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QUALITY OF PUBLIC TRANSPORT SERVICES IN CHISINAU

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Abstract. The quality of transport services represents the most comprehensive and synthetic attribute that reflects the performance of a transport system. In the public transport system, the quality of service is largely influenced by the way passengers perceive its performance. The quality of transport services is assessed according to a number of technical and economic indicators that characterize the performance of transport operators within the framework of the urban public transport system. The article aims to identify the criteria for evaluating the quality of urban public transport services based on the study carried out for the public transport system of the municipality of Chisinau and to describe the indicators that reflect the performance offered by the public transport system, as perceived by passengers. It should be noted that the quality of the urban public transport service has a direct impact on the quality of life of all city residents. The study includes a concrete survey of the beneficiaries of public transport in the municipality of Chisinau, which analyzes the quality criteria and their rate of appreciation by the inhabitants of the municipality. Finally, conclusions and future directions of action aimed at improving the quality of services and increasing the attractiveness of urban public transport are presented, thus contributing to the improvement of the quality of life of the inhabitants.

Keywords: *urban public transport system, quality indicators, case study.*

Rezumat. Calitatea serviciilor de transport reprezintă cel mai cuprinzător și sintetic atribut care reflectă performanțele unui sistem de transport. În sistemul de transport public, calitatea serviciului este influențată în mare măsură de modul în care pasagerii percep performanțele acestuia. Calitatea serviciilor de transport se apreciază după un număr de indicatori tehnici și economici care caracterizează performanțele activității operatorilor de transport în cadrul sistemului de transport public urban. Articolul își propune să identifice criteriile de evaluare a calității serviciilor de transport public urban în baza studiului realizat pentru sistemul de transport public al municipiului Chișinău și să descrie indicatorii care reflectă performanțele oferite de sistemul de transport public, perceput de călători. De menționat că calitatea serviciului de transport public urban are un impact direct asupra calității vieții tuturor locuitorilor urbei. Studiul include un sondaj concret a beneficiarilor transportului public din mun. Chișinău, care analizează criteriile de calitate și rata de apreciere a acestora de către locuitorii municipiului. În final, sunt prezentate concluzii și direcții viitoare de acțiune menite

să îmbunătățească calitatea serviciilor și să crească atractivitatea transportului public urban, contribuind astfel la îmbunătățirea calității vieții locuitorilor.

Cuvinte cheie: *sistem de transport public urban, indicatori de calitate, studiu de caz.*

1. Introduction

Public transport is an integral part of city or municipality life of population and helps to solve daily mobility problems. Ensuring high quality transport services and passenger satisfaction is a complex task with many parameters. The article discusses the problems of satisfaction with the transport services in the city of Chisinau, their changes, as well as the problems of the perceived quality of public transport.

The quality of the services offered by urban passenger transport determines the standard of living of the city's inhabitants. The analysis of the methods for evaluating the quality of transport services for passengers through urban transport showed that for this evaluation it is advisable to use complex indicators. The existing methods of evaluating the quality of urban passenger transport do not fully take into account the subjective evaluation of service quality criteria by passengers.

2. General description

The quality of the passenger transport service is a set of properties of the transport process and the passenger transport system that determine the satisfaction of the travel needs of passengers in accordance with the established regulatory requirements [1].

The properties of the transport process can be divided into simple and complex, which are combined according to functional characteristics. To manage the quality of transport services, it is necessary to select the quality indicators, establish their standard values, assess the degree of conformity, make an interval assessment of the quality and develop recommendations [2-4].

The growth of the urban population is accompanied, first of all, by the growth of the territory of the cities themselves. The increase in the area of cities is actually limited only by the physical size of the territory that can be occupied by the respective city.

The expansion of urban areas, the formation of large cities and urban agglomerations lead to the need to satisfy the needs of the population living in them for movement associated with the performance of various sociocultural functions by people. Historically, this problem was solved by organizing transport services for the population of urban and adjacent areas using various modes of transport. Thus, the mobility of the urban population is ensured by the mobility of transport [5-7].

