Assessment of the road and railway infrastructure and means of public transport by the aspect of the survey in the selected area of Poland

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Abstract. The current socio-economic conditions of some developed and developing countries are not favorable for the development of the public mass transport services. Most of the residents of large and medium-sized cities, but also smaller towns, use their own passenger car on mandatory trips. This phenomenon perfectly reflects the constantly growing of motorization index in such countries. The consequence of this is, of course, the decreasing number of passengers carried by means of public mass transport, in particular operating outside of large urbanized areas. This causes and unfortunately will cause not only further problems of automotive congestion on the transport networks of urban areas, reduction of the road safety level, but also adverse environmental effects in the form of pollution. The authors of the article analyzed the results of transport surveys, which were carried out in recent years among the public transport passengers. The research was carried out in one of the typical in terms of socio-economic conditions of Polish voivodships (a country dynamically developing in the passenger transport sector, as well as the quantitative and qualitative status of transport means and transport infrastructure). The voivodship subjected to such analysis was the Kuyavian-Pomeranian Voivodship, located in the central part of Poland. The respondents were asked to speak on topics related to, among others, transport infrastructure, means of transport, access to services of public transport systems, comfort and safety of traveling. The analysis also included assessments and postulates related to tariff systems, travel information systems, and transport integration systems - functioning in the voivodship. The results of the research were analyzed by the rail passenger transport and bus passenger transport as part of the voivodship public transport system. In the majority of cases, passengers' assessments were not satisfactory. The most frequently issued evaluations fluctuated only around the average (on a scale from 1 to 10). The authors have thoroughly analyzed the results of the transport survey, confronting the results obtained and trying to find out their causes depending on the characteristics of the area under analysis.

1. Introduction
Currently, in some developed and developing countries, public transport has a negligible role in passenger transport. First of all, the high quality of services in the public transport sector is desirable in the largest metropolises as well as large and medium-sized cities. In these urban centers there is a high level of motorization of the society and high traffic volumes on a very dense transport network with many intersections. Unfortunately, the largest share in road traffic is attributable to users of a private
passenger car and it is many times larger than in the case of public mass transport users. Therefore, it is directly required to strive to rationalize the use of public space in these urban centers by implementing a policy of sustainable development of transport with the main emphasis on favoring public collective transport measures [1, 2].

The situation in passenger transport is slightly different in intercity, regional and supra-regional transport. In some developed and developing countries, in the vast majority of cases, passengers are condemned to travel by car due to limited access to other means of transport (e.g., bus or rail) - mainly in areas with low population density. Even in the case when access to public transport services is provided to residents of less urbanized areas, the quality of these services (in terms of regularity and frequency of transport modes as well as broadly understood travel comfort) is disproportionate to expectations and habits regarding traveling by own passenger car. This is evidenced by the results and analysis of the volume of road and passenger traffic on non-urban traffic network (both roads and railways) [1, 3, 4]. For example, Figure 1 shows the volume of transport work carried out in passenger means of transport by car, bus and rail from the period 2010-2016 for selected EU countries. It is clear to be noted that there is a definite advantage of traveling by car in relation to public bus and public rail transport services in these countries. Transport performance by own car is on average about 10 times higher in analyzed countries. In addition, it should be noted that there is still a continuing increase in the passenger car's transport performance in the vast majority of countries. In most of the above-mentioned countries, in 2010-2016, there is a significant reduction in transport performance in the bus transport system, while in rail transport system there is a significant increase in this transport performance.

![Figure 1. Changes in the volume of transport performance in selected EU countries in 2010-2016, by passenger cars, buses and railways (source: own elaboration based on [1, 3, 4])](image)

Being aware of the dangers resulting from the constantly growing motorization rate in developed and developing countries, it was decided to carry out an analysis of the quality of transport services offered in interurban and regional passenger transport. For this purpose, surveys were carried out on residents of one of the regions in the central part of Poland, namely the Kuyavian-Pomeranian Voivodship. This region is characterized by typical political and socio-economic conditions for this country. In this voivodship there are two large urban centers with a metropolitan potential (~ 800,000 inhabitants in the functional area of Bydgoszcz and Torun). Apart from these centers, there are also 3 other, but much smaller, medium-sized cities (~ 100,000 inhabitants). Other towns should be classified as small towns or villages. The total number of inhabitants analyzed in the region is ~ 2.1 million, and the average population density of this area is about 116 people per km² [4, 5].

In the discussed region, the following regional public transport systems operate:
bus transport (suburban, inter-urban, regional and supra-regional systems),
- railway (Bydgoszcz-Torun metropolitan system, regional and supra-regional systems).

