

ANALYSIS OF THE INFLUENCE OF UNDESIRABLE ACTIONS OF OPERATORS OF TRANSPORT MEANS ON SAFETY OF TRANSPORT TASK ACCOMPLISHMENTS

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Abstract

Safety of transport is the main goal of transportation systems to achieve. This is of crucial importance for the road transportation as the number of used transport means is constantly increasing which involves a rise in the number of used vehicles and an increase in the intensity of traffic, especially in urban areas. Obviously, actions aiming at reducing the number of road collisions and protecting people involved in those events have been taken. These actions are taken both by vehicle designers both active and passive safety systems, as well as road traffic engineers who are responsible for actions aiming at increasing the safety level of transport infrastructure through implementation of Intelligent Transportation Systems.

Although there are more and more modern engineering solutions in the fields of vehicle design and road traffic, it is still the human who is the weakest link of the socio-technical system, including the system of road transportation.

For this reason, the authors of this work have made an attempt to analyze the undesirable impact of transport means on the safety of transport tasks. The experimental tests have been performed within a real system of municipal public transportation to illustrate a transportation system exposed to changing conditions of road traffic during twenty-four hours.

Keywords: transport system, hazard, safety working

1. Introduction

Efficient public transportation is one of the conditions of a harmonious development of the urban space. It also has a large influence on the road traffic safety. As many experts as 136 claim that Poland, similarly to the countries of the European Union, imitates the cycle of addiction to the car which results in the growth of air pollution, noise, and traffic congestion. There should be maintained a balance between the development of roads and use of private cars, on the one hand, and expansion of the network of connections within the public transportation, on the other hand. Tests show that approximately half of the households are not in possession of a car, which means that there is a numerous group of people for whom access to efficient public transportation is of big importance.

The main problems the public transportation has to face are insufficient layouts and investments and in consequence, obsolete fleet and lack of non-collision traffic solutions in the network infrastructure. In the years 2007-2009, there was reported a drop in the number of passengers carried by public transport (land) by 420 million people (that is 10.00%) – from 4001 m. in 2006 to 5779 m. people in 2009. However, an increase was reported only in provinces: the percentage of city dwellers using public transportation increased in the years 2007-2008 by 0.3 %, on the average, whereas an increase was observed in ten provinces (the highest in the Kujawsko-Pomorskie and Łódzkie provinces), and a drop in six (the highest in the Warmińsko-Mazurskie province).

2. The research thesis and goal

It is possible to assess the risk of an undesirable event occurrence, in the system of public transportation, on the basis of an analysis of reports on the events that occurred within the analyzed research object.

The research objective is to make an analysis of threats, resulting from improper behaviour of urban public transportation vehicles drivers, to safety of the transport tasks performance.

3. The research object and subject

In this article, the research object is the Bus Transportation Company carrying out transport tasks within a big urban agglomeration.

In the analyzed Bus Transportation Company, there are urban buses of different makes and types. The content of train in ZKA (Bus Transportation Company) according to the production year and the bus type, has been presented in Tab. 1 and 2.

Table 2 shows the fleet of trams, which proves that 94% of rail vehicles were purchased between 1977 and 1999. In 2003 Pesa Bydgoszcz SA modernized one tram and in 2008, in pursuit to meet the demand of elder and disabled persons, MZK Spółka z o.o. in Bydgoszcz purchased two low-platform vehicles of the type Pesa 122N. Besides, the company has one tram produced in 1989 which is used in the period of summer as a tourist attraction and two trams produced in 1960. In the period of vacations, one of them is used for rides promoting the city of Bydgoszcz and the company. The second one is used for technical rides in the event of a failure of regular trams in order to provide them with assistance to come back to the depot.

The basic functions of the identified research object include:

passenger land transport, urban and suburban,

- the remaining passenger land transport, not classified elsewhere,
- operation of passenger cabs,
- road freight transport,
- renting and leasing of the remaining automotive vehicles except for motor cycles,
- renting and leasing of the remaining machines, devices and property, not classified elsewhere,
- works connected with construction of roads and freeways,
- works connected with construction of railways and subway,
- works connected with pulling down construction objects,
- preparation of the land for construction works,
- maintenance and repair of passenger vehicles, except of motorcycles,
- service activities connected with the land transport,
- works connected with construction of telecommunications and electro-energetic lines,
- renting and management of own and leased real estates,
- the remaining tests and technical analyses,
- repair and maintenance of the remaining transport equipment,
- inland water passenger transport,
- renting and leasing of water transport means,
- research on the public opinion market,
- the remaining activities in the field of health care, not classified elsewhere,
- operation of advertisement agencies.