In the European Union, the distribution of the population between rural and urban areas shows the following trends: urban population - the 2021 census, approximately 74.8% of the EU population lived in urban areas, which include cities and suburbs, more specifically, 38.9% of the population lived in cities, and 35.9% in suburbs and small towns; and only 25.2% of the EU population lived in rural areas [8]. There are significant variations between EU member states in terms of the proportion of the rural population Figure 1.

It should be noted that, at the surface level, rural areas occupy 75.8% of the total surface of the EU, while urban areas occupy only 3.6% of the total, the remaining 20.5% are represented by small towns and suburbs.

These figures reflect a general trend of urbanization in the EU, with the majority of the population concentrated in cities and suburbs, although rural areas continue to cover most of the EU territory.

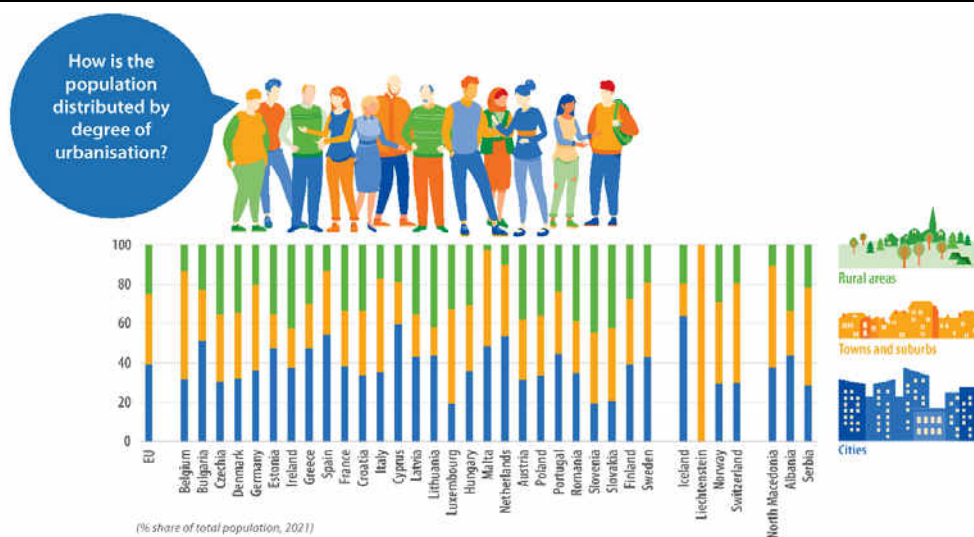


Figure 1. Distribution of the population by place of residence in the EU [9].

In the Republic of Moldova, according to statistical data [10], the same trend of percentage increase of the urban population in relation to the rural population is maintained, Table 1.

Table 1

The average number of the population with usual residence per year in the Republic of Moldova [10]

Year	Total per country, thousands of people	Urban environment, thousands of people	The rural environment, thousands of people	Urban share, %
2014	2857.8	1133.5	1724.3	39.66
2015	2836.0	1126.4	1709.6	39.72
2016	2803.2	1117.1	1686.1	39.85
2017	2755.2	1106.2	1649.0	40.15
2018	2707.2	1097.7	1609.5	40.55
2019	2664.2	1093.7	1570.5	41.05
2020	2635.1	1095.5	1539.6	41.57
2021	2595.8	1093.0	1502.8	42.10
2022	2528.7	1079.7	1449.0	42.70
2023	2457.8	1063.1	1394.7	43.26

Statistical data [11] show a constant increase in the population of the municipality of Chisinau and, implicitly, a greater need for mobility, which leads to an increased demand on the existing urban public transport system and, consequently, directly influences the quality of transport services.

Table 2

The dynamics of the number of inhabitants in the municipality of Chisinau [10], [11]

Years examined	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of inhabitants, thousands of people	804.5	809.6	814.1	820.5	825.9	832.9	848.8	864.6	874.1	882.6

The analysis of Table 2 shows an annual increase of the municipality's population of approximately 1%, which is quite large for a municipality with a number of 880 thousand inhabitants, which demonstrates the tendency of the urban population to increase compared to the rural one in the Republic of Moldova.

The study shows us that city dwellers need not only a denser public transport network with more frequent traffic, but also a high level of quality transport services. [5], [12] To meet current demands, public transport must be more flexible, more competitive and oriented towards providing quality services.

