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Results of Social-Transport Monitoring of Passenger Transportation Kremenchuk City

The article presents the results of social and transport survey of the population, which include indicators of the survey of families and users of transport, the purpose and methods of travel on routes, a comparison of the movement of passengers by districts, the satisfaction of the population with the work of transport. Passenger transport users were interviewed at Kremenchuk bus stops and online. It allows to predict the traffic of the population, to form organizational and economic decisions and to provide high efficiency and quality of passenger transportation.

passenger transport, social transport survey, transportation efficiency, monitoring, passenger flow

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Результаты социально-транспортного мониторинга пассажирских перевозок г. Кременчуг

В статье приведены результаты социально-транспортного опроса населения, которые содержат показатели опроса семей и пользователей транспорта, цель и способы поездки по маршрутам, сравнения движения пассажиров по районам, удовлетворенность населения работой транспорта. Пользователи пассажирского транспорта были опрошены на автобусных остановках города Кременчуга и в Интернете. Это позволяет прогнозировать транспортное движение населения, формировать организационные и экономические решения и обеспечивать высокую эффективность и качество пассажирских перевозок.

пассажирский транспорт, социально-транспортное опроса, эффективность перевозок, мониторинг, пассажиропоток

Formulation of the problem. Kremenchuk is a town of regional subordination. It is an administrative, industrial and cultural centre of Poltava region. It is situated in the moderate continental climate zone in the Dnipro lowlands and in the middle reaches of the Dnipro River on its both banks at the distance equals to 115 km from the regional center of Poltava and 290 km from the capital of Ukraine, Kyiv, at a trunk railways crossing which leads to a powerful railway junction. The territory of the town is 9600 ha while its population is about 230 thousand people.

The surveys are known (comparing with ordinary census) to be an effective method of attracting the population's attention to the local problems, so the use of their results' analysis

concerning the passenger traffic flow is the purpose of this work [3-5, 7-10]. The survey under consideration was aimed to study the aspects concerning the market and services supply provided by public transport in the fixed-route mode and in the minibus mode as well. There were three groups of the surveyed involved: family members, passengers and vehicles owners.

Analysis of recent research and publications. Social assessment or sociological transport survey of the population (STSP) is a system research of different social processes and factors of passenger transport which have a negative influence on the social development results [2, 6, 14].

STSP is used for the following purposes: to define the prominent participants of the transportation process and arrange their active participation while selecting the project for the passenger transportation improvement; [6] to ensure that the proposed changes are appropriate for all the parties involved; [7] to assess the social impact of investment projects on urban passenger transportation and, if any potential negative facts are identified, to find out the way for their overcoming, to assess in advance the level of public transport services for the population [1, 7, 14]. The paper highlights the particular features, methodology and results obtained of sociological transport survey of the population in the town of Kremenchuk.

Statement of the task. The research aims to develop the algorithm of sociological transport survey of the population taking into account the survey points concerning family members and transport users, the aim and the means of travelling, description of complete routes, comparison of the passenger flow according to the districts, public satisfaction with the quality of transportation service, the priority of using fixed-route taxis.

Outline of the main material. The survey mentioned was carried out in the town of Kremenchuk according to the provisions of Gloria Devis's paper "Social Assessment: Integrated Participation and Social Analysis" [11-13]. The researches similar to this one concerning the prediction of public transportation needs in cities were conducted for the first time in the 80s of the XXth century in the cities of Moscow and Omsk and the relevant method of sociological transport survey of the population was developed to solve the existing social transport problem by the Institute of Social Research of the Academy of Sciences of the USSR [8, 10, 11].

The survey in the town of Kremenchuk was carried out involving sociologists and software engineers who analyzed the information obtained (1200 surveys totally) due to especially created software. During the survey the following actions were taken: the survey was carried out in 120 families by using the random number method in housing estates considering to the percentage of the population. The survey consisted of the following questions: the number of the family members; the number of those being employed; the family income; the number of schoolchildren; the availability of transport and its use; the fares of public transport and private transport as well; satisfaction with the quality of public transport services provided; family expenses for commodities like purchasing food, etc.

The survey was carried out by four groups consisted of three surveyors and the head of the group who checked the form fillings and performed a duplicate check randomly. The forms were coded which made it possible to provide a feedback and control their filling in quality.

The survey was carried out during a weekend and a weekday (Saturday, Sunday and Monday) in order to provide maximum presence of people at home.

Passenger survey was carried out at transport stops during of the day. The surveyors approached people waiting for the means of transportation at the stops and asked them questions concerning the period of waiting, the trip duration, the means of transport used, the fare and purpose of the trip, satisfaction with the quality of the transportation services provided, the family income and willingness to pay for the service.

Three groups consisting of three surveyors each carried out the survey at stops in different parts of the town. Each group covered the area equals to about a third of the town territory. The groups were instructed to select the stops (either major or minor) independently and to carry out the surveys at different times. Totally, 520 people were surveyed chosen in the different town districts.

