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## Some issues of the integrated development of public transport in the Barnaul agglomeration

The development of motor transport is the most important factor, determining the quality of life of urban population. Hence, the topic of the work is relevant. The pronounced social nature of public passenger transport should translate into the guaranteed high quality conveyance of the least affluent categories of passengers.

The article studies the state and quality of passenger transport in the city of Barnaul, analyzes the operation of passenger transport organizations, and transportation payments made by the population. The article identifies the main problems of passenger transportation, including consequences of the poor-quality operation of transportation organizations in Barnaul and offers solutions towards the optimal development of the transport system.

The co-authors propose to use methods, based on the driver's observations, automatic recorders, polling methods, cross-sectional surveys or coupons, to improve the operation of transport routes.

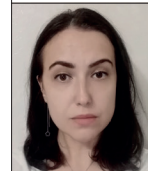
**Keywords:** public transport, Barnaul city, route network, unregulated tariffs

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### INTRODUCTION

As of the end of 2019, 29 passenger transportation enterprises, having different legal forms of organization, were in operation in the city of Barnaul. They included 16 limited liability companies, 12 individual entrepreneurs, and 1 municipal unitary enterprise<sup>1</sup>.

The urban route network has eighty-one routes, including sixty-nine bus routes and twelve electric transport routes<sup>1</sup>.

About seven hundred and eighty public transport vehicles are in operation in the capital of the Altai Territory. They include one hundred and eighty electric vehicles, up to three hundred large-sized buses, including about one hundred and forty low-floor buses, and three hundred small-sized buses. The passengers are concentrated along the routes, connecting the western part of the city with its business centre. Modernization and optimization of the transport system is relevant for the city of Barnaul. The main purpose of the work is to study the problems of passenger transportation and prepare proposals for their optimization.

The network of tram and trolleybus routes in the city of Barnaul and the pedestrian accessibility of bus stops is quite well developed, as it has access to almost all residential areas.

### MATERIALS AND METHODS

Neighborhoods, whose pedestrian accessibility exceeds ten minutes in terms of electric transport, were monitored within the framework of the development of a comprehensive traffic management pattern [1]. A map, showing duplicated existing routes of public transport was used to analyze the transport system in the city.

One of the main reasons for the extensive duplication of urban routes is the Barnaul town planning pattern, since the development of its network of streets and roads is restrained in the direction from large-scale residential housing areas to the city centre. The territory, full of natural and artificial barriers, complicates the development of the urban transport network, as the construction of massive artificial structures, including bridges and overpasses, is costly.

### RESULTS

According to the results of a survey on urban passenger transport traffic, conducted by the Municipal Unitary Enterprise "Tsentrtrans" in Barnaul, the daily traffic reaches about six hundred thousand passengers, which is twenty-eight percent less than the passenger traffic number identified in the survey conducted over ten years ago [2]. A decrease in the passenger traffic is also confirmed by an increase in the number of motor vehicles, that exceeds three hundred cars per thousand of residents.

Since December 2016, an electronic travel payment system has been in operation. It uses the "Convenient Route" technology, launched in Barnaul. Sixty-three routes (or seventy-eight percent) of public urban vehicles are connected to this system. 67,070,291 trips were made (6,097,299 trips per month) during the 11 months of 2018; 73,130,991 trips (6,648,272 trips per month) during the 11 months of 2019.

Since 01.08.2019, certain categories of citizens, registered in the Federal and Regional registers as social assistance recipients, have been using transport cards. On average, social assistance recipients make 2,425 thousand trips every month.

As for the passenger traffic, traced by bank wires, during the 11 months of 2018, 16,135,081 trips were made (1,466,825 trips per month), and

<sup>1</sup> The official website of the Barnaul City Administration. URL: <https://barnaul.org>

▶ 30,779,845 trips were made during the 11 months of 2019 (2,798,168 trips per month)<sup>2</sup>.

As a result, we have identified an increase totaling at 14,644,764 trips or 90.8 %. First of all, this increase was triggered by the introduction of bank card payments in February 2019; in addition, it was boosted by the transfer to the transport cards of social assistance recipients in August 2019.