4. Operational tests

Experimental tests were carried out in areal transportation system – Bus Transportation Company in a big urban agglomeration. Due to the set goal, data obtained for assessment of the system operation safety, concerned people involved in the system and its environment, the main

Tab. 1. State of the bus fleet of the analyzed system, on 31.12.2010

MAKE, MODEL AND TYPE OF BUS	YEAR OF PRODUCTION													
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
Mercedes Benz Conecto LF G	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Long														
Mercedes Benz Conecto LF	-	-	-	-	-	-	-	-	-	-	-	2	3	5
Short, low-platform														
Mercedes Citaro G 2008	-	-	-	-	-	-	-	-	-	-	-	12		12
Long, low platform														
Mercedes Citaro G 2007	-	-	-	-	-	-	-	-	-	-	9	-	-	9
Long, low platform														
Mercedes Citaro	-	-	-	-	-	-	-	-	-	-	2	-	-	2
Short														
Mercedes Conecto G	-	-	-	-	-	-	-	-	10	13	9	-	-	32
Long														
Volvo 7000A	-	-	-	-	4	-	-	-	-	-	-	-	-	4
Long, low platform														
Volvo B10 BLE	31	4	6	-	-	-	-	-	-	-	-	-	-	41
Short														
Volvo B10 BLE6x2	-	-	3	8	-	-	-	-	-	-	-	-	-	11
Long														
Volvo B10 LA	-	13	2	-	-	-	-	-	-	-	-	-	-	15
Long, low platform														
Volvo B10 L		7	-	-	-	-	-	-	-	-	-	-	-	7
Short														
Volvo B10 MA	9	6	-	-	-	-	-	-	-	-	-	-	-	15
Long														
MAN NG313	-	-	-	5	2	2	-	-	-	-	-	-	-	9
Long, low platform														
MAN NL 223	-	-	-	7	-	-	-	-	-	-	-	-	-	7
Short														
Jelcz M181M/1	-	-	8	-	-	-	-	-	-	-	-	-	-	8
Long, low platform														
	40	30	19	20	6	2	0	0	10	13	20	14	6	180

data, which were obtained from the tests, concerned:

- bus driver's identification number
- bus driver's age
- successive hour of the drivers work,
- the driver's seniority in the analyzed system,
- establishment of number of passengers at the time of an event,
- establishment of the event perpetrator.

Tab. 2. State of the tram fleet of the analyzed system, on 31.12.2011

MAKE AND TYPE OF TRAM	PRODUCTION YEAR						
	1898	1960	1977-1990	1980	Modernization 2003	2008	Total
Herbrand	1						1
5ND		1					1
Konstal 5N		1					1
Konstal 805Na			115				115
Konstal 805NM				1			1
Konstal 805NMD					1		1
Pesa 122N						2	2
Total	1	2	115	1	1	2	122

5. Results of experimental tests

The experimental tests provided data on the number of road events and their perpetrators. The results of carried out tests are contained in the annex to this paper and the most important of them have been presented in a graphic form, in Fig. 1-9.

As the data presented in Fig. 1 shows, it is the bus transportation system, which has generated a bigger number of undesirable events, which accounts for 68% of all the events. Analyzing the events according to the type, it can be seen, that in the Tram Transportation Company, apart from accidents, there also occur derailments, which further will not be dealt with as they account for merely 4% of all the events. After having analyzed the source data, dead or injured people were not reported in result of those events.

The next step of experimental tests involved identification of perpetrators of the accidents, which occurred during the analyzed period of time. In Fig. 2 we can see the number of road events related to Bus Transportation Company, with regard to perpetrators of given types of events.

