

ANALYSIS OF CONTROL EFFICIENCY OF VEHICLES VALIDITY AT TECHNICAL INSPECTION STATIONS OF VEHICLES IN BOSNIA AND HERZEGOVINA – PERIOD FROM 2008 TO 2012

Fuad Klisura¹, Sabahudin Jašarević², Safet Brdarević², Mustafa Mehanović³, Dragana Agić¹

¹Institute of Comercial Engineering d.o.o. Fakultetska 1, 72000 Zenica, Bosnia and Herzegovina,

²Faculty of Mechanical Engineering, University of Zenica, Fakultetska 1, 72000 Zenica, Bosnia and Herzegovina,

³Faculty for Traffic and Communications, University of Sarajevo, Zmaja od Bosne 8, Bosnia and Herzegovina,

ABSTRACT

The paper will present a brief analysis of locations of stations for technical inspection of vehicles in Bosnia and Herzegovina (BiH). Different criteria during the openings of new stations for technical inspection of vehicles lead to unfair competition, and thus to "destroying" the reputation of stations for technical inspection of vehicles as well as the staff. Statistical data of traffic accidents in BiH are shown, too. For this purpose was conducted a correlation analysis of dependencies between variables, and in order to determine the functional dependence was applied the method of regression analysis. At the end, in addition to measures for improving these operations conclusions will be given.

Keywords: Station for technical inspection of vehicles, traffic accident, vehicle validity.

1. INTRODUCTION

The causes of traffic accidents are classified in three main groups: human, vehicle and road. Always actual question is how much certain factors of the individual groups influence the emergence and consequences of traffic accidents.

Influential factors related to the vehicle and its validity are noted as very important and are the subject of many measures which are carried out in order to improve traffic safety.

System of control of technical validity of vehicles in BiH is performed by stations for technical inspection of vehicles divided into three subsystems, or subsystems that are in the two entities and one district. Based on data from all stations for technical inspection during previous five years, an analysis of impacts on traffic safety was done. In addition was made a comparison of results in neighboring countries.

Results of the analysis are applied in making decisions that will improve the level of technical validity of vehicles, and therefore to traffic safety.

2. CONTROL SYSTEM OF VEHICLES VALIDITY IN BOSNIA AND HERZEGOVINA

In Bosnia and Herzegovina control system of technical vehicles validity includes stations for technical inspection of vehicles (STPV) in entities. Main features of the functioning of the system are given through the checked vehicles, participation in the total number of inspected vehicles.

Stations for technical inspection of vehicles represent a small test lab which should ensure technical validity of vehicles as one of the essential prerequisites for the safety of all road users with pre-equalization of legislation in this area and to ensure the quality of work of the stations and financial viability of the stations [2]. Quality supervision over the work of the stations, professional and administrative supervision can bring positive results to thereby ensure the implementation of applicable laws.

Each vehicle involved in the traffic on the roads has to be technically valid, in other words, must meet the technical inspection.

Technical inspection of vehicles is compulsory for all motor vehicles and trailers, regulated by legal provisions, in most countries in the region and by Safety Act of traffic on the roads [3].

Area of control of technical validity of vehicles officially began to computerize in early 2007, in order to improve the job on April 1st in 2008- first in the Federation entity, then, on January 1st in 2009- in the Republika Srpska, and in December 2009 in the Brčko District. First results of statistical indicators from these bases, such as the number of vehicles, brands, types, age, color, therefore errors and defects in the vehicles shown justification for the introduction of information systems (IS) to stations for technical inspections of vehicles in BiH. These indicators will help in preparing the analysis of the situation, the causes of failures, the causes of traffic accidents, making a variety of studies on the state of the fleet in BiH, state and preventive patterns of traffic accidents. They can be used in all areas for recording situation and development in traffic, awareness of drivers, maintenance of vehicles, vehicle age, insurance, vehicle registration, evaluation of traffic accidents, educating people who write Records of traffic accidents.

3. STATISTICAL DATABASE

Statistical base presented in this paper consists of data collected from the stations for technical inspection of vehicles in Bosnia and Herzegovina and Federal Ministry of Interior, Ministry of Interior of Republika Srpska, Ministry of Internal Affairs of Brčko District and Cantonal Police.