The main factors that influence the choice of public transport, compared to other types of transport, and the type of means of public transport of passengers in cities are:

- the presence of the direct route;
- the cost of the trip;
- frequency of traffic on the direct route;
- waiting time for the means of transport;
- the time spent in the means of transport;
- walking distance to the station;
- use of rolling stock capacity;
- the level of travel comfort;
- travel safety;
- age and state of health of the passenger;
- traffic schedule;
- climatic conditions;
- the density of the route network, etc.

Many of these factors, which influence the choice of passengers, are difficult to consider because they cannot be expressed quantitatively [13, 14].

To determine all the factors that influence the choice of passengers and respectively the quality of transport services, complex statistical studies are needed, the results of which are often not proportional to the research costs.

Therefore, it is recommended during the studies, to consider only the factors that influence the choice of passengers the most: the presence of the direct route; cost of travel; waiting time for transport; the time spent in transport and the frequency of movement of vehicles on the direct route.

3. Methodology for determining the quality of public transport services in the municipality of Chisinau

Regulatory requirements for quality indicators of public transport services in the municipality of Chisinau are contained in the "Regulation of road transport of passengers and luggage on the territory of the municipality of Chisinau.

The regulation establishes the criteria and quality factors of public transport services, the classification and the minimum degree of assessment of service quality indicators [15].

Table 3 presents the criteria and quality factors of public transport services for all types of public transport within the territorial-administrative range of the Chisinau municipality.

Table 3

Criteria and quality factors of public transport services regulated for the municipality of Chisinau and the value of the pre-established indices at the interview [15]

Quality criteria	Quality factors	The value of the indices at the interview
Reliability	<ul style="list-style-type: none"> • The age of the rolling stock. • Duration of changing the damaged vehicle with another functional one. 	8 + 0.5
Comfort and convenience	<ul style="list-style-type: none"> • Punctuality. Compliance with traffic schedules. • Travel time, transport speed. • Capacity of transport units. Load factor. • Delays and deviations from the schedule or itinerary. • Races not completed. • Access for people with disabilities. • Comfort level (air conditioning, soft seats, ventilation, salon lighting, heating system, etc.). 	7 + 0.5
Safety and security	<ul style="list-style-type: none"> • Safety of the passenger during the journey - being in the means of transport. • The number of sanctions applied for non-compliance with the traffic legislation in force. • Number of road accidents, injured vehicles %, injured persons, deceased persons. • Equipping the vehicle with anti-fire equipment and medical kits. 	7 + 0.5
Information	<ul style="list-style-type: none"> • In intermediate stations and terminus stations. • On the information boards of the means of transport, when they arrive at the station. • Inside the means of transport, during the journey. • The announcements of the drivers of the means of transport. • Information through mass media. • Information regarding delays and deviations from the itinerary. 	5 + 0.5
Conduct of the driver of the means of transport in traffic	<ul style="list-style-type: none"> • How to drive the vehicle. • Traffic safety. • Boarding and disembarking passengers. • Arrival of means of transport at the station and parking at the station. 	7 + 0.5
Cleaning	<ul style="list-style-type: none"> • Exterior of the means of transport. • The interior of the means of transport and hygiene. 	8 + 0.5
Complaints and relations with passengers	<ul style="list-style-type: none"> • The ability to resolve travelers' requests and complaints. 	7 + 0.5

The same regulation [15] provides for the determination of consumer satisfaction indices based on surveys, which prescribes the solicitation of consumer opinion on the estimation of quality criteria on a scale from 1 (unsatisfactory) to 10 (excellent). An average grade will be calculated for each quality criterion.

During the surveys, the perceived quality of the services based on the passenger experience is determined and often compared with the expected one or with another experience that the passenger has using another type of means of transport, in another city or in another country and are influenced by the main factors described in Table 3.

4. Case Study

Between November 28 and December 2, 2022, the team of specialists with students from the Transport department of the Technical University of Moldova, at the request of the Chisinau City Hall, conducted a survey of the residents of Chisinau regarding the activity of the public transport system.

