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Problems of Development of Public Transport in Yerevan

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ABSTRACT

The problems of improving the quality of public urban transport services, environmental protection, and public health in large cities and megacities have taken the leading place among the issues on the agenda of public administration bodies, as well as of non-governmental and international organisations.

This context determined the study on the significance, modern conditions, problems, and development outlook regarding the urban public transport in Yerevan.

Important part of the population of the Republic of Armenia lives in the city of Yerevan. Main economic activity of the Republic, as well as urban and private transport facilities are most concentrated in the capital city. The total number of vehicles circulating in the city on working days exceeds 300 thousand units.

Urban public transport of Yerevan plays an important role in ensuring the normal life of residents and guests of the city. At the same time, several serious socio-economic problems are associated with transport, which are aggravating while the economy develops and the volume of cargo, passenger transportation and motorization of the city grows. Such problems, first, include the growth of the number of road traffic accidents, then, serious environmental degradation in the areas adjacent to the highways and in other districts of the city.

In recent years, it has become obvious that the solution to those problems goes beyond the competence and responsibility of the city hall or of any single ministry and requires focusing the efforts of the number of government bodies and of the public at large.

The objective of the study is to identify the main factors affecting the efficiency and safety of urban public transportation, as well as the impact of road traffic on the environment in Yerevan.

Their identification will improve the quality of transport services and transportation safety, as well as reliability of vehicles and of their service properties, reduce their environmental impact, and develop a unified integrated effective and viable system of measures towards a comprehensive and effective solution of transport problems of public urban transport.

Keywords: *road transport, Yerevan, urban transport, cargo transportation, passenger transportation, technical condition.*

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Background. According to the official data of the authorized bodies in the field of statistics of the EAEU member states, in 2018, road transport provided about 81,7 % of the total volume of goods transported by transport (excluding pipeline transport) and 94,1 % of passenger transportation in the EAEU [1].

Road transport is still a source of increased danger. According to World Bank estimates, 1,25 million inhabitants of the Earth die every year in car accidents and another 50 million are injured [2]. Growing motorization results in serious deterioration in the comfort of living in large cities and megacities, and that is the issue of concern. According to experts, by 2050, two-thirds of the world population (or 5,4 billion people) will live in cities, many of which are growing rapidly, with serious socio-economic and environmental problems arising from this [3]. In Europe, Luxembourg is the most motorized state, with 654 cars per thousand inhabitants. In Germany, known for its automotive industry and ideal roads, this figure is 556 cars [4]. There are more than 200 cars per thousand inhabitants of Armenia, which is very alarming, given the length and technical condition of roads in Armenia and the relatively low driving culture. In 2017, the number of registered vehicles in Armenia amounted to 554957 units, taking into account the dynamics of imported vehicles, this figure in 2019 will be more than 620000, despite the fact that the total length of roads in the Republic is only 7575,0 km [5].

In 2017, about 35 thousand cars were imported into the country, in 2018 73 thousand vehicles were imported, while in the first half of 2019 more than 70 thousand vehicles were imported [6]. With more than half of all vehicles concentrated in the capital of Armenia, it creates big problems for operation of urban public transport. Let us note that in 2018, the operation life of 90 % of imported cars was above 10 years, which poses a real environmental threat.

In terms of road traffic fatalities, Armenia ranked third in the world several years ago. The main causes of road traffic accidents are a growing number of cars, speeding, exit to the oncoming lane in conditions of almost zero visibility, seatbelts not fastened, and technical condition of cars and roads [7].

Objective. The *objective* of the study is to determine the main factors affecting the efficiency and safety of urban public transport and road traffic, their negative impact on the environment in Yerevan.

Methods. During the study, the methods of content analysis were used; to analyze the current situation in the field of public transport, a visual inspection of rolling stock was carried out.

The article presents the main factors regarding the urban public transport that affect the increase in the efficiency of technical operation, environmental and traffic safety in Yerevan.

