uniform manner the field of technical inspections of vehicles in Bosnia and Herzegovina, and in the Republic of Srpska [7, 11]. Licensing and supervision of technical inspection stations for motor vehicles and trailers is the responsibility of respective Ministries of Transport and Communications of the entities, cantons and Brcko District. The organizational scheme pertaining to vehicle technical inspections is shown in Figure 8, [9].

A very important position in the organizational scheme is held by the Expert Institution for vehicle technical inspection of the Ministry of Transport and Communications of the Republic of Srpska.

Along with various types of expert and technical support, the Expert Institution is in charge of the education and licensing of technical inspection stations staff.

In order to achieve the best possible quality of work, supervision over work, and a simplified vehicle registration procedure, all technical inspection stations have been linked to a single information system since 2009. This system links the vehicle inspection stations, the BiH Agency for identification documents, registers and data exchange (IDDEEA), and the Ministry of Transport and Communications of the Republic of Srpska. In the Republic of Srpska, the total of 209 technical inspection stations have been linked to the system. Through this system, the Ministry of Transport and Communications tracks the work of the stations in real time, collects data on the number and type of technical inspections, on the way vehicle inspections are conducted, on time spent on conducting a vehicle inspection, on the work of the station staff, etc. From this single information system, we can obtain data on the number and type of vehicles in the Republic of Srpska and their characteristics, on the number of unroadworthy vehicles in first inspections, extraordinary technical inspections and on the type of detected malfunctions in vehicles. The single information system, apart from being used for the analysis of data relevant for road safety, is used for other analyses, too (assessment of the impact of exhaust gas emission on the environment, public road fee charge within vehicle registration, etc.), [9].

The introduction of this system has greatly improved the quality of vehicle technical inspections in the following areas:

- employment of qualified personnel (traffic engineers and mechanical engineers),
- constant education and training of station personnel;
- single information systems facilitates a full insight into the work of technical inspection stations in real time;
- established database on vehicles and technical inspections necessary for further analyses and improvement of the system and road safety.

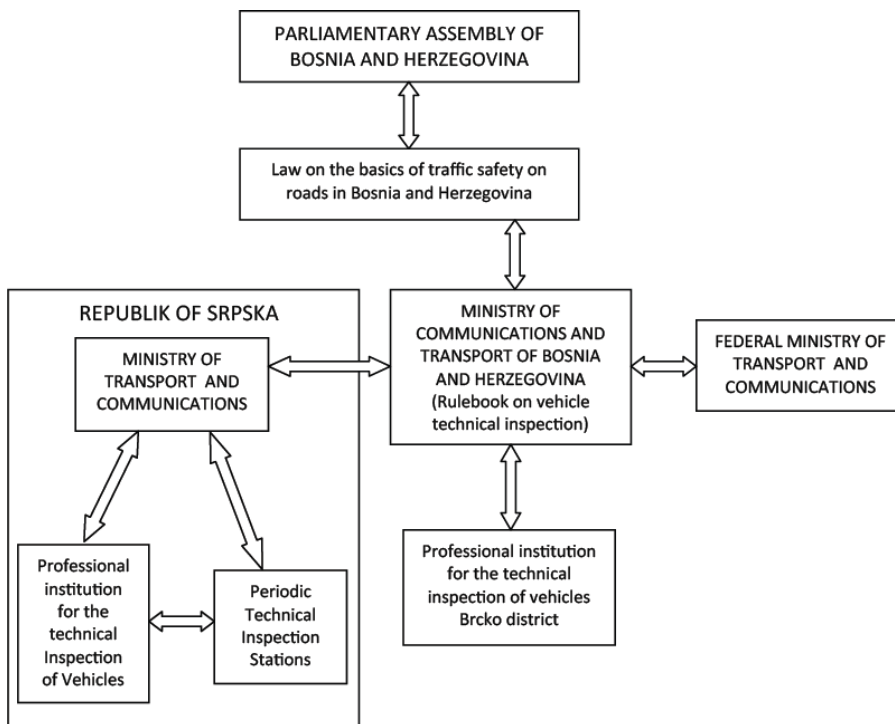


Figure 8 Organizational scheme of activities relating to vehicle technical inspection in the Republic of Srpska

To substantiate the above said, we shall point out that the percentage of vehicles that failed their technical inspection over detected malfunctions increases every year. Table 1 shows data relevant for vehicle inspections in the Republic of Srpska: number of registered vehicles, number of vehicle inspection stations, number of vehicle inspections, number of unroadworthy vehicles identified during inspections, and average vehicle age for each year in the period from 2007 to 2013.

