

VEHICLE OPERATOR AS A THREAT SOURCE

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Abstract

The road transport systems are sociotechnical systems of a Human – Technical Object – Environment <H – TO – E> type. The primary operation goal of these systems is safe realization of the transport services. Safety is dependent on interaction of the following forcing factors:

- *working – depending on TO operation,*
- *external – describing impact of the environment on people and technical means of transport,*
- *antropotechnical – affecting a TO due to intentional and unintentional actions of a man.*

From the data regarding the reasons for road accidents in road transport systems provided by the Police results that 97% of the analysed reasons are antropotechnical factors. While 78% refers to improper drivers' actions that was why it was attempted herein to identify the sources of the threats resulting from the intended and unintended actions of the vehicle operators in a public road transport system.

In order to increase safety of the bus passengers and people who are in the system environment, it is needed to undertake actions aimed at elimination or reduction of improper drivers' behaviours. Information of the paper may be an initial point for making decisions aimed at increased safety of the transport system operation.

Keywords : *safety, transport, threatening event, road event*

1. Introduction

The superior aim of the transport systems operation, including the systems of public road transport, is safe realisation of the transport tasks. This safety depends on the following factors [13]:

- working – depending on TO operation,
- external – describing influence of the environment on people and technical means of transport,
- antropotechnical – affecting a TO due to intentional or unintentional human actions.

Influence of the forcing factors may be a reason for creating threats in the road transport systems. The opinion presented in the studies [3, 5, 6, 9, 11] says that a threat is a conditional possibility of generating losses due to occurrence of a threatening (undesirable, dangerous) event.

A threatening event – is an event that may cause damage such as loss of life, health detriment, loss of property or disturbance of ecological balance in the environment [7]. Various threatening events, called also as road events, may be distinguished in the road transport: a road accident – an event occurred within a road space, resulting in at least one killed or wounded person, and a road collision – an event, resulting only in material losses [4].

A road event is a complex phenomenon and it may be a result of a human fault, technical condition of a vehicle and the environmental influence. When analysing the reasons for occurrence of the road accidents they should be treated as occurrence of independent events that may occur singly or collectively (table No. 1).

The table 1 represents possible sequences of the events whose occurrence causes states of threat to the safety of a transport system, whereas:

- 1 – stands for such an event that the analysed factor had influence on occurrence of a road event,
- 0 – stands for such an event that analysed factor had no influence on occurrence of a road event.

Tab. 1. Possible sequences of the events leading to a road accident occurrence

Pos.	human faults	technical object condition	environmental influence
1	1	1	1
2	0	1	1
3	1	0	1
4	1	1	0
5	1	0	0
6	0	1	0
7	0	0	1
8	0	0	0

The state of threat to the system safety denoted with No. 8 in the table 1 is an abstract state in which none of the factors mentioned had influence on occurrence of a road accident.

It has been attempted in this paper to evaluate the threat states in which a human had an influence on occurrence of the road accidents. This influence is called as antropotechnical factor of affecting TO due to intentional or unintentional human actions.

The data provided by the Municipal Police Headquarters regarding the reasons for the road accidents in the systems of road transport prove that 97% of the analysed causes are antropotechnical factors. While 78% refer to improper drivers' actions, as presented in the figure No. 1.

