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PERIODIC TECHNICAL INSPECTIONS OF VEHICLES AND ROAD TRAFFIC SAFETY WITH THE NUMBER OF ROAD ACCIDENTS INVOLVING FATALITIES

SYSTEM OKRESOWYCH BADAŃ TECHNICZNYCH POJAZDÓW A BEZPIECZEŃSTWO RUCHU DROGOWEGO I LICZBA ZDARZEŃ DROGOWYCH Z UDZIAŁEM OFIAR ŚMIERTELNYCH*

The article is an attempt to find relationship between the implemented system of periodic technical inspections of vehicles and the number of road accidents, reliability of vehicles and road safety. The study utilises results of comparative tests, where the relationships and parameters could be directly observed for the cases with the system implemented and some without periodic technical inspections at all (for example: between the states of the USA, Australia and the research work conducted in Norway in the 90's). The analysis of results leads to unexpected conclusion that system of periodic technical inspections of vehicles does not have statistically significant effect on the number of accidents, including the number of road accidents involving fatalities.

Keywords: *vehicles periodic technical inspections, road traffic safety, road accidents, technical condition of vehicles.*

Artykuł jest próbą znalezienia relacji pomiędzy wdrożonym systemem okresowych badań technicznych pojazdów, a liczbą zdarzeń drogowych i szerzej niezawodnością pojazdów i bezpieczeństwem ruchu drogowego. W pracy między innymi wykorzystano wyniki badań porównawczych, dla których można było wprost obserwować zależność i parametry dla przypadków z wdrożonym systemem okresowych badań technicznych i bez niego (na przykładzie Stanów Zjednoczonych, Australii i Norwegii). Analiza wyników prowadzi do zaskakującego wniosku, że wyżej wymieniony system nie ma statystycznie istotnego wpływu na liczbę wypadków, w tym liczbę zdarzeń drogowych z udziałem ofiar śmiertelnych.

Słowa kluczowe*: okresowe badania techniczne pojazdów, bezpieczeństwo ruchu drogowego, zdarzenia drogowe – wypadki, stan techniczny pojazdów.*

1. Introduction

There is a common, rather obvious opinion that the system of technical inspections of vehicles and the number of defects occurring in the vehicles affect the road safety and the number of road accidents involving fatalities. However, assessment of the magnitude of this effect turns out to be difficult to estimate and the data depending on its source can significantly differ from each other. The problem should be considered in two stages. The first step is a relationship between of the system of periodic roadworthiness inspections and the current technical condition of vehicles on the public roads, while the second is the proportion of the number of road accidents with fatalities, due to technical reasons, to the total number of such road accidents.

Another aspect that has an effect on reducing the number of accidents is a development of automotive technology, the use of ever more sophisticated passive and active safety systems, manufacturing of increasingly sophisticated cars that meet more and more stringent type-approval requirements.

There are two trends that have opposite impact on the road safety: an increasing number of vehicles and ever more perfect vehicles designs. The quality and organization of road infrastructure has also substantial impact .

Both the police as well as scientists involved in road safety issues, as the main causes of road accidents perceive the two factors, which are: man and road infrastructure.

The purpose of this article is to find the answers, to the question, what impact the vehicle's technical defects and the organization of the roadworthiness inspections system have on the road safety.

This article contains an analysis of several studies on this subject. The papers [3] and [7] contain a number of interesting statistics, but are based on unverifiable assumption of proportional impact of periodic technical inspections of vehicles on the reduction of the number of road accidents by limiting the share of vehicles with defects in the road traffic. The papers [2], [5] and [9] attempted to compare the impact of the roadworthiness tests system on the road safety in the United States, where in some states the roadworthiness tests system is in place and functioning properly and in some there is no technical inspection of vehicles at all. The similar situation is in Australia [6], but the paper from Norway [4] made use of the data from before the date of implementation of the vehicles technical inspection and after the implementation, with the turning point date in this case being 1995. Unfortunately, the investigations [2, 4, 5] were carried out in the 70s, up to the beginning of this century, and therefore one can claim that they are not fully up to date nevertheless the empirical character of the data and its direct use, without making a priori assumptions, are worth noting.

(*) Tekst artykułu w polskiej wersji językowej dostępny w elektronicznym wydaniu kwartalnika na stronie ***www.ein.org.pl***

2. Impact of periodic technical inspections of vehicles on the road safety.

"Effect of Vehicles Defects in Road Accidents" by R. W. Cuerden, M. J. Edwards and M. B. Pittman was published in March 2011 and represents relatively new investigation for the UK market [3].