The attention of the heads of the groups was focused on the traffic flow intensity and its congestion. The passengers who were waiting for transport were counted thrice within the interval of five minutes. Besides, the total number of people at the stops and the number of men and women in particular were recorded. In total, 27 stops were surveyed and 273 assessments were performed. Additionally, the heads of the groups counted the number of vehicles approached the stop or passed by without stopping for the reason of being crowded. Subsequently, 118 assessments were made.

Additionally, the survey group carried out an informal interview and had talks with family members, passengers, representatives of transport operators and private transport owners.

The main conclusion of the survey is in the fact that in most cases people are not satisfied with the quality of public transportation services and so, no matter how the questions were asked, 65% of respondents admitted being dissatisfied.

The reasons of such situation are the following: insufficient number of vehicles on the route, their unsatisfactory maintenance and operation, along with the absence of the essential road infrastructure. However, particular dissatisfaction concerning the minibus service quality was expressed in connection with high fare rate comparing with low quality of the service provided.

Thereby, the results of the work are to be concentrated on the problems of the public transportation service improvement as its quality should be aligned with the fare rate. Another problem worth paying attention is the development of optimal route system which can satisfy public demand for transportation. It encouraged carrying out a complex assessment of passenger traffic flow at the town fixed routes.

STSP algorithm is the following:

a) survey concerning family members and passengers:

On average, a surveyed family consists of 2.5 people, where the one is employed.

Approximately 65% of the families surveyed are Ukrainians; 25% of those are Russians and representatives of other ethnic groups. Most families (75.9%) live in their apartments while 14.1 % own or rent a detached house. In accordance with inauthoritative sources, an average family income is 857 Ukrainian Hryvnias and almost 65% of that is spent on food. Although just about 20% of the income is left for other expenses, about 38% of the families surveyed own cars. This relatively large index value may be caused by the fact of using loans.

The family survey was concentrated on employed people, so it was separated into a particular observation. For example, the number of the men employed in the family does not greatly exceed the number of the women employed; they are 54.7% and 43.5% respectively. In the family the employed man income exceeds the employed woman income by 30% on average. Besides, a man works longer hours a week, spends more on transport, commutes further, but he is more satisfied with the quality of transport service than a woman.

People who walk to work or other places or go by cars were not surveyed. It might be predictable that people who do not use public transport, on average, have higher income than those who are public transport passengers. This way, the enhancement of the municipal passenger public transport (MPPT) work will be essential for those with lower income level. The women public transport (PT) users' income is by 30% lower that the men income.

b) the purpose of the trip and the means of transportation:

PT users surveys showed up that citizens of Kremenchuk use public transport mainly to get to work (54% of the users surveyed), to meet up with friends (15%), to do the shopping (8%), to get to the place of study or recreation (13%) and to get back home afterwards (40%).

As the employed are a considerable group of PT users, their needs were under thorough analysis. The family survey data found out that 20% employed among 30.2% of all the surveyed families walk to work. Average walk lasts for 16 to 19 minutes, which is 15 minutes less than average transport trip period (34 minutes). It confirms the data from inauthoritative sources concerning the fact that a lot of people prefer to work closer to their homes.

Almost 20% of all the families surveyed admitted that at least one employed family member uses only a personal car or combines it with other means of transport. Among the people surveyed, 13.8% confirmed that they use their cars partially going to work, while 10.2% entirely prefer private way of transportation.

Employed population relies on the public transport operation efficiency in a great measure. Predominantly, 60.3% of the employed people use trolleybuses or minibuses. Indisputable, minibuses are not used more often than trolleybuses. At the same time, about 65% of the employed prefer a trolleybus in their way at least on a fractional basis. More than 60% use minibuses going to work and only 38% prefer minibuses exceptionally.

Comparing the means of transport and employed women and men preferences, it is possible to define that the vast majority of women walk to work. Women use private cars much less. Simultaneously, employed women demonstrated greater dependence on public transport comparing with men. A considerable part (above 50%) of the employed in each group prefers trolleybuses and minibuses.

The analysis related to doing the shopping confirms high dependence on public transport: 75.1% of purchasers travel by trolleybuses or minibuses, while 48.1% use buses only. At the same time, purchasers walk more often than the employed (taking into account the fact that it is hard to cope with the bags in a crowded vehicle). 30% of surveyed family member respondents do the shopping on foot and do not use either public or private transport comparing with the corresponding index which is up to 20% among those who use PT going to work.

In the following way, the family survey data analysis showed that people use public transport in a significant degree for different purposes. Important role of minibuses comparing with trolleybuses is highlighted. These conclusions are confirmed by the results of user survey when passengers on the stops were interviewed concerning the means of transport they were waiting for. The analysis demonstrated that 30% of the surveyed as a rule wait for minibuses and prefer this way of transportation.

While determining the demand for the means of transport the employed family members prefer, the attention was concentrated on social characteristics of groups of transport users according to their preferences among means of transportation commuting to the working place. As mentioned above, about 20% of the employed surveyed walk to work.

This group consists predominantly of women (63% of all the foot passengers) comparing with the group of users who live near their homes (54.3% of employees work in their neighbourhood). The result is confirmed by the fact it takes shorter time for foot passengers to walk a shorter route than transport users to go (19 minutes versus 35 minutes). Foot passengers are also indicated as those with a lower monthly income comparing with those who use transport.

