

ACCESSIBILITY ANALYSIS OF THE URBAN PUBLIC TRANSPORT SYSTEM IN PETROSANI

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Abstract: The number of users in urban public transport is continuously decreasing in cities, at the same time as the intensive growth of the number of personal cars with effects on pollution, increasing traffic congestion and high energy consumption. EU Member States must improve public transport to offer better active mobility options and implement zero-emission urban logistics, taking into account the needs of people and businesses who need to have access to the city for work, leisure, shopping or tourism. The decrease in carbon dioxide emissions can take place by increasing the attractiveness and improving the accessibility and comfort of use of public transport and non-motorized means of transport. The mobility of residents is one of the necessary conditions for ensuring a functional urban area. The higher the mobility of residents and the easier accessibility to points of interest, the higher the quality of life. Accessibility indicators are often tailored to a specific place or activity and to a specific set of individuals.

Keywords: Public passenger transport, road mobility, accessibility

1. INTRODUCTION

Access to public transportation has become crucial in determining and analyzing the mobility and sustainability of the transit system. In addition to the transportation system itself, the perceived accessibility of public transportation has a considerable impact on life satisfaction [1]. Public transport officials and operators are always busy delivering services and rarely manage to find time to take a close look at the performance of their services unless there are budgeting issues or reports show glaring problems.

Public transportation management should regularly monitor key metrics that can help them avoid bigger problems later. The same metrics also help them understand the strengths and weaknesses of their operations in order to establish plans to mitigate or encourage improved business functions. Areas of high interest include:

- driver productivity;
- vehicle use;

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- management/staff productivity;
- customer satisfaction.

Key performance indicators (KPIs) for public transport companies involve, among other things, route planning and scheduling. Each company prioritizes its metrics based on certain unique features they bring to the region.

According to Order No. 972 of October 3, 2007 for the approval of the Framework Regulation for the provision of local public transport and the Framework Specifications for local public transport services, the organization and performance of specific activities of local public transport services must ensure the satisfaction of public utility requirements and needs of local communities, namely [2]:

- priority satisfaction of the transport needs of the population and economic operators on the territory of the administrative-territorial units;
- improving road safety, environmental protection and the quality of local public transport;
- safe and comfortable travel, including through risk insurance of transported goods and people, as well as their belongings through insurance policies;
- equal and non-discriminatory access of transport operators, respectively of authorized carriers, to the local public transport market;
- optimizing the functioning of the local public transport market by ensuring a normal, dynamic and fair competitive framework.

2. QUALITY INDICATORS OF URBAN PUBLIC TRANSPORT SERVICES

The operation of the local public transport service must ensure [2]:

- increasing the level of service quality and comfort of users of local public transport services through regular services;
- access to local public transport services and protection of disadvantaged social categories;
- informing the traveling public;
- execution of local public transport of people through regular routes in conditions of regularity, safety and comfort;
- correlating transport capacity with existing passenger flows;
- continuity of local public transport service for people through regular routes.

The performance indicators regarding the provision of local public passenger transport through regular routes are as follows:

- the number of trips, routes on which the operator suspended or delayed the execution of transport compared to the traffic schedule;
- the number of routes on which the operator did not perform local public passenger transport for a period of more than 24 hours;
- the number of passengers affected by the situations provided for above;
- the total number of means of transport used daily compared to the number

- required to carry out the traffic schedule;
- number of passenger complaints regarding the quality of transport, of which:
 - number of justified complaints;
 - number of complaints resolved;
 - the number of complaints to which travelers did not receive a response within the legal deadlines;
- the number of zero-emission vehicles compared to the total number of vehicles required to carry out the traffic program;
- the age of the means of transport and the comfort facilities for passengers;
- compensation paid by transport operators/authorized carriers for failure to comply with quality and environmental conditions regarding the conduct of transport;
- number of violations found and sanctioned by authorized personnel regarding non-compliance with legal provisions;
- the number of traffic accidents caused by the fault of the company's own personnel or the transport operator/authorized carrier.

There is a wide variety of indicators that characterize the quality of public transport services. These indicators can be introduced into different categories, such as [3, 4, 5, 6, 7]:

- accessibility – indicators that evaluate the accessibility of a potential passenger to a public transport service, for different types of travel;
- service monitoring – indicators that evaluate the experiences of passengers who use public transport services daily;
- journey time – indicators that measure the duration of journeys in the public transport system and compare them with the durations achieved with other modes of transport or with an ideal value;
- safety and security – indicators that assess the likelihood of a passenger being involved in an accident or becoming a victim while using a public transport service;
- reliability – indicators of the effectiveness of the operator's program and its ability to meet the commitments made through the programs made public;
- economic characteristics – economic indicators of public transport service performance;
- capacity – the ability of operators to fully satisfy the demands placed on the public transport system in different areas and at different times.