In the UK the roadworthiness inspection system in its current shape was established by the Road Traffic Low in 1988. It is worth noting that according to the regulations, the certificate of roadworthiness test refers to the vehicle's condition during the test and should not be treated as evidence of:

– technical condition of the vehicle at a different time,
– the overall condition of the vehicle
– the vehicle meeting all requirements of construction and use.

These provisions mean that the inspector is responsible for testing vehicle within a scope in which the vehicle is being checked, and that inspection does not guarantee roadworthiness in the period between the tests.

The inspection stations are run either by private entities or the local authorities. These stations are authorized and supervised as far as the personnel and equipment is concerned, by a specialized agency "Vehicle and Operator Services Agency" – VOSA. The authorization specifies which type of vehicle the test centre may examine depending on the equipment and personnel possessed. Test centre sends the findings to a national database, and they include the time, place and the final result of the inspection, data of the vehicle and a separate panel containing information about detected defects with their descriptions. Full computerization of the system took place on the 1st April 2006 and since then it is complete, and contains data from the whole of the country. The study [3] was based on data from 2008-2009. For the purpose of the analysis there was all the data used which allowed to evaluate the share of vehicles defects in the periodic technical inspections.

Accidents are the events that occur seldom, and those for technical reason are even less frequent. Overall, the sensitivity of the databases to the technical factor is limited. While the databases point to a certain contribution of technical factors to the accidents, usually an accident is a conglomerate of a number of factors and circumstances and the exact separation of causes requires to conduct of a thorough investigation. Currently available accident databases are not focused primarily on finding roadworthiness of the vehicle during the accident.

The analysis [3] used four databases. The first is STATS19, which is a national database of reported accidents where at least one person suffered injuries. It should be noted that not all such accidents are reported to the police and, therefore not all are in the database. The database collects about 50 different pieces of information on the time and place of the accident through to the details of the vehicle and the nature and extent of injury. Wounds are classified as slight, not requiring hospitalization, serious requiring hospitalization and fatal, as the result of which the victim dies within 30 days of the event.

The VOSA organization mentioned earlier, being an instrument of the Department of Transport, is responsible for the vehicles roadworthiness system and its supervision. Its competences include also cooperation with the police in the area of analysis of the technical condition of vehicles taking part in accidents. In particular, the VOSA needs to determine if the technical condition of the vehicle was the cause or had an impact on the accident, verify the driver's version of,events, check if the mechanical or structural defects did not occurre prior to the accident and whether there were any penalties for other offences committed by the driver. As part of VOSA's cooperation with the police there is a second database being created.

The third database registers fatalities and is created by TRL (Transport Research Laboratory) based on data delivered by the police.

The fourth and the last database was linked with the research project carried out in 2000–2010 and founded jointly by the Department of Transport and Roads Agency. The project collected information on the causes and consequences of accidents which could provide a basis for the assessment factors: driver, road and vehicle. The data was collected by sending teams of experienced researchers to the accident site and at the same time to the emergency services and the police. Details of the event were the subject of analysis in all cases, however they were limited to the territory of the two regions: Thames Valley and Nottingham and included a total number of 4744 accidents investigations, while the approach to the problem guaranteed recording all accidents reported to the police.

It should be remembered that the researchers did not have such powers as the police and, therefore, their actions were limited and largely confined to observation. Based on the data from 2005 there was a chart created showing the causes of accidents taking into account the most important factors like the man, the road and the vehicle. It should be noted also that that this data is also estimated.

The following distribution of the factors causing accidents was established:

– 96,6% belonged to the human factor (74,4% only human),
– at least one factor associated with the road – environment – 19,9% with for only 1,1% it was the only factor,
– the factor associated with the vehicle – 4,7% where at least one of the factors was connected with the technical defect, but only for 0,6% it was the only the only factor.

