ANALYSIS OF COSTS OF REPAIRS OF UNDESIRABLE EVENTS OCCURRING IN A MUNICIPAL BUS TRANSPORTATION SYSTEM

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Abstract

Systems of public transport carry out their tasks on the territory of a given town and in the suburbs performing the same functions as in towns. A distinctive feature of this type of system is performance of its task for twenty four hours, in different traffic intensity conditions over an assigned administrative area. This type of variables has a large influence on occurrence of undesirable events (failure of vehicles and their devastation, collision and accidents). In the work, an attempt of identification of undesirable events occurring in the analyzed transport system has been made. Moreover, an analysis has been made which covers one day of the week, time of the day and weather conditions in which particular events took place.

Another aspect of the work was to make an analysis of the vehicle driver's age, job experience and a given hour of work on the day of the event occurrence. Obtainment of such data allowed demonstrating the structure of events according to the criterion of the event type, and costs connected with bringing the damaged transport means to the state of serviceability.

The obtained results of experimental tests provide a basis for taking rational decisions by decision makers employed in a given system. These decisions are supposed to reduce the number of undesirable events occurrence and costs connected with them.

Keywords: *transport system, collision, devastation, failure*

1. Assessment of road traffic safety of public transportation systems in urban complexes.

Transportation safety is an important problem both social and economic. This issue has been a subject of numerous researches. Nowadays, the public transportation has to face an enormous challenge which is meeting a constantly increasing needs of the society connected with mobility of its members.

Considering the fact that migration of people in towns is carried out in many different ways: on foot, by individual transport means or by public transportation, the choice of one of them should be provided with arguments for and against. Thus, comparing individual transport with the public one, the first one is to be favoured, as it provides [1]:

- better safety (three times fewer casualties as compared to the individual transportation),
- better efficiency (ten times smaller road network area is needed),
- more environment friendly (as calculated per one passenger they pollute the atmosphere a few times less), which is a factor which is of great importance nowadays.

The above mentioned advantages refer mostly to bus transportation which prevails over other municipal transportation forms. Despite many advantages, bus transportation has also some drawbacks. Passengers can find inconvenient its overcrowding or sometimes unavoidable delays and its dependence on changing weather conditions. However, for the passengers of public transportation, being provided with a high level of the transports safety is of primary importance.

Unfortunately, currently road traffic safety in relation to a municipal transportation is characterized by [2]:

- significant scale of randomness on the part of local authorities and institutions supervising the transportation systems,
- deficiencies in the field of risk analyses (especially risk assessment – acceptable risk limits),
- management of transportation at the local level,
- no ‘benchmarking’ – sharing experience between towns,
- evaluation of risk based on events reported (problems with personal security).

Evaluation of road traffic safety of public transportation systems in urban agglomeration is adversely influenced by a series of problems the cities and their transportation systems have to deal with.

The most important problems of towns are [3]:

- increasing traffic and its impact on the road conditions, including functioning of municipal transportation; a decrease in the speed of travel which diminishes attractiveness of the public transport and raises costs of operation and maintenance, overcrowding is becoming a problem not only in big cities but also in medium and smaller towns. In small towns transit traffic is a big inconvenience, posing hazards for people and the environment,
- lack of methodical planning of transportation systems development in regard to spatial planning, in most towns; decisions on localization of objects generating heavy traffic (e.g. shopping malls,) are rarely based on thorough analysis taking into consideration many aspects; tests of transport behaviours are a rarity,
- although the number of towns whose authorities have developed transportation policies, basically positive for the public transport is rising, their implementation is carried out very slowly; solutions giving priority to trams and buses (separate traffic lanes, separate roads, traffic lights) are rarely applied,
- financial means appropriated for public transportation by local governments are hardly sufficient to cover the difference between operation and maintenance costs and proceeds from sale of tickets; the situation is getting worse because of the common practice to adjust financial planning according to yearly budgets, including expenditures of long-term investment programs; lack of stable rules of tariff policy and funds for modernization and development of the local transportation causes that the range of investment and repairs is not sufficient and in some towns the investments do not occur,

- the share of public transportation in travel is being diminished, especially in medium towns; In big cities the public transportation has the tendency to stabilize the numbers of transports, mainly due to increasing mobility of inhabitants. In small towns and some medium ones a private minibus transportation functioning without subsidies from the local authorities plays a more and more important role. In many cases it is the only form of transport. However, operating with no institutional supervision, it can be dangerous for peoples' health and lives,
- a positive attitude of the society to trams is growing though it does not apply to all the towns in which there exist tram systems and the pace of completion of modernization projects is slow; the main cause are high costs of exchange of the outdated trains which poses danger itself,
- the technical state of infrastructure including the road surface, despite efforts of maintenance workers, is poor. The scale of road investments in towns varies considerably; public transportation is not sufficiently supported financially,
- wide range, technologically advanced systems of traffic and information management are not being created; these low capital consuming investments are characterized by specially high efficiency leading to fast improvement in the traffic continuity and reduction of its inconvenience,
- transportation systems of towns, due to their weak integration, do not favour promotion of inter-modal travel (travel using a few different transport means).