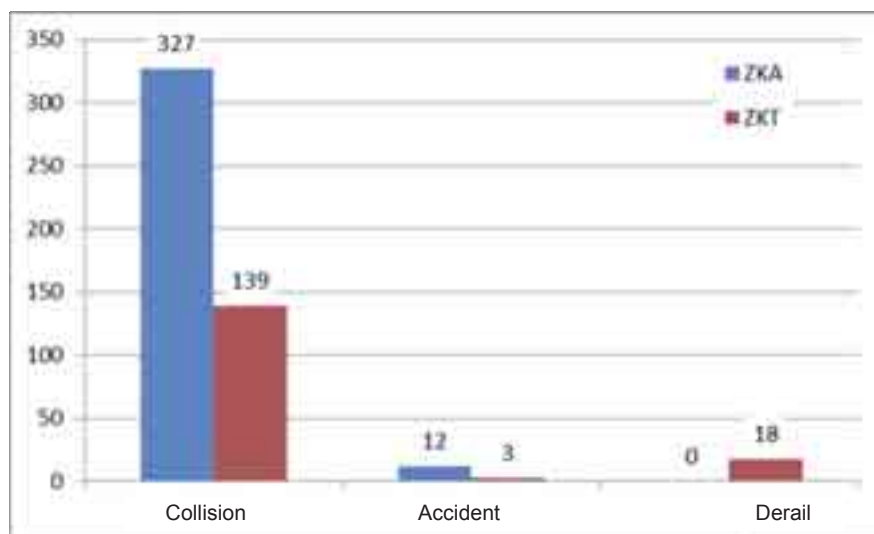


Fig. 1. Number of undesirable events which occurred in the analyzed systems: the Bus Transportation Company and the Tram Transportation Company

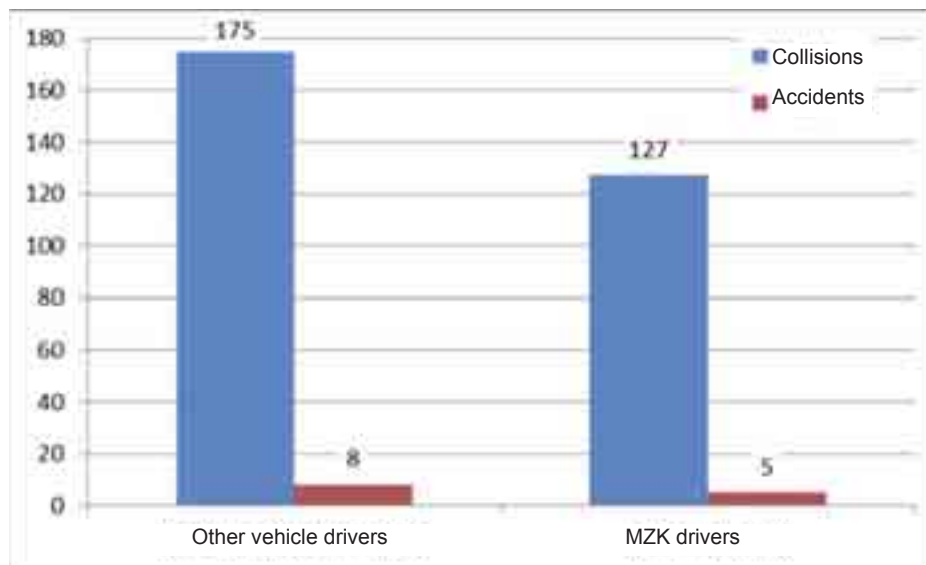


Fig. 2. Number of undesirable events related to the Bus Transportation Company with regard to the perpetrator of a given type of event

According to the data presented in Fig. 2, the involvement of other cars drivers and drivers of the analyzed system is even. In the analyzed period of time, approximately 57% of road collisions were caused by improper behaviour of drivers of other cars, and 43% by drivers of MZK buses (Bus Transportation Company). The situation is different in case of the Tram Transportation Company whose vehicles were involved in 39 road collisions and 3 road accidents. As many as 74% were caused by drivers of other vehicles which happened to be in the environment of the analyzed system.

