

APPROBATION OF METHODS FOR ASSESSING TRANSPORT SERVICES QUALITY

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ABSTRACT

The article presents the results of approbation of the methodology for assessing the quality of public service by urban passenger transport of municipal routes, which are assigned to commercial enterprises under the new management model, regarding the city of Moscow. The model provides for provision of services of regular transportation of passengers and baggage on the basis of public contracts with city administration.

According to the results of a previously performed hierarchical cluster analysis, where the

Euclidean distance with a single rule for cluster unification was used as a measure of proximity using the Ward method, ten routes were selected for assessment.

Key parameters for assessment the quality of provided services comprised accessibility of stopping points, of social facilities, of transport facilities for people with disabilities, information facilities, price affordability, comfort, optimal passenger capacities of vehicle, and ecological friendliness.

Conclusions have been drawn that the level of quality of transport services for passengers in Moscow is high.

Keywords: management model, Euclidean distance, Ward method, ground urban passenger transport, quality of service, social standard of transport service, assessment method.

Background. Current methodology for assessing quality of transport services provided to the population in Russia, which establishes quality indicators, their standard values, and the scoring procedure, has been set by the order of the Ministry of Transport of the Russian Federation [1].

Previously performed analysis [2] has shown adaptability of the methods and techniques of its application to the conditions of the city of Moscow, revealed the ways of obtaining the initial data and of identifying non-optimal or incorrect positions, developed proposals for the improvement of the methodology [1].

The study, presented in the article, was dedicated to the assessment of compliance with the quality indicators of the Moscow metropolitan urban road routes served by commercial enterprises within the framework of public contracts of the city administration.

Objective. The objective of the authors is to test methods for assessing transport services quality in urban road transit at the example of the city of Moscow.

Methods. The authors use general scientific methods, comparative analysis, economic analysis, content and legal analysis, specific tools of transport management, other scientific instruments (Euclidean distance formula, Ward's method of hierarchical cluster analysis, multivariate examination).

Results.

Assessment of accessibility parameters

At the initial stage of the study, using the hierarchical cluster analysis, the Euclidean distance, taken as a measure of closeness with a single rule for cluster combining, and the Ward method, ten routes were chosen to be assessed. The scheme of routes is shown in Pic. 1 on the next page.

According to the results of the analysis of the routes' itineraries, it was established that nine of them have a transport accessibility factor of stopping points equal to 1 and one of them has the factor equal to 0,98.

We define the arithmetic mean value of the transport accessibility of stopping points as the ratio

of the sum of the individual values of the indicator for each route to their total number.

According to the results of assessment of the arithmetic mean of the values of the coefficient of transport accessibility of stopping points (0,998), this indicator gets 10 points.

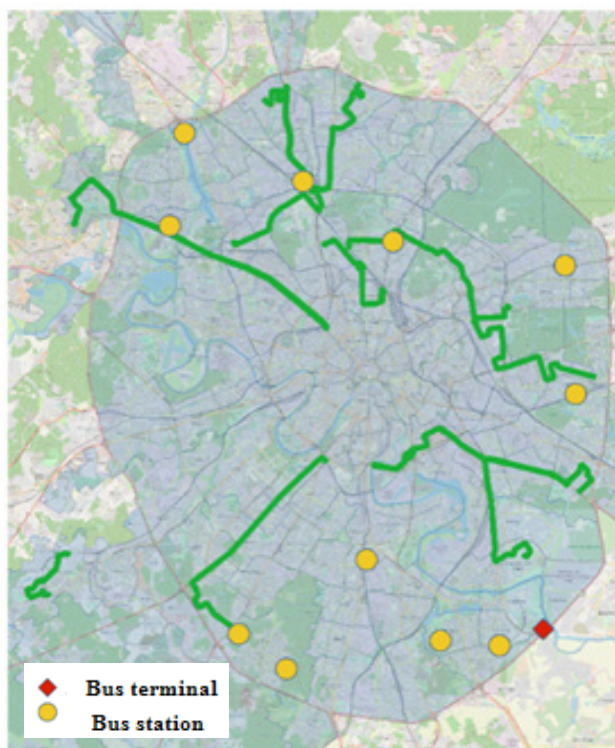
The analysis showed that the selected routes serve 620 stopping points and three bus stations.

All bus terminals and bus stations that are served by regular transport routes must meet the requirements established by [3, sub-clauses 7.4.9–7.4.21; 4], and all stopping points should meet the requirements of sub-clauses 7.3.1–3.3.16 of the methodological recommendations [5, pp. 44–48].

It should be noted that the social standard of transport services does not contain any weights of relative significance of indicators of accessibility of stopping points that would meet the requirements [3–5], and the parameters approved in [5] are recommendatory in nature. According to the results of field surveys, it was found that, for the most part, stopping points do not comply with the recommendations [5, pp. 44–48] in terms of designating the transparent walls of the pavilions by relief signs and of arranging tactile signs for blind and visually impaired people.