2. Research object and subject

The research subject of the paper covers costs of occurrence of undesirable events within a selected transportation system. The Municipal Transportation Company in an urban agglomeration with the population of 400 thousand inhabitants – its fleet, drivers and all other elements involved in road events with participation of public transportation vehicles, in Bydgoszcz in 2009.

At present the Municipal Transportation Company in Bydgoszcz is the biggest carrier which deals with public transport on the territory of Bydgoszcz.

The operation range of the company covers:

- Land passenger transportation, Urban and suburban,
- The remaining passenger land transport, not classified elsewhere,
- Taxi transport,
- Taxi passenger operation,
- Freicht road transport,
- Rent and leasing of the remaining automotive vehicles except for motorcycles,
- Hire and lease of remaining car vehicles, excepting motorcycles,
- Rent and lease of the remaining machines and devices and material objects, not classified elsewhere,
- Works connected with construction of railroads and underground railways,
- Works connected with construction of roads and freeways,
- Pulling down architectural structures,
- Preparation of the ground for a construction site,
- Maintenance and repair of automotive vehicles except for motorcycles,
- Service activities supporting land transportation,
- Works connected with building telecommunication and electric power lines,
- Rent and management of private and rented estates,
- Remaining tests and technical analyses,
- Production of locomotives and rail trans,
- Repair and maintenance of the remaining transport equipment,
- Inland water passenger transportation,
- Rent of water transport means,
- Market and the public opinion research,

- Other activities in the field of health care, elsewhere not classified,
- Operation of advertising companies.

Tab. 1. Bus fleet of the analyzed transportation system – state from 2010

Make and type of bus	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Suma
Mercedes-Benz Conecto G													3	6	**9**
Mercedes-Benz Conecto LF												2	3	4	**9**
Mercedes-Benz Citaro											2				**2**
Mercedes-Benz Citaro G											9	12			**21**
Mercedes-Benz O345G									10	13	9				**32**
Volvo 7000A					4										**4**
Man NG313				5	2	2									**9**
Man NL223				7											**7**
Jelcz M181M			4												**4**
Volvo B10BLE 6x2			11												**11**
Volvo B10L		7													**7**
Volvo B10LA		13	2												**15**
Volvo B10BLE	31	4	6												**41**
Volvo B10MA	8	7													**15**
Suma	**39**	**31**	**23**	**12**	**6**	**2**	**0**	**0**	**10**	**13**	**20**	**14**	**6**	**10**	**186**

3. Thesis and goal of research

There is a possibility to analyze the costs of undesirable events in a real transportation system on the basis of experimental tests carried out in the system. The research goal is an analysis of undesirable events and costs involved.

4. Analysis of costs of undesirable events

The obtained experimental provided basis for an analysis of factors which could have an impact on occurrence of undesirable events connected. Data obtained for the tests come from protocols of Police and Traffic Supervision.

The carried out tests enable an analysis of events in terms of:

- type of event-for the whole year 2009 and in division into seasons and months,
- quantity of road events costs in division into particular months and seasons,
- percent values of costs of events in division into particular months and seasons,
- defining the most frequent hours of undesirable events occurrence and their impact on the height of costs,
- defining frequency of the involvement of a particular bus drivers in road events and costs generated by them,
- the most frequent kinds of failures, their % share in all the reported failures and costs generated,

- analysis of the influence of weather conditions on occurrence of undesirable events and costs involved.

An analysis of these components will enable to formulate conclusions concerning the main causes of road events occurrence which in 2009, involved costs equal to 580 090.59pln.

