

Keywords: transport and passenger flows; urban passenger transport; survey methods; route network

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SURVEY METHOD IMPROVEMENT OF URBAN PASSENGER TRANSPORT WORKS

Summary. The article presents the implementation in the Omsk region of the project "Safe and high-quality roads," which is currently being implemented in various regions of Russia. Studies included the development and implementation of programs for the development of roads and municipalities, bringing the urban agglomeration network into a normative transport and operational state, eliminating the congestion of the urban agglomeration road network, including by transferring passenger traffic to public transport, optimizing traffic flows, and improving the efficiency of the traffic management system. To this end, a number of surveys of passenger and traffic flows have been carried out. The results of the surveys formed the basis of the transport model, through which programs were developed to optimize the route and transport networks of agglomerate cities. A proposal was made to use a survey of public transport drivers to obtain competent opinions on the need for appropriate changes and improvements.

1. INTRODUCTION

As part of efforts to give effect to the priority project of the Russian Federation "Safe and high-quality roads" in the Omsk region, a program was developed for the integrated development of Omsk agglomeration transport infrastructure. The purpose of the article is to highlight the experience of conducting surveys necessary for transport model compilation, which is the basis for developing programs, as well as for optimizing route networks of agglomeration cities. In the course of the work, the following were organized and carried out: a transport survey, a survey of passenger traffic, and a survey of passengers in agglomeration cities.

Surveys conducted have identified discrepancy between the passenger capacity of the transport used and the existing passenger traffic. Not all Omsk agglomeration settlements are provided with a permanent transport connection. There are no planning solutions for the temporary placement of transport in most social infrastructure facilities: shops, school and preschool institutions, universities, and offices. There is a general low satisfaction among the population regarding public passenger transport.

The visual and silhouette methods allow the accountants to determine the filling of buses according to a conditional point system and enter the data into special tables, provide the ability to collect data on stopping points with significant passenger exchange, as well as determine the moving passengers in the rolling stock.

The disadvantage of these methods is the high probability of obtaining large errors in the survey. It is impossible to determine the amount of correspondence between the districts. As a rule, surveys are conducted in autumn peak times, when it is dark outside. Large accumulations at the stations of rolling stock and people make it difficult to conduct video surveys. Filling out forms on the street in cold weather is not possible. The definition of filling the rolling stock interferes with tinted glass, advertising. The rolling stock often goes without stopping. The human factor, the skills of accountants, video processing, camera resolution, viewing angle, weather, etc. play an important role.

The fare system data also have certain disadvantages. They show only the number of transported passengers in a given period of time on certain routes, as well as the number of passengers entering the rolling stock at stops. The magnitude of correspondence is also impossible to determine. Not all rolling stock is equipped with such systems.

SibADI specialists have tested a new method of questioning the drivers of urban passenger transport in a number of cities. This method is not used in official methods but has shown the greatest efficiency in transport research. This is explained by the fact that drivers, working on different routes, gradually recognize the entire route network, even know their regular passengers. When filling out the questionnaires after the flight, taxi drivers can accurately name how many people entered at each stop and how many got off. They know the intensity of passenger and transport flows between different areas and their change by seasons, days of the week, and time of day, and they are able to assess the profitability of routes, as well as the need to open new routes. With the help of mobile communication, they can arrange intervals between flights, for optimal loading of rolling stock. In addition, they can provide recommendations for improving the organization of traffic and road safety. It is surprising that this method is not paid attention to among the researchers of route networks.

As part of the priority Project implementation "Safe and high-quality roads" in the regions of the Russian Federation, the process of developing complex traffic management schemes (CTMS) is being improved, which became the basis for the complex transport infrastructure development programs (CTIDP). CTIDP provides a solution to issues related to road safety, bringing the urban agglomeration road network into a regulatory transport and operational state; eliminating road congestion network of urban agglomerations, including by switching passenger traffic to public transport; optimizing traffic flows; improving the efficiency of the traffic management system; switching to modern models of transport infrastructure development using integrated schemes for organizing public transport services; synchronizing the development of all transport types and transport infrastructure; and increasing citizen satisfaction with the urban agglomeration road network state.