A classification of public transport performance indicators based on priority and objective criteria is given in [8] (Figure 1).

3. ACCESSIBILITY OF THE PUBLIC TRANSPORT SYSTEM

According to Sustainable Development Goal 11 [9], access to public transport is considered convenient when an officially recognized station is accessible within a

walking distance along the street network of 500 m from a reference point, such as a home, school, workplace, market, etc. to a low-capacity public transport system (e.g. bus) and/or 1 km to a high-capacity system (in the case of Petroșani municipality, rail).

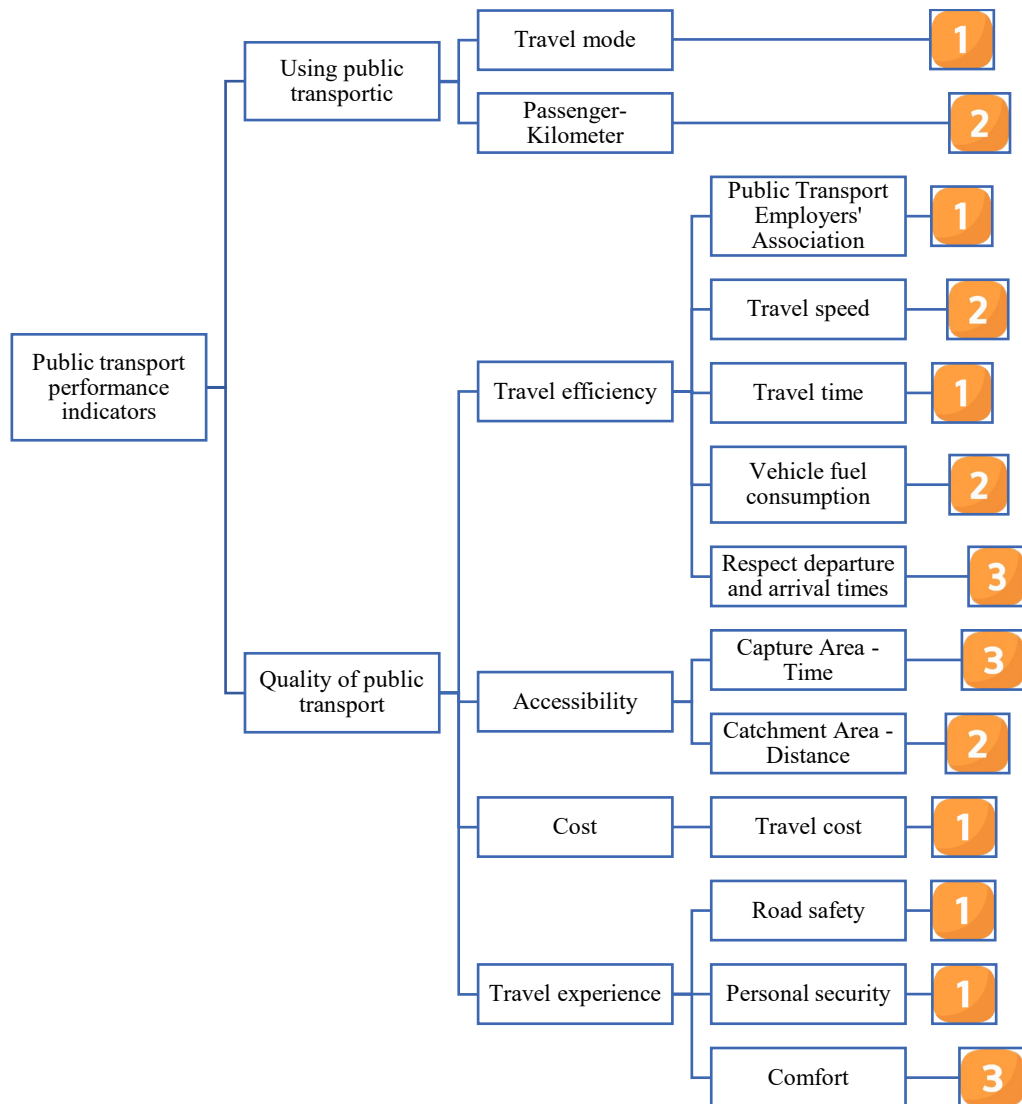


Fig. 1. Performance indicators and their priority in public passenger transport

In Petroșani, due to the configuration of the street network, the accessibility of low-capacity public transport stations is very good, respecting this criterion according to the “Program for paid road transport of people through regular services”, at the level of Hunedoara county [10]. Petroșani Municipality also meets the criterion of high-capacity public transport systems, having railway stations [9]:

- public transport with frequent service during peak travel times;
- stops present a safe and comfortable station environment.

