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Assessment of Quality of Passenger Transportation in the City of Volzhsky in Conformity with the Requirements of the Social Standard

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ABSTRACT

The article considers organisation of transportation services for passengers with public transport followed by their quality assessment in conformity with the requirements of the social standard. The objective of the article is to determine quality of passenger transportation by a municipal passenger enterprise with buses of large and medium capacity and by individual entrepreneurs carrying out transportation with minibuses. The article uses reporting materials on transportation of passengers by municipal and private carriers. To achieve the purpose, quality indicators of passenger transportation by public transport were calculated using the methodology of the social standard approved by the Ministry of Transport of the Russian Federation. The number of points for each indicator defined by the social standard for municipal carriers and individual entrepreneurs is determined, the results of relevant calculations are presented. The analysis of quality of passenger transportation services provided by municipal and private carriers was carried out. The quantitative characteristics of quality indicators values made it possible to determine the current state of passenger transportation services, identify shortcomings and make a forecast for improving quality of services. To improve quality of passenger transportation services, measures were proposed for bodies responsible for transportation and carriers.

Keywords: *urban transport, social standard, quality indicators, public transport, passenger carriers, availability indicators, reliability indicators, comfort indicators.*

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Background. The works and studies of researchers studying the issues of organisation of passenger transportation by public transport propose to introduce quantitative assessment of the quality level. This quality assessment is possible at all levels of organisation and management of passenger transportation (ministries, city administrations, enterprises), as well as for studied time periods. The approaches of some authors of quality of the transportation process are presented in [1–6].

Prior to establishment in 2017 of the social standard for transportation services for residents, the administrations of cities and settlements in Russian regions established their own quantitative indicators of quality of public transportation services, which were necessary to assess the level of organisation of passenger transportation and to develop measures to improve transportation quality.

One of the first sectoral regional standards for quality of public transportation services provided on regular municipal and inter-municipal routes of public motor transport were established in the Republic of Tatarstan in 2008 [7]. The development of regional standards based on the requirements of GOSTs [State standards], which established the requirements for passenger transportation services and determined the nomenclature of quality indicators [8–13].

The Ministry of Transport of Russia has developed a «Social standard for transportation services for transportation of passengers and luggage by road and urban land electric transport» [14], which defines quantitative indicators of quality of services of passenger transportation by public transport.

The social standard is of a recommendatory nature, but it defines a single approach to assessment of quality of passenger transportation for all organisations responsible for passenger transportation and carriers.

In the city of Volzhsky, public passenger transportation is carried out by the Municipal Unitary Enterprise «Volzhskaya A/K No. 1732» [bus enterprise; or «motorcade» if literally translated] that operates buses of large and medium capacity, and by individual entrepreneurs [individual businesses] operating GAZelle low-capacity buses [minibuses] [15].

Ensuring proper quality of passenger transportation services is the primary task of the responsible body, which is local government, and of public passenger carriers. The *objective* of the study is to determine quality indicators of passenger transportation in the city of Volzhsky by municipal and private carriers and their compliance with the social standard.

The following data sets were used as the initial data to determine quality indicators: an electronic map of Volzhsky city, the number of residents in 4 zones of the city, a list of stopping points, parameters of activities of municipal and private carriers, and buses' specifications.

To determine quantitative characteristics of quality indicators of transportation in the city of Volzhsky, the authors used the *technique* presented in the social standard [14].

The principles of the standard include universality of indicators, passenger priority, bilateral control. The structure of the standard establishes the following quality indicators: availability indicators, reliability indicators, and comfort indicators.

Availability indicators should assess the range of possibilities for the inhabitants to receive passenger transportation services: the walking distance to stopping points should not exceed 400 m, and 300 m to hospitals and clinics; providing access to stopping points, bus stations and bus terminals, as well as to vehicles for people with limited mobility; affordability of the trip (costs of traveling with public transport should not be higher than 7 % of the average monthly income); equipment of bus stations, bus terminals and stopping points with devices for informing the passengers; frequency of service of stopping points.

The *reliability indicator* is ensured by respect of the schedule of regular transportation routes: cases of a bus delay of more than two minutes should not exceed 15 % of the total number of trips.