In accordance with [6], twelve stopping points within the boundaries of the city of Moscow have been approved, which are allowed to be used as start and (or) end points of interregional regular passenger routes. The analysis made it possible to identify three bus stations («VDNKh», «Tushinskaya», «Tyoply Stan»), served by previously selected municipal routes and so subject to further analysis. It should be noted that the bus station «Verkhnie Likhobory» is actually not in use.

According to the results of assessment [7–9], the variants of the organization and the current state of accessibility of social infrastructure facilities and of the main structural and functional zones for various categories of people with limited mobility have been determined in compliance with the regulations' clauses [10, 11]. When calculating the integral assessment of accessibility of stopping points, bus



Pic. 1. Itineraries of the routes under study.

terminals and bus stations for such groups of citizens, the value of accessibility coefficients is equal for stopping points, bus stations and bus terminals. Consequently, it implies the same degree of importance of indicators of stopping points, bus terminals, and bus stations.

Let us note the need to determine the importance factor (or weight factor), which would reflect the significance of the corresponding parameter for each level of accessibility. One of the best scientifically substantiated methods for obtaining expert assessments is the method of independent multivariate examination [12, pp. 115–121; 13, pp. 163–178; 14, pp. 214–217; 15, pp. 29–38].

The obtained value of accessibility of stopping points, bus terminals and bus stations for people with limited mobility is of $<0,1$, and that indicator scores only 1 point.

Based on the analysis results and considering the parameters of transportation stipulated in existing public contracts [16, 17], the total number (121 units) and the class of vehicles, operated on the selected routes, were established.

The requirements of approved transportation parameters [17], stipulate that the vehicles of larger and medium capacity should be equipped with a ramp for landing wheelchair users, and should provide at least one specially equipped place with appropriate fastening mechanisms.

Following the results of the assessment, the accessibility factor of vehicles for people with limited mobility on regular municipal routes is 0,81, and this indicator gets 9 points.

An additional analysis was made as for some other requirements established for vehicles used for passenger transportation within the framework of concluded public contracts. Thus, in terms of the

passenger information system, requirements have been approved for equipping the vehicles with an automatic voice informer, speakers, a microphone, front, rear and side direction screens (displays) with the possibility of transmitting information in accordance with clause 32 [19]. According to the calculations, the information equipment factor is equal to 1, and, accordingly, this indicator gets 10 points.

The equipping of bus terminals, bus stations and stopping points with devices, visually informing passengers and providing relevant information, and with other technical means must meet the requirements established by sub-clauses 14–18 of the rules of passenger and baggage transportation [19]. Conformity assessment was made by the method of field survey. According to the results of the analysis, the equipment ratio of the named objects is equal to 1, and, accordingly, this indicator scores 10 points.

Price affordability

Calculation of an indicator of the price affordability of trips along regular municipal routes with a scoring of the coefficient obtained was performed, using the formula:

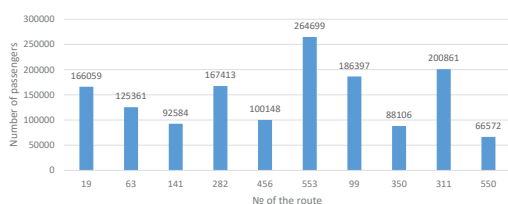
$$k_a = \frac{E}{AM_{weight}} = \frac{E}{\frac{\sum M_i \cdot w_i}{\sum w_i}},$$

where E – average monthly passenger expenses for traveling by road and land electric transport on regular transport routes within the municipality, rubles;

AM_{weight} – arithmetic weighted average of per capita monetary income of the population in the federal entity of the Russian Federation, where the municipality is located, rubles;

M_i – median value of per capita monetary income with a corresponding share in distribution of the





Pic. 2. The volume of passenger transportation on the routes under study.

population in terms of per capita monetary income in the federal entity of the Russian Federation, where the municipality is located;

w_i – share of the population of the federal entity of the Russian Federation, where the municipality is located, possessing the amount of income below the average per capita income.

The procedure for determining the value of the arithmetic weighted average of per capita monetary income of the population was approved in [1]. The cost of a long-term use ticket is equivalent to the cost of a TAT [tram – [auto]bus – trolleybus] ticket for 30 days as of the date of the survey and amounts to 1080 rubles [20, Appendix 1]. The weighted average arithmetic value of the average per capita monetary income of the population of Moscow was obtained on the basis of the data of the territorial body of the Federal State Statistics Service [21], and it was fixed at the level of 57882 rubles.

An analysis of distribution of the population in terms of the average per capita monetary incomes and the values of the arithmetic weighted average per capita monetary income for the period from 2010 shows the admissibility of a biased interval estimate. According to the results of the calculations, the value of the coefficient of price affordability of trips along regularly serviced routes is equal to 0,033, and this indicator gets 7 points.