Data for 2015 show that there were ~ 46.7 million passengers using bus services, which was ~ 7% fewer passengers than in 2014. It should be noted that the reduction in passengers transported in bus transport occurred despite the fact that transport performance in this sector of public transport services increased in relation to 2014. In 2015, it was ~ 1 034.4 million pkm, which is worse than in the previous year by ~ 2% [4, 5]. In rail transport, in 2015, ~ 7.5 million passengers were transported. There were definitely more travelers than in 2014 by ~ 21%. Transport performance, in the period of 2014 and 2015, was at a comparable level and amounted to 5.5 million pkm. Unfortunately, for several years, both in bus and rail transport, there has been an unfavorable downward trend in the number of passengers, despite the growing financial outlays on the operation and maintenance of these sectors of public transport services. A similar trend in other typical regions of Poland can also be noticed (with the exception of large metropolitan regions and the capital city) [4, 5].

2. Implementation of surveys

Survey research was carried out using a direct interview with residents of the Kuyavian-Pomeranian Voivodship. A specially prepared form for a detailed assessment of the existing network of connections in public transport and the identification of possible expectations and preferences by the travelers to improve the current situation was used for this purpose. These studies were an integral part of the Transport Study Document, developed for the needs of the “Plan for sustainable development of public transport in the analyzed voivodship” [6].

Questionnaires were carried out both inside public transport vehicles and within the point of public transport infrastructure (stops, stations and multimodal interchange). In total, interviews were conducted:

- 2 745 questionnaires with rail transport passengers,
- 1 316 questionnaires with bus transport passengers,

and were made by 50 interviews.

Among other things, the traveler’s assessment: the condition of public transport infrastructure, means of public transport, tariff and ticket systems functioning in the analyzed area, passenger information systems, comfort and travel safety. In each of these groups of assessments, the respondents were able to express their postulates from the point of view of a passenger of public transport, regarding possible changes in a given partial criterion of the assessment. The scale of grades ranged from 0 ÷ 10. Grades below 5 were considered unsatisfactory (below mediocre) [6].

3. Passenger ratings and preferences

3.1. The conditions of infrastructure and means of public transport

The respondents evaluated the condition of infrastructure and means of public transport divided into the following elements: the condition of point and line infrastructure, accessibility to the stops, adapting stops and vehicles to disabled people, availability of car parks at stops, and the possibility of transporting a bicycle. Figure 2 presents average values of grades according to the examined criteria related to the condition of infrastructure and means of public transport in bus and rail transport systems, along with the frequency distribution of these assessments.

The average score for the quality of rail and bus infrastructure and means of transport amounted to 5.16, so it is not an assessment that could be considered satisfactory. The lowest grades were achieved by the adaptation of stops and stations and the adaptation of transport means for the disabled. A lot to be desired also leaves the state of stops and stations, because the average rating can’t be considered satisfactory. The highest score achieved accessibility to bus stops and train stations.
The average score from all the partial criteria of the existing railway infrastructure and means of transport is 5.17, and the bus infrastructure and means of transport is 5.18. They are practically the same. Such a result was influenced by a very low score regarding the possibility of transporting a bicycle with buses, because the ratings for other sub-criteria for the bus infrastructure and vehicles were already higher.

Figure 2. Distribution of grades divided into selected categories in relation to the condition of infrastructure and means of public transport in the bus- and railway systems

The condition of the existing railway and bus infrastructure as well as the means of transport has not been favorably assessed by the respondents and in their opinion leaves much to be desired. Most of the grades obtained hovers around 5 and demonstrates the need for investments and modernizations aimed at improving the quality of point and linear bus and railway infrastructure, as well as means of transport.

In figure 3 presents the percentage of travel information provided by travelers about expectations and preferences related to the existing infrastructure and means of public transport (railways and buses).
As it turns out, a big problem for travelers traveling by rail is the entrance and exit of the wagon, and therefore the most serious expectation is to increase the number of low-floor wagons. More space for bicycles in wagons and more free parking spaces at the railway stations are the next expectations of travelers using trains. Similarly in the bus transport - use of lower curbs at bus stops is the expectation of disabled people. Further expectations are related to the increase in the number of parking spaces at bus stations and the equipment of bus stops in sheds.

3.2. Existing tariff and ticket systems
Figure 4 presents the average values of the ratings of individual questions related to existing tariff and ticketing systems in bus and rail transport, along with the frequency distribution of these assessments. The assessed elements were: ease of ticket purchase, their diversity and the number of their prices. Figure 5 presents the percentage of travel information provided by travelers on the expectations and preferences related to tariff systems in rail and bus public transport systems.
Figure 4. Distribution of grades divided into selected categories in relation to the existing tariff systems in the bus- and railway public transport systems

The highest score was obtained by the criterion regarding the ease of buying tickets, and the lowest (as expected) ticket prices. The analysis of detailed data shows that both average values of partial grades and standard deviations of these assessments regarding the operation of railway and bus tariff systems are similar. Based on the distribution of all the evaluations submitted, it can be concluded that tariff systems in regional public transport are assessed at a fairly good level.