Comfort indicators are determined by the level of convenience in using passenger transportation services, including the absence of physiological and psychological discomfort. Comfort indicators include equipping buses with passenger awareness systems; interior temperature in winter should not be less than 12°C, and in summer not more than 25°C; capacity standard: 3 passengers per 1 m^2 of bus floor area; the service life of buses should not exceed ten years; environmental friendliness of buses: compliance with Euro-4, Euro-5 standards; number of transfers [during a trip]:

Table 1

Assessment of public transportation services quality

Interval value of TQ	Quality of transportation services provided to the population
TQ ≤ 30 %	non-satisfactory
30 % < TQ ≤ 50 %	minimal
50 % < TQ ≤ 80 %	average
TQ > 80 %	high

Source: Decree of the Ministry of Transport of the Russian Federation dated 31.01.2017 No. NA-19-r «Social standard for transportation services for transportation of passengers and luggage by road and urban land electric transport» (as amended on 13.04.2018).

no more than 2 in municipalities with population of more than 500 000 people, no more than a single one in other municipalities. Requirements for indicators are specified in regulatory documents [16–19].

The maximum number of points that can be achieved per each indicator is 10. The level of quality of public transportation services along regular routes (KO) is determined by the formula:

$$TQ = B_{sc}/B_M \cdot 100\ \%, \quad (1)$$

where B_{sc} is total number of points scored, calculated by summing the points scored when assessing each indicator;

B_M is maximum possible number of points, equal to 130 points for settlements with population of less than 250 people; 120 points for any other settlements, thus for the city of Volzhsky, the number of points obtainable is equal to 120.

Based on the results of the calculations, a conclusion is drawn about quality of transportation services provided to the population along regular municipal routes in accordance with the values indicated in Table 1.

Results.

The authors upon calculating the indicators values according to the social standard of the Ministry of Transport developed Table 2, which presents the calculated indicators of quality of passenger transportation in the city of Volzhsky [20].

Quality indicators were calculated both for carriers, which are the municipal unitary enterprise «Volzhskaya A/K No. 1732» operating buses of medium and large capacity and private carriers operating minibuses, and for the body responsible for organisation of transportation which is the Administration of the city of Volzhsky.

The indicators that depend on the Administration comprise: territorial and pedestrian accessibility of stopping points; availability of stopping points, bus stations and bus terminals for people with limited mobility; affordability of trips on municipal routes of regular transportation; equipment of bus stations and stopping points; number of transfers. These indicators are common for MUE «Volzhskaya A/K No. 1732» and carriers operating minibuses (fixed route taxis) and have the same values. The following indicators were calculated separately for carriers: accessibility of buses to disabled people and passengers with prams, equipment of buses with devices for informing the passengers, temperature in the compartment, environmental characteristics, and age of buses (Table 2). The Table 2 also contains indicators (in brackets) targeted following implementation of measures to improve quality of passenger transportation [20].

Calculation of quality indicators according to the social standard of the Ministry of Transport showed that quality of public transportation services provided by the MUE Volzhskaya A/K No. 1732 is average, and the value of TQ is 79 % (Tables 1, 2).

For private carriers operating fixed route taxis, the quality of service is also average, TQ value is 56 %.

The quality indicators of private carriers are lower than those of municipal carriers.

The differences in quality of passenger transportation between MUE and individual entrepreneurs are further shown:

1. Accessibility of vehicles for people with limited mobility.

The municipal bus enterprise A/K No. 1732 has 111 low- or medium-floor buses out of 176 vehicles, allowing transportation of disabled people and passengers with prams. In fixed route taxis of private carriers, there is no availability for transportation of passengers with limited mobility.

Table 2

Indicators of quality of passenger transportation in the city of Volzhsky (compiled by the authors)

Quality indicators	Number of points	
	MUE V/AK № 1732	Private carriers
Territorial availability of stopping points	9	
Accessibility of stopping points, bus stations and bus terminals for people with limited mobility (PLM)	6 / (8)	
Vehicle accessibility for PLN	7 / (8)	1
Price affordability of trips	10	
Equipment of bus stations, bus terminals and stopping points with devices for informing the passengers	4 / (6)	
Compliance with the schedule	10	1
Equipment of vehicles with devices for informing the passengers	10	10
Temperature in the passenger compartment of buses	8 / (1)	1
Compliance with capacity standards	10	10
Number of transfers	10	10
Environmental friendliness	5 / (8)	1
Exceeding the service life of vehicles set by the manufacturers	6 / (8)	4
Total score	95 / (103)	67 / (71)
MUE V/AK No. 1732	95·100/ 120 = 79 % / (89 %)	
Private carriers		67·100/120 = 56 % / (59 %)

Note: the value of TQ is between 50 % and 80 % (50 % < KO ≤ 80 %), therefore the rate of quality of services provided is average. When performing the activities, the quality level of 89 % (TQ > 80 %) is high for V/AK No. 1732.