Omsk region CTIDP was developed by the Research Institute of Automobile Transport in 2018 on the basis of the contract "Development of complex traffic management schemes for public roads of regional or intermunicipal importance relating to Omsk region property and organizing public transport services system in the Omsk region in part of Omsk agglomeration borders for the period 2019-2041". The collection and analysis of the initial data for the calculation tools development of the multimodal transport model was performed by SibADI specialists. The objectives of the study included the following:

- analysis of the road network parameters and existing road traffic management schemes and identification of problems affecting the transport system development;
- applied and exploratory research in the field of the Omsk region population mobility, identifying the transport behavior features of the Omsk region population, as well as identifying patterns of traffic flows distribution on roads of regional or inter-municipal importance;
- analysis of the existing passenger and freight transport system;
- analysis of the existing network of transport correspondence within the boundaries of municipalities; and
- analysis of the existing road traffic conditions obtained as a result of the Omsk agglomeration transport macromodel development in the software package PTV Vision® VISUM.

2. METHODS

The resulting transport model is the basis for the forecast model development for the Omsk agglomeration territory, as well as to optimize the route networks (RN) of the agglomeration cities. For this purpose, we organized and carried out a transport survey, a passenger traffic survey, and a survey in the Omsk agglomeration municipalities.

Public transport reform is linked to the introduction of market mechanisms into management [18]. The introduction of benefits and restrictions for passengers and transport operators will allow the effective development of the public transport system. [19]. Therefore, it is necessary to establish the most effective way to regulate the system of passenger transport, including the definition of policies of municipal authorities taking into account the interests of transport operators and passengers. Public transport is a socio-economic system, the main element of which is the passengers [20].

Urban space needs to be reinvented to optimize traffic flows and to increase the use of walking and bicycles [15]. As it is presented in the resolution adopted by the General Assembly (2018), by 2030, it would be necessary to provide all inhabitants with safe, inexpensive, available, and eco-friendly transport systems, on the basis of increase in traffic safety, in particular, to expand use of public transport for handicapped passengers.

Fossil fuel reserves are being depleted; their price is rising and are subject to unpredictable fluctuations. Locally, greenhouse gas emissions and particulate pollutants adversely affect human health and habitat. To this end, many European cities are trying to adopt planning strategies aimed at the sustainable use of public transport. These policies differ greatly in terms of costs and expected benefits, both globally and locally. Owing to the generally recognized non-linear interdependence of urban transport systems [8], the effects of these policies are difficult to anticipate. Sometimes the end effect can contradict intuitive expectations, causing inverse consequences. Excise taxes can be defined generally as indirect taxes of a selective nature. Given that fuel consumption is directly dependent on the use of transport, some states (e.g. Germany, Switzerland) have introduced a certain share of excise tax collection as a source of financial support for public passenger transport [9]. Thus, the higher price of fuel involves lower tariffs in public passenger transport, and it also involves reducing congestion and greenhouse gas emissions. In addition to some EU member states, this method of financing public transport is also used in the United States [11].

The share of public transport travel per capita per day in the United States is 2%, Austria 17%, Sweden 14%, Germany 12%, the United Kingdom 10%, Norway 10%, France 8%, Finland 8%, and Switzerland 24% [2]. Several factors explain the lower passenger traffic of public transport in the United States than in Europe and Canada. First, the US has lower population density and lower suburban infrastructure density, often with strict land use division. Low population density is difficult to serve effectively by public transport [16;17]. Second, easy car availability and low cost of ownership make it difficult to compete with public transportation [10]. Third, a convenient transport connection with free parking makes driving very attractive and cheap [14]. Finally, several studies have identified poor quality of public transportation in the United States compared with other countries.