3.1. Data base of stations for technical inspection and traffic accidents in Bosnia and Herzegovina

The following tables will give a short presentation of the results of work of authorized stations for technical inspection of vehicles in the entities of Federation of Bosnia and Herzegovina, Republika Srpska and Brčko District, for the period from 2008 to 2012, as well as data on road accidents in The Federation of Bosnia and Herzegovina, Republika Srpska and Brčko District. (Table 1.).

Table 1: *Overview of the number of accidents and breakdown in the Federation entity [1], [4]*

	2008	2009	2010	2011	2012
Number of vehicles	525,724	539,800	569,859	581,654	596,457
The number of defective vehicles during the first inspection	3,537	9,027	10,711	9,324	8,300
The number of defective vehicles during the second inspection	42	256	349	186	72
Road accidents	29,578	29,456	28,506	27,986	25,958

Malfunctioning of the vehicles in the Republika Srpska are presented according to age (Table 2.).

Table 2: *The number of accidents and breakdown in Republika Srpska [1]*

	2009	2010	2011	2012
Total inspected vehicles	94,781	330,947	330,947	335,488
Number of defects per individual systems/devices	2.142	6.292	20.852	52.412
Road accidents	10.076	9.732	9.378	8.441

Table 3. presents the data for the Brčko District of Bosnia and Herzegovina.

Table 3: *Overview of the number of accidents and breakdown in Brčko District [1]*

	2010	2011	2012
Total inspected vehicles	28.529	29.318	30.402
Number of defects per individual systems/devices	617	552	574
Road accidents	673	564	485

3.2. Data on the control of technical validity of vehicles in neighboring countries

Data on technical inspections in the EU and Serbia are given in Table 4.

Table 4. Comparison of the number of performed technical inspections and authorized stations for technical inspection of vehicles in BiH and the region for year 2012 [1]

Country	Number of authorized stations for technical inspection of vehicles	Number of vehicles	Number of vehicles per station (2:1)	There are criteria for Stations YES/ NO
	1	2	3	4
Slovenia	86	1.326.549	15.425	YES
Croatia	156	1.817.920	11.653	YES
Serbia	1.278	1.920.480	1.503	NO
Bosnia and Herzegovina	393	972.549	2.475	YES/NO
Administrative units in Bosnia and Herzegovina				
Federation of Bosnia and Herzegovina entity	162	602.444	3.719	YES
Republika Srpska entity	213	337.565	1.549	NO
Brčko District BiH	15	30.402	2.020	NO

What are the parameters that lead to traffic accidents is a permanent question that arises with the aim of preventive action to reduce the number of traffic accidents, and therefore their effects. It is often impossible to determine many parameters that led to the accident, because the consequences are very serious traffic accidents. Below are given data from which it is possible to accurately estimate the appropriate participation of errors on the validity of the vehicles.

4. DEPENDENCE BETWEEN VALUES CONNECTED TO TECHNICAL VALIDITY OF VEHICLES AND TRAFFIC SAFETY

To determine the dependence between the variables was used Pearson correlation coefficient method.

$$\rho_{X,Y} = \frac{\text{cov}(X, Y)}{\sigma_X \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y} \dots\dots\dots(1.)$$

where: cov - covariance, σ - the standard deviation of X, μ - the mean value of X, E – expectation

Pearson's correlation coefficient, when applied to a sample is usually represented by the letter r, and can be applied to the sample of correlation coefficient and the sample of Pearson correlation coefficient. We can get a formula for r by substituting estimates of covariance and variance based on a sample of the above formula

$$r = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}} \dots\dots\dots(2.)$$

Unlike the covariance, the correlation coefficient is reduced, so that its value is independent of the units in which they expressed the analyzed variables. The value of the correlation coefficient must be between -1 and +1 inclusive and bounds. [5]

This tool can be used to analyze the correlation of all pairs of observed variables to determine whether two observed variables are correlated.