Pic. 1. «SHTRIKH-TahoRUS» tachograph. [Electronic resource]: www.auto.shtrih-m.ru/. Last accessed 03.09.2020.

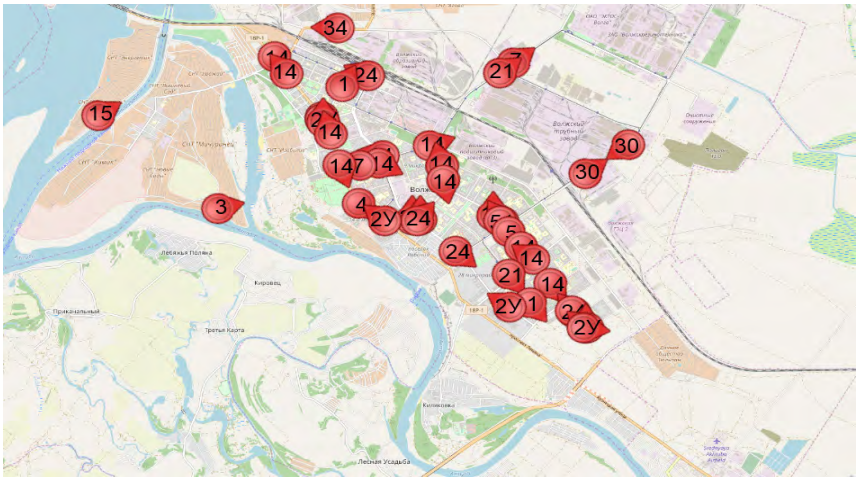
2. Reliability. Respect of the schedule of regular transportation routes.

The schedule is respected by all the drivers of the municipal bus enterprise. The regularity of the bus conformity with the schedule on the route is controlled by the central dispatch service of the municipal bus enterprise. This guarantees the travel of passengers. For this, a navigator is installed in the driver's cabin. Two «Granit-2» or «Granit-4» types of navigators are used for this purpose. The mobile unit registers the position and speed of a moving object and fixes them in memory at specified intervals. Data on the current position of the vehicle is transmitted to the dispatch centre via GPRS or CSD/SMS connection. CSD/SMS connection is used as an alternative data transmission channel when GPRS is not available. The information received is displayed on the dispatcher's monitor in the form of a map of the serviced area. The dispatcher can identify the current position of the vehicle, request a route travelled for any period, monitor the status of sensors and executive devices. The installed monitoring system via GLONASS/GPS module allows the VTS dispatcher to track regularity of the respect of a bus schedule. This system motivates the driver and ensures that delays are minimized on each route.

All buses of the municipal bus enterprise are equipped with «SHTRIKH-Taho RUS» tachographs (Pic. 1).

Tachograph features:

• accumulation and storage of data for 366 days;



Pic. 2. Information about bus positioning using Smart Transport application. Russian language interface. [Electronic resource]: http://www.bus62.ru/Google.Play^https://play.google.com/store/apps/details?id=ru.bus62.SmartTransport&hl=ru. Last accessed 03.09.2020.

• control over the modes of work and rest of drivers;

• indication and storage in the device memory of indices of vehicle speed, mileage, driver working time, etc.

There is no control over the regularity of the bus schedule on the routes of private carriers. The regular inspections of private carriers operating fixed route taxis by Avtodornadzor [Office for road transport supervision] and Volzhsky City Administration show that private carriers often violate the schedule and work only during peak hours when there is the highest passenger traffic.

To ensure control, Avtodornadzor, when issuing license certificates to private carriers, has bound vehicle state registration numbers [number plates] to the given route. In the future, the City Administration plans to install CCTV cameras at stopping points to monitor the work of private carriers, and, particularly, the respect of the schedule.