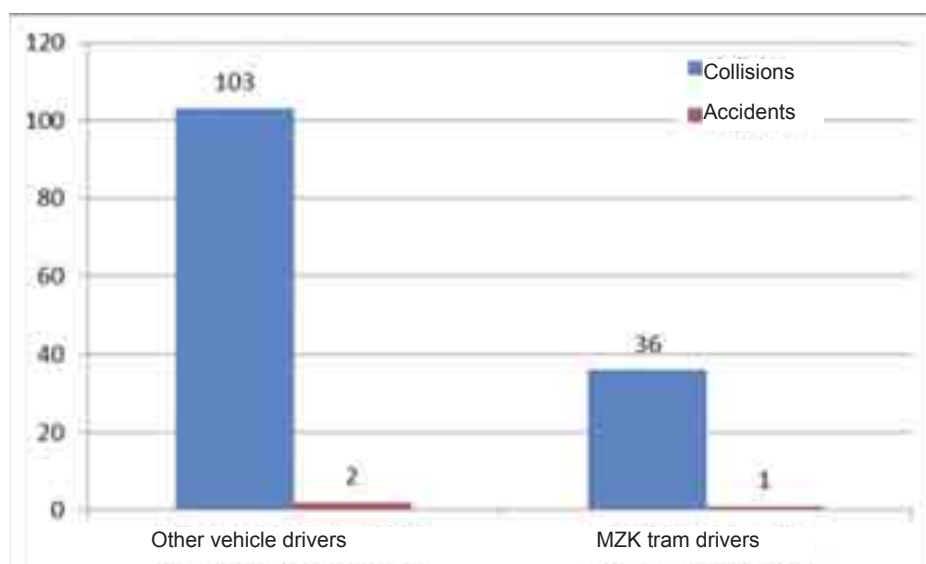


Fig. 3. Number of undesirable events which occurred in the Bus Transportation Company with regard to the perpetrator of a given type of event

Further, in this work, the accident perpetrator's sex is analyzed with a division into other cars drivers and ZTK (Tram Transportation Company) drivers. The results of this analysis have been presented in Fig. 7, 4 and 5. According to the data, the great majority of accidents perpetrators are men. In 63% of road collisions tram drivers were involved. For obtaining more precise data it would be advisable to perform tests in order to find out the number of employed men and women drivers.

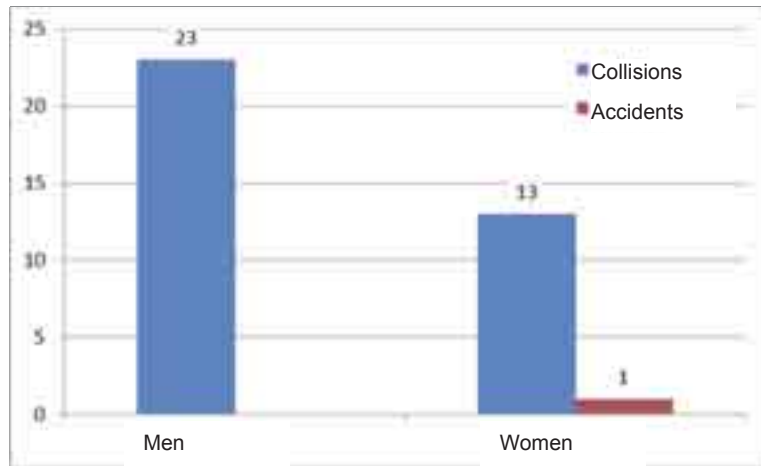


Fig. 4. Number of undesirable events which occurred in the Tram Transportation Company caused by the company drivers with regard to the drivers' sex