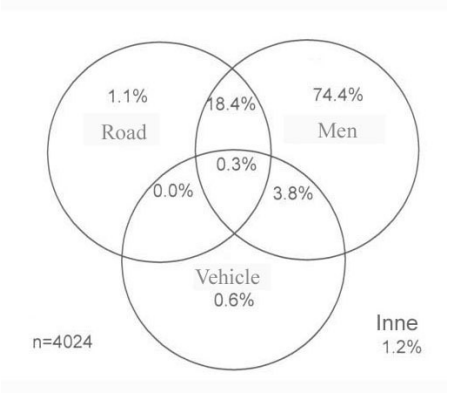

Fig. 1. Distribution of the factors affecting the traffic accident, the data relates to 2005 [3]

In the study [3] Cuerden and Edwards have analyzed the results of technical inspection of vehicles carried out in 2008 when 34 million of periodic technical inspections were done and in 2009 with more than 35 million inspections. Rejection ratio was 29.2% of the population of vehicles in 2008 and 30.3% in 2009 while the minor defects were reported in 9.5% of all vehicles both in 2008 and 2009. Minor defect is one that has no significant effect on the safety and re-examination is not necessarily required, while the car after a quick repair at the inspection station or somewhere else, the same day obtains a positive result of the inspection. Database ignores the fact that some vehicles were tested more than once. The share of positive findings is 60.5% in 2008 and 59.4% in 2009. Statistics also confirmed that newer vehicles have fewer defects than older ones. For the three years old passenger cars (from the date of the first registration in 2006) rejection ratio was 21% while for the thirteen years old (from the date of the first registration in 1996) it increased to 56%. For all negative results the defects were identified and reported. This group of tests was accompanied by an instruction which indicated what should be urgently repaired or serviced.

The distribution of defects reported in 2009 for passenger cars was as follows:

– lighting and signalling equipment 18%
– steering system 3%,
– suspension system 18.9%,

– braking system 25.3,
– tires 14.8%,
– wheels 0.6%,
– safety belts 1.8%,
– body and chassis 1.8%,
– exhaust and fuel system 7.5%,
– field of vision 6.9%.

The data analysis also shows that minor defects concentrated on the braking system, tires and suspension system for all vehicle categories. It has been observed that the number of failures increases for vehicles with their age, but only up to a point, beyond which clearly starts to decrease.

Negative result of the test depending on the defect in decreasing order:
– lighting and signalling equipment 28%,
– braking system 19%,
– suspension system 17%,
– tires and wheels 10%.

Other parts and assemblies constitute a total of less than 10%.

The above data concerns passenger cars, and it differs for other vehicle categories, with every category having own specifics.

Further on the study attempts to predict the likely impact on the road the safety of the changes in the frequency of periodic roadworthiness tests, and to find hypothetical relationship between defects detected in the periodic inspections and accident victims. It is assumed that the number of cases where the technical failure factor had a direct impact on the occurrence of the accident is proportional to the number of vehicles with technical defects in the road traffic. However, due to the uncertainty associated with the quantitative assessment of the share of vehicles with defects in traffic, when the roadworthiness system is in use, the analysis allows only to understand better the mechanism, for the most hazardous defects that can serve as substitute indicators of the vehicle's technical condition. Assuming that 3% of accidents are due to technical reasons about 52 deaths were caused by such accidents in the UK in 2009. For the adopted model it was found that the change of the frequency of the tests from 3-1-1-1 to 4-2-2-2 would cause increase the number of fatal victims by 16-30 and 180-330 of serious injuries.

The model used assumed a hypothetical relationship between the number of defects detected during tests and the number of road accidents victims. However, the authors cautioned that the relationship between the type of defects and their number related to the time when the last periodic technical inspection was carried out is not known. The approach of the driver may also be different in the absence of stress caused by the lack of the periodic technical inspection time approaching.

Conclusions of the study are as follows:
– it is not precisely known how many accidents occurred in Great Britain for technical reasons,
– it was estimated that probably for 3% of the accidents the main reason was the technical defect,
– about 40% of the vehicles failed the test in 2009,
– the age of the vehicle increases the likelihood of a defect occurring (60% of the 13 years old vehicles had a major defect),
– the higher the mileage, the greater probability of a defect occurring (50% of the vehicles with the mileage of more than 90000 miles had major defect),
– there is no direct relation established between the system of periodic technical inspection and the number of accidents due to technical reasons and one can only presume that greater number of technical defects that occur on the road, especially those relevant to road safety, increases the likelihood of an accident involving technical reasons,
– the work involved the analysis of the impact of the frequency of periodic technical inspections on accidents due to technical reasons, and the study used axiomatic assumptions model and found that reducing frequency of testing will increase the number of accidents down to technical reasons,
– the authors believe that factor more susceptible to the probability of failure is the age of the vehicle rather than the mileage, newer vehicles of high mileage are serviced more often and checked and for this reason are less prone to defects,
– the authors stated the need for further research, of an experimental nature aimed at more precisely determining the examined relationships.

