

DETERMINING THE LEVEL OF SATISFACTION AMONG USERS OF PUBLIC TRANSPORT IN LUBLIN

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Abstract

The purpose of this work was to present the public transport system operating in the city of Lublin, including its history, organizational structure, elements of line and point infrastructure, and analysis of the results of the survey conducted among 248 people who are passengers of public transport. The questionnaire contained 20 questions whose answers were developed in the form of charts and tables and their discussions. In addition, comparative data from a study carried out in 2016 by the Municipal Transport Authority in Lublin were added to some of the results. The elaboration of results allowed the assessment of the level of satisfaction among respondents, including proposed changes submitted by the respondents. They are a suggestion for the body dealing with the organization of public transport in the city, as well as for entities performing transport within it, regarding future projects improving the operation of public transport, thus satisfying the needs of potential passengers.

Keywords: urban transport; transport system; radial-ring type; passenger needs

1. Introduction

Satisfying human needs has been for centuries associated with the movement of people, loads or information. There are restrictions that make it necessary for people or loads to move around. These include, for example, different locations of places where individual needs are met. Areas with different specifications have different modes of movement. The article focuses on urbanized areas where public transport, also called as urban transport, is a necessity. The purpose of the article was to analyze and present the level of satisfaction of Lublin residents using public transport.

The current layout of public transport lines in the city of Lublin has been evolving for many years with the development of the city. The determinant of such changes was and is mainly awareness of the need to meet the expectations of residents. Their use of public transport boils down to traveling for professional purposes, due to the fact that work centers are often far away from where they live. In addition, a large proportion of users of the public transport

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network are pupils and students who are not able to travel to schools or universities by car. It should be added that similarly older people, pensioners, move in city buses to health facilities or other places, as it is the most accessible to them mode of transportation. Mobility, as one of the basic needs of the population, is a necessary condition for the development of the region in which the population migrates. The quality of the connection between rural and urban areas is a key factor in preventing a serious outflow to urban centers. Due to its capacity, cost-effectiveness, spatial rationality and ecological acceptance, public transport serves as the basis for mobility. On the other hand, the lack of high-quality public transport services is the reason why passenger car migrations currently have a significant share in the distribution of means of transport in urban areas as well as in rural areas [20].

In connection with the listed needs, as well as others, which appear among the passengers of public transport, analyzes are carried out to adjust, among others course of lines, their optimal length so that travel time is as short as possible. The largest number of destinations as well as the highest frequency of travel are taken into account [25]. What's more, the development of housing (the creation of new housing estates) results in an increase in passenger flows, and hence the need to organize new or modify routes of existing connections. According to the author of one of the articles [12] on the demographic conditions of the demand for daily public transport journeys, the way in which the additional population will be placed, in green areas or post-industrial areas, will be important when making decisions regarding investments in the transport system. The increased population density in existing urban areas facilitates access and is best served by public transport. It is important that the decreasing share of car journeys (in the mentioned article on the example of the city of London) illustrates the possibilities of reducing traffic congestion and carbon dioxide emissions [12].

To succeed in market competition with the car, a significant proportion of the resources of the public transport system must be directed to the main transport corridors. This concentration of resources in the region must, however, be balanced by the need to ensure a minimum level of transport services to all citizens, regardless of car availability, physical capacity and place of residence. Lines served only a few times a day and lines that do not follow established routes will not be included in the planning of the main line structure. This means that areas with low public transport demand must have different transport solutions to ensure access to stops, stations and nodes of the main public transport network [14]. Moreover, according to research conducted in Great Britain and France regarding the main circumstances determining the advantage of public transport over individual transport, state policy plays a huge role. The main conclusion was that public transport demand is relatively sensitive to tariff changes, so policy measures to lower the tariff (subsidization) can play an important role in encouraging the use of public transport, thereby reducing the use of private cars [2].

Increasing the level of satisfaction of people using public transport is all the more important as the use of public transport can be counted as environmental protection measures. The need to reduce emissions from the transport sector is becoming urgent, and public transport can play an important role in the transition to low-carbon fuels. To a large extent, public transport in Europe is provided by regional authorities, which control traffic to varying degrees, from total public monopoly to competitive tenders. The organization of the public bus transport market influences the introduction of renewable fuels [1].

The intensive influx of people to cities accelerates the already intensified process of global urbanization and presents managers with numerous challenges aimed at balancing the flow of population, goods and information, while guaranteeing the security of residents [17]. The combination of economic, ecological and social goals gives a chance for a more effective management of the city's resource flows and meeting the residents' expectations in the long run. For the city to function properly, efficient public transport should be organized, among others [17]. The basic measure to improve the functioning of public transport should be to meet the demands of users. Understanding the factors that motivate satisfaction with travel is necessary to design attractive public transport systems [8]. The rank of the requirements for public transport cannot be clearly determined because they are different for a given local environment. Very often, helpful in establishing the hierarchy of transport demands is research on the preferences of residents carried out by local public transport organizers, local authorities or external companies [6].

The requirements for those providing public urban transport services depend on the results obtained when collecting opinions among its users. Each passenger deciding to use the public transport makes a decision based on satisfying his individual needs. This decision is influenced, among others, by the purpose of travel, the time the traveler will have, as well as many other factors [11]. The travel safety expected by passengers is quite important. It depends, among others, on the technical condition of the vehicles, but also on the persons driving these vehicles. A high level of occupational stress is observed among the drivers of public transport, as well as in others. However, when comparing drivers, for example, transporting loads with drivers of passengers public transport, the former obtained higher results at a statistically significant level. This can be justified by the fact that public transport drivers experience less stress because their routine is the same, so their work environment is more stable. Daily, cargo drivers must travel on different routes (depending on delivery locations), which creates uncertainty. In addition, public transport drivers are relieved of the stress of finding a parking space in the city center, which is a daily challenge for a freight transport driver, but not only for them [9]. The same problem is observed among the passenger car drivers. Thus choice of public transport is also attractive referring to everyday stress of people driving in cities area.

The presented article is an analysis of one of the surveys conducted among passengers of public transport in the city of Lublin in order to determine their preferences, which allowed to examine which factors are decisive in choosing this type of transport. The research also allowed to outline what should be changed and improved in the scope of services provided by the Municipal Transport Authority in Lublin.

2. Characteristics of the studied area

The communication network in the city is based on the existence of communication lines, which, according to the Act of 6 September 2001 on road transport is defined as "a communication connection on a specific road between stops indicated in the timetable followed by regular passenger transport" [22]. There are 71 such connections in Lublin, including 56 bus lines, 12 trolleybus lines and 3 night lines. In addition to regular lines, special dedicated lines are launched, including commuting to places related to various cultural events, national holidays [15].

Each functioning line has a specific direction of travel, route along with a system of stops defining it, and a publicly updated timetable, which is defined as ordered, in relation to the days of the week, a list of departure times from each stop on the routes different variants of the line assigned to it along with the travel times between stops set depending on the time of day. It is also a work schedule for drivers and vehicles. The layout of these lines is created taking into account the shape of street routes in a given city, where types such as: circumferential, radial, tangential, diametrical or mixed (combination of different types) are distinguished [24]. The city of Lublin is characterized by a radial-ring type system [26].