If we analyze the passenger traffic on electric transport during the 9 months of 2019, electric transport was used by 38 million 254 thousand passengers, which is 2.3 % (882.0 thousand) passengers less than in the same period of the previous year<sup>3</sup>.

In order to optimize costs, the schedule of electric transport vehicles was revised with a reduction in the number of vehicles on weekends and holidays. As a result, the occupancy of cars increased, because in 2018 61.5 people were transported per hour, and in 2019 this number went up to 64.2 people. Hence, the growth rate was 4.4 %.

The passenger traffic has the following structure: the share of paying passengers is 50.2 %, while the share of social assistance recipients is 49.8 %. The main reason for the large number of trips made by social assistance recipients is, of course, the low per-trip price.

The structure of trips is as follows: in 2018, cash payments amounted to 76 %, non-cash payments reached 24 %; in 2019, cash payments amounted to 44 %, non-cash payments — 56 %.

The share of non-cash trips increased by thirty-two percent if compared to 2018.

Currently, the largest share is the one of the trips made by social assistance card holders, it has reached forty-six percent, the share of trips paid for using bank cards is sixteen percent, fourteen percent is the share of trips paid for by electronic travel cards of pensioners, and seven percent of passengers use electronic wallets to pay for their trips.

Given that a passenger, being a System user, does not have to perform any additional operations (connection, activation of an electronic means of payment) to find out the fare using a contactless bank card, the electronic payment system can invalidate a personal transport card in case of its issuance to a citizen who does not have the right to use the card to pay for a trip.

Over the entire period of operation of the system, about one hundred and fifty-five thousand cards have been distributed. More than sixty thousand cards (39 %) were sold to certain categories of citizens, registered in the Federal and Regional registers of recipients of social assistance.

The share of paying passengers is 50.2 %, the share of social assistance recipients is 49.8 % in the structure of electric transport passengers. The main reason for the large number of social assistance recipients among passengers is the low fare payable by holders of social transport cards [3].

Ten trams and two trolleybuses were overhauled, a new tram was supplied in 2009–2012, according to the regional program.

In 2012–2014, the municipal enterprise obtained two new trams, eight new trolleybuses, at the expense of the company's funds, one tram was overhauled within the framework of different programs at various levels. Currently, two hundred tram cars and forty trolleybuses need a repair. The cost of a new tram starts from twenty million rubles, the cost of an overhaul of a tram car is six

million rubles, the cost of a new trolleybus is fifteen million rubles. In 2019, 109 trams and 25 trolleybuses were repaired in Barnaul.

The municipal enterprise has 287 trams and trolleybuses, including two hundred and twenty-seven trams. The wear of tram cars is 97 %, the wear of trolleybuses is 83.3 %.

The standard service life of a tram is fifteen years. The average age of trams is thirty-three years. The standard service life of trolleybuses is ten years, and the average age of trolleybuses is twenty-one years.

## DISCUSSION

In 2019, the company launched an overhaul of trams in a tram depot. When a tram car is overhauled, its chassis, roof, the lining of the passenger compartment are replaced, the tram car is insulated, passenger seats and electrical wiring are replaced [4]. In addition, electrical wiring is upgraded to reduce the risks of technical malfunctions and the amount of energy consumed by a tram up to fifty percent.

In 2020, after the launch of a high-alert mode, passenger traffic went down by seventy percent. Due to a nose dive of the passenger traffic numbers, the number of vehicles on the line went down by fifty percent.

The passenger transport occupancy rate is monitored on a daily basis, and the same about the checking of masks on the faces of passenger.

At the terminal stops, measures are taken to check whether public transport enterprises fulfill the requirements dealing with the sanitary treatment of vehicles [5]. Administrations of urban districts, acting in collaboration with the Barnaul Department of the State Emergency Service, have designed routes for notifying the population using mobile means of notification, checking the rules of conduct compliance by citizens and organizations in the context of a high-alert and emergency situation.

In 2020, more than six hundred bus stop pavilions, underground pedestrian crossings, and Barnaul public areas were cleaned twice in compliance with the sanitary and hygienic requirements.