Public transport can be selected for a trip when the transport service is accessible at the point of origin, at the time the trip is desired, if there is a station near the departure point, if there is sufficient transport capacity at that time and if the decision-maker is aware of that service and knows how to use it. If one of these conditions is not met, then public transport will not be selected and as a result the trip will be made using another mode of transport or will either be made at a less convenient time or will not be made at all. If the service is not accessible, the quality of the public transport service is no longer important for the person concerned. Accessibility at the station level is measured by the frequency of the service, which represents how many times in an hour a passenger can access public transport, assuming that the service is offered within a reasonable walking distance and during the period in which the trip is desired. The frequency of service is a component of the total journey time, based on which the waiting time at the station and the average interval between vehicles are determined. The average interval between vehicles is equal to the inverse of the frequency. Table 1 presents the service quality levels for both intervals and frequency. The notion of service level was introduced as early as 1965. To determine the service levels, a range consisting of six steps of a certain performance is determined, each step being assigned a letter. The service quality levels (QSLs) for frequency are determined for a specific station, by destination, because several lines can serve the same station, but not all serve the same destination. [3, 4, 5, 7].

Table 1. Service quality levels defined for the frequency of means of transport

QSLs	Average interval between vehicles, min	Frequency, vehicles/hour	Observations
A	<10	>6	No circulation program required
B	10-14	5-6	Frequent service, passengers consult the schedule
C	15-20	3-4	Maximum accepted waiting time
D	21-30	2	Unattractive service for people who have other alternatives available
E	31-60	1	Services available every hour
F	>60	<1	Unattractive services for all passengers

Service quality has a direct effect on the intention to use public transport more and that this effect affects both the intention to use one's own car less and the intention to use more sustainable means of transport [11]. The choice of travel mode is determined by several factors, such as contextual factors (the environment of available travel modes), an individual's abilities and constraints (owning a car), and various psychological factors (evaluations and motives) [12].

When selecting a transit mode, most passengers consider travel time to be the most important factor. Thus, people may be discouraged from using public transportation if the time between departures is excessive. Speed and delay are service characteristics that relate to travel time. From the statistical data of the traffic tracking

program, the tracking intervals between vehicles during times considered to be peak traffic times were highlighted. In addition, it reveals which routes and time periods need to improve the level of service [13]. The theoretical levels of service quality in frequency were established for the Victory Square route and return (Figure 2, Table 2). The quality of service for frequency for Petroșani Municipality results in level A for the time intervals between 07:00 and 16:00, level B for the time intervals between 16:00 and 18:00 and level C for the time intervals 06:00-07:00, 18:00-19:00 and 19:00-20:00. The conclusion is that the public passenger transport service is frequent and falls within the maximum accepted waiting time of 20 minutes. [14].

Table 2. Scheduled levels of service quality in frequency for the Victory Square-Airport route

Route	Route length, km	Time interval	Tracking interval, min	Frequency, vehicles/hour	Service level
Victory Square-Airport	4,2	06:00-07:00	30	2	D
		07:00-08:00	8	7,5	A
		08:00-13:00	9	6,67	A
		13:00-15:00	8	7,5	A
		15:00-16:00	9	6,67	A
		16:00-19:00	12	5	B
		19:00-20:00	20	3	C

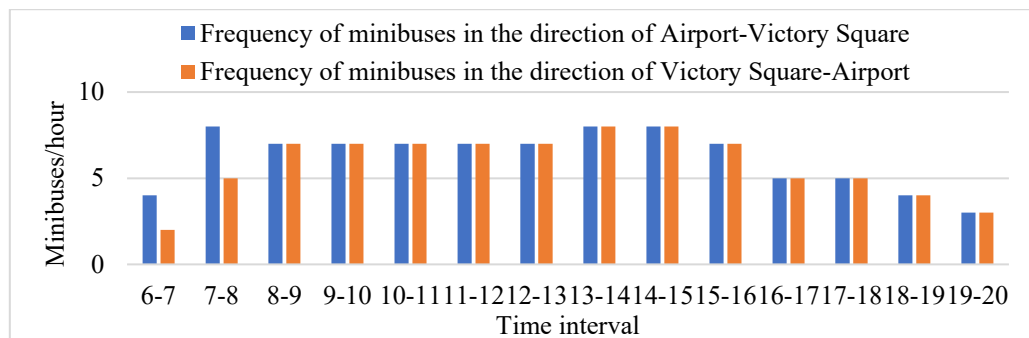


Fig. 2. Number of minibuses in 24 hours on the Airport-Victory Square route and return