## STRATEGIES FOR IMPROVEMENT OF VEHICLE TECHNICAL INSPECTION IN EU

The results of conducted researches and experience gained in individual projects helped in the creation of EU regulations regarding improvement of the vehicle inspection technology.

In October 2009, the EU member states adopted amendments to 2009/40/EC and 2000/30/EC Directives on vehicle technical inspection, [1,8]. Amendments to 2009/40/EC Directive envisaged the control of electronic safety systems to be introduced into vehicle technical inspection. The first step was the MIL lamp check, and the EU member states can also use the “scan tool” devices to control the following systems [2,4,5,10]

- anti-lock braking system (ABS),
- electronic braking system (EBS),
- electric power steering (EPS),
- electronic stability control (ESC)



- seatbelt system (safety belt load limiter and safety belt pre-tensioner),
- airbag,
- SRS systems.

Table 1 Relevant data for vehicle technical inspections, (Source: Republic of Srpska information system)

Year	2007	2008	2009	2010	2011	2012	2013
No. of registered vehicles	278,339	276,885	274,827	294862	300,278	318,697	330,270
Average vehicle age (years)				16.3	16.6	16.7	16.7
No. of vehicle inspection stations	189	189	181	199	214	208	209
No. of vehicle inspections				330,948	331,264	335,425	350,560
No./percentage of extraordinary inspections				1,989/0.6	2,100/0.6	2,647/0.8	2,821/0.8
No./percentage of vehicles that failed inspection				4,376/1.3	8,377/2.5	21,928/6.5	42,416/12.1

Visual inspection of the above systems is already envisaged by 2010/48/EC Directive, stating eliminatory reasons as for all the other vehicle systems inspected during vehicle technical inspection, whilst the application of “scan tools” is not stated as mandatory. It is expected that with the revision of Annex II of the Directive, the control of effectiveness of electronic safety systems by using adequate tools will become mandatory.

A research project named IDELSY (Initiative for Diagnosis of Electronic Systems) is one of important EU research projects with a focus on exploring possibilities for the application of diagnostic tools to control electronic systems in vehicles with safety related functions, [2,4,5,14,15,16]. The seven participating technical inspection organisations were: RWTÜV Fahrzeug GmbH (Essen), TÜV Rheinland Kraftfahrt GmbH (Cologne), TÜV NORD STRASSENVERKEHR GMBH (Hannover), DEKRA Automobil GmbH (Stuttgart), TÜV Süddeutschland (Filderstadt), APPLUS ITEUVE (Barcelona), Vehicle & Operator Services Agency - VOSA (Bristol).

One of the project goals was to explore test procedures (roadworthiness control) for vehicle electronic safety systems by using diagnostic tools (scan tools), whilst roadworthiness control activities would be integrated in the current vehicle technical inspection. Another goal of the research project was to establish proposals for an EU regulation for periodic technical inspections with regard to electronic components.

The research project consisted of three modules, with each module covering predefined activities. Module 1 included collection of data about Europe’s vehicle fleet and capabilities of the existing diagnostic tools, and also a specification of test procedures was designed and a questionnaire for vehicle owners formulated. Module 2 of IDELSY project resulted in the design of test procedures aimed at the electronic components of motor vehicles with safety related functions. The contents of the test procedure and sequence of individual activities are shown in Figure 9. Resulting from a need for new software, IDELSY Manager was developed within Module 2.