3. Comfort. Equipping vehicles with passenger information systems.

The buses of municipal and private carriers are equipped with passenger information devices in accordance with the requirements of the Passenger Transportation Rules.

Additional information is provided in the buses of MUE Volzhskaya A/K No. 1732. Passengers are informed on stopping points through a one-way speakerphone. In addition, information can be obtained directly from the conductor and the driver. Buses of «Volgabus-6270» and «Volgabus-5270G2» models are equipped with a creeping line inside the compartment. Creeping line information contains the name of the stopping point, ambient temperature, advertising of various nature, including information and announcements of the municipal bus enterprise. Besides information boards are installed on the outside of the bus.

MUE Volzhskaya A/K No. 1732 has launched the «Transport Online» service since September 21, 2017. The service allows tracking the position of public transport in real time. Besides, information about time of arrival of the bus at a specific stopping point can be also obtained. The service is based on data from GLONASS and bus enterprise's dispatching service. The application is called Smart Transport for mobile devices in the Play Market online store.

Passengers can also use the Smart Transport mobile application to find out about movement of buses from their phone (Pic. 2).

The application allows passengers to track time of approach of buses to the stopping point for each specific bus, to rationally plan their schedule and their trips. Also, through the application installed on the smartphone, it is possible to find out the schedule of arrival of the bus at each of the stopping points.

Also, the very first and so far, the sole smart stop in the city of Volzhsky was arranged at Sverdlov Square (Sverdlov Square stop) opposite the Medical College (Pic. 3).

The pavilion is equipped with USB ports for charging various phones and with free Wi-Fi. On the built-in electronic display, passengers

Pic. 3. «Smart» stop at Sverdlov Square (authors' photo).

Table 3

Pedestrian accessibility for Volzhsky residents of stopping points by zones (developed by the authors)

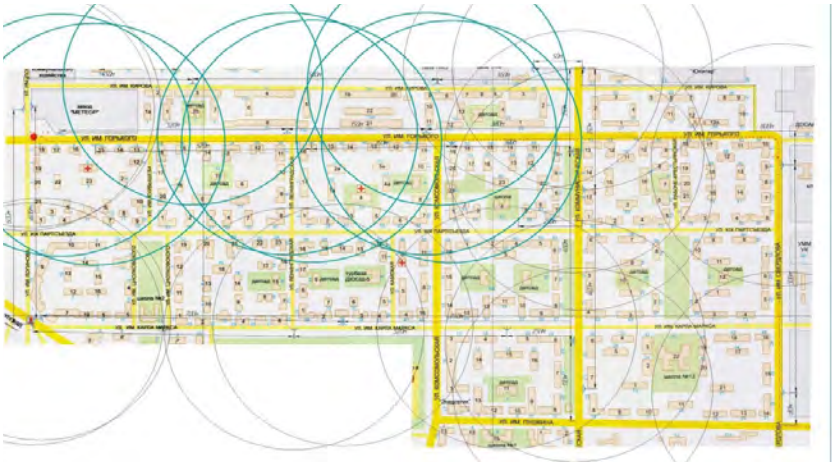
No. zone	Number of residents	Number of residents			Zone area, km^2
		Of whom live in the zone of walking distance	Outside the walking distance	Population ratio in the zone / accessibility, %	
1	26826	11284/22742	15542/3084	42,1/84,8	2,134
2	77835	67684	10151	87	4,666
3	117585	101108/ 104380	16477/13205	86/88,8	5,64
4	104479/107779	102730/ 106619	1749/1160	98,3/98,9	7,854
	326725	282806	43919	78,4/89,9	20,294

Pic. 4. Zoning of the territory of Volzhsky (developed by the authors).

can see the map of the city, find out the different routes of bus traffic, time of arrival of public transport vehicle at a given stop and its destination. There is a creeping line showing the arrival time of the nearest bus. Meanwhile, Volzhsky residents have already noticed that the screen and the display show the travelled routes of even those buses that do not stop at this stopping point (routes No. 5, 7, 14 and 34). The pavilion has LED lighting and a video surveillance camera. The walls of the pavilion have a vandal-proof protective coating.