Since 30.03.2020, employees of the city administration have conducted 11 inspections to check the implementation by public transport enterprises of a set of preventive sanitary treatment actions in respect of transport vehicles [6]. Inspectors also asked line workers to demonstrate their personal disinfectants and masks. Also, control is conducted over the sanitary treatment of public vehicles (wiping handrails, seat backs, ventilation of cabins). According to the results of inspections, letters are sent to public transport enterprises with a request to provide line workers with protective items, check the availability of disinfectants, and generate awareness about the need to take preventive measures at the terminal stops [7]. Inspections are made at the terminal stops Spartak-2, the Spartak Square, Furniture Factory, the V.N. Bavarin Square, and the Victory Square.

## RESULTS

Barnaul has launched a municipal programme on the development of the urban road transport system until 2025<sup>4</sup>. This municipal programme entails the subsidizing of socially significant and electric

2 AMIK Information Service. URL: <https://www.amic.ru/news/458137>

3 CBM Center trans. URL: <https://tk-barn.ru>

4 On approval of the Plan for the development of regular transportation of passengers and luggage by road and urban ground electric transport of the city district of the city of Barnaul for 2016–2020 : Resolution of the Administration of the city of Barnaul dated 18.07.2016 No. 1447. URL: <http://docs.cntd.ru/document/438985392>

transport routes from the city budget to ensure the transport accessibility of particular settlements and gardening establishments.

The annual amount of urban budget subsidies is about two hundred and twenty million rubles.

Barnaul trams and trolleybuses can be overhauled within the framework of targeted programs, including the program on the development of the transport system of the Altai Territory, which entails measures for the development of urban electric transport, but the financial resources, needed for their implementation, will be provided from the city budget starting from 2023.

Therefore, the following measures must be taken to develop public transport in the city of Barnaul.

It is necessary to ensure high quality transport services, efficient production of vehicles and competitive transport services, so that passenger transportation organizations are able to successfully operate in the transport market [8].

When optimizing the route network in the city, it is necessary to reduce the level of duplication of urban passenger transport routes. At the same time, it is necessary to ensure the minimal duplication of suburban and urban routes. As a solution to this problem, it is necessary to cut suburban bus routes at the nearest transfer point within the city borders [9].

Also, Barnaul needs complete modernization of urban public transport to be funded from regional, local and federal budgets [10].

The project, proposed by VEB.RF, encompasses the renovation of the fleet of vehicles and the introduction of intelligent traffic management systems such as dedicated lanes, traffic lights, recording/documentation facilities to ensure comfortable and safe trips and increase the velocity and attractiveness of public transport [11].

To ensure the transport accessibility of suburban areas, a motor transportation division was organized at the Municipal Unitary Enterprise Gorelektrotrans of Barnaul. It will entail the purchase of eco-friendly buses (the city needs about sixty of them) running on gas fuel [12].

In turn, such a large-scale modernization will affect the tariff policy in the field of passenger transportation and will require an annual revision of fares, an increase in the tariff gap between electronic and cash payments [13].

It will be impossible to optimally develop the transport system in the city of Barnaul and other cities of the Russian Federation without the implementation of the above approaches.

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## Некоторые вопросы комплексного развития общественного транспорта Барнаульской агломерации

Развитие автомобильного транспорта является важнейшим фактором, определяющим уровень качества жизни городского населения, поэтому тема его работы является актуальной. Ярво выраженный социально значимый характер осуществления деятельности общественного автомобильного пассажирского транспорта должен выражаться в гарантированности высокого качества перевозок наименее обеспеченным категориям пассажиров.

В статье рассматривается состояние и качество работы пассажирского транспорта на территории города Барнаула, проведен анализ работы пассажироперевозящих организаций, оплата транспортных услуг населением. В статье обозначены основные проблемы пассажирских перевозок, в том числе описаны последствия некачественной работы автоперевозчиков для города Барнаула и предложены пути их решения для оптимального развития транспортной системы.

Для корректировки режимов работы существующих маршрутов предложено использовать методы, основанные на наблюдениях водителя, применении автоматических регистраторов, а также методы опросов, срезовых обследований или талонов.

**Ключевые слова:** общественный транспорт, Барнаул, маршрутная сеть, нерегулируемые тарифы

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