Thereby, three factors have the considerable meaning to make a decision to walk to work which are: a relatively close location of the working place, deficiency of money to use public or private transport in a regular way and a considerable traffic flow interval. It might be that some foot passengers, especially those who do not use public transport considering

financial problems or transport unserviceability, will join the group of users when transport starts operating more regularly and prices become more reasonable. More than 80% of the foot passengers surveyed pointed out that municipal transport operation needs improvement.

As mentioned above, about 38% of the employed use private vehicles to get to work. The analysis demonstrates that men use private vehicles the most (83%). Besides, these users have a larger monthly income than foot passengers and passengers of other means of transport.

It is found out that the choice of means of transport is stipulated by people's income. Users of trolleybuses (19% of the employed) have a considerably lower income comparing with others. It is inquisitorial that people waiting for a minibus have the highest income index. They take a trolleybus if it is the first one to arrive, but also they can afford a more expensive minibus.

c) description of the trip concerning the routes:

The surveyed, as a rule, walk to a bus stop getting to work, to a market, etc. On average, it takes a passenger 9.2 minutes, 51% of the users spend about 10 minutes or so doing this and only 11% walk more than 20 minutes.

According to the survey results, the intervals of public transport running and, therefore, the waiting time and vehicles fillability depends on the day of the week and the time of the day.

The heads of the groups processed the transport movement intervals: during 15 minute intervals they fixed the number of vehicles and their types while morning (6.30 to 9.30) and evening rush-hours (16.30 – 19.00), and during the passenger flow decrease and at weekends as well. The analysis proved that in the morning rush-hours the number of buses and trolleybuses is thrice as intensive as in the evening rush-hours. An average minibuses movement interval during rush-hours is 3 to 4 times as intensive as in the passenger flows decrease.

It is defined that average waiting time while passenger flows decrease is less than in the evening rush-hours (11 minutes versus 14). This way, the transport movement interval is satisfactory while the morning rush-hours and it incrementally worsens till the end of the day, and later on in the evening rush-hours it declines greatly, which does not satisfy the transportation demand.

Gender comparison highlights that women have to wait for transport a bit longer than men (15 minutes compared with 12 minutes). It is due to the fact that women use the transport more than men with their extra work activity during the passenger flows decrease, when the traffic intensity falls down.

Taking into account the family monthly income indices and comparing them with monthly transport expenses, it makes it possible to conclude that those surveyed with lower income spend a noticeably larger income part on public transport comparing with those whose income is rather high.

Concurrently, passengers with lower income prefer to buy bus passes and to use electric transport which is cheaper. Despite the fact of using cheaper transport and bus passes, their income is lower and the transport expenses percentage is higher.

d) comparison of employees flow in districts:

There are some districts in the town of Kremenchuk. Townspeople on a large scale work in the central part of the town while living in remote residential areas. For better understanding of the employees flow schemes, the study was carried out. It was found out that 24% of all the employees work in the district they live in. While 70% of them are foot passengers, 30% of the surveyed use different kinds of transport.

Vast majority of the employees (76%) have to commute to other districts. The most densely part of the town is its centre, that is, Svobody Avenue, Kyivska street, where cultural and administrative institutions, consumer services facilities and other establishments are located which make the passenger flows overcrowded by 45%. Among the other densely districts are

Molodizhnyi housing estate, Port (23.3%); I, II and III Zanasyp residential areas, Rakivka (in particular, detached houses sector) (14%); railway station and bus station (20.3%). The fact that a considerable part of the townspeople uses public transport for 2 or 4 stops should attract special attention as this way the vehicles are overloaded significantly. It vitally important for the central part of the town as it is the territory where buses and electric transport are in use.

Paying attention to the fact that electric transport is considered to be the cheapest means of transport and keeping in mind that its routes, as a rule, run through the town center, this means of transport is considerably used for street trade of goods and food. As the survey shows, the majority of people (68.9%) consider it unpractical to place consumer services and commercial enterprises in the center and only 20.3% (mainly the store-keepers themselves) are of different views. The surveyed do not have the particular position concerning this question. Besides, being asked about the unsatisfactory transport operation and its connection to markets location, most of them (60.7%) admitted their negative effect.

e) satisfaction of the population with the quality of transport services:

While being surveyed, people were asked whether they were satisfied with the quality of modern state of transport service or not. The results found out that 59% of the employed in the families and 87.4% of MPPP users admitted its unsatisfactory state. Women revealed more dissatisfaction than men. Women's critical attitude towards MPPT service quality is not extraordinary as they spend more time at the stops.

Being not always satisfied with the transport service quality, the surveyed were proposed to mention the improvements they would like to obtain. A respondent gave his/her own answer or was limited by three options. Afterwards the similar answers were grouped according to a topic peculiarity. In both surveys conducted the measures mentioned the offers to raise the frequency of the period's buses run, to opt for buses which are more commodious and comfortable. Other offers were as follows: "new extra routes", "better sanitary conditions for buses". These observations were completed by informal interviews with the users.