The purpose of the survey is to collect information from the residents and visitors of the municipality of Chisinau in order to carry out a further analysis and provide recommendations regarding the improvement of public transport services in the municipality.

The method of carrying out the survey - face to face. The survey was conducted at 16 public passenger transport stations in both directions of traffic, located at the most important junctions and at the entrances to the city on the main arteries.

The survey was conducted on a sample of 2084 people, of whom 45.2% are women and 54.8% are men. The participants were divided into 7 age categories, starting from 12 years old. Following the checks, the error is approximately 1.3%.

Of the people surveyed, 69.1% are residents of the city, 30.9% - residents of the suburbs or guests of the capital.

The structure of the surveyed residents of the municipality of Chisinau, according to the vehicle they use to travel, is presented in Figure 2. This structure actually reflects the structure of passengers transported by various types of urban public transport.

The distribution of surveyed residents according to age is presented in Figure 3 and reflects quite closely the age structure of passengers transported by different types of urban public transport.

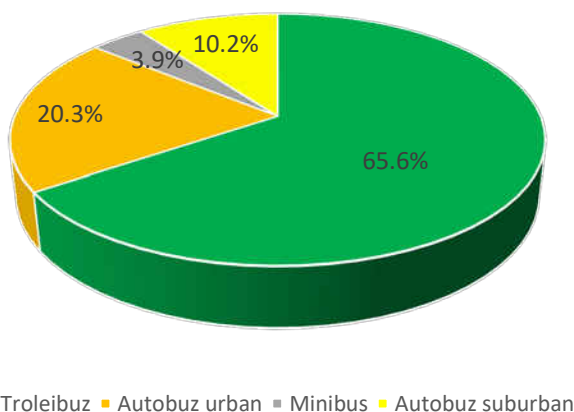


Figure 2. Distribution of respondents according to the type of public transport used.

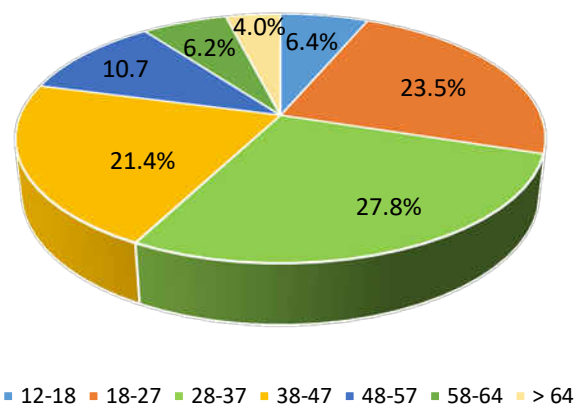


Figure 3. Distribution of passengers by age category, years.

The data presented in Figure 4 shows that 84.73% of the surveyed residents use public transport services in the city almost every working day of the week.