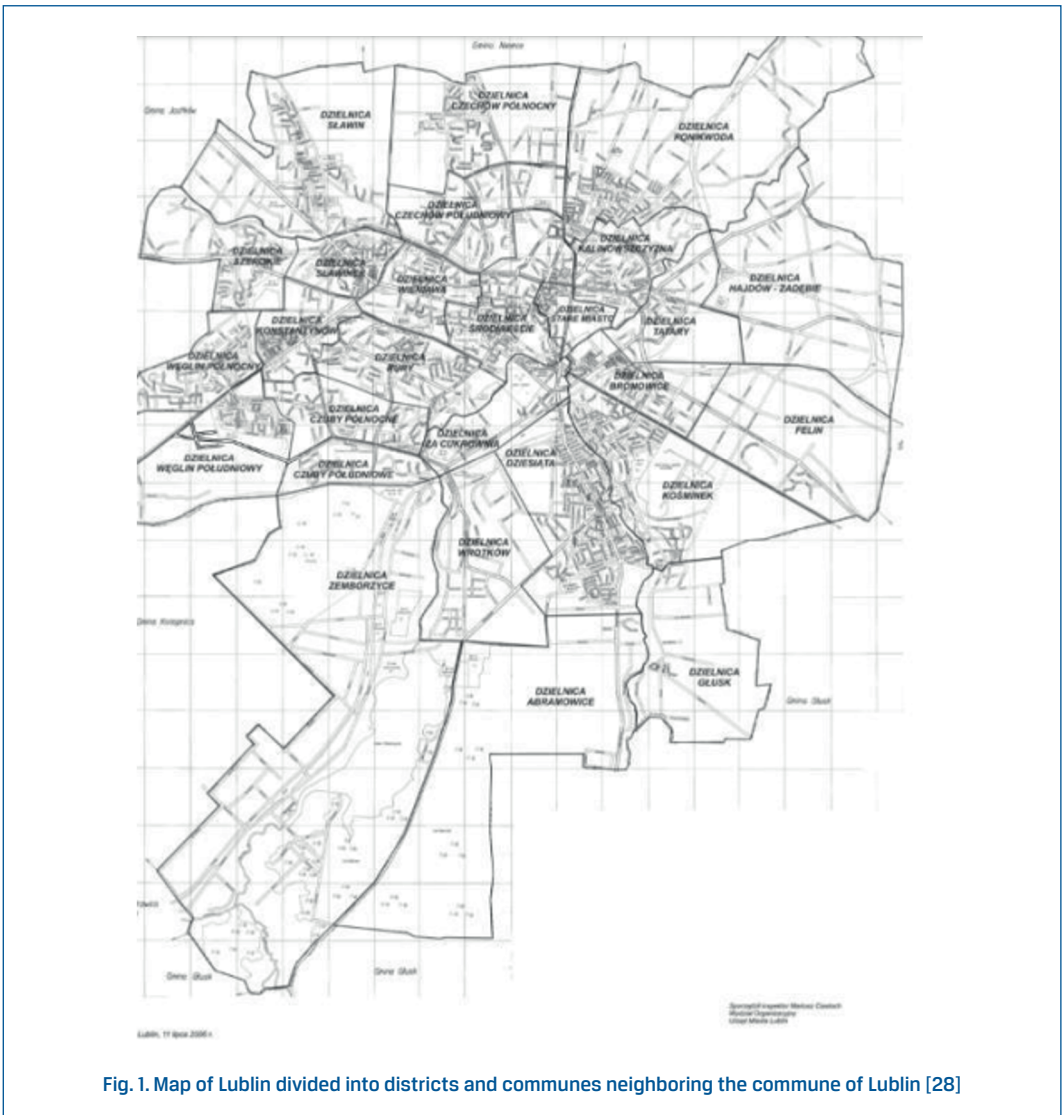


Fig. 1. Map of Lublin divided into districts and communes neighboring the commune of Lublin [28]

The directions of the Lublin public transport line are determined by stops located in different districts of the city, which connect these districts in various combinations and in neighboring municipalities with which the city has signed appropriate agreements. The administrative division of the Lublin commune is shown in Figure 1. Hajdów - Zadebie, Wrotków and Felin are defined as mainly industrial districts. The Economic Zone, called the "sleeping areas", includes Northern Czechów and Southern Czechów, Northern Czuby and Southern Czuby, Kalinowszczyzna or Węglin [26].

Recent years have abounded in further significant changes and modernizations of the city's transport system - including the north-east and west part of the city beltway was created [26], in the area of the downtown beltway (running along the streets: Poniatowskiego, Sowińskiego, Głęboka, Muzyczna, Stadionowa, Lubelskiego Lipca 80, Unii Lubelska and Aleje Tysiąclecia) restrictions were imposed on passenger vehicles, paid parking zones were created, and priorities for public transport have been established as part of the intelligent road traffic control system [18].

3. Research methodology

The purpose of the research was to assess the level of satisfaction of passengers using public transport services in the city of Lublin. It was the result of an analysis of the survey conducted partly in paper form, partly electronically. The research period covered July and the turn of September, October and November 2018. The questionnaire consisted of 20 questions. Five of them were metrics, other were concerned to the frequency of using public transport, travel destinations, the minimum expected standard of travel, general assessment of issues such as travel safety, ticket prices, vehicle equipment, quality of information provided to passengers or bus stop infrastructure. As many as 248 respondents, including 162 women and 86 men took part in the study. The respondents were divided into five age groups: under 18 (pupils - elementary, middle and high school students), 19 to 26 years old (student age), 27 to 35 years old, 36 to 49 years old and people over the age of 50. The most numerous group are people at the student age (up to 171 respondents, or 69% of the total), while the least numerous are people aged 50 and more (6 respondents, which is 2.4% of the total). In addition, the number of women over men clearly prevails in each group.

The percentage share of all five examined groups is shown in Figure 2:

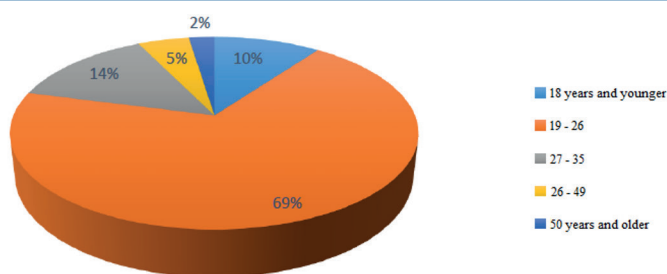


Fig. 2. Age of respondents [7]

Slightly less than half of the respondents have student status (47.6%). The second largest group are employed (over 31%), while the lowest percentage among those surveyed is characterized by non-working persons, i.e. the unemployed, housewives as well as pensioners (in both cases less than 3%). The number of all surveyed groups is presented in Figure 3:

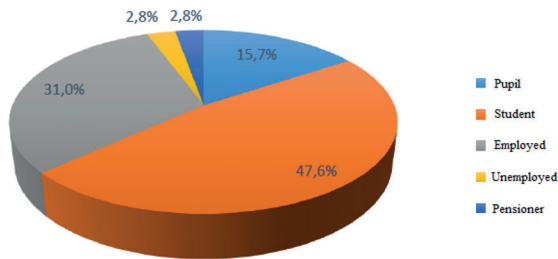


Fig. 3. Professional status of respondents [7]

Tab. 1. Place of respondents residence depending on the professional situation [7]

Professional status \ Place of residence	Professional status					Total
	Pupil	Student	Employed	Unemployed	Pensioner	
Lublin city	22	66	58	3	7	156
Neighboring municipalities	6	9	10	2	0	27
Another town in Lublin Voivodeship	10	36	6	2	0	54
A town outside of Lublin Voivodeship	1	7	3	0	0	11
Total	39	118	77	7	7	248

The chart in Figure 4 illustrates the place of residence of the surveyed group. The vast majority of respondents, which constitute less than 63%, are people living in Lublin. A group of respondents from the other city in the Lublin voivodship has more than one-fifth of the population (21.8%), which is the second in order. The least number of people (4.4%) come from towns located in the province other than Lublin voivodeship. Referring to Table 1 in this case, it can be seen that 8 out of 11 respondents belonging to the least numerous group are pupils and students. The situation is similar in the case of people from another town in the Lublin Voivodeship - 85.2% (46 people) of the respondents are young people under 26 years of age. Therefore, it can be stated that the main reason for their stay in Lublin are educational goals.

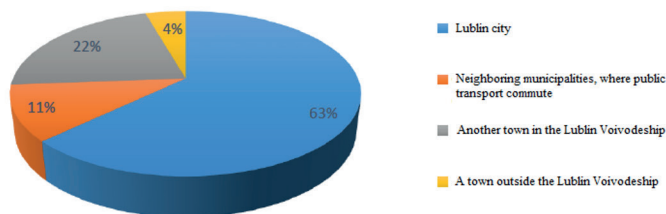


Fig. 4. Place of residence of the respondents [7]

Considering the fact of owning a vehicle and using it every day, it was noticed that almost 45% of respondents do not own a car, slightly more than 40% of respondents have their own means of transport and are its active users. The rest of the respondents are people declaring that neither they nor any of the household members own car. The answer to this question is presented in the diagram in Figure 5:

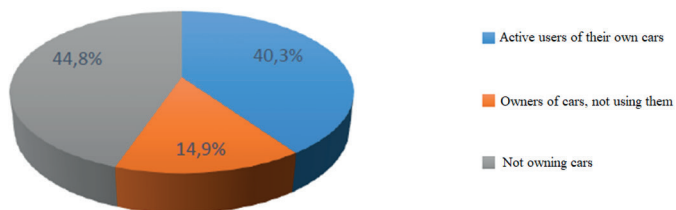


Fig. 5. Status of respondents related to car ownership [7]

4. Analysis of the results of the main part of the survey

The main part of the survey referred to the use of public transport by the respondents. Over half (58.1%) of the respondents use public transport every day, over a fifth (22.2%) choose this way of traveling around the city several times a week. The rest of the respondents are people using public transport occasionally or several times a month. Graphically, the frequency of respondents' use of public transport is shown in Figure 6:

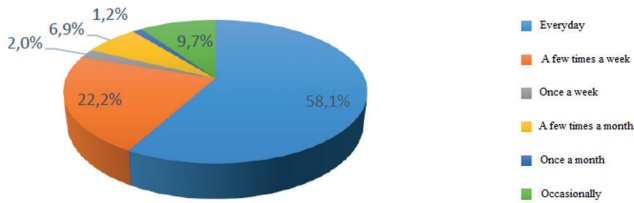


Fig. 6. Frequency of respondents using public transport [7]

In the case of the type of transport used by the respondents as a part of public transport, the vast majority, which accounts for over 77.02% of the total, chose the bus. The remaining part, which has 57 respondents (22.98% of the total), more often chooses a trolley bus. Over 61% of travel destinations were schools or university. Over two-fifths of respondents declared that public transport give access to places where they can use medical services, settle official matters, private matters, go to the pharmacy or meet social needs. A large percentage of passengers chose as a destination a workplace - 38.3%, a place where they can shop - 38.3%, and a place to visit friends or family - 35.9%. The others are presented in Figure 7:

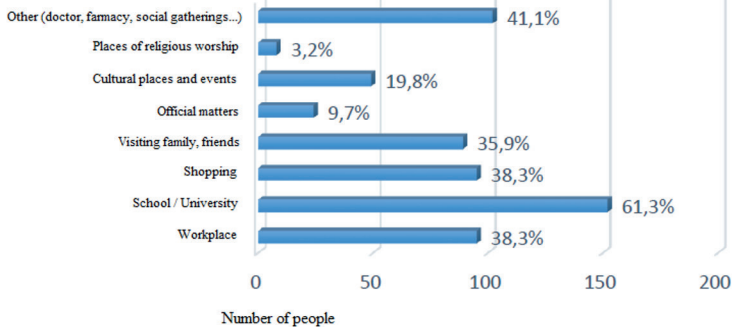


Fig. 7. Travel destinations in public transport [7]

The survey also asked about the days of the week when the respondents most often use public transport (Figure 8). Over half of the respondents, i.e. 56.5% of all participants, replied that they travel by bus or trolleybus both on weekdays and on weekends (Saturdays and Sundays). The least respondents, only 2%, choose to travel by public transport only on weekends. Others go only from Monday to Friday.

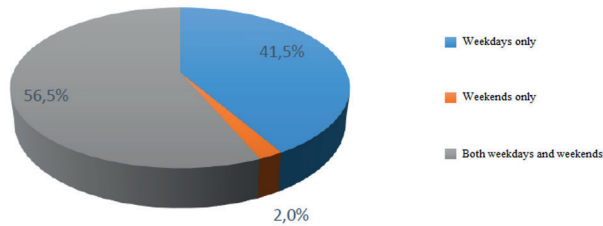


Fig. 8. Part of the week in which respondents use public transport [7]

Referring to hours of respondents' travel, the number of passengers in hourly groups into which the day was divided is presented on Figure 9. It should be noted that the respondents had the opportunity to enter not only one specific time. In this way, the majority, as much as 69% of passengers travel by public transport in the time range from 14:00 to 16:00. These are afternoon rush hours when people leave work and students finish school. Slightly less - 65% of the respondents travel during the morning rush hours, i.e. from 8:00 to 10:00, and their purpose is usually commuting to work or school. A high percentage of respondents also chose hours from 10:00 to 12:00 and from 12:00 to 14:00 - 62% and 63% respectively of all those who answered. The least frequent passengers use public transport at night, i.e. from 24:00 to 5:00 in the morning, as well as from 5:00 to 6:00 in the morning. The numbers are 4% and 6% respectively. During this period, the most common users of public transport are participants of cultural events, visiting public places (in the case of night hours) and commuters.