Some offers were not expressed in the same order: "make buses (trolleybuses) run more often", "make traffic intervals shorter", "more commodious buses", "fare payment monitoring", "buying tickets in advance", "extra routes", "scoping of distant neighbourhoods", "better way to get to the market".

These observations can conclude to the following: townspeople urge the increasing of the passenger traffic flow frequency, concerning trolleybuses as a matter of priority, the necessity to keep up to the schedule and the route. New extra routes are essential for the remote residential areas where residents suffer from the transport service faults considerably comparing with the residents of the centre of town.

What means of passenger transport do you use?

Also there was a survey in the Internet. A form was created for the survey and reference for the site in some social networks. All those who wished had an opportunity to log in and take part in the survey. The form included four questions and variants of answers.

The first question was "What means of transport do you use?" and one of the means should be chosen among the listed ones. The next question was "How old are you?" to define the respondents' categories, namely, schoolchildren, students, employed, retired. The third question concerned the criteria people use while choosing the means of transport. There were the basic criteria proposed concerning transport selection, which were the following: price, speed, safety, convenience and possibility to get to the destination. Certain criteria should be chosen. The last question dealt with discomfort in vehicles. The list of main inconveniencies and a possibility to supplement the answer was proposed.

According to the survey results, most population prefers route minibuses – 75%, among which are: 13 schoolchildren 9%; 37 student 26%; 55 workers 40%. Some people prefer

trolleybuses 24%, with 9 schoolchildren 6%; 1 worker 1%; 24 pensioners 17% among them (Fig. 1).

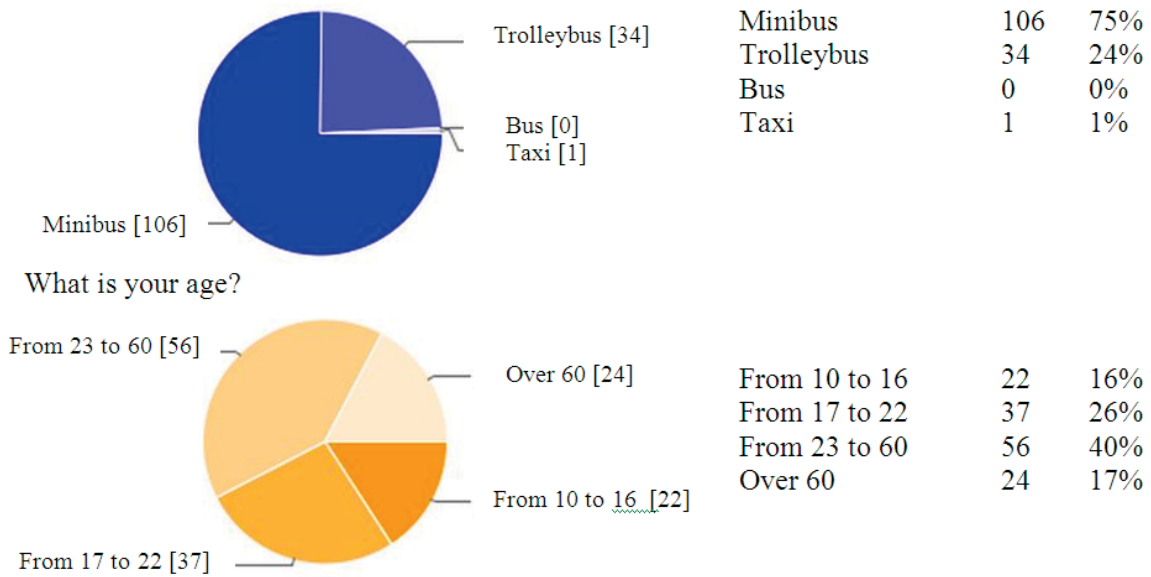


Figure 1 – Concerning the analysis of the choice of municipal transport

Source: author's development

The question concerning the choice of criteria was answered the following way: the most answers (37%) were “speed of motion”, which is one of the reasons for choice of minibuses. Another reason in favour of minibuses is in the possibility to get to the destination point 30%, as trolleybus routes mostly run in the central streets without going to the minor ones (Fig. 2).

“Fare” was another priority criterion – 35%, most of answers were in favour of trolleybuses. “Travel convenience” was the next criterion with 21%, most respondents prefer minibuses. “Safety” as a criterion was chosen by not so many people.

According to what criteria do you choose passenger transport? (several variants)