Days when students are in class were chosen for the analysis, as the transport demand for the public transport system is higher and also coincides with an increased intensity of road traffic. Due to the complexity of the evaluation factors and the difficulties of quantifying qualitative indicators, it is difficult to accurately describe the objective reality, but finding closed-form solutions for the state-dependent optimal traffic intensity and the optimal switching state of the service rate is possible [15]. Accessibility is a key element in the geographical analysis of transport because it is a direct expression of mobility. Efficient and well-developed public transport systems offer a high level of accessibility. In most cases, economic development has been achieved in parallel with a significant increase in mobility and accessibility. In Petroșani Municipality, the accessibility of the population to public transport is very good, from

the survey carried out on 160 households with 398 people, it resulted that 90% of the population has access to a local public transport station within a maximum of 10 minutes of walking (Figure 3). The duration of a trip is 90% of a maximum of 20 minutes (Figure 4). Travel takes place in a proportion of 70% in the time interval 6.00-9.00 (Figure 5).

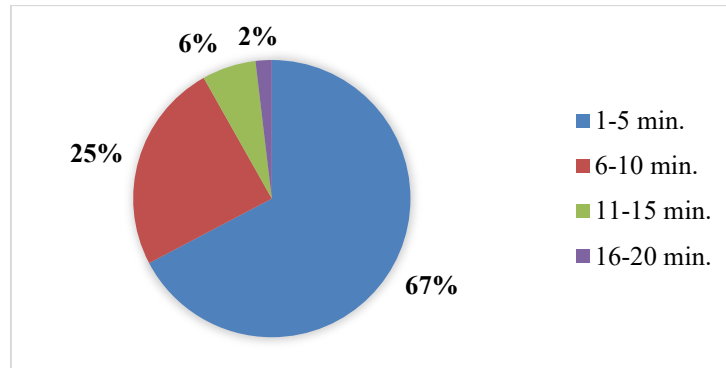


Fig. 3. Travel time to the first stop

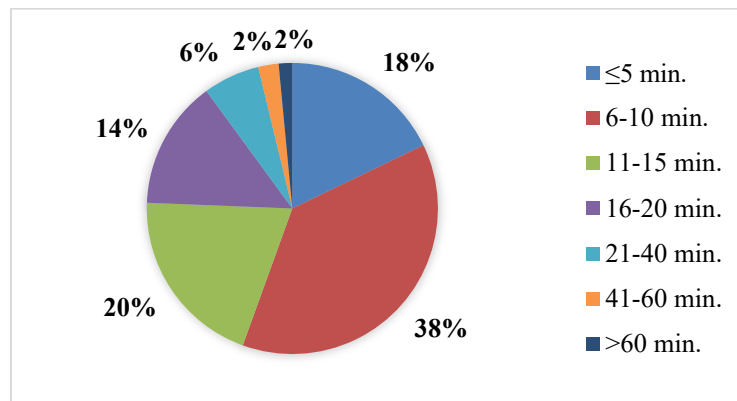


Fig. 4. Duration of a trip

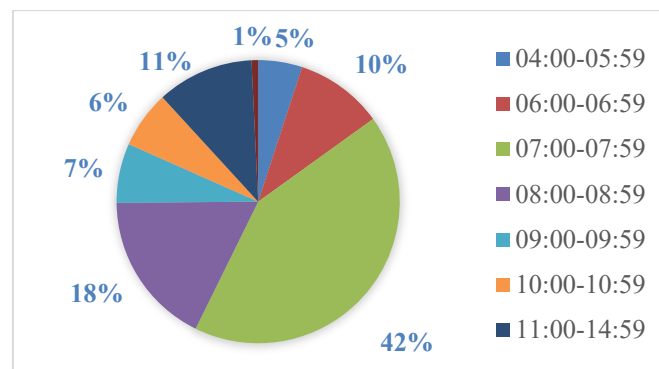


Fig. 5. Travel by time interval

5. CONCLUSIONS

A high-quality public transport system is characterized by its ability to efficiently meet people's mobility needs. For users, a high-quality public transport system must be accessible, fast, reliable, affordable and attractive. The current public passenger transport system in Petroșani municipality meets the requirements of a quality service, in terms of the level of service for frequency, the duration of people's walking to the first stop and the duration of the journey. However, urban public transport should be reliable and safe, and this requires periodic modernization of the fleet.

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