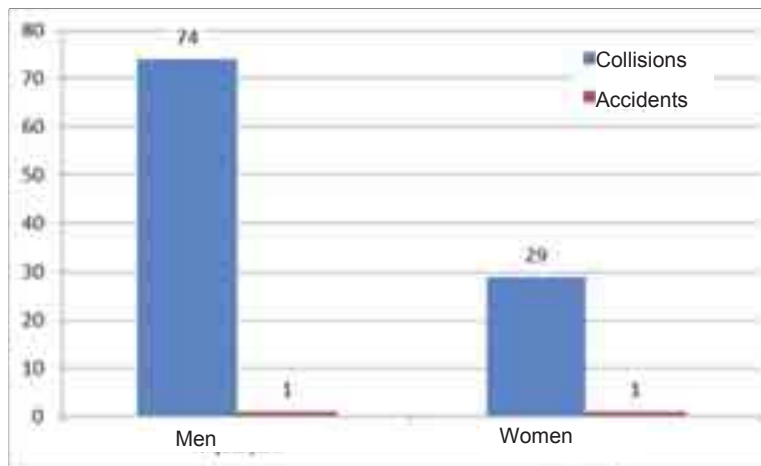


Fig. 5. Number of undesirable events occurred in the Tram Transportation Company caused by other cars drivers with regard to the drivers' sex

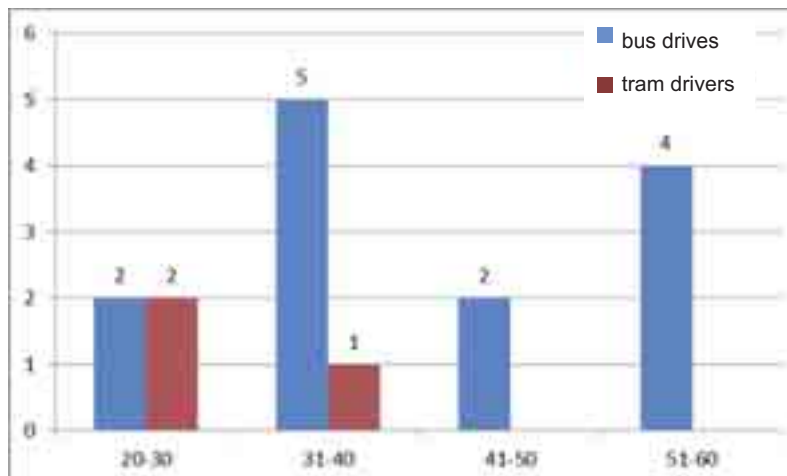


Fig. 6. Number of road accidents in terms of age of drivers involved in accidents

In this work there has also been analyzed the age of drivers, and tram drivers involved in road events. Results of this analysis have been presented in a graphic form, in Fig. 6 and 7. The group of drivers involved in most of road accidents, both from ZKA and ZKT, includes those one whose age is between 41 and 50.

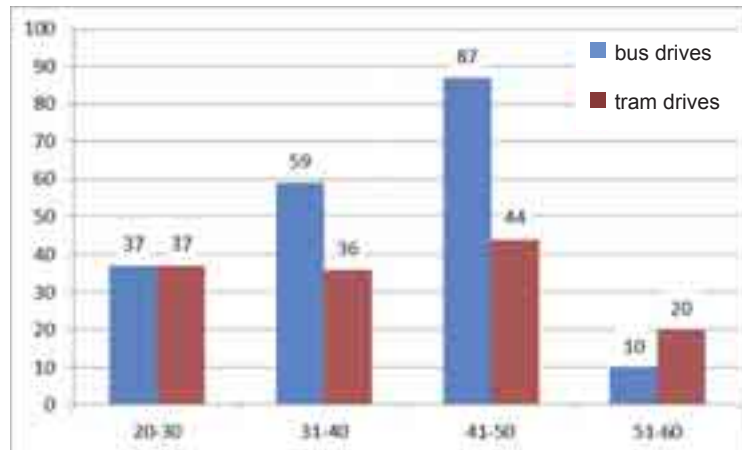


Fig. 7. Number of road collisions with in terms of the age of bus and tram drivers involved in these collisions

In Fig. 8 and 9 there is a number of road events with regard to seniority of the analyzed system employees who have been involved in these events. Due to a bigger number of road collisions than accidents with the involvement of transport means of the analyzed system, Fig. 9 is more clear.