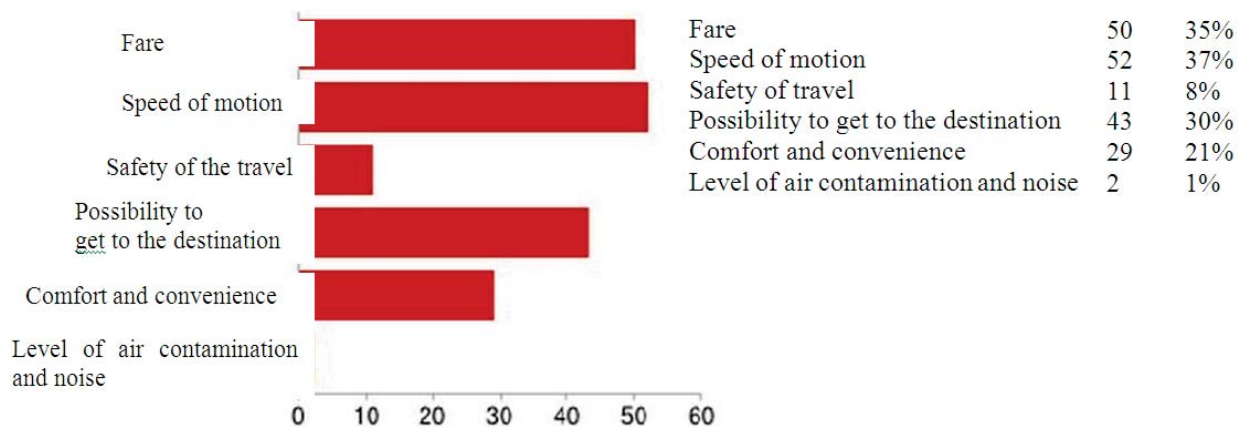


Figure 2 – Concerning the analysis of transport modes priorities

Source: author's development

The following question concerned inconvenience in transport (Fig. 3). The population considered “lack of transport during rush-hour” as the most important inconvenience (40% of

respondents chose this answer). “Improper technical condition” was the second one (24%); this condition is caused by minibuses contravention for public conveyance and an old trolleybus depot. The third one is the absence of stops announcements (21%). This mostly concerns minibuses as stops are announced in trolleybuses. Another complaint (21%) deals with inappropriate sanitary condition of the vehicle and the passenger saloon. Most vehicles are not properly cleaned.

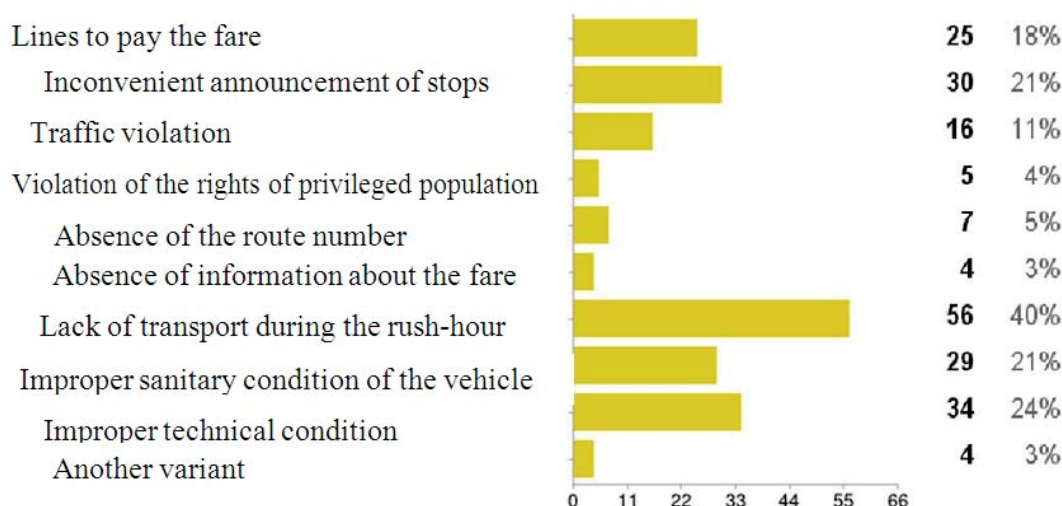


Figure 3 – Concerning the analysis of transport modes priorities

Source: author's development

One more inconvenience is queues the fare to pay (18%) which mainly refers to minibuses, as in trolleybuses there is a conductor who in the saloon who takes the fare. Other inconveniences concern minibuses among which are: traffic contravention (11%), the route number absence (5%), contravention of the privileged population rights (4%), absence of information about the fare rate (3%).

What inconveniences do you come across in public transport? (several variants)

The main conclusion that can be arrived at on the basis of these observations is that residents of the city want the traffic frequency to increase, which especially concerns trolleybuses, the schedule and the route to be kept. Extra new routes are very essential for the residents of distant neighbourhoods, who suffer from the transport service faults more than those who live in the centre of the town.

f) preference for minibuses use:

The research showed up that 6.4% of respondents use minibuses to go at the distance less than 5 km; 21.3% of the surveyed up to 7 km; 42.5% of them up to 10 km; 29.8% travel over 10 km. Minibus fixed-routes connect residential areas (28.2%); bus station and railway station, port (31.8%); medical facilities (11.8%); suburbs (8.2%); educational establishments (13.6%); production (16.4%).

A question was asked about the number of people who enjoy the benefits of fare in public transport. The answer was that, on average, 29.6% of the passengers receive such benefits. For clearness, the output data and obtained results of the survey of the population of the town of Kremenchuk are shown in Tables 1 – 4 and Figure 4-12.