For the first time, A.H Zilbertal approached the issue of optimizing route networks (RN) of public passenger transport (PPT) from the scientific point of view in Russia and in 1932 proposed a method of linking routes along nodes for tram routes [6]. At the same time, it was proposed to optimize the RN of cities taking into account the population needs and the particular city layout. In 1934, the work of G.V. Sheleikhovskiy "Street network and related standards" came out. Furthermore, in 1939, the work "Urban Passenger Transport" was introduced [13]. In a number of articles, the issues of evaluating the results of the work of UPT based on the solution of rank problems and the search for the optimal integral index were considered [12;13].

A.M. Yakshin [12] analyzed the planning decisions to reduce the time spent on mobility. At the beginning of the 60s of the 20th century, heuristic methods for optimizing the RN of the UPT began to actively develop. The first work that marked the beginning of a new stage in the development of methods for optimizing the RN of the UPT engine technology, which was the basis for further major developments and research in this area, was the work of B.L. Geronimus "Method of determining the

optimal automobile routes scheme". The work was performed in 1962-1963 in RIAT. In fact, it became the antecedent of the RIAT method, which was further developed, supplemented, and improved by many authors in the future.

In the 2000s, with the growing transportation problems in cities and increasing strains on urban highways, scientists began to devote their work to a comprehensive study and study of the issues of optimizing RN. A large number of optimization devices appeared, taking into account as the main parameter of optimization the overload of the transport network and allowing it to be reduced on the basis of streamlining routes and optimizing the structure of the rolling stock of UPT in terms of capacity and quantity. The software and computational tools for optimizing RN were improved and complicated, which made it possible to set a large set of input data and constraints to solve the problem.

Finding the best route is NP-hard tasks. Methods for solving such problems are divided into exact, heuristic, and metaheuristic [7]. Exact methods are based on a complete enumeration of all possible solutions, which, in turn, makes them ineffective. Heuristic methods produce a relatively limited search for solutions and usually find a fairly good solution in a reasonable time. However, these methods also have a disadvantage, namely, they are approximate [1]. Metaheuristic is the most effective, but in these methods, there is a parameter that directly affects the result, based on the input data [3], and in practice, you have to debug this parameter again every time.

Work analysis of the period under review shows that the methods for optimizing the RN of the UPT differ in two main criteria for the transportation process quality: some authors define the main criterion as a reduction in the time costs for passengers to move, whereas others reduce the number of the route transfers and non-straightness. In the countries of the European Union and the USA, a system of not-a-large number of routes and, as a result, a high level of transfer rate, has been developed for a long time. At the same time, the normal conditions preservation for the use of UPT passengers is ensured by the massive introduction of the zone-time interchange tariffs system.

KoleberYu.A. [6] formulated the following features characteristic of the optimization process of RN of the UPT:

- optimization of the RN of the UPT is impossible without first obtaining the passenger correspondences matrix;
- optimizing process of the RN of the UPT should be preceded by the process of collecting a large amount of source data;
- the task of optimizing the RN complicates the divergence of the interests of carriers and passengers in the UPT system; and
- with the modern development of methods for optimizing the RN of the UPT, it is impossible to do without the use of appropriate complex software and computing systems, but at the same time, final assessments of experts are needed.

To solve these problems, the following classification of survey methods is used:

1. Full-scale methods lie in attracting a large number of accountants for the route transport flows (RTF) surveys with the exception of using automatic means of collecting information about passengers traveling on the PPT and are divided into tabular, survey, talon, visual (eye), and silhouette methods.
2. The questionnaire method provides for filling out a questionnaire with the city population about mobility nature and directions, makes it possible to determine the average mobility range in the city and correspondence between city areas, characterized by a relatively small error.
3. Reporting statistical method.
4. Automated methods are based on the use of special metering devices that automatically record incoming / outgoing passengers at each stop and are divided into contact, non-contact, indirect, and departmental.