5. Exemplary tests results

Analyzing the costs of road events for 2009 born by the studied system of municipal bus transportation, it can be noticed that among the selected events in 2009, its biggest part includes collisions. There were 266 collisions and the costs connected with this type of events reached the sum of 444,498>48 PLN. Collisions accounted for 59% of all the events and their cost accounted for as much as 77% of costs of all the events. Next, according to the classification, were devastations whose number was 143 which cost 114,119.92 PLN. Devastations accounted for 32% of events and their value for 20% of all the costs.33 events ware in 2009 were failures at the cost of 18,870.52PLN . they accounted for 7% of all the events and 3% of all the costs. Other events did not involve significant costs. Altogether in the year 2009, 447 undesirable events were noted, and they involved costs at the level of 580,090.59 PLN. Tab. 2 shows a detailed presentation of the number and costs of undesirable events which occurred in 2009.

Tab. 2 Presentation of number and costs of undesirable events which occurred in 2009

Year 2009	Number	Sum[PLN]
Collision	266	444 498.48
Devastation	143	114 119.52
Failure	33	18 870.52
Unknown circumstances	3	1 429.07
Lack of data	2	1 173.00
Total	447	580 090.59

As it can be noticed, the main source of costs is collisions with participation of MTC (Municipal Transportation Company) drivers. The second source of costs is devastations of the vehicles which are caused by their users. In this case the cause of serious costs is an external factor.

The same costs have also been analyzed in division into particular months, the type of event and in terms of both frequency and sum of costs –which has been presented in Tab. 3.

Considering the remaining costs, in division into particular months and events, the following facts can be noted:

The majority of collisions took place in January (13%), February (10%), March (14%), and April (12%). In terms of collision costs, the biggest share of costs occurred in January (24% - 104,725.53 PLN) and February (22%-96,310.23PLN). Devastations are not characterized by a defined occurrence scheme. Their big number occurred both in January (15%) and April (14%) and in June (10%). According to the above presented data the highest costs connected with devastations were born in November (19% 22.213, 26 PLN , in April (18% -20.894,23PLN) and in May (11%-16,117.26PLN). Thus, the number of devastations is not necessarily connected with the amount of costs. The most frequent failures happened in October (24%) and May (21%). Whereas the highest costs resulting from failures were reported in July and accounted for 42% of the whole sum (the sum was 7,707.00pln).

Tab. 3. Analysis of undesirable events in 2009 in terms of the event type – in division into particular months

	Collision		Devastation		Accident			
Year 2009	Number of events	Sum [PLN]	Number of events	Sum [PLN]	Number of events	sum [PLN]	Number of events	Sum [PLN]
January	35	104 725.53	21	12 699.16	0		2	588.01
February	26	96 310.23	13	7 846.52	0		0	
March	38	55 245.89	16	9 266.15	2	604.71	0	
April	32	42 442.08	20	20 894.23	0		1	1 153.70
May	23	14 988.19	14	16 117.26	0		7	2 979.62
June	27	48 474.36	15	8 304.26	0		2	242.89
July	19	9 803.42	8	10 280.95	0		2	7 707.00
August	10	3 057.62	2	560.00	0		1	130.00
September	9	26 421.27	4	708.20	0		6	1 234.00
October	21	10 120.84	8	1 845.00	0		8	2 723.00
November	4	7 972.00	12	22 213.26	0		3	1 839.30
December	20	24 332.34	10	3 384.53	0		1	273.00
Sum	**264**	**443 893.77**	**143**	**114 119.52**	**2**	**604.71**	**33**	**18 870.52**

6. Conclusion

According to the carried out tests, the group of undesirable events that generates the highest costs are road events. Therefore, it is necessary to take actions to reduce post-collision costs connected with a road event with involvement of buses. These can be additional trainings for bus drivers being, responsible in most cases for such events, and in consequence will improve their qualifications and skills These actions can also include works aiming at an improvement of road surfaces, the infrastructure and organization of traffic.

Moreover, actions should be taken to make passengers aware of the fact that devastations impair the quality of the services provided by the system of public transportation and in order to charge vandals with fines the existing fleet should be equipped with monitoring systems.

References

[1] Szołtysek, J., *Podstawy logistyki miejskiej*, Katowice, Wydawnictwo Akademii Ekonomicznej, s. 70-71, 2007.

[2] Franek, Ł., Dźwigoń, W., *Transport publiczny w zintegrowanym systemie BRD*, s. 2 http://www.gambit.fril.org.pl/files/Prezentacje/06_F_Dzwigon_L_Franek-Transport_publiczny _ w_zintegrowanym_systemie_brd.pdf, stan na 13.04.2011

[3] *Polityka Transportowa Państwa na lata 2006 – 2025*, Ministerstwo Infrastruktury, Biuro informacji i promocji, s. 28-29, Warszawa 2005.