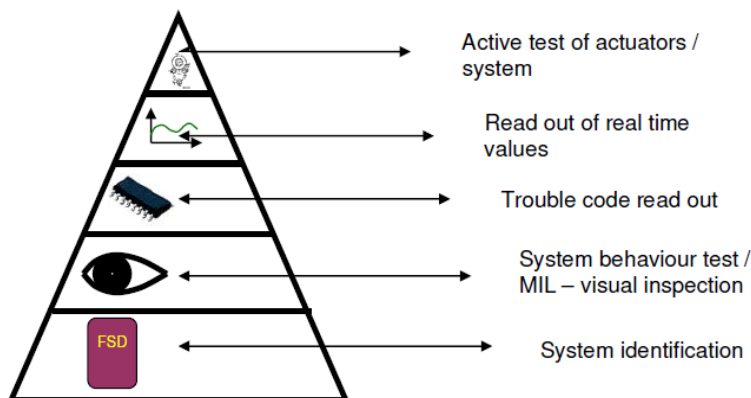


Figure 9 Sequence of individual activities during testing of vehicle electronic systems [17]

Within Module 3, 2.234 vehicles were tested (38 different vehicle manufacturers), vehicle owners were interviewed (questionnaires drafted in Module 1 were filled in), and test results were sorted. The following systems were subject to testing (ABS/ESP, airbag system, engine ECU, and lighting group ECU).

The results obtained from the IDELSY research project justified the initiative for the introduction of control of electronic systems that improve road safety. Only in the first eight months of the project duration, it was detected that around 38,000 vehicles out of the total number of tested vehicles in Germany had defective airbag systems. Recommendations were addressed to vehicle manufacturers, scan tool manufacturers, and to road authorities in charge of the legal regulation of vehicle technical inspections. As to diagnostic tools intended for the control of electronic systems, it was pointed out that the primary goal should be the possibility to achieve a clear identification and communication with all vehicles. Figure 10 shows the structure of the pilot project for technical inspection of vehicle electronic components.

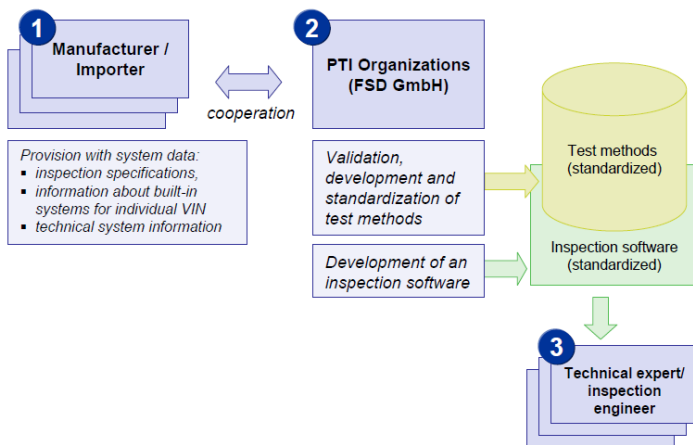


Figure 10 Structure of the pilot project for technical inspection of vehicle electronic components [17]

## **CONCLUSION**

Due to the lack of reliable information, some other factors (usually the human factor) are often stated as the cause of road accidents rather than unroadworthy vehicles. We can therefore assume that the number of unroadworthy vehicles that have caused traffic accidents is much bigger than presented in official statistics. The driver is able to exploit the real potential of any vehicle system only if the system is fully functional.

The improvement of the technology of vehicle technical inspection is a way to seriously contribute to the advancement of active and passive safety of road users. It is therefore necessary that all the systems that improve road safety, including electronic safety systems, be checked within vehicle technical inspection. Full inspection of electronic safety systems within vehicle technical inspection includes, apart from visual inspection, the inspection of functionality and effectiveness of individual systems by means of appropriate tools.

As for the regional level, in order to improve vehicle roadworthiness and thus, road safety, and to create a more favourable environment for the operation of technical inspection stations, it is necessary to:

- work on the improvement of legal regulations and their harmonisation with European and international directives (for example, regional restriction on the number of technical inspection stations, vehicle registration renewal at technical inspection stations, modernisation of the technical inspection technology, etc.),
- conduct continuous preventive and repressive measures through extraordinary technical inspections (inspection of transportation companies' vehicle fleet, etc.),
- work on the improvement of the information system.

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