Among the field survey methods of RTF, the most widely used is the tabular method. This is due to the fact that among all the natural methods that give the most accurate results, the tabular method is less labor intensive and allows you to get a significant number of indicators as a result. In order to cover the entire RN of the city, a visual method is usually used, which allows you to record the

passenger traffic capacity on routes and gives information about the transport areas capacity for departure and arrival [4]. However, this method does not allow to obtain the value of correspondence.

Improvement of MS survey methods and their application in practice are described in Safronov, E., and Safronov, K. [12; 13].

3. RESULTS AND DISCUSSION

3.1. Computer modelling

The PTV Vision®VISUM software package is an information and analytical system that allows strategic and operational transport planning, traffic intensity forecasting, justification of investments in the transport infrastructure development, transport system optimization in cities and regions, as well as systematization, storage, and visualization of transport data. It integrates all the participants in the movement (cars, various classes of trucks, public transport, pedestrians, etc.) into a single mathematical transport model. The system combines geoinformation, statistical data into a single multi-level database.

The modeling of traffic flows consists of two fundamental models - the transport demand model and the transport supply model (Fig. 1).

The demand model for transport describes movements qualitatively and quantitatively and takes into account the causes and choice of the traffic flow purpose, the choice of vehicle, and the choice of path.

The model of the transport proposal is a transport network consisting of nodes (intersections, junctions, etc.) and the edges connecting them (streets, roads, etc.), providing the ability to move for participants in traffic and describing the costs of these movements. The transport offer model also includes information about stops and public transport routes.

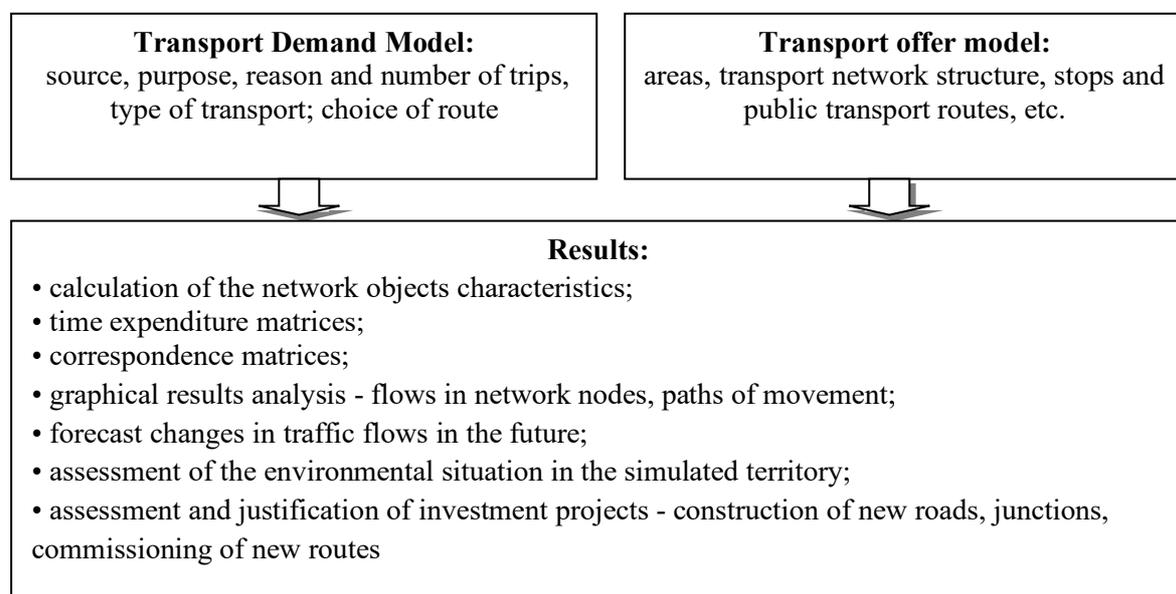


Fig. 1. The structure of the transport model

To build a transport model of the Omsk agglomeration, the following initial data were used:

- transport zoning of the territory;
- data of the transport network graph;
- data of socio-economic statistics; and
- data of the actual traffic intensity.