Results. Yerevan is not only the capital of the Republic of Armenia, but also a major socio-economic, transport and logistics center; main cargo and passenger transport flows of the Republic of Armenia pass through Yerevan. The number of residents of Yerevan as of January 1, 2018 reached 1077,6 thousand people, which is equal to 36,2 % of all residents of Armenia. The total area of the city is 223 km^2, which is 0,7 % of the area of the Republic of Armenia. The main areas of economic activity in Yerevan are: industry that represents 40,8 % of the country's industry, agriculture (1,2 %), construction (47,9 %), retail trade (74,1 %), services (80,7 %) [8].

In 2018, 84 % of cargo and more than 85 % of passenger transportation was carried out by road transport, the value of which can hardly be overestimated in socio-economic and environmental terms and in the field of road safety. As can be seen from Tables 1–4, road transport plays a decisive role in cargo and passenger transportation in Armenia and, in particular, in Yerevan.

A significant part of cars' runs in the Republic of Armenia and in Yerevan falls on passenger buses and minibuses, which proves their great significance for the socio-economic life of the city (Table 5, 2016–2017).

As can be seen from Table 6, up to 15–16 % of the vehicles is idle, which directly affects performance of road transport and, ultimately, the cost of transportation. One of the main reasons for downtime of public transport is an unsatisfactory technical condition, which leads not only to a sharp

Table 1

Passenger transportation by road public transport [8]

Region, country	January–December 2018, thous. people	January–December 2018 as compared to January–December 2017, %
City of Yerevan	124402,8	87,8
Total: the Republic of Armenia	159037,4	90,5

Table 2

Passenger turnover of road public transport [8]

Region, country	January–December 2018, mln pass-km	January–December 2018 as compared to January–December 2017, %
City of Yerevan	1599,6	89,3
Total: the Republic of Armenia	2227,5	92,7

Table 3

Key indicators of cargo transportation by road transport [9]

Country, region	Cargo transportation by road transport, thous. tons (2014–2017)				Cargo turnover of road transport, mln t • km (2014–2017)			
	2014	2015	2016	2017	2014	2015	2016	2017
Republic of Armenia	62722,5	67724,7	78679,1	98579,2	842,6	892,2	942,4	1103,9
City of Yerevan	5198,2	6187,7	988,9	5892,2	461,2	477,7	481,2	605,9

Table 4

Key indicators of passenger transportation by road transport [9]

Country, region	Passenger transportation by road transport, thous. pass. (2014–2017)				Passenger turnover of road transport, mln pass.-km (2014–2017)			
	2014	2015	2016	2017	2014	2015	2016	2017
Republic of Armenia	206060,6	188842,7	186170,1	181488,6	2594,4	2453,6	2494,3	2462,9
City of Yerevan	163110,3	149786,5	150536,0	143476,3	1845,0	1763,7	1835,4	1794,1

decrease in reliability and performance of a vehicle and can cause significant downtime but can result also in serious accidents.

Yerevan's trolleybus fleet totals 79 units, of which 20 % are in a technically malfunctioning state. 34 units of SKODA brand have an operation life of about 27–30 years, 35 units of LIAZ brand are 9–10 years old, and 9 units of RENAULT brand have operation life of 20–30 years [10].

The bus fleet totals 522 units of vehicles, including 142 units of BOGDAN brand, operation life of 77 % of which exceeds 10 years, 195 units of Haiger brand, operation life is 4–6 years, 75 % of GAZEL minibuses have an operation life of more than 10 years. Monthly expenses for technical maintenance and repair account for 7,6–9,8 % of operating costs.

High deterioration of infrastructure and increased congestion lead to a decrease in speed and in quality of passenger service. In Yerevan, average operating speed of buses is 19–20 km/h, of minibuses have average speed of 19–21,5 km/h, and trolley buses of only 14,4 km/h. At peak hours, on the busiest highways, speed decreases to 5–10 km/h.

Let us note that average speed of public transport in Moscow in 2018 was 15,7 km/h. In 2017, average speed of buses and trolleybuses in Minsk was 15–18 km/h, in Astana it attained 18–21 km/h, and in Kiev 14–18 km/h [11].

In order to increase efficiency and safety of operating public transport in Yerevan, special attention must be paid to the existing problems.