Table 1 – Mode of transportation of the population depending on the sex

Mode of transportation	men, %	women, %
Only on foot	13,6	28,3
Part of the way by car	19,7	6,5
Bus or trolleybus	59,3	64,5
Only bus and/or trolleybus	24,6	31,8

Source: author's development

Table 2 – Data of family survey (average)

Number of family members	2,5 people
Number of employed people in the family	1,5 people
Number of employed men	0,8 people
Number of children	0,8 people
Number of schoolchildren	0,8 people
Number of pensioners	0,4 people
% of families living in apartments	85,9%
% of families living in detached houses	14,1%
% of the family income that is spent on food	69,3%
% of families who own a car	34,1%

Source: author's development

Table 3 – Mode of transportation of the population (everyday purposes)

Mode of transportation	%
Only on foot	34,5
Bus or trolleybus	65,2
Only minibus	34,8

Source: author's development

Table 4 – Priority of the use of public transport

Transport mode	%
Trolleybus	48,3
Route minibus	19,8
Taxi (car)	0,3
Passing transport	-

Source: author's development

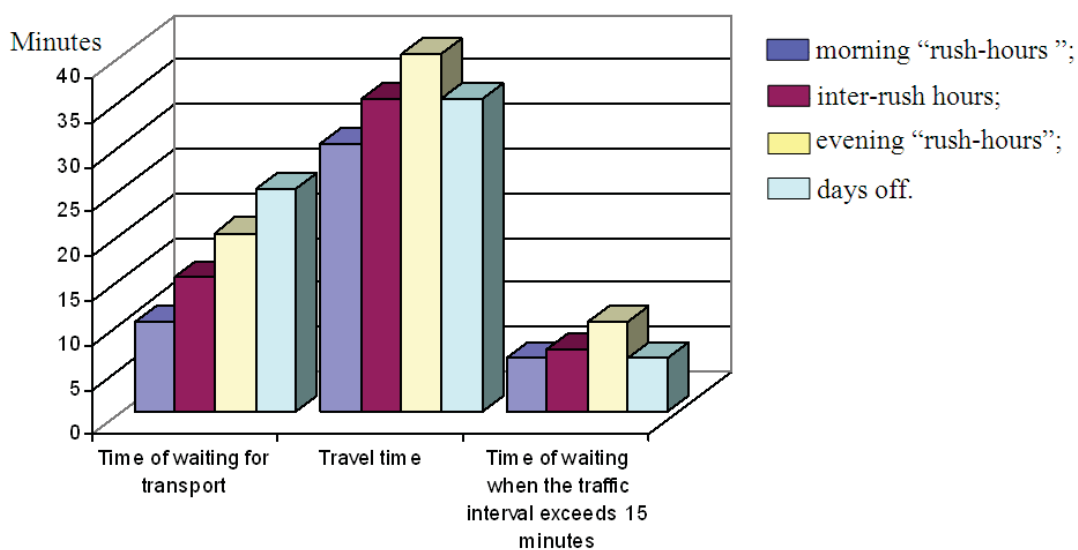


Figure 4 – Concerning the analysis of special features of transport motion during the day

Source: author's development



Figure 5 – Concerning the analysis of family expenditure for transport

Source: author's development

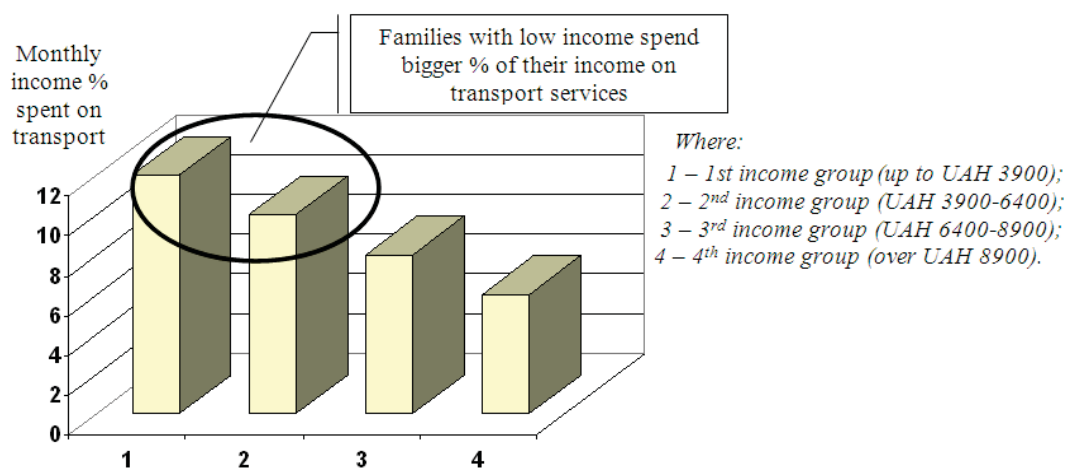
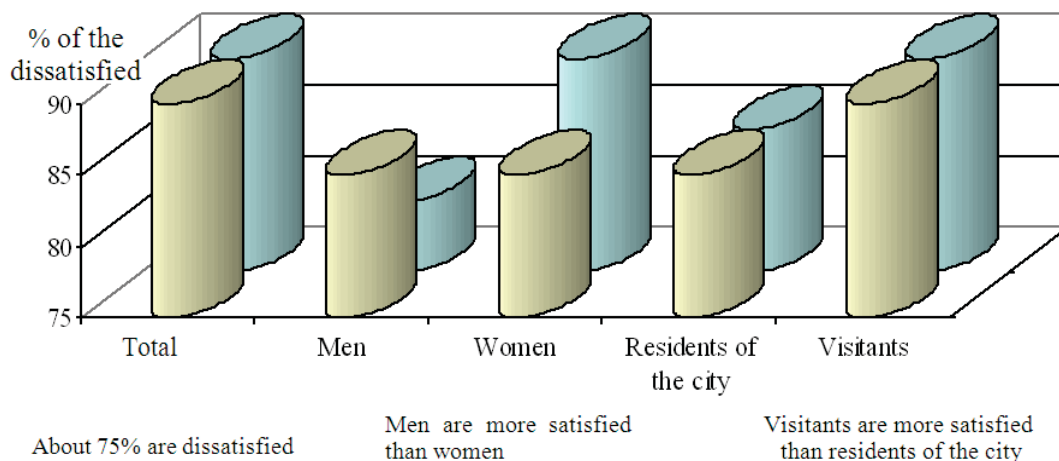