The Road Safety Report 2007 by DEKRA [7] has been divided into several parts according to the main factors affecting road safety, one of which being "safe driving in a safe car", which contains a number of interesting statistics and useful analyses. It provides, inter alia, the average age of the vehicles, which for Germany is 8.1 years, 7.9 years for France, 8.4, for Italy and almost 14 years for the Czech Republic. It was also found that in Germany the 12 years old vehicle on average is being removed from use.

In Table 1 presented are statistics that contain the number of victims of road accidents in the current European Union (27 countries), the data is from the years 1991 to 2006.

The study [7] confirmed that technical defects occur more often in older vehicles. The diagram showing the relationship between the number of defects detected, and the age of the vehicle. The report states that with the increase of the vehicles age the probability of the defect occurring, increases while the willingness of some owners to take the vehicle to the garage for repair and maintenance, decreases. This results in a rise of the number of defects and thus creating a potential danger.

Often, in order to reduce expenses, repairs are done by the owners themselves and are of questionable quality.

According to accidents statistics it was discovered that 26.5% of vehicles taking part in accidents had some defect and 6% of them had serious affect on an accident.

Comparative studies from U.S. in the states where the system exists and the states where there is no such system of periodic technical inspection at all, are presented in the paper [2] written by Crain where accidents rates were compared as well.

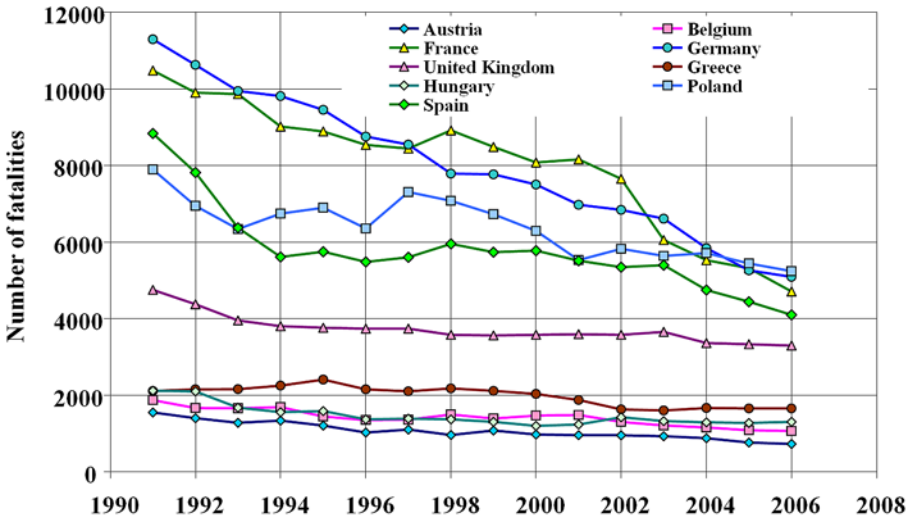

Fig. 1. Number of fatalities in road accidents in selected EU countries for the period 1991 – 2006 [7]

Table 1. The number of fatalities of road accidents in the EU in the years 1991-2006 [7]