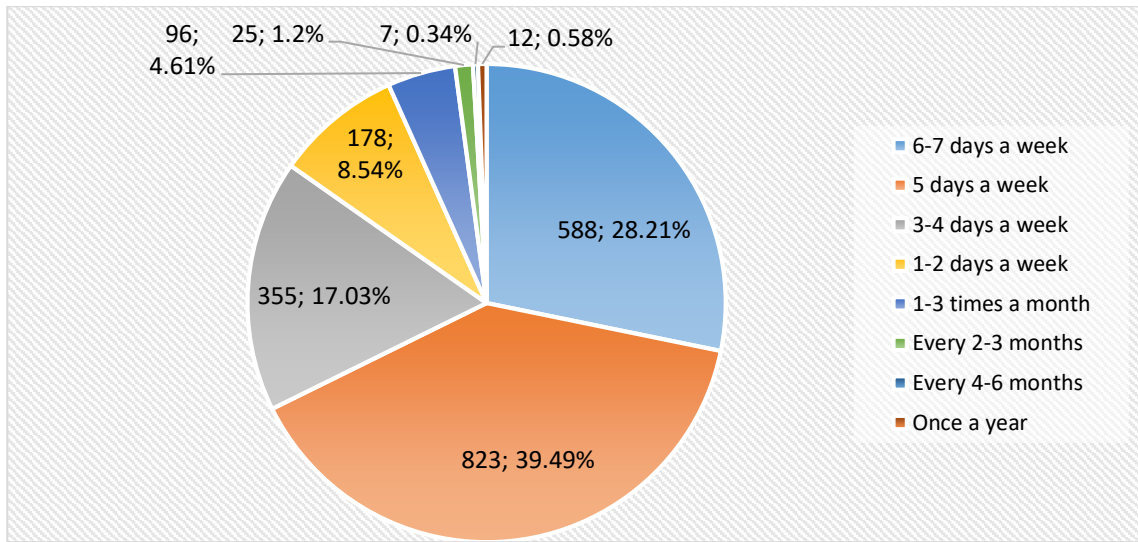


Figure 4. Frequency of public transport trips.

The research evaluated the importance for travelers of different factors that influence the choice of the type of urban public transport. Residents of Chisinau were asked to select three of the six main factors discussed in this article. The results of these surveys are shown in Figure 5. The analysis of the results allows us to conclude that for the vast majority of service consumers, the determining factor in choosing urban public transport is the minimum time spent traveling from the point of departure to the destination. Specialists in the field of passenger transport know that the total time of a single movement cycle includes: the time to approach a public transport station; waiting time for a vehicle at the station; travel time; travel time from station to destination.

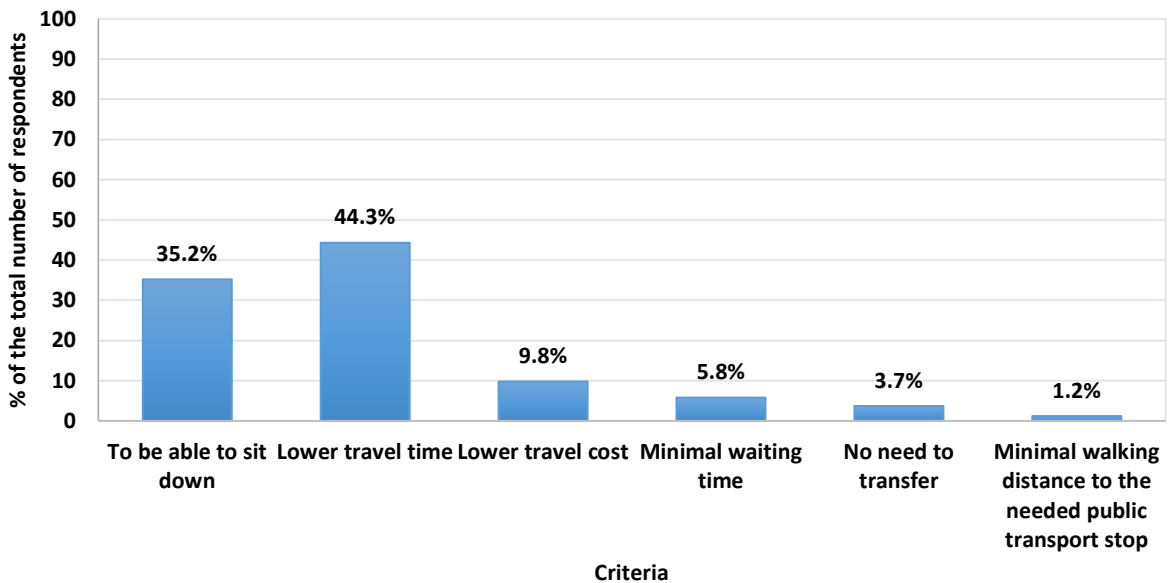


Figure 5. Criteria for choosing the public transport route.

The analysis of the factors presented in Figure 5 allows us to conclude that four factors are directly or indirectly related to the aforementioned time spent traveling.

The total score of these four factors is 55%, which is significantly higher than the second significant factor (ability to sit - 35.2%), reflecting the level of comfort of the trip. The

third significant factor related to travel cost is significantly lower than the first two factors and represents 9.8% of the total significance of all factors (100%).

It should be noted that the travel time factor is always in the top three main factors in passengers' choice of travel mode. However, in large cities with a population of up to 1 million, this factor is particularly significant. This is explained by the lack of alternatives to land urban transport. As a rule, these cities do not have underground and/or surface metro lines and cannot offer passengers journeys with average speeds higher than 25-30 km/h.