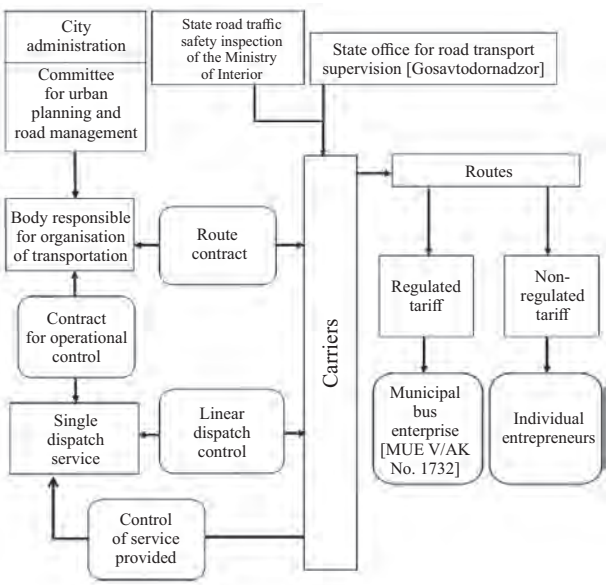
Based on the results of identification and analysis of quality indicators [20], the authors, together with the Administration of the City of Volzhsky, have developed measures to improve quality of passenger transportation. Table 2 shows (in brackets) the improved quality indicators based on the results of the developed activities.

During modernisation of stopping points, it is planned to install 26 transparent triplex glass stopping pavilions with creeping lines in the city, and six metal stopping pavilions in the



Pic. 5. Radii of pedestrian accessibility in zone I (developed by the authors).

Pic. 6. Radii of pedestrian accessibility in zone IV (developed by the authors).



Pic. 7. The structure of management and control of public passenger transportation (developed by the authors).

Industrial Zone. The City Administration is replacing stopping pavilions with new modern ones, able to display information for passengers.

Improved accessibility of stopping points has been achieved through construction of new stopping points in the old part of the city, as well as during construction of new facilities and microdistricts of the city. As a result, the population ratio in zones I, III and IV (Pic. 4) has grown, and the total city population ratio has also increased from 78,4 % to 89,9 %.

Table 3 shows the pedestrian accessibility for Volzhsky residents of stopping points by zones [20]. In the zone I near the railway station, the population ratio in the zone of pedestrian accessibility is 42,1 %. That is, there are no stopping points in the zone I and required quality of services is not provided.

Pics. 5 and 6 show zones I and IV of Volzhsky city with marked pedestrian access radii of 400 m. In the pictures, the centres of pale-coloured circles are located at the existing stopping points, the centres of the deep colour circles are at new stopping points equipped in accordance with the requirements of the social standard.

There are wheelchair ramps at all stopping points to enhance access of people with limited mobility. The bus station will provide access for people with limited mobility to the bus station building; the access to ticket offices has been provided; there are three wheelchair accessible chairs, an information board, and related marking.

Besides existing low- and medium-floor buses, it is planned to purchase 50 new low-floor buses of Euro 5 ecological standard and equipped with air conditioning systems, capable to carry people with limited mobility based on the requirements [20].

As a result of implementation of the planned measures, the indicator of the quality of transportation and service provided to passengers by municipal bus enterprise will attain a high level (according to the standard high level should have TQ > 80 %): TQ = 89 %. For individual entrepreneurs, the level of service quality will increase from 56 % to 59 % only due to measures taken by the City Administration.

All bodies responsible for transportation and carriers are involved in ensuring and improving the quality of passenger transportation with public transport. The management and control of the transportation process carried out by the municipal bus enterprise and individual entrepreneurs should be executed through the central dispatch service (CDS) of the Administration of the City of Volzhsky. It is also necessary to provide the City Administration a possibility to control the quality of passenger transportation and to coordinate municipal and private carriers through the CDS. The planned structure of traffic management in the city of Volzhsky is shown in Pic. 7.

To improve quality of public passenger transportation, it is also necessary to apply modern methodologies proposed by leading researchers [21].

Conclusions.

The performed calculation of the level of quality of passenger service provided by urban public transport made it possible to identify shortcomings in organisation and to develop appropriate measures to improve the services provided to the residents of the city of Volzhsky by ensuring pedestrian accessibility and offering buses that provide comfortable conditions for passengers and are more environmentally friendly. The activities are considered and embodied by the City Administration when developing planning documents on scheduled transportation.

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