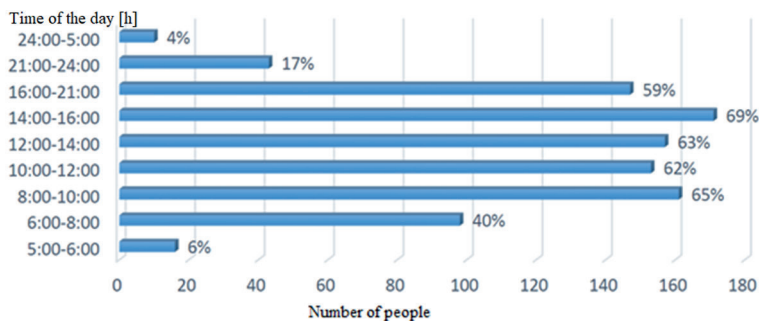


Fig. 9. Hours indicated by respondents [7]

5. Level of satisfaction of respondents with public transport in the city of Lublin

After a preliminary analysis of the data, allowing to determine the group of respondents and trends observed among users of public transport in Lublin, a further part of the survey was developed and its results were compared with the data obtained during the survey carried out by the Municipal Transport Authority in Lublin in 2018 and 2016. The time was also determined by the respondents' expectations. What is more, the number of transfers, as well as the minimum travel comfort were examined.

The most respondents, over 42% of the total, defined the average time within (5-10) minutes. Two years earlier, the same time interval was chosen slightly less often - by four tenths of a percentage point less than in 2018. The percentage of people who waited at stops 5 minutes decreased in 2018 by more than 16 percentage points, while the increase is observed in ranges of waiting times above 10 minutes compared to 2016. The most alarming is the percentage of passengers waiting for public transport over 20 minutes, which are more than 3 percentage points, as shown in Figure 10:

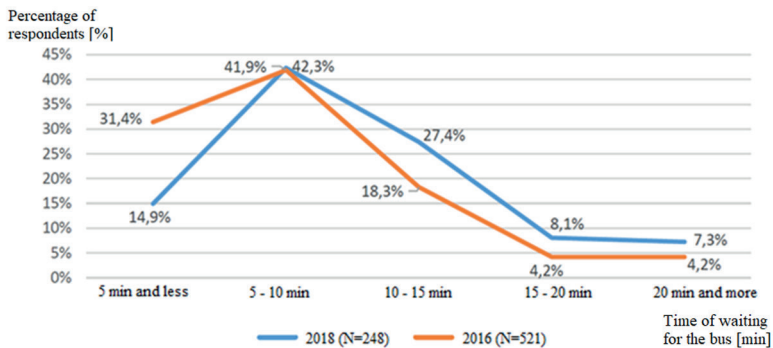


Fig. 10. Waiting time of respondents for public transport vehicles in 2018 and 2016 Source: study based on own research and MTA data in Lublin [16]

As for the number of transfers usually carried out by the potential passenger, the number of research groups was 248 people in 2018 and 521 in 2016. Based on the chart in Figure 11, it can be seen that more than half of the respondents, i.e. 54.03%, usually declared one or two transfers, in the case of surveys from 2018. Need to be noted that two years ago the number of bus changes by more than 30 percentage points less studied. Direct journeys were declared by 40.32% of passengers in 2018, while in 2016 the same answer was given by 76.4%. Last year, the number of people making 3 or more transfers increased to 5.65%.

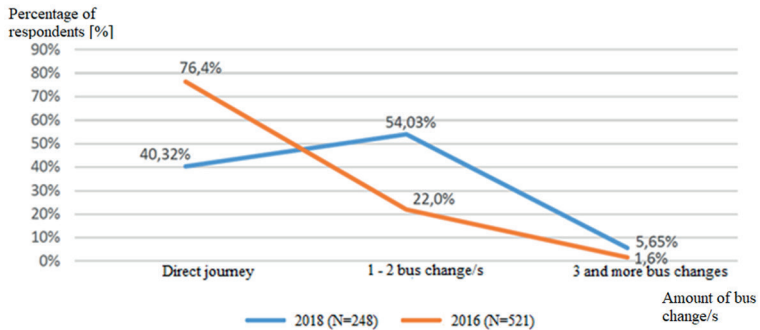


Fig. 11. Number of transfers performed by passengers in 2018 and 2016 Source: based on own research and MTA data in Lublin [16]

Another question that the respondents answered was about the minimum standard of travel they expect in public transport vehicles. In 2014, more than half of the passengers declared that they expected a seating place, two years later the value of this indicator decreased by almost 4 percentage points, while in 2018 only 37% of the respondents expected to ride in a sitting position. Definitely more people are able to ride in a standing position, as much as 46% of the total, where in previous years every 4 person was able to choose this type of standard, in the case of 2014, and even only 13.2% of those surveyed in the year 2016. Driving on a crowded bus is still not preferred by travelers, although last year the percentage of people able to drive in crowds was at 16% - 6 percentage points more than four years earlier. Preferences for other standards are shown in Figure 12:

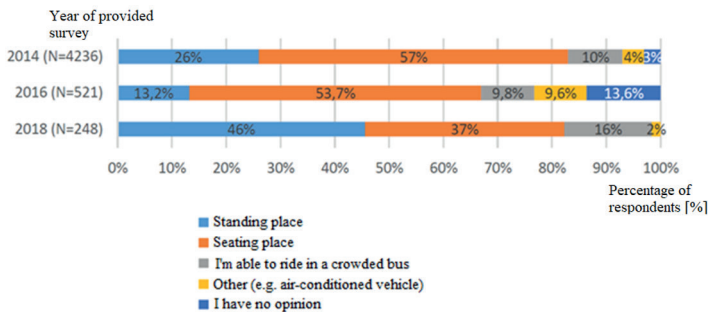


Fig. 12. Minimum travel standards expected by passengers in public transport vehicles in 2018 and 2016 (N - size of the research group) Source: based on own research and MTA data in Lublin [16]

When using public transport, it is necessary to have a document / confirmation authorizing travel on a given section in a specific vehicle, which is usually a ticket. Passengers can choose between normal and half-price tickets. In 2018, most people used half-price tickets (68% of respondents), where in previous years less than two-fifths of passengers used this type of ticket. Much more respondents then chose normal tickets – over half of the respondents. Most people used free travel in 2016 - over 20% of those participating in the survey, while the least in 2018 – 4% of those surveyed (Figure 13).