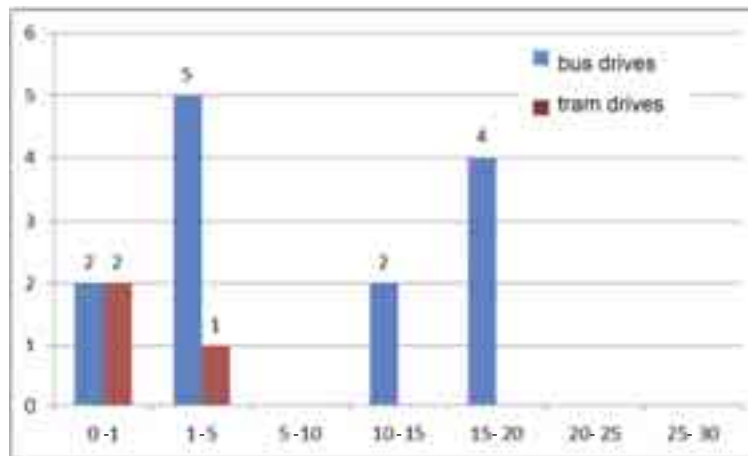


Fig. 8. Number of road accidents in terms of seniority of drivers and tram drivers involved in these accidents

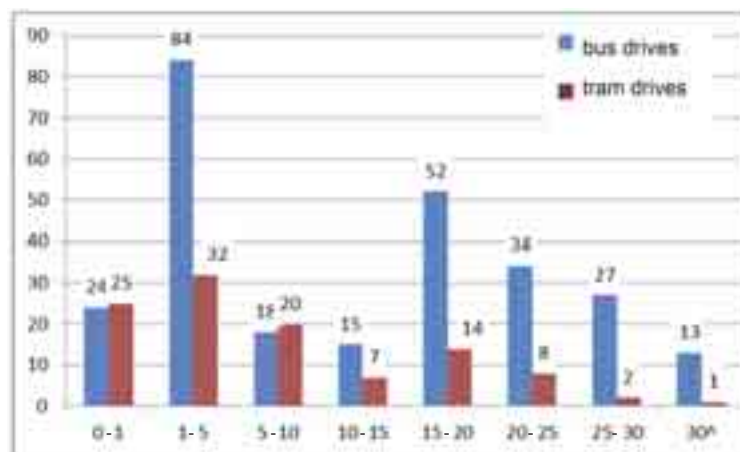


Fig. 9. Number of road collisions with regard to seniority of the drivers involved in those collisions

According to Fig. 9, the group of drivers who have been involved in the most of accidents are those whose seniority is not longer than 5 years. In this figure, employees who have not worked one year are specially distinguished. This is because of the big rotation of drivers employed in ZKA. Drivers employed in ZKA for not longer than 5 years account for 40% of drivers involved in road collisions. The situation in ZKT is similar as drivers whose seniority is shorter than 5 years account for 52% of all drivers.

6. Conclusion

On the basis of experimental tests carried out in the analyzed objects, the following conclusions can be formulated:

- the Bus Transportation Company is more exposed to road traffic events which results from a larger number of rides performed by this transportation system, bigger number of roads, and a bigger number of transport means used in this system,
- the involvement in undesirable events of other drivers and bus drivers, from the analyzed system, is equal. In the studied period of time, approximately 57% of road collisions occurred in result of improper actions of other drivers, whereas 43% in result of improper actions of bus and tram drivers,
- in the great majority road accidents were involved men who were also dominant in the group of accident perpetrators,
- the most numerous group of drivers involved in road events includes those who are at the age between 41 and 50,
- the group of drivers involved in the majority of accidents are those with 5 year-seniority. Drivers employed in the Bus Transportation Company (ZKA) with seniority longer than 5 years account for 40% of drivers involved in road collisions. An analogical situation is in the Tram Transportation Company (ZKT) where the drivers involved in collisions with seniority shorter than 5 years account for 52 % of all drivers. It would be advisable for the company to minimize the rotation of employed drivers which would result in employment of more drivers with long experience, thus reducing the number of accidents,
- as it results from the literature study ,another group of factors, which involve a necessity of improving road safety, is the undesirable impact of external factors on the driver. Therefore, it would be advisable to perform relevant tests in order to identify the undesirable impact of the environment on the people involved in the transportation system and its environment,
- due to the research set goal, such undesirable events as devastations have not been analyzed in this work. They do not pose a direct threat to human life and health and they are caused by passengers whose behaviours are not the subject of this study. Nevertheless, these events generate costs, so in order to improve efficiency of the public transportation system they should also be significantly limited.

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