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	1551	1403	1283	1338	1210	1027	1105	963	1079	976	958	956	931	878	768	730
Belgium	1873	1671	1660	1692	1449	1356	1364	1500	1397	1470	1486	1306	1214	1162	1089	1069
Bulgaria	1114	1299	1307	1390	1264	1014	915	1003	1047	1012	1011	959	960	943	957	1043
Cyprus	103	132	115	133	118	128	115	111	113	111	98	94	97	117	102	86
Czech R.	1331	1571	1524	1637	1588	1562	1597	1360	1455	1486	1334	1431	1447	1382	1286	1063
Dania	606	577	559	546	582	514	489	499	414	498	431	463	432	369	331	306
Estonia	490	287	321	364	332	213	280	284	232	204	199	223	164	170	169	204
France	10483	9902	9865	9019	8892	8540	8445	8920	8486	8079	8162	7655	6058	5530	5318	4709
Germany	11300	10631	9949	9814	9454	8758	8549	7792	7772	7503	6977	6842	6613	5842	5261	5091
UK	4753	4379	3957	3807	3765	3740	3743	3581	3564	3580	3598	3581	3658	3368	3336	3297
Greece	2112	2158	2160	2253	2412	2157	2105	2182	2116	2037	1880	1634	1605	1670	1658	1657
Hungary	2120	2101	1678	1562	1589	1370	1391	1371	1306	1200	1239	1429	1326	1296	1278	1305
Ireland	445	415	431	404	437	453	473	458	414	418	412	376	337	374	399	368
Italy	8109	8053	7187	7091	7020	6676	6714	6313	6688	6649	6691	6739	6065	5692	5818	5669
Latria	923	729	670	717	611	550	525	627	604	588	558	559	532	516	442	407
Lithuania	1193	779	893	765	672	667	752	829	748	641	706	697	709	752	760	759
Luxem-bourg	83	69	78	65	70	71	60	57	58	76	70	62	53	49	46	36
Malta	16	11	14	6	14	19	18	17	4	15	16	16	16	13	17	10
Poland	7901	6946	6341	6744	6900	6359	7310	7080	6730	6294	5534	5827	5640	5712	5444	5243
Portugal	3217	3086	2701	2505	2711	2730	2521	2126	2028	1877	1670	1655	1542	1294	1247	969
Romania	3782	3304	2826	2877	2845	2845	2863	2778	2505	2499	2461	2398	2235	2418	2641	2478
Slovakia	614	677	584	633	660	616	788	819	647	628	614	610	645	603	560	579
Slovenia	462	493	493	505	415	389	357	309	334	313	278	269	242	274	258	262
Spain	8837	7818	6375	5612	5749	5482	5604	5956	5738	5777	5517	5347	5400	4749	4442	4102
Finland	632	601	484	480	441	404	438	400	431	396	433	415	379	375	379	336
Sweden	745	759	632	589	572	537	541	531	580	591	583	560	529	480	440	445
Nether-lands	1281	1253	1235	1298	1334	1180	1163	1066	1090	1082	993	987	1028	804	750	730
Σ	76076	71104	65322	63846	63106	59357	60225	58932	57680	56000	53909	53090	49857	46832	45296	42953

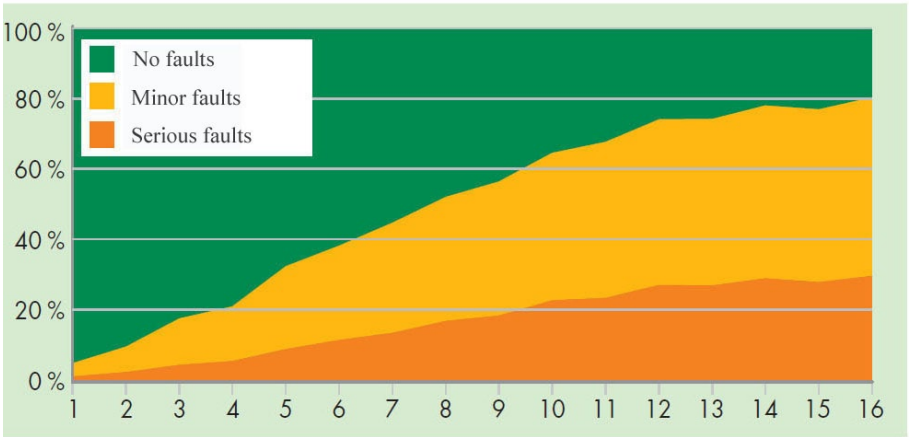

Fig. 2. The share of minor and serious defects depending on the vehicle's age [7]

All data, from 1974, consisted of:
– death rates (number of highway deaths per year per registered vehicle, obtained from the National Safety Council),
– injury rate (number of individuals injured per year per 1,000 vehicle-miles, obtained from the US Federal Highway Administration), and
– accident rate (number of non-fatal accidents per year per 1,000 vehicle-miles, obtained from the US Federal Highway Administration).

The analysis involved the use of statistical model taking into account such basic variables as: the implemented technical inspection program and its scope, procedures for the driving license renewal, and minimum damage required for reporting an accident. In addition, in order to equalize the states on all measures, the following independent variables were incorporated into the statistical equations: population density, median of the family income, fuel consumption, share of federal highways, the percentage of the population between 18 and 24 years of age, and alcohol consumption.