Comfort parameters

In determining the indicator of compliance with the schedule, an estimate of the planned, performed trips and trips, performed with a tolerable deviation from the planned schedule, is given for October. Calculations of the compliance rate on selected municipal routes amount to 0,854, accordingly, this indicator scores 7 points.

The assessment of compliance of the temperature in the passenger cabin of vehicles with standard temperature, established by regulations, was made in October; respectively, the indicators of the share of days and the share of trips will be further determined relative to the studied season and period.

In terms of ensuring the temperature mode, the requirement (approved by the order of the Ministry of Transport of the Russian Federation of April 13, 2018 No. NA-55-r) stipulates that the temperature of the air in the bus passenger cabin should not be less than 12 degrees and not more than 25 degrees on the Celsius scale. Besides, the requirements for the system of heating, ventilation and air conditioning are stipulated in the transportation parameters [17].

Let us note that in the statistical data, the meteorological day in Moscow begins at 18 o'clock of global time (at 21:00, local time). Let us remind that the calculation period was October, so the number of days with an average daily temperature above 20°C was zero. Accordingly, accounting of

the number of trips made with the specified temperature was not conducted. The number of days with an average daily ambient temperature of less than 5–7 °C, was, respectively, $D_{\text{days} < 5} = 0,23$. The number of days with an average daily temperature in the range from 5°C to 20°C was 24, respectively $D_{\text{days} < 20 \text{ and } > 5} = 0,77$.

In accordance with the parameters of transportation, as approved in public contracts [17, pp. 2, 4–7], the number of trips performed on weekdays with an average daily temperature of less than 5°C was 13590, and the number of trips performed on weekends – 1018; the number of weekdays' trips with an average daily temperature in the range from 5°C to 20°C was 21140, on weekends – 7126.

The analysis of the temperature in passenger cabins of vehicles was obtained from the results of records of the values of the information board, as well as from the results of instrumental measurements of the parameters of the microclimate. Temperature measurements were made for each class of vehicles used on the selected routes. The share of trips with a standard temperature in the cabin of the vehicle is equal to 1, and this indicator gets 10 points.

While determining the compliance with the capacity rates, using the results of the analysis of data of the automated fare control system (AFCS, Pic. 2), it was established that the total number of passengers on selected municipal routes in October was equal to 145200 persons.

The parameters of transportation [17] establish three categories of passenger capacity of vehicles: larger one, which is of 85 people with at least 22 seats; medium one – of not less than 40 people, and at least 17 seats; small capacity – of at least 19 people.

According to the results of field surveys during peak hours and during inter-peak hours on weekdays and weekends, compared with the AFCS data, it was established that the coefficient of compliance with capacity standards is equal to one, and this indicator gets 10 points.

The total number of passengers making interchanges, including when making a trip on selected routes, was determined by the method of questioning. The calculation of the required number of respondents was made with a confidence level of 95 %, a confidence interval of 5 % and a size of the general sample, equal to the total number of passengers using interchanges during a single trip.

The survey was conducted among the respondents by individual non-repetitive selection at all stopping points, i.e. among passengers awaiting to take a required vehicle. In order to ensure a given level of representativeness of the sample, the number of respondents was increased by 50 % and amounted to 576 people.

The revealed coefficient of compliance with standards for the number of interchanges is 0,98, and this indicator scores 10 points.

Information on the service life is given in the vehicle specifications. In general case, if the manufacturing plant has not specified the service life, then in accordance with art. 6 of the Law of the Russian Federation on Consumer Protection [22, Article 6], the service life is deemed to be ten years from the date of transfer of the vehicle to the consumer. Particularly regarding the age of vehicles, a limit value has been established, that is a vehicle should be no

older than two years from the date of its first trip on serviced routes and, according to the study, this indicator gets 10 points.

The method of calculation of the indicator of the share of vehicles with a high environmental standard compliance and the relevant scoring procedure were approved in [23]. The high environmental standard means the compliance of vehicles with European exhaust emissions standard 4 and above. In [17] the requirement for compliance with environmental safety standard is defined: medium and larger capacity vehicles should comply with at least standard 5, and vehicles of smaller capacity should comply with at least standard 4. As the features meet those requirements to the high extent, then this indicator scores 10 points.

Conclusions. The quality index of services provided to citizens, with regard to transportation of passengers and their baggage by road and urban ground electric transport along regular routes, is determined by the ratio of the number of accumulated (summed) points assigned to the set of indicators to their maximum value = 120.

The calculations result in a conclusion on the quality of transport services in municipalities in accordance with the values of Table 1.

Table 1

Assessment of quality of transport services provided to passengers

Interval values of quality	Quality of transport service
$QS \leq 30 \%$	unsatisfactory
$30 \% < QS \leq 50 \%$	minimal
$80 \% < QS \leq 80 \%$	average
$QS > 80 \%$	high

According to the obtained results of approbation of the method of assessment of quality of transportation services provided to population, which reached 87 % (104 points), the overall quality level of transportation services in Moscow can be considered as high.

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Article received 24.12.2018, accepted 21.02.2019.