Using digital maps, a transport network of the Omsk agglomeration was developed, which allows developing the most accurate forecasts of traffic intensity over the Object.

Calculation of the average annual daily traffic intensity on highways was carried out in accordance with the method described in GOST 32965-2014 "Methods for accounting for traffic flow" using automated metering data. Different types of transport are presented in the model using transport systems, each of which relates to one or more segments of demand.

When developing the transport model, a standard four-step model for calculating transport demand was used. The advantages of using this particular model are related to the fact that it accurately describes all the stages of generating demand for transportation, while allowing you to work with aggregated data without losing the quality of the simulation results, which in turn reduces the calculation time and allows you to evaluate a larger number of forecast scenarios in unit of time. Calculation is usually carried out on separate layers of demand. The result of the computational algorithm of the model are the calculated values of the traffic intensity.

The standard four-step demand model consists of the following steps:

- A model for generating traffic. At the stage of creating traffic, the volumes of traffic from the source and the volumes of traffic to the target for all transport areas are calculated, detailed by demand layers. The calculation results are the total rows and columns of the correspondence matrices.
- A model of the distribution of traffic by district. At the stage of distribution of traffic by regions, the volumes of traffic flow between all transport regions are calculated, detailed by demand layers, but without detailing by mode of transport. The calculation results are the elements of the correspondence matrices.
- Model of transport choice. At the stage of transport selection, correspondence matrices are calculated, each of which corresponds to trips using a certain type of transport.
- Path selection model. Calculation of the redistribution, differentiated by mode of transport, allows to obtain model values of the intensity of traffic flows. The redistribution phase is final in the demand calculation cycle.

The transport model is a simplified representation of the real transport situation. After entering the initial data and calculating the transport demand, the model is checked, and it is determined how exactly the model matches the real situation. The reliability of the result of the redistribution of the transport model is assessed by statistical comparison of the observed data and the estimated load in the model. In the process of calibrating the transport model, a series of computational experiments is carried out, during which certain parameters of the model are changed in order to achieve the highest possible level of compliance of the actual traffic data with the calculated values.

At the last stage of calibration, the main indicators of the model as a whole were evaluated and compared with those collected as a result of the surveys. Such indicators include, for example, travel time between control points measured by the floating car method, the behavior of the queues, their average length, duration and nature of formation, and measured delays.

3.2. Application of UPT survey methods

To carry out the calibration, you must first bind the field data to the model objects. PTV Vision® VISUM uses "metering points" for this. Accounting points are network objects that mark a position on a segment where data are collected for a specific segment direction. You can enter any number of parameters at each counting place — daily, hourly intensities, if necessary, by type of transport.

A survey of traffic flows was carried out at 105 intersections and sections of the street road network (SRN) in Omsk. Measurements were performed during peak hours (from 7.00 to 8.00 or from 8.15 to 9.15 in the morning and from 18.00 to 19.00 or from 19.15 to 20.15 in the evening) on weekdays, excluding Monday morning and Friday evening. The duration of each survey was 1 hour and was made on a video camera with the subsequent processing of the material in tabular forms.

The results of the survey of traffic intensity are considered on the example of one of the intersections of Omsk. Surveys were conducted on a weekday on October 11, 2018 (morning survey)

and a weekday on October 10, 2018 (evening survey). The situational scheme and the allowed geometric directions at the intersection are shown in Fig. 2.