Figure 6 – Concerning the analysis of family expenditure for transport

Source: author's development



1 – Family survey; 2 – user's survey

Figure 7 – Concerning the analysis of passengers' dissatisfaction with transport operation

Source: author's development

Diagram of transport service improvement proposed by the population

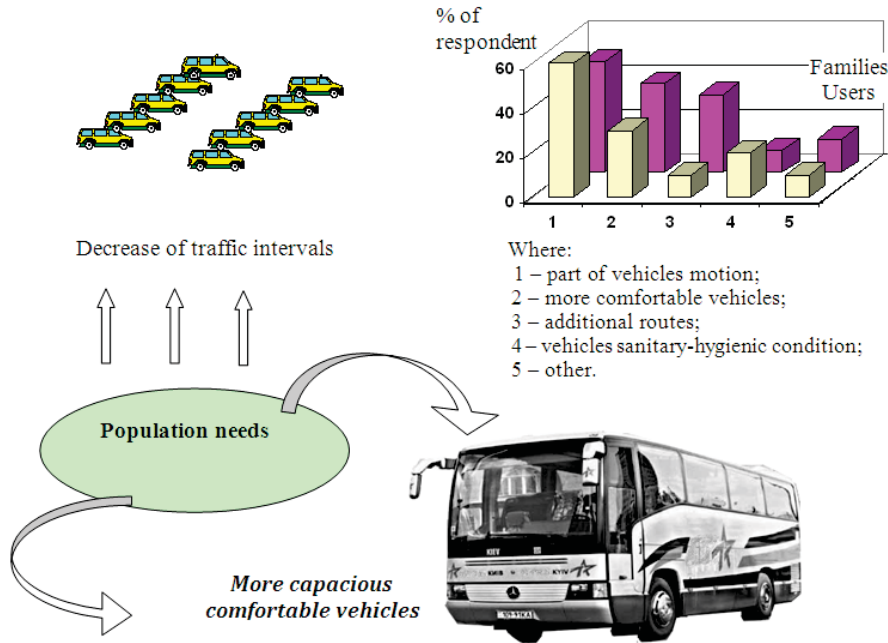


Figure 8 – Concerning the analysis of transport service improvement proposed by the population
 Source: author's development

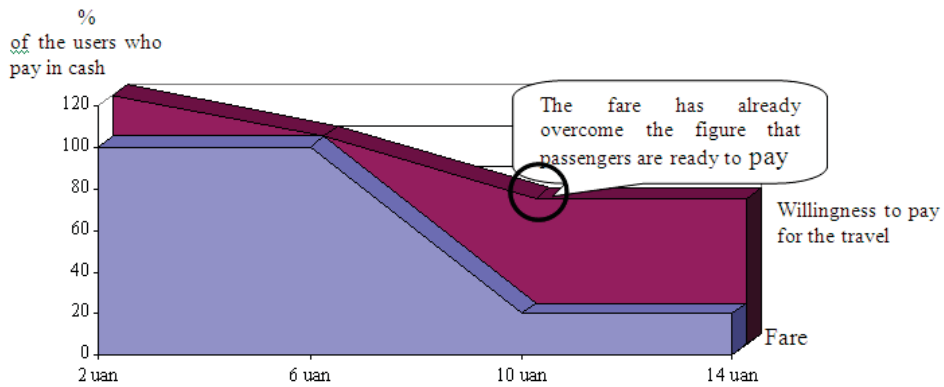


Figure 9 – Concerning the fare and willingness to pay more
 Source: author's development

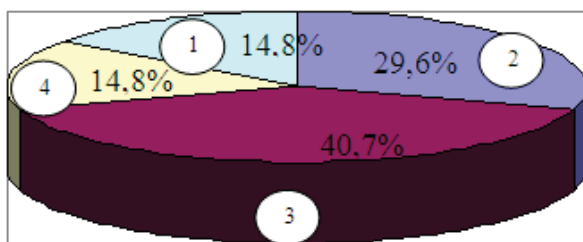
The results of the information analysis concerning the preferences of buses in the mode of route minibuses at the public transport fixed-routes.