In fact, the high demand of Chisinau residents in the first decade of the 2000s to travel with low-capacity road vehicles, noted in the paper [1] from 2011, is associated precisely with the opportunity to save time, despite the reduced comfort.

However, the comfort factor, with the increase in the standard of living of the inhabitants of Chisinau, has become more significant for urban trips. In the urban passenger transport market, a conflict has arisen between the interests of passengers and the level of transport comfort offered by private operators with small capacity vehicles.

Because of this conflict, the Chisinau municipality administration decided to massively refuse transport with small capacity vehicles.

Currently, the main efforts of the Chisinau municipality administration are aimed at increasing the comfort level of passenger transport. This problem is mainly solved by operating high-capacity buses on urban and suburban routes. However, at the same time, the unit costs for a passenger's trip also increase (service cost, passenger*km/lei).

The transition to passenger transport with high-capacity buses and new trolleybuses did not solve the problem with the main need of the inhabitants of Chisinau, associated with the reduction of time spent on urban trips. The relevance of this problem will only increase as the city of Chisinau develops.

Another objective of the study was to evaluate the level of organization of urban passenger transport (Table 4).

The assessment was carried out in three areas:

- evaluation of various informational aspects related to public transport;
- evaluation of the level of satisfaction with public transport stations;
- evaluation of the level of satisfaction with public transport during the journey on the most frequently used route.

Table 4

The results of the survey regarding the perceived quality of public transport services in the municipality of Chisinau

N/a	Indicators	Medium value
Evaluation of different informational aspects related to public transport		
1.	Availability of the correct public transport timetable at the stops	7.36
2.	Easy to read and understand a public transport timetable at stops	7.95
3.	Information shown on electronic scoreboards at some stops about the time of arrival of public transport	6.24
4.	Available mobile apps	4.97
5.	Actual compliance with established public transport timetable	6.07
6.	Considering each of the aspects listed, the general satisfaction with the provision of information about public transport timetables	6.77

Continuation Table 4

Evaluation of the level of satisfaction with public transport stations		
7.	Illumination	7.66
8.	Cleanliness and the amount of garbage	7.30
9.	The opportunity to hide from rain and wind	6.72
10.	Possibility to sit	6.66
11.	Pavement condition	6.95
12.	Congestion of passengers at a time when you usually drive	6.21
13.	Considering each of the aspects listed, the general satisfaction with public transport stations	7.02
Evaluating the level of satisfaction with public transport while traveling on the most frequently used route		
14.	Public transport cabin occupancy	6.95
15.	Softness of public transport travel	7.42
16.	Comfort inside the cabin	7.29
17.	Temperature inside the cabin in winter	7.74
18.	Temperature inside the cabin in summer	6.81
19.	Quality and level of illumination of the cabin	8.20
20.	It is easy for you to get in and out of the public transport (applying physical force)	6.50
21.	Considering each of the aspects listed, the overall satisfaction with the means of public transport during the trip	7.22

Despite the fact that the passenger survey is relatively objective and often depends on many factors (how the questions were formulated, who was the researcher, what time of the day the survey was carried out) the level of satisfaction with the organization and performance of the urban public transport activity can be rated with classic grades "good" and "satisfactory".

The analysis of the survey results indicates that all services responsible for the activities of the municipality's public transport system. Chisinau, it is necessary to pay more attention to the quality of public transport services offered.

5. Conclusions

The global population urbanization process in recent years has been significant for the capital of the Republic of Moldova. The population growth of Chisinau municipality at a rate of one percent per year puts great pressure on the existing urban public transport system. The city's busiest thoroughfares are at their carrying capacity.

The studies carried out showed that the system for assessing the quality of the transport services provided, approved by the city administration, does not correctly reflect the interests of the residents of Chisinau in achieving their mobility.

The factor of time spent traveling is the most important in choosing a method of urban mobility for the inhabitants of Chisinau. In this respect, the long-term development plans of the city of Chisinau should now lay the foundations for the development of high-speed transport.

Conflicts of interest: The author declares no conflict of interest.

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