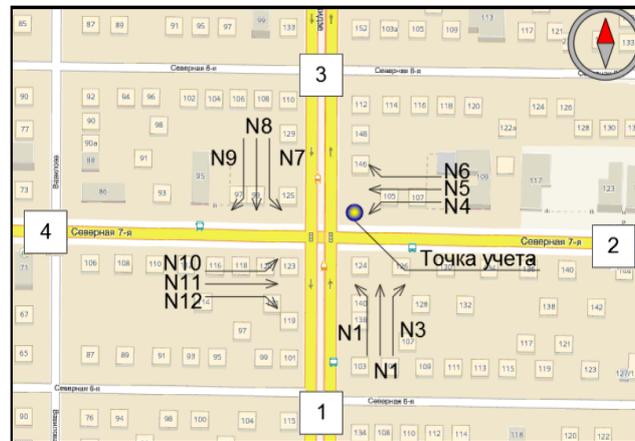


Fig. 2. Crossroads traffic metering scheme 7 Severnaya st. - Ordzhonikidze st.

The calculation of the average annual daily traffic intensity on roads is made in accordance with the methodology set out in GOST 32965-2014 "Methods for accounting for traffic intensity" using automated accounting data. Different modes of transport (vehicle classes) are presented in the model using transport systems, each of which belongs to one or more demand segments [5].

Table 1 presents the values of traffic intensities indicators at the examined intersection in the morning and evening "rush hours".

To determine the passenger traffic intensity, three surveys were conducted: passenger traffic examination during peak hours at stopping points in Omsk, survey of occupancy of public transport vehicles on the roads and Omsk road network, and survey of occupancy of public transport vehicles on the roads and the road network in the centers of eight municipalities of the Omsk agglomeration.

The survey methodology is as follows:

1. Video recording of entered and exiting passengers was carried out at 123 public transport stops on the territory of the Omsk agglomeration in the morning and evening peak hours. These video recordings after processing were recorded in the accounting card. The duration of each examination in the morning and each examination in the evening is 1 hour of continuous work. The stops entering into one transport knot were surveyed simultaneously.
2. Video recording of occupancy of the rolling stock of public transport on auto-mobile roads and the road network in the territory of the Omsk metropolitan area during the morning and evening peak hours at 72 points was carried out. The data were recorded in the accounting card. The duration of each examination in the morning and each examination in the evening is 1 hour of continuous work.
3. Video recording of occupancy of the rolling stock of public transport in the centers of municipalities of the Omsk agglomeration in the morning and evening rush hours at certain points was carried out. The data were recorded in the accounting card. The duration of each examination in the morning and each examination in the evening was 2 hours of continuous work.

The duration of passenger traffic surveys is based on the experience of SibADI in conducting such surveys for many years in different cities of the country in different climatic conditions. Measurements are taken only at rush hour and give an idea of peak passenger flows and maximum load of rolling stock. The longer duration of surveys does not improve the quality of the information received. Loading in inter-peak periods is within 10-20%, and the total volume of traffic is known.

The analysis of the data obtained showed that the total number of passengers served at public transport stops (PTS) was 17,481 people. Passenger traffic is evenly distributed between peak hours: morning – 8703 passengers and evening – 8778 passengers. The number of fixed-route taxis was

2,763 units, buses – 2,023 units, trolleybuses - 545 units, and trams – 206 units, equaling a total number of 5,599 units. The share of buses in the total composition of the UPT surveyed park was 33%, route taxis – 59%, trolleybuses – 7%, and trams – 0.3%. The rolling stock (RS) of a large capacity class made up 24% of the surveyed fleet, an average capacity of 19% and a small 58%. The average filling level of the PS GPT passengers during peak hours indicates an overload of the middle class UPT (66%), optimal loading of the small class (45%), and underloading of a large (22%) of the total capacity. The average passenger service time at the bus stop was 16.1 s.