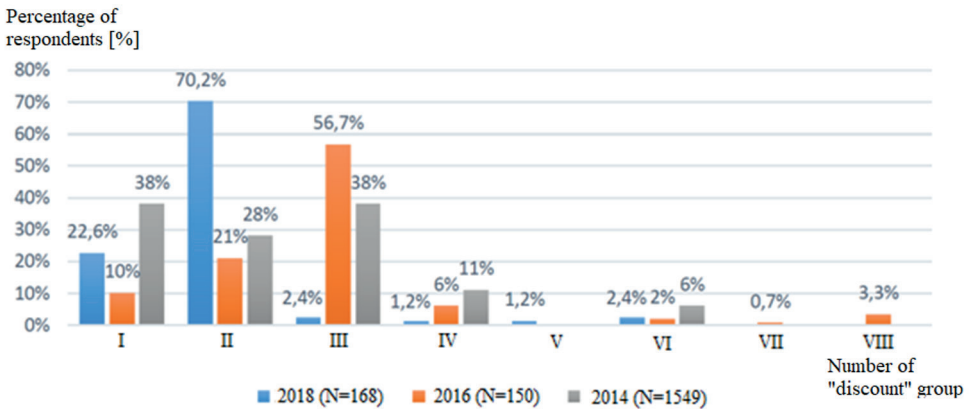


Fig. 13. Types of tickets used by passengers in 2018, 2016 and 2014 Source: based on own research and MTA data in Lublin [16]

The next question related to people who answered that they were using reduced-price tickets and concerned the type of discount on the basis of which they could buy these tickets. In 2018, the largest percentage of respondents who chose half-price tickets chose to have student status as a basis for their use, and thus student ID – over 70%. In previous years, 2016 and 2014, less than 30% gave the same answer. In 2016, the second largest value was achieved in relation to pensioners – over 56% of respondents. The least of all respondents in a given year marked the following types: in 2018, 1.2% – a student or student of foreign high schools and universities up to the age of 26 and a participant in doctoral studies; in 2016, 0.7% – veterans; while in 2014 6% – a high school or university student up to the age of 26. All answers are presented in Figure 14:

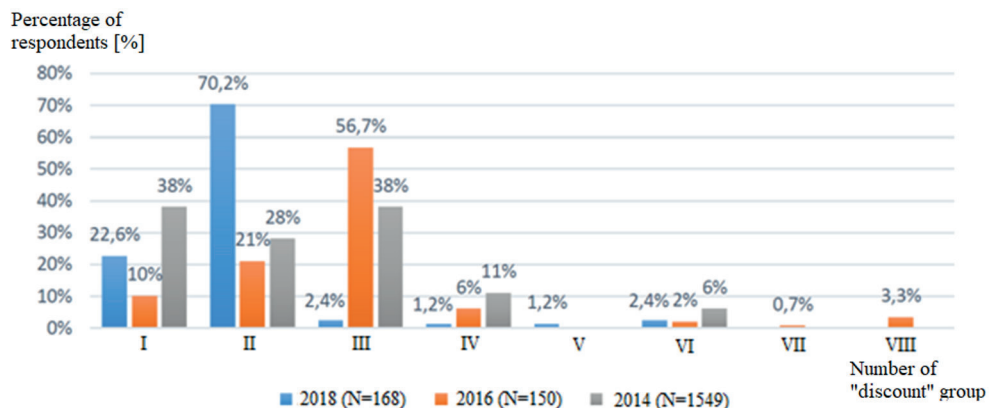


Fig. 14. Summary of the number of passengers using half-price tickets based on the given type of discount in 2018, 2016, 2014 Where: N – size of the research group, I – Pupil of primary, high, secondary and post-secondary schools (not longer than until the age of 24); II – Student of Polish universities; III – Pensioner; IV – A disabled person with a moderate (formerly II group of disability) or mild (formerly group III) disability; V – Participant of doctoral studies; VI – Pupil or student of foreign high schools and universities until the age of 26; VII – Veterans; VIII – I don't know / hard to say Source: study based on own research and MTA data in Lublin [16]

In the case of using free journeys, the rules are the same as in the case of half-price tickets - the appropriate conditions must be met, the list of which is presented in Figure 15. The largest numbers in individual years were achieved for the following types of entitlements: in 2018 – an employee of Municipal Transport Company during travel by MTC funds employed on the basis of an employment contract – 55% of respondents, in 2016 and 2014 – a person over age 70 – 86.2% and 72% of respondents, respectively. The least number of people declared such entitlement bases as: Distinguished Honorary Blood Donor – 2% of respondents in 2014; a person with a significant degree of disability, i.e. completely unable to work and live independently (formerly the first disability group), accompanying people with disabilities and a person decorated with the Golden Honor Badge of Merit for the City of Lublin – respectively 0.9% of respondents in 2016, as well as a student residing in the Lublin Commune, attending public primary and junior high schools as well as public and private primary and junior high schools, a person with a significant degree of disability, i.e. completely incapable of work and independent existence (former disability group I) and a person over 70 life – 9% of respondents in 2018, respectively.

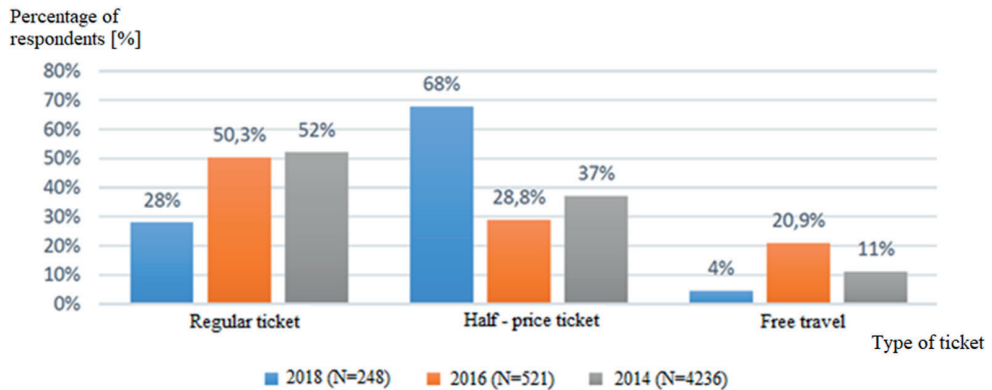


Fig. 15. Summary of the number of passengers using free journeys based on a given type of entitlement in 2018, 2016, 2014 Where: N – size of the research group, A – Student of public primary and junior high schools run by the Lublin Commune; B – Student residing in the Lublin Commune, attending public primary and junior high schools as well as public and private primary and junior high schools; C – Child or young person with a disability, no longer than until the age of 16; D – Person with a significant degree of disability, i.e. completely incapable of work and independent existence (former disability group I); E – Accompanying people with disabilities; F – Person who has reached the age of 70; G – Person with the Gold Honor Badge of Merit for the City of Lublin; H – Distinguished Honorary Blood Donor; I – Employee of the Municipal Transport Authority in Lublin while performing official duties; J – Employee of Municipal Transport Company during MTC travel, employed on the basis of an employment contract *Source: based on own research and MTA data in Lublin [16]*

However, the question that was a direct assessment of the satisfaction of public transport users was the rating on a scale of 1 to 5 selected issues related to public transport in Lublin, where 1 is very dissatisfied, 2 – rather unsatisfied, 3 – it's hard to say, 4 – rather satisfied, 5 – very satisfied, as shown in Figure 16. The highest average grade was obtained by the quality of information on the bus / trolleybus (e.g. placing necessary information on boards and displays regarding the route – grade 4.0, slightly lower bus stop infrastructure (including the presence of bus shelters, timetable boards, displays) – 3.9 rating. The lowest average rating was for air conditioning – only 2.9. It is clearly seen that the 2018 ratings are much lower than those from 2016. The largest decrease was recorded in the assessment of the location of stationary ticket vending machines and other ticket outlets from 4.36 to 3.3, in addition, when assessing the ratio of drivers to passengers from 4.22 to 3.2 and regarding the quality of stop infrastructure from 4.51 to 3.5. Only the ticket price rating remained at a similar level, i.e. in 2018 it was only 0.17 percentage points lower.