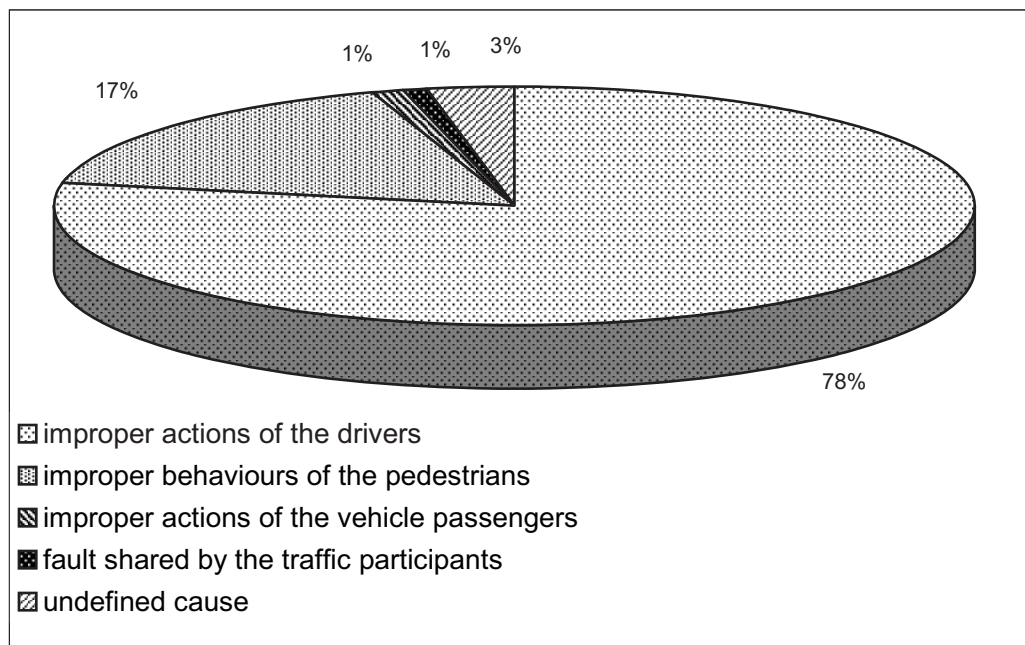


Fig. 1. Percentage of the reasons for occurrence of road accidents (elaborated based on [1])

2. Aim of the study

The aim of the study is to identify selected reasons for occurrence of the threats caused by a human acting, within a system of public road transport, as an operator of the means of transport.

It is to form an initial point to make decisions increasing safety of people situated within this system and its environment.

3. Object and subject of the study

The object of the study is an urban bus transport system, inside a large urban agglomeration. While the subject of the study is influence of the bus drivers' actions on safety of the passengers and people situated within the environment of the road space.

4. Reasons for occurrence of the threats caused by the operators

An operator (a driver), when realising a task, is committed to observe continuously the environment, the situation inside the vehicle, judge the technical condition of the vehicle and process these data in order to choose the best possible steering variant to be safe for the people, vehicle and environment at the same time. The negative side of the activity is human ability to make various faults, that may be intentional (e.g. lack of observance of traffic regulations), or unintentional (which may result from poor health condition, low intelligence level or driver's age). The classification of the operator's conditions and behaviours affecting occurrence of the threats, which may result in occurrence of a road event, are presented below [6].

1. Driver's conditions:

a. psychophysical [10]:

- sight defects,
- hearing defects,
- sickness,
- late reactions (no reaction to potential threat).

b. psychological:

- intelligence level,
- habits.

2. Driver's behaviours:

- driving a vehicle after drinking alcoholic beverages,
- driving a vehicle after taking drugs,
- driving a vehicle after taking medicine reducing the driver's motor abilities,
- driving a vehicle in poor health condition,
- driving a vehicle in bad psychical condition,
- vehicle speed not adjusted to the traffic conditions,
- non-compliance with vehicle right of way,
- incorrect overtaking,
- incorrect passing,
- incorrect passing by,
- incorrect driving over the zebra crossings,
- incorrect turning,
- incorrect stopping,
- incorrect driving back,
- driving on wrong side of the road,
- driving in when red light,
- non-observance of signs and signals,
- failing to keep safe distance between the vehicles,
- sudden braking,
- driving without required lights,
- others.

The conditions and behaviours presented above may cause occurrences of the road events resulting in death or loss of human health.

5. Investigations of the road traffic safety

The investigations were to gather information regarding road accidents in which urban transport system busses were involved. The information was obtained from the road event cards filled in by the police officers at the event place, and from the telegrams describing the event, attached to the cards, which include detailed description of a road event.

An information card intended to gather information concerning the road accidents was elaborated to satisfy the needs of our own investigations. An example of such a card is presented in the table 2. This card was used to describe the course of a selected road event, and namely doors trapping a passenger when she was alighting a bus.

This event was chosen because of the fact that it is the most frequent event appearing in the analysed transport system. The cause for the events of such a kind is closing the bus doors by the driver without prior making sure that all the passengers have already boarded or alighted the bus.

Tab. 2. Card describing a road event (own elaboration)

ROAD EVENT DESCRIPTION			
Date	Time	Additional information on the event.	
11 June 2004	1:15 p.m.		
<i>Event place description</i>			
Bus stop, single carriageway, single direction, hard and dry surface, good weather conditions, daylight			
<i>Event description</i>			
The driver of an IKARUS bus trapped a passenger alighting the bus when closing the doors. He left the bus stop dragging the alighting woman. The backbone of the bus passenger was broken. At 6:00 p.m. the doctor on duty reported the death of the passenger that took place at 4:50 p.m.		The driver did not keep special attention.	
<i>Age</i>	Perpetrator		
aged 43	Bus driver – sober		
<i>Age</i>	Sufferer		
aged 51	Bus passenger – sober		Event result - death

6. Chosen investigation results

The data concerning overall number of the road accidents and collisions of the urban transport system busses as well as the data regarding the number of the road events caused by improper behaviour of the bus drivers were obtained based on the investigations performed – as presented in the table 3.