Expectations of passengers traveling by train are related to the improvement of their service regarding the purchase of a ticket. Unnecessary delays resulting from too few active cash registers and ticket machines cause both the nervousness of travelers, as well as strongly affect the already unprofitable image of the railway public transport system. In the case of bus public transport system, the expectations of travelers are also associated with the facilitation of buying tickets.
3.3. Existing passenger information systems

Figure 6 presents the average values of assessments of individual issues related to existing passenger information systems in bus and rail transport systems, along with the frequency distribution of these assessments. Figure 7 shows the percentage of expectations and preferences related to travel information systems in rail and bus public transport systems.

![Diagram showing distribution of grades divided into selected categories in relation to the existing passenger information systems in the bus- and railway public transport systems](image)

**Figure 6.** Distribution of grades divided into selected categories in relation to the existing passenger information systems in the bus- and railway public transport systems.
The evaluation was made using the following sub-criteria: availability of information points, quality of service at information points, availability of current information outside stations and stops, current passenger information in the vehicle, information on timetables at stops and stations, availability of information on ticket fares and discounts, availability information about multimodal interchange and coordination, availability of transport regulations, availability of information on delays and lack of courses, availability of information on additional connections.

The analysis of the data shows that in the opinion of the respondents, much to be desired leaves the availability of information on delays and lack of courses and the availability of information on additional connections. These criteria have the lowest scores, below 5 points, so they are inadequate. In assessments very similar tendencies can be noticed only in the railway travel information system and only in the bus travel information system. It is considered that the travel information system is assessed as quite functional.

The presented data show that the urgent problem to be solved in the case of railway transport is the information about the next station, which would definitely increase the comfort of traveling (eliminating unnecessary stress). The same problem concerns the provision of information on the internet, from which platform the train departs. Almost every fourth respondent pointed to the need for clearer messages from the loudspeakers by the information services. In the case of bus transport, as many as 60% of respondents point to the need to exchange damaged timetables at bus stops.

Figure 7. Preferences of travelers in relation to the existing information systems in the regional public transport

3.4. Travel comfort
The assessment of travel comfort consisted of the following partial criteria: travel time, interchange, synchronization with other modes of transport, frequency and regularity, comfort in the vehicle, seat guarantee, quality of service by drivers and conductors, cleanliness in the vehicle, cleanliness at stations and stops, ease of getting in and out of the vehicle, punctuality.

Figure 8 presents the average values of individual questions related to travel comfort in bus and rail public transport systems, along with the frequency distribution of these assessments. In turns, Figure 9 shows the percentage of travel information provided by travelers on the expectations and preferences related to travel comfort in rail and bus transport.
With regard to general data for the entire public transport service sector, the respondents rated cleanliness at stations and stops as the lowest (insufficient rating). Low cleanliness was mainly influenced by cleanliness at railway stations and stops. The other partial criteria were quite well assessed. The crew of vehicles deserves praise, which the respondents rated as very good (with a relatively small standard deviation of this average rating).

The main expectations of rail travelers mainly concern the increase in the number of connections and the number of seats on the trains. The condition and quality of the toilets should also be considerably

Figure 8. Distribution of grades divided into selected categories in relation to the comfort of travel in the bus- and railway public transport systems
Figure 9. Preferences of travelers in relation to the travel comfort in the regional public transport improved. However, in bus transport, expectations primarily concern the increase in the number of low-floor buses as well as the number of connections.

Just over 15% of respondents point to the necessity of equipping buses with air conditioning. However, only slightly more than 1% of travelers express the same view of trains.

3.5. Travel safety
Figure 10 presents the average values of assessments related to the travel safety in bus and rail transport systems, along with the frequency distribution of these assessments. The assessed elements were: traffic safety (on the road and rail), safety in vehicles, safety at stations and stops, and luggage security. In contrast, Figure 11 shows the percentage of travel information provided by travelers about the expectations and preferences related to the travel safety in rail and bus public transport systems.
Analyzing the value of ratings posted on Figure 10 the respondents rate slightly above average safety of traveling in public transport. It is worth noting the safety assessment at stops and stations as well as the security of luggage, in particular in the case of rail transport. The security of the regional public transport sector is considered to be good due to the relatively low frequency of low ratings in the context of travel safety.

Taking into account the expectations and demands of passengers of the regional public transport, the largest number of respondents, as many as 65% expect an increase in the number of patrols at railway stations.
stations and on trains, which indicates a relatively low sense of safety for rail travelers. Many people expect to increase the number of cameras to monitor stations, especially bus stations. Over 22% of respondents are concerned about the high speed of buses, which may be related to the low technical condition of some of these means of transport.

4. Conclusions
On the basis of the collected survey results of the travelers' assessments and preferences by the regional transport, it can be concluded that the passengers in this public services sector are relatively satisfied with the existing tariff systems, travel comfort and travel safety. Unfortunately, both the state of point and line infrastructure as well as existing passenger information systems were considered mediocre.

This is a clear message of urgent interest in the issue of the quality standard of the infrastructure and means of public transport. The main focus should be on the adaptation of stops, stations and vehicles for the disabled people.

A big problem also applies to the damaged timetables. Hence, in the case of the travel information, special attention should be paid to dynamic passenger information on the stops and stations, including the data on vehicle delays or failures on the transport network.

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