Table 1

Traffic intensity in directions and modes of transport

Type of transport	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12
Morning rush hour												
Bus	0	4	0	0	9	0	0	6	1	0	6	1
Minibus	4	35	4	6	32	1	1	46	9	7	17	2
Passenger transport	121	549	117	95	618	79	92	516	118	73	485	110
Freight transport (up to 2 t)	2	21	9	4	27	5	4	26	3	1	26	4
Freight transport (from 2 to 6 tons)	2	2	1	0	4	1	0	3	1	0	3	1
Freight transport (from 6 to 8 tons)	0	1	0	0	2	0	0	2	0	0	0	0
Freight transport (up to 14 t)	0	1	0	0	0	0	0	5	0	0	0	1
Freight transport (more than 14 tons)	5	9	3	1	5	0	0	10	1	0	2	0
Road trains (up to 12 t)	0	1	1	0	0	0	0	2	0	0	0	0
Evening rush hour												
Bus	1	3	0	0	6	0	0	3	0	0	11	0
Minibus	2	32	6	2	15	1	1	30	3	6	12	1
Passenger transport	97	522	146	83	492	64	79	402	67	72	543	113
Freight transport (up to 2 t)	3	15	4	1	13	2	1	9	1	0	15	3
Freight transport (from 2 to 6 tons)	0	1	0	0	0	0	0	2	0	0	2	0
Freight transport (more than 14 tons)	0	1	0	0	1	0	0	5	0	1	1	2
Road trains (up to 12 t)	1	0	0	0	0	0	0	0	0	0	0	1
Road trains (up to 20 t)	0	0	0	0	0	0	0	0	0	0	1	0

A survey of 3,500 people living in the administrative districts of the city of Omsk, as well as residents of the Omsk agglomeration, was conducted. The proportion of men in the survey was 48%. The distribution by age is as follows: 15–24 years old – 12.8%, 25–54 years old – 52.2%, 55–64 – 17.4%, and 65+ – 17.6%. Individual transport use was 70.2%. The survey was able to identify the main problems associated with the use of public transport, personal transport, and bicycles.

The survey of truck drivers was conducted by the method of questioning. A total of 628 truck drivers participated in the survey: 60.2% were of the first category (low-tonnage and medium-duty vehicles); 32.8% – freight transport of the second category (heavy vehicles); and 7% – autos-yes. Drivers assessed the condition of the road network and traffic management.

3.3. Surveys revealed the following problems

1. The discrepancy between the passenger capacity of the used passenger transport and the existing passenger traffic flows is especially noticeable when planning inter-municipal transportation using outdated rolling stock.
2. Not all settlements of the Omsk agglomeration are provided with a permanent transport connection; this is due to the poor condition of access roads.
3. Owing to the lack of high-quality backup roads in the city of Omsk and lack of parking places in the central part of the city, drivers leave cars on the roadway, further reducing road capacity. There are also no planning solutions for the temporary accommodation of transport in most social infrastructure facilities: shops, school and preschool institutions, universities, and offices.
4. There is a general low satisfaction among the population with public passenger transport. The visual and silhouette methods allow the determination of bus filling by the accountants on a conditional point system and enter the data into special tables, provide the possibility of collecting data on stopping points with significant passenger exchange, as well as determine passengers traveling in the RS.

The disadvantages of these methods are the high probability of obtaining large errors during inspection. It is impossible to determine the value of correspondence. As a rule, surveys are carried out by the new-at-peak, when it gets dark early on the street. With a large accumulation of RS at the bus stop, it is difficult to inspect. Filling out forms on the street in cold weather is not possible. The tinting of the windows of the salons interferes with the determination of the RS filling, the RS can pass past the stop, etc. A large role is played by the human factor and qualifications of accountants and video handlers, camera resolution, viewing angle, image capturing, shooting defects, video marriage, etc.

There are also data from the electronic fare collection system. They also have certain disadvantages. They show only the number of passengers transported in a given period of time on certain routes, as well as the number of passengers included in the RS at stops, but there is no correspondence. Not all RS are equipped with such systems.

3.4. Options for the development of a system of public transport services

In the territory of the Omsk city agglomeration, on all types of public passenger transport, a decrease in passenger traffic is annually observed. One of the significant reasons is the continuous growth of motorization: the transport demand of the population for trips is gradually redistributed in favor of using personal transport. A number of other factors influencing the decrease in passenger traffic are the low quality of public transport services for the population and the lack of permanent transport links in remote areas with the core of the agglomeration.