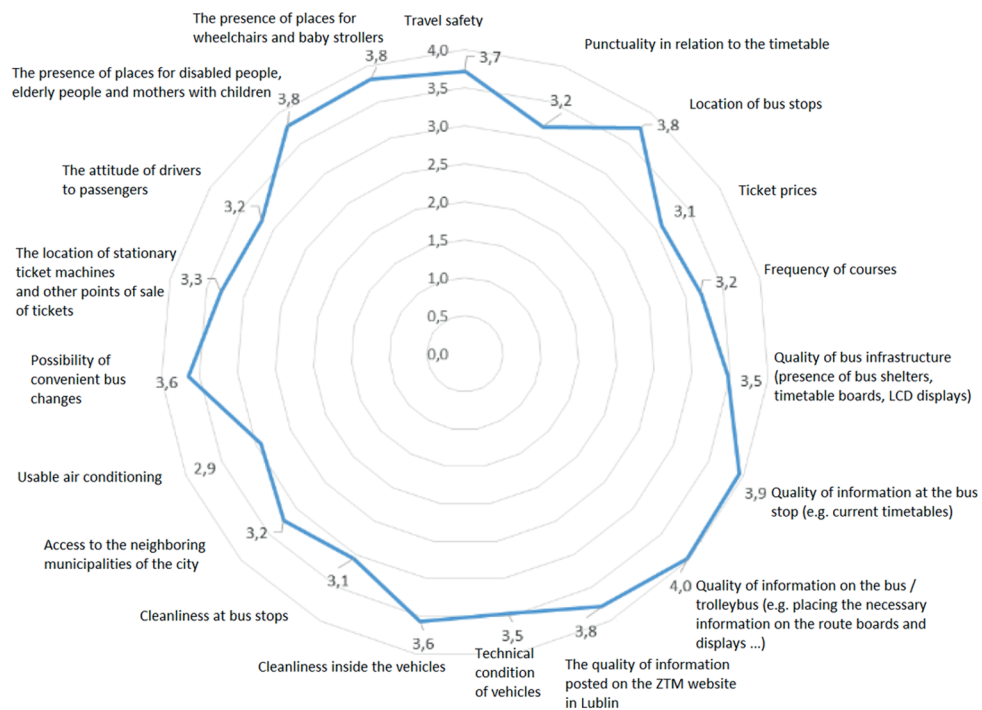


Fig. 16. Assessment of respondents regarding issues related to public transport in Lublin [7]

In the scope of functioning of public transport in Lublin, some changes were introduced last year, which concerned, among others extending the transport offer with new places, such as Kawka or Nasutów, as well as introducing new vehicles, expanding the list of persons entitled to free travel, including for elementary and middle school students, creation of new lines and others. Figure 17 presents the degree of visibility of these changes among the respondents. Over 66% of those surveyed said they noticed these changes, but changes were not noticed by 16.5% of all respondents. Others answered "I don't know."

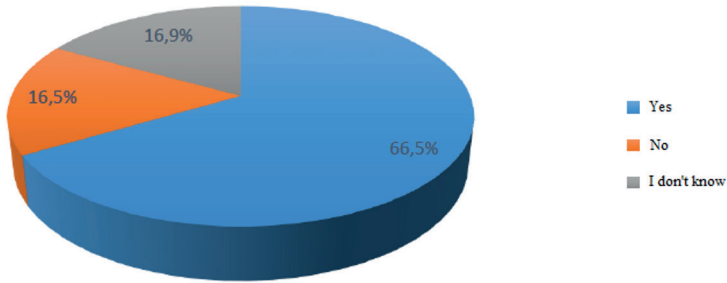


Fig. 17. Summary of the number of respondents regarding the visibility of the changes introduced to the public transport system in 2018 [7]

The level of passenger satisfaction depends on the changes referred to above. Based on the chart in Figure 18 it can be concluded that in 2018 the level of satisfaction increased by less than 3 percentage points (from 63.7% in 2016 to 66%), while the values are compared by the sum of the answers 'very good' and "rather good". In 2016, the changes were rated best by women and the elderly, who most often went by public transport, while two years later, young and under-26 people gave good and very good marks, especially women.

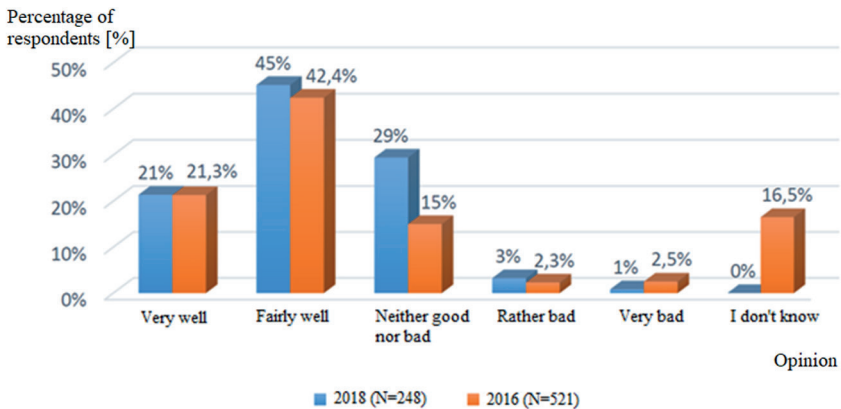


Fig. 18. Assessment of changes introduced in the public transport system in 2018 and 2016 Source: study based on own research and MTA data in Lublin [16]

The last question the respondents answered was about what they thought should be changed in public transport. Most people said that they liked the current system - 19.4%. A similar number of respondents, i.e. 17.3% of the total, would like to increase the frequency

of courses, especially during peak hours, both in the afternoon and morning hours. In addition the increase is expected in the number of lines commuting to neighboring municipalities as well as the lines, that buses run on Saturdays and Sundays. Over 11% of respondents proposed modernizing the connection network, including the introduction of new routes, extending some of the existing ones. The remaining respondents include such suggestions as:

- Increasing punctuality of arrivals and departures from stops – 10.5%;
- Reduction of ticket prices – 7.3%;
- Changes in vehicle equipment, including lower ones placing handles, seats, installing more ticket machines with the possibility of card payments, more frequent services, reducing the number of advertising posters hung on the windows of vehicles – 6.9%;
- Change in drivers' attitude – 5.7%;
- Introduction of more new vehicles equipped with air conditioning – 5.2%;
- Modernization of bus stop infrastructure, including an increase in the number of stationary ticket vending machines and the number of LCD displays – 5.2%;
- More frequent activation of air conditioning – 3.6%;
- Introduction of more roomy vehicles, in particular on the busiest lines commuting to neighboring municipalities – 3.6%;
- Increased care for cleanliness in vehicles – 2%;
- Modernization of public transport infrastructure, including the introduction of priority transit for public transport vehicles (so-called "bus lanes") on more streets, extension of the trolleybus traction – 2%.