Statistical comparisons were undertaken on data from selected states. The comparisons included:

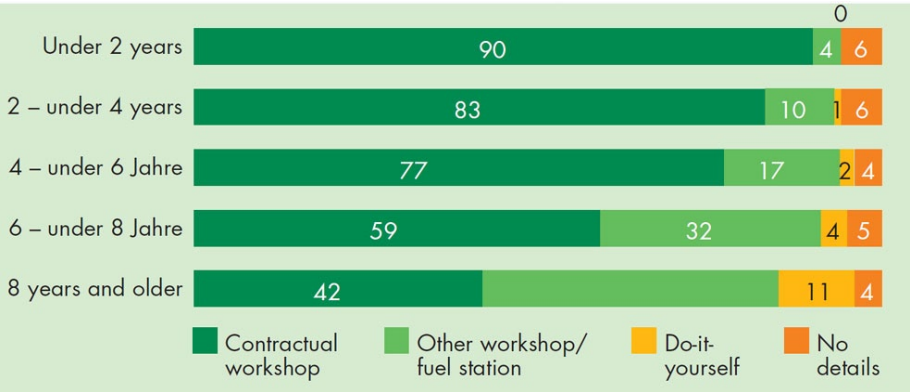

Fig. 3. The type of garage conducting servicing depending on the vehicle's age [7]

– the accident rate of states with *periodic motor vehicle inspection* (PMVI) compared with those states with no PMVI (including those with random inspections),
– states requiring annual inspections compared with the states requiring biannual inspections, and
– states employing random inspection procedures compared with those that employ compulsory periodic inspections and those with no inspection programs.

The results of the analyses showed no statistically significant differences in the accident and injury rates for the states with PMVI compared to the states without PMVI. There was no statistically significant difference in accident rates between the states with biannual PMVI and states with annual PMVI. Crain (1981) has noted that "… vehicle technical inspection programs do not have the expected effect of reducing accident rates" and that "…more frequent inspections do not result in the reduction of the accident rates".

In addition, there were two unexpected findings of this study. The first was that there was a tendency for states with PMVI programs to have higher death rates than those without PMVI, although this was not a statistically significant difference. The second was that states that conduct random vehicle inspections were found to be those with the lowest accident rates.

Crain (1981) suggested two reasons why PMVI programs may have failed to reduce crash rates. Firstly, additional resources devoted to vehicle maintenance as a result of periodic inspection may not affect the vehicle's safety systems, and secondly, even if they do, it is. dissipated by adjustments in drivers behaviour who convinced about their vehicles reliability adopt more risky behaviour.

In the National Highway Traffic Safety Administration (NHTSA) study [5] (1989), data was analyzed to determine whether PMVI system was having an impact on reducing the accident rates of passenger cars.

Three series of analyses were carried out. The method for all three series involved analyzing the crash rate proportion of old to new cars in each state and comparing the results for the states with PMVI system with the results for non-PMVI states. The rationale for this is as follows. As vehicles age, the condition of components critical to safety deteriorates and therefore the likelihood of accident involvement as a result of mechanical failure increases. If PMVI is successful in maintaining the mechanical condition of cars, then there will be less difference in the accident involvement rates of old to new vehicles in PMVI states than in non-PMVI states. Differences just in the accident involvement rate of newer cars in PMVI states as compared to non-PMVI states may discount the effects of PMVI, as new cars would have not been in service long enough for significant wear of mechanical components to occur.

Of all the states in the USA, 22 had PMVI and 29 did not at the time of this study.

Three main data sources were used in the NHTSA analyses:

– Fatal data. This was obtained through the Fatal Accident Research System (FARS). This is a census of all fatal motor vehicle crashes in the US occurring on a public roads in which a death occurs within 30 days of the crash. A limitation of FARS data is that it only contains data for fatal crashes, which make up less than 1% of all crashes. The advantage of this data is that it is available for all states within the US, so valuable comparisons between the states can be made.
– State accident data. State accident file data, obtained from each US state, was also used. Limitations of this data include the fact that only a small number of states were included, and that there may be differences in accident reporting styles between states. The advantage is that this data includes all types of accidents. This data was used for 10 states; four PMVI states and six non-PMVI states.
– Component failure data. CARD file data (Crash Avoidance Research Data) supplied information on component failure. This data identifies vehicles coded by police officers as having a component failure that was suspected of contributing to the crash, as well as coding for all other causes of accidents. Thus, the proportion of vehicles believed to have a component failure contributing to the crash can be identified. Component failures that were identified were categorized into defective brakes, defective steering, defective or improper lights, worn or defective tires and all other defects.

The author has commented on two factors that may be influencing the data. Firstly, 19 out of the 29 non-PMVI states conduct random inspections of passenger vehicles (roadside inspections). Secondly, within the PMVI states there is considerable variation in the equipment items inspected and the procedures, rules and regulations for inspections.