Table 5 – Time of waiting for traffic

Time of waiting at the stop	% of respondents
5 minutes or less	29,4
From 5 to 10 minutes	21,3
From 10 to 20 minutes	29,8
Over 20 minutes	22,4
Average time of waiting	17,3

Table 6 – Duration of travel

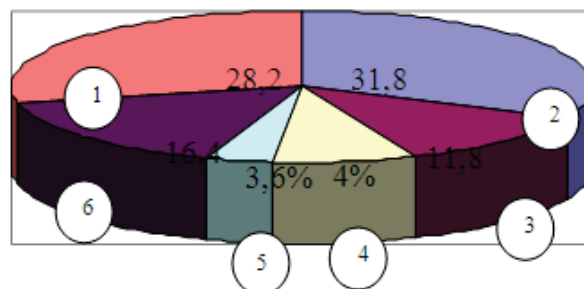
Duration of travel	% of respondents
5 minutes or less	11,3
From 15 to 20 minutes	27,3
From 20 to 30 minutes	30,4
From 30 to 40 minutes	27,5
Over 60 minutes	7,4
Average duration of travel	33,6



1 – distance up to 8 km; 2 – distance up to 10 km;
3 – distance up to 15 km; 4 – distance over 15 km

Figure 10 – Diagram of distribution of minibus routes depending on the distance of respondents' travel

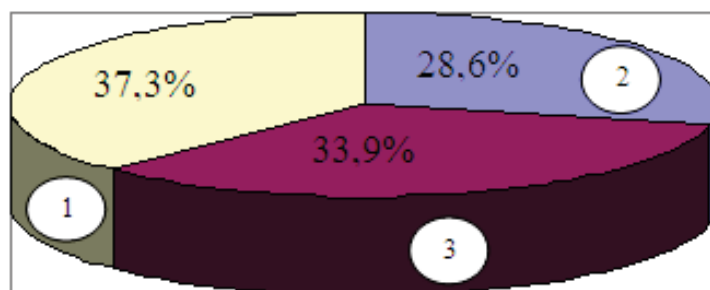
Source: author's development



1 – densely populated districts; 2 – stations;
3 – medical establishments; 4 – suburbs;
5 – educational institutions; 6 – production

Figure 11 – Diagram of distribution of minibus routes providing connection

Source: author's development



1 – drivers' fault; 2 – passengers' fault; 3 – no opinion

Figure 12 – Diagram of distribution of respondents' opinions as to dissatisfactory service level

Source: author's development

Conclusions. The data obtained make it possible to predict public transport movement and make corresponding organizational-economic decisions and provide high efficiency and quality of passenger transportation on this basis.

The results of the research of passenger flows and sociological transport survey are the output data for working out measures for the improvement of the particular routes operation efficiency.

At the same time, according to the data of the research and corresponding processing of the materials concerning the study of the population needs at trolleybus routes in the town of Kremenchuk, there is a tendency to keep the passenger flows, which enables keeping the existing network without correcting changes of the line and functioning of the trolleybus routes for the nearest prospect (7-10 years).

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Результати соціально-транспортного моніторингу пасажирських перевезень м. Кременчук

Метою статті є висвітлення результатів розробки алгоритму соціологічного опитування населення, що включає показники опитування сімей та користувачів транспорту, мету та спосіб подорожі, опис усієї поїздки маршрутами, порівняння робочих рухів за районами, задоволеність населення роботою транспорту, пріоритетність використання маршрутного таксі.

Під час соціальних досліджень було здійснено наступні дії: проведено опитування у 120 сім'ях методом випадкового вибору в мікрорайонах, пропорційно чисельності населення. Інтерв'ю включало такі питання: кількість членів родини; кількість зайнятих; дохід; кількість учнів; наявність та використання транспорту; вартість проїзду в громадському транспорті та в приватному транспорті; задоволеність роботою громадського транспорту; сімейні витрати на придбання продуктів харчування тощо. Також було проведено опитування в Інтернеті. За результатами опитування побудовано діаграми вибору муніципального транспорту, пріоритетів видів транспорту, проведено аналіз особливостей руху транспорту протягом дня, сімейних витрат на транспорт, незадоволеності пасажирів транспортною діяльністю. Досліджено думки населення щодо транспортних послуг, тарифів та готовності платити більше, а також наведені схеми розподілу маршрутних засобів залежно від відстані подорожі респондентів і діаграму розподілу думок респондентів щодо незадовільного рівня обслуговування.

Отримані дані дозволяють прогнозувати транспортне переміщення населення та приймати відповідні організаційно-економічні рішення та забезпечувати на цій основі високу ефективність та якість пасажирських перевезень. Результати є вихідними даними для розробки заходів щодо підвищення ефективності експлуатації конкретних маршрутів. Водночас, за даними дослідження та відповідної обробки матеріалів щодо вивчення потреб населення на тролейбусних маршрутах у місті Кременчук, спостерігається тенденція до утримання пасажиропотоків, що дає змогу підтримувати існуючу мережу без виправлення змін лінії та функціонування тролейбусних маршрутів на найближчу перспективу.

пасажирський транспорт, соціально-транспортне опитування, ефективність перевезень, моніторинг, пасажиропотік

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