6. Assessment of public transport in Lublin and suggestions for its improvement

The system of public mass transport in Lublin organized by the Municipal Transport Authority in Lublin is an integral part of the residents' existence and meeting their expectations is its main task. Thanks to this procedure, it is possible to create a transport offer suitable for passengers, promotion of which can help in gaining their favor. Generating such a scheme of activities that will be the most optimal taking into account the goal of satisfying the needs initiated by users of public transport and the use of cash outlays, is based on marketing research [3, 27]. Following trends in the opinions and assessments of public transport users allows to draw conclusions regarding the need to change or pay attention to certain aspects in order to meet the needs of passengers. Comparing each newly obtained result with the results from previous years gives a picture of the changes taking place and their impact on the satisfaction of urban public transport passengers.

Based on the research, it was found that the overall level of satisfaction of communication users in Lublin, referring in this case to the assessment of its selected features is at the level of 3.48, where it is the average of all notes that have been awarded and can be described as good enough. This value, compared to 2016, is much lower, since it was over 4,0. Then there were also changes in the standards of travel that passengers were able to

accept as a minimum. Over the years, travelers have been more likely to accept standing instead of using a seating position. In addition, they felt less discomfort when getting into a crowded vehicle. The best rated issue was the quality of information provided at stops (e.g. current timetables, real arrival times of vehicles displayed on LCD screens), while the least satisfactory was the operation of air conditioning in vehicles, or rather its activation in highly uncomfortable conditions. The perceptibility of changes that are constantly introduced in the functioning of public transport is at the level of 66.5%, and their assessment was mostly at the level of "well" and "very well" (66% of respondents provided such answers). Compared to the assessments made two years ago, the level of satisfaction with the implemented facilities increased. Despite only sufficiently good assessments of the satisfaction features of a functioning communication system, many passengers were satisfied with its current condition, although most of them indicated in their opinion, specifying in their opinion the weakest sides of the transport services provided. The most frequently chosen was the frequency of courses, especially during rush hour, lines commuting to adjacent municipalities, or trips taking place on Saturdays and Sundays. In addition, it turned out that other issues that should be modernized are the existing routes, which could be extended, and the creation of new connections. Overall, a decrease was noted in the level of satisfaction of Lublin passengers, despite the fact that the city is gradually investing in increasing the innovativeness and environmental friendliness of rolling stock, transport infrastructure and other elements of this structure. Nevertheless, the opinion on the overall activity is constantly changing and should be constantly monitored to know what direction to take next.

Since the beginning of its activity, MTC has put a lot of emphasis on ecology, an example of which can be trolley buses and currently introduced electric buses or gas vehicles. The location of the extra-urban bus station and train station is a big challenge for public transport. The distance between these objects makes it necessary to properly establish connections to ensure the possibility of change. In recent years, Municipal Transport Company has completed the investment of extending the bus depot at Grygowa Street in Lublin. This depot is located near Witosa Street, which is an exit road from the city center towards Ukraine. Thanks to its location, it provides easy and fast communication with any point of the city. As part of the extension, hangars and technical buildings for trolleybus rolling stock were made. The investment was carried out due to the need to move the trolleybus depot from the former location at the intersection of Nałęczowska Street and Aleja Kraśnicka. The old depot was located in the city center, which caused frequent problems with the departure of buses and did not meet the technical requirements associated with modern rolling stock. In addition to this investment, a depot on Stefczyka Street was also put into use. This depot mainly serves buses that are designed to ensure communication between the Czechów estate and the city. The third investment is the construction of a depot at Głuska street, which is to support buses finishing their courses in Abramowice [5].

Improving the functioning of public transport can be implemented using infrastructure and organizational concepts [10, 21]. Construction, reconstruction, renovation, maintenance and protection of public roads are just some examples of infrastructure solutions that directly affect the duration of travel. The layout of the communication network within the city should be transparent and its throughput utilized in an even and comprehensive manner.

This will definitely increase the speed of communication and increase the frequency of journeys [19].

In other cities one can observe and treat as inspiration for changes some solutions aimed at obtaining priority in the movement of vehicles for public transport:

- adaptation of street signals to the traffic of public transport vehicles: - simple signals that are triggered by vehicles- more complex signals that adapt to the number of passengers in the vehicle, the approaching vehicle "weight" is assigned to the intersection depending on its filling, this solution requires equipping public transport vehicles with "transmitting" devices;
- Separation of lanes for buses and / or trolleybuses - the use of this solution must be justified by the high intensity of traffic of buses and trolleybuses and their filling, traffic load by the street, in addition, the number of lanes should be taken into account (for roadways with 3-5 lanes in a given direction and high filling of means of transport, this solution is justified already at the frequency of 25 vehicles per hour, usually a lane separation in one direction is used, when the stream of vehicles is 40 per hour) [23].

Quite modern and increasingly used solutions include organizational and infrastructure solutions. Examples of these activities are Park&Ride, Bike&Ride, and ticket systems. Thanks to parking lots located on the outskirts of cities, passengers commuting to the center can change their vehicles for public transport. This requires that urban transport organizers have the right solutions, including proximity to stops, the introduction of an electronic ticket system, which often takes the form of a multi-functional card for paying fees for using public transport, parking lots, entertainment, etc. Thanks to this type of solutions, the demands most frequently reported by passengers: cost, convenience, travel time as well as safety journeys can be improved [6, 23].

The purchase of new or the modernization of old means of transport or the increase in the number of seats are just some of the possibilities to improve the comfort of passengers in public transport. Organizers of public transport are trying to influence the sense of comfort of travel by inventing new solutions. Feeling satisfaction with public transport is a problem phenomenon because it depends on individual needs. Often, users feel security and convenience in the definition of comfort. We can talk about safety in public transport in two aspects: safety of stops and safety on board. In the first case, improving safety at stops can be achieved through their proper location and equipment. In addition, stops should be easily accessible for disabled people, the elderly, prams for children, pedestrians and cyclists. Security in public transport can be improved by installing on-board video cameras that reduce vandalism. An important element necessary for comprehensive implementation of passenger traffic improvements in the city is the use of telematics [13]. It combines information and telecommunications technologies and allows to improve the efficiency and security of public transport. Collective public transport management systems improve its quality by automatically monitoring the position of the vehicle, direct communication between the driver, passengers and the dispatch center. Another example of telematics solutions is the monitoring and recording of timetables, deviations from them, the number of public transport users, and ticket sales. The collected data can be used to verify the efficiency and effectiveness of actions taken to improve the functioning of public transport [4].