Table 5. presents the correlation coefficients of four variables related to technical inspections in the Federation of Bosnia and Herzegovina. For the analysis are taken couples which have mutual dependence.

Table 5. Correlation coefficients of accidents and influencing factors according to Table 1.

	Line	R1	R2	R3	R4
Number of vehicles	R1	1,000			
Number of defective vehicles during the first inspection	R2	0,610	1,000		
Broj neispravnih vozila na II pregledu Number of defective vehicles during the second inspection	R3	0,070	0,806	1,000	
Road accidents	R4	-0,914	-0,316	0,264	1,000

The number of traffic accidents and the number of vehicles on the technical inspection have a correlation coefficient (-0.914) suggesting that it is a high degree of correlation and quality inspection.

The number of traffic accidents is significantly correlated with the number of send back vehicles during the first inspection (0.610).

The dependence of the number of traffic accidents and the number of vehicles in the Republika Srpska was significant (-0.634), and the number of defects in vehicles very significant (-0.992). With the increasing number of vehicles partly the number of traffic accidents was increasing too (0,545).

Table 6: *Correlation coefficients of accidents and malfunctions in stations for technical inspection of vehicles from Table 2.*

	Line	R1	R2	R3
Total inspected vehicles	R1	1		
Number of defects per individual systems / devices	R2	0,545	1	
Road accidents	R3	-0,643	-0,992	1

The dependence of the number of traffic accidents and the number of vehicles in the Brčko District is very significant (-0.983) therewith the increasing number of cars meant a decreasing number of accidents. The influence of defects in vehicles to the number of accidents is significant (0.717). The increasing number of vehicles has slightly decreased the number of accidents (-0.579).

Table 7: *Correlation coefficients of accidents and influencing factors from Table 3.*

	Line	R1	R2	R3
Total inspected vehicles	R1	1,000		
Number of defects per individual systems / devices	R2	-0,579	1,000	
Road accidents	R3	-0,983	0,717	1,000

5. CONCLUSION

The awareness of all participants in traffic, vehicle control, maintenance, police, inspection, experts accidents must drastically change because provided indicators are implacable. Considering the available statistics on road safety as well as information about the condition of the vehicle at technical inspections, in the past five years, among other things, it is necessary to focus the attention of the responsible entities for road safety to establish at least ten technical stations in BiH, which would carry out the testing of vehicles after accidents, especially if the death occurred as a result of the collision. Indicators on send back vehicles from stations for technical inspection of vehicles as technically defective and indicators on the participation of technically defective vehicles in traffic accidents, according to official reports, and in making the minutes of the accident (the police) and the reconstruction of an accident (expert witnesses) as a problem indicate human factors.

6. REFERENCES

- [1] Klisura F.: "Contribution to the determination of effectiveness of the work of station for technical inspection of vehicles in order to improve maintenance of motor vehicles" PhD dissertation in production (2014).
- [2] Klisura F.,Brdarević S.,Mustafić I.,Jašarević S., Plevljak F.: ANNALS of FACULTY of ENGINEERING, - Thema: „Efficiency of the integral information system and video surveillance over the work of stations for technical inspection of vehicles and traffic safety contribution“, - hunedoara Romania 267-274,Tome X (Year 2012). Fascicule 3. ISSN 1584 – 26 73
<http://annals.fih.upt.ro/pdf-full/2012/ANNALS-2012-3-44.pdf>
- [3] Klisura F., Jašarević S, Brdarević S., Agić D., Barut M.: TTEM- Tehnics Tehnologies Education Management- Theme: „Effects on traffic safety-effects by the surveillance system over the work of stations for tehcnical inspections of vehicles in the Federation Bosnia and Herzegovina in the period 2007-2012“ Sarajevo, B&H, 486-494, Vol.8, No. 2, (Year 2013) ISSN 1840-150
http://www.ttem.ba/pdf/ttem_8_2_web.pdf
- [4] Statistics of technical inspections, IPI Institute for Commercial Engineering, Zenica, 2008-2012.
- [5] Mehanović, M.: "Assignments and examples from theory and practice in public transport of passengers", Faculty of Transport and Communication, Sarajevo, 2005.