Tab. 3. Numbers of the road events in which the busses of urban agglomerations were involved from 2000 to 2005

Year	Number of road events		Caused by the bus driver	
	Number of collisions	Number of accidents	Number of collisions	Number of accidents
2000	247	67	106	6
2001	250	71	87	9
2002	277	68	100	9
2003	226	70	77	4
2004	264	65	98	5
2005	273	64	105	7
The average values of the numbers of the analysed road events between 2000 and 2005				
	256.17	67.5	95.5	6.67

As the data entered in the table 3 prove the average number of the road accidents within the analysed time range is equal to 21% of all the road events. The reasons for about 10% of the road accidents were incorrect actions or faulty decisions made by the bus drivers when realising a transporting task.

While table 4 presents the numbers of the people suffering from the road accidents occurred within the analysed period of time that is from 1 January 2000 to 31 December 2005. This table presents also numbers of the people who were killed and injured because of the accidents occurred due to improper actions of the bus drivers.

The data stated in the table 4 prove that 13 people were injured because of improper drivers' actions what represents 17% of the overall number of the people suffering from the accidents occurred.

Tab. 4. Numbers of the people suffering from road accidents in which urban transport system busses were involved between 2000 and 2005

Year	Number of sufferers		Including number of the killed people	
	Overall	By the bus driver's fault	Overall	By the bus driver's fault
2000	62	7	0	0
2001	92	35	2	1
2002	74	15	0	0
2003	80	8	0	0
2004	90	6	1	0
2005	70	7	1	0
The average values of the numbers of the people suffering due to the road accidents occurred within the analysed period between 2000 and 2005				
	78	13	0.67	0.17

On the basis of the data presented in the tables 3 and 4 an index of the killed people per each 100 road accidents $W_{Z/W}$ was determined, the values of this index were calculated according to the following dependence (1).

$$W_{Z/W} = \frac{L_Z}{L_W} \cdot 100, \tag{1}$$

where:

L_Z – number of the people killed due to the road accidents occurred within the time range $\langle 0, t \rangle$,

L_W – number of the road accidents occurred within the rime range $\langle 0, t \rangle$.

On the basis on the data obtained from the performed investigations the values of the index of the killed people per each 100 road accidents $W_{Z/W1}$ and of the index of the killed people per each 100 road accidents occurred due to improper actions of a vehicle driver $W_{Z/W2}$ were set.

In order to illustrate the values of the indices $W_{Z/W1}$ and $W_{Z/W2}$ inside the analysed transport system, they were compared to the values of these indices calculated for a road transport system in a chosen urban agglomeration in Poland and in the European Union. The values of these indices are presented in the table 5.

Tab. 5. Values of the obtained indices $W_{Z/W1}$, $W_{Z/W2}$ within the analysed time range from 1 January 2000 to 31 December 2005

Index	Index value			
	Within the analysed transport system	Within an urban agglomeration	In Poland	In the European Union
$W_{Z/W1}$	0.99	5.93	10.99	3.35
$W_{Z/W2}$	2.54	6.56	10.37	3.15

The values of the indices presented in the table 5 reflect the state of the road traffic safety in various areas starting from the area of selected urban agglomeration, province, Poland to the area of 15 states of the European Union (excluding Poland).

Because of the investigations performed, the values of the indices $W_{Z/W1}$, $W_{Z/W2}$ obtained for the analysed transport system are of special importance.

As it results from the data included in the table, the number of the people killed per each 100 road accidents occurred resulting from improper drivers' actions ($W_{Z/W2}$) inside the analysed transport system is two and a half times higher than the value of the index $W_{Z/W1}$ for the same system. Such high value of the index $W_{Z/W2}$ may result from improper actions of the vehicle drivers that may be caused by the environment or a technical object affecting the drivers as well as by poor psychophysical condition of the drivers.

The values of the indices of the road traffic safety for an urban agglomeration, in which the study object and the other transport systems were analysed are similar, it means that the value of the index $W_{Z/W2}$ is higher than the index $W_{Z/W1}$. The difference between the analysed indices is about 10%. The situation related to Poland and to 15 selected states of the EU is a little bit different. The value of the index $W_{Z/W2}$ inside the European Union is three times less than in Poland.

7. Analysis of the results and conclusions

Based on the results obtained in the course of the study realisation it may be stated that improper actions of the bus drivers are the main reasons for the road accidents occurred inside the analysed transport system. The professional drivers, in the road transport systems, make up a professional group of increased risk, because they are more extensively exposed to forcing factors what results in faulty vehicle steering. These faults may result from the routine actions, fatigue caused by intense traffic, noise, bus stop frequency, and driving a car in poor health condition leading to non-observance of the traffic regulations, decreased watchfulness, etc.

In order to increase safety of the bus passengers and people who are in the system environment, it is needed to undertake actions aimed at elimination or reduction of improper drivers' behaviours.

That is why it is reasonable to continue further studies in order to describe the detailed and most frequent reasons for improper actions of the operators of the urban means of transport. Gathering such information may be an initial point for making decisions aimed at increased safety of the transport system operation.

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