Table 5

Total mileage of road public transport for certain types of vehicles, in 2016–2017, mln km [9]

Country, region	Trucks		Passenger buses (minibuses)		Passenger cars	
	2016	2017	2016	2017	2016	2017
Republic of Armenia	35,927	48,111	133,257	138,981	47,310	47,789
City of Yerevan	23,024	31,312	99,657	103,145	39,573	38,882

Table 6

Public passenger buses (minibuses) in 2016–2017 [9]

Country, region	Quantity, car-day							
	Total		In work		Are in downtime and in the process of technical maintenance		Are in downtime, but technically sound	
	2016	2017	2016	2017	2016	2017	2016	2017
Republic of Armenia	1281050	1230292	840946	827710	202968	194553	237136	208029
City of Yerevan	881352	849090	583187	571544	142920	128609	155245	148937

Problems in technical condition of public transport vehicles in Yerevan

One of the important factors determining efficiency of urban road transport is technical condition and reliability of the vehicles. Depreciation of fixed assets of road transport exceeds 65 %. This directly leads to an increase in costs of technical maintenance and repair, a decrease in safety, reliability and operability of individual mechanisms, assemblies and a car as a whole, a decrease in quality of transport services, an increase in harmful emissions, and cost of transportation. During operation of rolling stock, it is also necessary to adjust frequency and schedule of technical maintenance operations taking into account peculiarities of actual operating conditions, which often and sharply differ from each other, depending on the route, and respecting those conditions will improve reliability indicators. It should be noted that in recent years, increasing reliability of vehicles has become of particular importance, since it directly affects both technical and operational performance of vehicles, as well as operating costs, quality of service and environmental safety.

Problems in the field of negative impact of public road transport on the environment, public health, and the climate of Yerevan

According to 2011-2015 data published in 2017, emissions of harmful substances into the atmosphere of the Republic of Armenia amounted to 291,1 thousand tons, of which 51,50 % are from motor vehicles, 48,5 % are from stationary sources. About 7 % of all harmful emissions were produced in the city of Yerevan and accounted for 19780,4 tons. Harmful emissions per inhabitant of Armenia amounted to 47,4 kg, or 4,96 tons per km^2 (excluding the area of Lake Sevan) [12].

Equally important is noise background created by vehicles. In recent years, due to a sharp increase in the number of vehicles in Yerevan, the permissible noise level in the city center has increased by 25–30 dB.

The low level of efficiency and safety of urban public transport and road traffic, an increase in the negative impact on the environment in Yerevan are due to the following factors:

1) relatively low length of the transport network and the existing quality of roads that impede the growth of passenger transportation;

2) low quality of fuels and lubricants;

3) sharp increase in the use of personal vehicles by residents of Yerevan and suburban areas;

4) low efficiency of the system of training, advanced training, and certification, as well as motivation of drivers;

5) low quality of technical condition of public passenger transport, especially of vehicles with an operation life of more than 10 years, due to limited and insufficient financing of this sector and the lack of mutually beneficial and effective cooperation between the public and the private sector;

6) lack of modern high-tech and highly efficient systems in the field of organization and regulation of traffic;

7) lack of an effective system for monitoring the technical condition of vehicles in operation;

8) low efficiency of the system of periodic technical inspections [13];

9) relatively low efficiency of technical maintenance, repair and quality of work performed;

10) lack of a system that would consider operating conditions for better organization of technical maintenance and repair, while it is very important for urban public transport in Yerevan [13].

Conclusion. Improving the efficiency of public urban transport can be ensured by implementation of necessary technical, economic and organizational measures, in particular, by introducing a modern effective system intended to improve quality of technical maintenance and repair, reliability of mechanisms and assemblies and operation of a car as a whole, as well as by introduction of high-quality car service, taking into account operational conditions and individual factors. The most important purpose of the car service is to preserve consumer qualities [14], necessary technical and operational properties of vehicles providing thus better conditions for respect of traffic safety and environmental safety [15, 16], to prevent defects in components, assemblies, engine, possible causes of failure characteristic of the work, to reduce wear rate of parts and components, and on the opposite to achieve the increase in reliability of vehicles.

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