Two comparisons were carried out as part of the first series of analyses. The first comparison was between crash rates of cars ranging from one year to three years old over a single 12 month crash period between July 1 1985 and June 30 1986. FARS and state accident data were used for this comparison. The FARS data showed that fatal crash rates are higher in PMVI states for some model years and lower for others. There is no clear indication that crash involvement rates across vehicle model years are consistently different in non-PMVI, compared to PMVI states. The state accident data showed that the overall accident rate was always higher in states without PMVI, regardless of the age of the vehicle (a 10% difference overall). The fact that this finding was for vehicles of all ages makes the analysis of the effectiveness of PMVI, confusing. If PMVI was having an effect, then there should be no difference in the crash rates of new cars in PMVI states when compared to non-PMVI as they would not yet have had a chance to deteriorate and therefore be able to benefit from inspections. These findings give "…no evidence that PMVI programs affect the crash involvement rates of older vehicles compared to newer vehicles".

The second comparison was for crash rates of 1975 model year cars over the years 1976 to 1986, using the FARS data. It was found that there was a decrease in the relative fatal crash rates as vehicles aged for both PMVI and non-PMVI states. There was no difference between PMVI and non-PMVI states for an older car to have a crash. Thus, there "…is no trend supportive of a PMVI effect".

A second series of analyses used Crash Avoidance Research Data from 1984 to 1986 for four states, Maryland and Washington, which are non-PMVI states, and Pennsylvania and Texas, which are PMVI states. Only passenger cars 10 years or younger were included in the analysis.

The proportion of crashed vehicles with a component failure that was reported to have contributed to the crash was found to be signifi-

cantly greater in the states without PMVI for cars of all ages. This difference ranged from less than 0.25% to a 2.5% difference, depending on the age of the car. Older cars experienced a greater difference.

In a follow up analysis, using FARS data, it was found that the proportion of vehicles involved in a fatal crash with defects reported as having contributed to the crash is consistently higher in non PMVI states than in PMVI states. There was a non statistically significant tendency for this difference to be greater the older the vehicles. The fact that proportion of older crashed vehicles with a component failure reported to have contributed to the crash was found to be greater in the states without PMVI, supports the notion that the difference is due to inspections. However, the author has noted that ".....the differences in defects reported in relatively new vehicles between non-PMVI and PMVI states were most likely due to factors other than the presence or absence of a PMVI program"

Using Crash Avoidance Research Data leads to similar conclusions. Tyre failures were found to be significantly more common (up to 2.5%) in non-PMVI states for almost all vehicle ages, possibly indicating a PMVI effect. However, again, "....the fact that non-PMVI states reported a significantly higher percentage of component failures in relatively new cars suggests that factors other than the presence or absence of PMVI may account for the difference in component failures reported".

An interesting contribution to these considerations makes the study by Christensen and Elvik 2006 "Effects on accidents of periodic motor vehicle inspection in Norway" [1]. System of periodic technical inspection was established in 1995, when Norway signed an agreement with EU in 1994 to ensure access for the Norwegian export to the inner market of the EU. There were negative binomial regression models used in the analysis. Data on the inspections carried out between 1998 to 2002 (5 years) were obtained from the Public Roads Administration. This data contained, for each car, the number of inspections and the outcome (defects coded) of each inspection. Data on the inspections was then forwarded to a major insurance company in Norway and matched with policy holders data (including accidents reported to the insurance company) for cars insured by that company. Data was successfully matched for 253,098 cars. There were the following findings:

1. Technical defects in cars are associated with a small, but statistically significant increase in accident rate.
2. Periodic inspections lead to the repair of technical defects.
3. Following periodic inspections, the accident rate of inspected cars does not decline, but shows a weak tendency to increase.

The third finding was surprising, trying to explain the authors speculated, that after roadworthiness test driver's become convinced that their cars are fully functional and safe, and therefore adopt more risky behaviour.

The next interesting experimental study from Norway [6] was made by Fosser „An experimental evaluation of the effects of periodic motor vehicle inspection on accident rates" several years earlier, when there was no periodic technical inspection. For the purpose of the study there was randomly selected sample of 204000 cars which were divided into three groups. 46000 cars were tested every year, 46000 were tested once every three years and 112000 cars were not tested at all. Accidents involving these vehicles (204000) were recorded in four years. There was no difference in the rate of accidents among groups. The technical condition of tested vehicles was better than those that have not been inspected. The conclusion Fosser reached was: the frequency of periodic technical inspection has no effect on reducing the accident rate, and that periodic technical inspection has no effect on reducing the accident rate if there is roadside inspection system implemented.