Implementation of measures can be carried out according to one of three main development options:

"Inertial"

It assumes the preservation of existing trends in the transport system development and the absence of active actions for its modernization. The characteristics of transport services for the population of the Omsk agglomeration regarding suburban passenger transportation will not undergo significant changes owing to funding restrictions, inaccessibility of some roads owing to their technical condition in rural settlements, and a number of other reasons.

There will be a slight increase in passenger flows on public transport, as the "inertial" development option is primarily aimed at maintaining existing trends, as well as limited containment of negative factors affecting the decline in the quality of transport services to the population through the implementation of measures provided for by the existing planning documents and passenger development programs public transport in the Omsk agglomeration.

"Balanced"

It provides, in contrast to the "inertial" option, measures aimed at the formation of new forms of transport services for the population in remote areas, more intensive updating of the passenger

transport infrastructure, and the creation of the basis of a system of transport and transfer hubs (TTH) in the metropolitan area. It is also planned to develop a system of allocated lanes of route transport in Omsk, create conditions for unhindered use of transport by all groups of the population, including people with limited mobility, develop solutions to increase the information and price attractiveness of transport services, and establish clear development priorities between modes of transport.

«Dynamic»

Among the fundamental ideas of a “dynamic” development option are provided for:

- development of rail transport;
- the use of guided rolling stock that can move along subway tunnels and on ordinary roads;
- comprehensive development of the TTH network, combining urban and suburban communications with the updated tram system in Omsk;
- formation of the image and infrastructure of the Omsk agglomeration as an international transport hub based on the creation of a new international airport and the provision of continuous transport links with the main TTH;
- development of intercity railway communication;
- bringing 100% of the infrastructure of public transport agglomeration in normative condition

This development option provides, inter alia, for the implementation of most of the activities according to the “inertial” and “balanced” development options. Thus, within the framework of the “dynamic” development option, a comprehensive development of a high-quality agglomeration transport system is foreseen with the formation of a convenient public passenger transport system, a basic network of high-speed rail transport in the city of Omsk, which together ensure the reliable functioning of the Omsk agglomeration transport system.

4. CONCLUSIONS

For more than hundred years, scientific progress has made great strides in questions of improving the transport system and the urban metropolitan area. Nowadays, complex calculations, programming, modeling, neural networks, and genetic algorithms have been added to this. Such approaches would be in great demand at the dawn of passenger transport development, when it would be necessary to apply residential, industrial, and social infrastructure to develop a transport and route network to the city plan. Currently, the layout of cities is difficult to radically change. Therefore, more often the question arises about the adjustment of the existing route network, caused by the construction of separate residential complexes or large objects of attraction. Sometimes changes concern a number of routes, individual provisions of the tender documentation, bringing them to the requirements of social standards related to quality of service, comfort, fare, availability, etc. Attempts to completely recalculate and change the route network, if we are not talking about the emergence of new types of transport, are doomed to failure, because people get used to using routes at the genetic level, any changes are perceived very negatively and most often lead to the abolition of innovations. Therefore, it is advisable to listen to the opinion of those who work directly on the MS and use this method as less costly and more efficiently as possible.

The global trend in the development of urban transport infrastructure is an increase in the share of public transport in serving the population. Recently, new methods of project management have been actively developing; they began to be used for the implementation of program activities. The role of science needs to be strengthened, especially at the initial stage of improving the transport infrastructure of our cities. The factors and proposals considered are aimed at effectively solving the problems posed. In particular, the methods of interviewing passengers and drivers were used. The method of interviewing passenger drivers is effective for a number of reasons:

- drivers approach this issue objectively and assess the need for transport based on the possibilities of transport infrastructure and
- drivers assess the loading of rolling stock throughout the route, working time, days of the week, and time of year.

Currently, electronic toll collection systems are being introduced to track the number of passengers on routes and even at stops. Research should be conducted on how to process and analyze such data.

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Received 28.04.2019; accepted in revised form 28.08.2020