7. Conclusions

Solutions that will improve ecological conditions in the city and keep up with the development of road infrastructure are constantly being sought. Aiming at a comprehensive solution ensuring efficient and effective movement within the city, special attention should be paid to public transport and ways to improve its operation. The above examples of improving the functioning of public transport are just some of the possible attempts to change the communication behavior of residents. The effectiveness of these solutions depends on the size and type of the city, the number of inhabitants, the possibility of introducing new solutions (financial, organizational, legal) and, above all, the reported transport demands.

The organizers of public transport are facing a serious task. Activities aimed at encouraging users to change their preferences and communication behaviors should be part of the overall vision of the city and promote sustainable transport. Actions must be taken that will improve the level of customer service and meet the shipping demands. The effectiveness of these actions can be checked at subsequent preference studies. If the percentage of residents abandoning car travel for public transport increases, the actions taken will bring the expected effect.

8. Nomenclature

MTA – Municipal Transport Authority (pl.: Zarząd Transportu Miejskiego – ZTM)

MTC – Municipal Transport Company (pl.: Miejskie Przedsiębiorstwo Komunikacyjne – MPK)

References

- [1] Aldenius M., Influence of public bus transport organisation on the introduction of renewable fuel. *Research in Transportation Economics*. 2018, 69, 106-115, DOI: 10.1016/j.retrec.2018.07.004.
- [2] Bresson G., Dargay J., Madre J., Pirotte A.: The main determinants of the demand for public transport: a comparative analysis of England and France using shrinkage estimators. *Transportation Research Part A: Policy and Practice*. 2003, 7(37), 605-627, DOI: 10.1016/s0965-8564(03)00009-0.
- [3] Drożdźiel P., Wińska M., Madleńak R., Szumski P.: Optimization of the position of the local distribution centre of the regional post logistics network. *Transport Problems*. 2017, 12, 43-50, DOI: 10.20858/tp.2017.12.3.4.
- [4] Gójlik A.: Inteligentne systemy transportowe jako instrument racjonalizacji transportu miejskiego. *Transport w logistyce. Łańcuch logistyczny, Konferencja Naukowa, Jurata, Akademia Morska w Gdyni, 2003, (Intelligent transport systems as an instrument for rationalizing urban transport)*.
- [5] Goliszek S.: Zmiany dostępności miejskim transportem zbiorowym w Lublinie w wyniku inwestycji infrastrukturalnych finansowanych z funduszy UE do roku 2020, (Changes in accessibility by municipal public transport in Lublin as a result of infrastructure investments financed from EU funds until 2020). *Transport miejski i regionalny*. Warszawa, 2014, 15-22.
- [6] Gwarda K.: Przykłady działań racjonalizujących funkcjonowanie komunikacji miejskiej w Gdyni (Examples of activities rationalizing the functioning of public transport in Gdynia). *Logistyka*. 2012, 3, 727-732.
- [7] Gzik A.: Ocena zadowolenia pasażerów komunikacji zbiorowej ze świadczonych usług na przykładzie miasta Lublin (Assessment of the satisfaction of public transport passengers with the provided services on the example of the Lublin city). *Praca dyplomowa inżynierska*, Lublin, 2019.
- [8] Ingvardson J.B., Nielsen O.A.: The relationship between norms, satisfaction and public transport use: A comparison across six European cities using structural equation modelling. *Transportation Research, Part A: Policy and Practice*. 2019, 126, 37-57, DOI: 10.1016/j.tra.2019.05.016.

- [9] Mamcarz P., Drożdżiel P., Madleňáková L., Sieradzki A., Drożdżiel P.: Level of occupational stress, personality and traffic incidents: Comparative study of public and freight transport drivers. *Transportation Research Procedia*. 2019, 40, 1453-1458, DOI: 10.1016/j.trpro.2019.07.201.
- [10] May A.: Urban Transport and Sustainability: The Key Challenges. *International Journal of Sustainable Transportation*. 2012, 7(3) 170-185, DOI: 10.1080/15568318.2013.710136.
- [11] McFadden D.: The measurement of urban travel demand. *Journal of Public Economics*. 1974, 3, 303-328.
- [12] Metz D.: Demographic determinants of daily travel demand. *Transport Policy*. 2012, 21, 20-25, DOI: 10.1016/j.tranpol.2012.01.007.
- [13] Mikulski J.: The Possibility of Using Telematics in Urban Transportation. *Modern Transport Telematics*. 2011, 54-69, DOI: 10.1007/978-3-642-24660-9_7.
- [14] Nielsen G.: Network design for public transport success – theory and examples, Truls Lange, Civitas group of consultants Oslo, Norway, 2007.
- [15] Official website of the Zarząd Transportu Miejskiego: <https://www.ztm.lublin.eu/> [accessed on: 07.01.2019 r.].
- [16] Own materials of the Zarząd Transportu Miejskiego w Lublinie.
- [17] Przybyłowski A., Podbielska M.: Publiczny transport zbiorowy w Gdańsku w kontekście równoważenia rozwoju miast. *Studia i Prace WNEiZ US*. 2017, 47(2), 253-264, DOI: 10.18276/sjp.2017.47/2-23.
- [18] Siostrzewitowska M.J.: Nowe idee w rozwiązywaniu problemów komunikacyjnych miast (New ideas in solving city communication problems). Wydawnictwo Politechniki Lubelskiej, Lublin, 2018.
- [19] Small K.: Urban Transportation Economics. Taylor&Francis, London, 2013.
- [20] Šipuša D., Abramović B.: The possibility of using public transport in rural area. *Procedia Engineering*. 2017, 192, 788-793, DOI: 10.1016/j.proeng.2017.06.136.
- [21] Tundys B.: Logistyka miejska. Koncepty, systemy, rozwiązania (Concepts, systems, solutions). Warszawa, Difin, 2008.
- [22] Ustawa z dnia 6 września 2001 roku o transporcie drogowym, Dz. U. 2001, Nr 125, poz. 1371 z późniejszymi zmianami, (The Act of 6 September 2001 on road transport, Journal Of Laws 2001, No. 125, item 1371 as amended).
- [23] Wyszomirski O.: Transport miejski ekonomika i organizacja (Urban transport economics and organization). Wydawnictwo UG, Gdańsk, 2008.
- [24] Wyszomirski O.: Zarządzanie komunikacją miejską (Public transport management). Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, 1999.
- [25] Zalewska A.: Dobór środków transportu komunikacji zbiorowej do tras przejazdów oraz potrzeb pasażerów (Selection of public transport means of transport to the routes and needs of passengers). *Autobusy - technika, eksploatacja, systemy transportowe*. 2017, 6, 1799-1802.
- [26] Zalewska A.: Dobór środków transportu zbiorowego do linii komunikacyjnych w mieście Lublin (Selection of public transport to communication lines in the city of Lublin). *Autobusy - technika, eksploatacja, systemy transportowe*. 2017, 6, 1803-1808.
- [27] Zhang X., Paulley N., Hudson M., Rhys-Tyler G.: A method for the design of optimal transport strategies. *Transport Policy*. 2006, 4(13), 329-338, DOI: 10.1016/j.tranpol.2005.12.006.
- [28] <https://lublin.eu/rady-dzielnic/dzielnice/> [accessed: 09.01.2019 r.].