3. Conclusions and evaluation of the literature data

Polish statistics are consistent with the results of studies [1, 2, 4, 5]. In Poland there were 3571 fatalities, according to the data of Traffic Department of the Police Headquarters in 2012, out of which six people died due to technical causes, which represents 0.17%. It means that six people died in accidents that occurred for the reasons caused by technical defect, but this number is underestimated, as in other cases, the technical problems causes may also have a significant impact, which, however has not been clearly proven.

It is unquestionable that as a result of periodic roadworthiness tests, the defective cars are repaired and their share in road traffic is decreasing, but on the other hand periodic technical inspection does not guarantee proper technical condition of the vehicle in the period between the tests. During that time the user is responsible for the technical condition of the car. Inspection centre only helps to diagnose defects and forces the user to make a repair. Caring for the condition, attitude, state of mind of the average citizen, as well as his material status is crucial for the proper condition of the vehicle. Test centre disciplines citizens in that matter.

The problem of estimating the exact percentage of the number of road accidents involving fatalities due to technical reasons results from the fact that only the competent authority, which is police, has access to the critical data and cases and the data is only in their discretion and judgment as well as the insurer. Thus the access to this legal sensitive data is difficult for researchers dealing with road traffic safety. The cause of accident is often complex and it may be dependent on the combination of factors and circumstances. It is believed that the number of road accidents that occurred for technical reasons is underestimated relative to the real number of such events [5]. Many publications [3, 6, 7, 9] as an axiom assume that the implemented roadworthiness system reduces the number of road accidents that occurred for technical reasons. In the paper [8], the authors estimate that the implementation of roadworthiness system reduces the number of accidents due to technical reasons by a half. On the other hand comparative studies [1, 2, 4], where the direct comparison was carried out, showed no statistically significant difference between the number of road accidents that occurred for technical reasons for the territories with implemented and not implemented system of periodic technical inspection. There are many publications where the authors take axiomatic assumptions and on its basis build theory of quantifying impact of the roadworthiness system on the number of road accidents due to technical defects. A strong counter-argument to this approach is represented by the results of [1, 2, 4, 5] papers, where they deny correctness of the accepted axioms. It is difficult to solve who is right, because of the difficulties associated with the correct assessment of the methodology adopted, however the author of this paper is inclined to the view that one should not overestimate the impact of the system of periodic technical inspections on the road traffic safety. The system performs the task of reducing the share of vehicles with defects on the road, but it should not be overrated, and its impact on the road safety and the number of accidents due to technical reasons is limited. In the U.S., where there is highly developed automotive industry, in the times of crisis, many states abandoned the system of technical inspection of vehicles [9]. In 2011, only 18 states had the system contrary to the maximum number of 31 states before the crisis. In the states that have moved away from the system of technical inspections there does not seem to be any significant negative impact observed on the indicators related to the road safety. Therefore, when designing new regulation in this area, in the current economic situation, authorities should pay particular attention to the effects of new solutions in conjunction with the burdens for citizens and investments on the side of entities performing technical inspections. Already functioning system should be rationalized so that the changes resulted in the desired high quality of inspections without increasing the burden to the citizens and the

economy. Our Polish solutions should not go beyond the requirements which are set out in the draft Directive on roadworthiness tests for motor traffic, in July 2012.

4. Final conclusions

Review of the literature indicates that the spread of the results of the effects of periodic roadworthiness tests system on the road traffic safety is quite significant. Depending on the methodology adopted it produces result of several percent, but also some empirical studies found no such effect at all, as was the case in the previously cited Fosser's work [4] and Christensen and Elvik [1] who found that the ratio of defects among tested vehicles markedly decreased, but contrary to expectations it had not a significant impact on reducing the number of accidents involving technical causes.

The number of accidents involving also technical causes (failure) is usually estimated at (2–6) %, while for the accidents, where the technical defect was identified as the only cause, the rate is below 1%. All this allows to formulate the thesis that the impact of periodic roadworthiness tests on the road safety should not be seen as a big value, but rather as being too small to be measurable. It is usually estimated at a few tenths of a percent, as for example in the above cited work by Cuerden [3] where for technical reasons there were only 28 cases out of the analyzed sample of 4744 recorded cases, which is equal to about 0.6%.

Above findings lead to a question about the rationality of drastically increasing requirements for roadworthiness inspection system. The European Commission has published a draft "Package on roadworthiness – more stringent checks of vehicles in order to save lives", which began a hot discussion about the need to improve system and inspect the vehicles to a greater extent than before. This discussion was the inspiration for this article. It should also be noted that at the time of work on a draft package a significant number of stringent regulations was dropped and the current version is much less restrictive than the original version.

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