

# Modern Approaches to Improve the Performance of the Transport System of the City (on Moscow Case)

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**Abstract**— The article studies the problems of improving the transport service of the urban population in the aspect of improving the work of public passenger transport of the capital city. In the construction of transport facilities, it is proposed to carry out preliminary modeling, which assesses the consequences of their commissioning and saves significant financial resources. An important condition in ensuring the continuity and rhythm of public transport is the renewal of the fleet. The introduction of satellite navigation systems on public transport, the use of intelligent transport systems can reduce the level of congestion of roads and increase their capacity, optimize the use of road transport and increase the availability of transport services. A number of measures are proposed to improve the local transport situation in the cities.

**Keywords**—urban transport system; transport infrastructure; urbanization; population, metropolitan metropolis; strategic development of the city.

## I. INTRODUCTION

Currently, due to the increase in the level of motorization (annual growth of about 5%), there is an increase in labor and business activity of the working population. This leads to a rapid increase in demand for movement in both quantitative and qualitative terms [1]. In September 2017, at a meeting of the Presidium of the State Council devoted to the issues of integrated development of passenger transportation in the Russian Federation, Russian President Vladimir Putin said: "the Mass character, the great social importance of public transport dictate high requirements for passenger transportation. This is a wide coverage of the route network, reliability of communication and, of course, safety and quality provide services» [2].

World practice in the transport business shows that when a certain level of development of transport infrastructure is achieved, its further improvement is meaningless. There is a

vicious circle: there is an increase in the number of cars, which is accompanied by an increase in the construction of new roads. In the end, the situation returns to the old order of things - constant traffic jams. As a result of the situation, there is a deterioration of traffic conditions, an increase in the number of congestion, violation of the environmental situation, fuel consumption, as well as an increase in the number of road accidents [3, 4].

The ill-considered construction of new roads, interchanges and their reconstruction, starting from a certain point, gives little, as the number of cars on the roads increases faster than there are new transport opportunities.

Below are the different approaches to improving the transport system of the city (for example, Moscow)

## II. DIFFERENT APPROACHES TO IMPROVE THE PERFORMANCE OF THE CITY' TRANSPORT SYSTEM

### 2.1. Development of an information model

The development of an information model of the city transport system confirms this conclusion - a significant increase in the number of transport facilities in the model does not lead to a dramatic improvement in the transport situation as a whole, which once again indicates the need for a selective approach to the construction of transport facilities and the need for preliminary modeling of the consequences of their commissioning [4]. The growth of motorization, changes in traffic flows, despite this construction, will lead in the future to an increase in transport problems and subsequent possible serious traffic difficulties - if not to apply scientifically sound, proven by world practice for many decades, methods of transport planning and modeling to solve transport problems [5,6]. Of decisive importance in the selection of the construction of a transport object will have the results of the

preliminary simulations, giving an estimate of the impact of their commissioning and saving significant financial resources due to the choice of effectively operating the transport of objects [7].

## 2.2. Public transport fleet Renewal and organizational aspects

Other methods of dealing with traffic jams all over the world are considered to be all-round improvement of public transport. One of the measures to achieve this goal is the constant renewal of the Park of municipal vehicles (trolleybuses, buses). It is necessary to ensure the rhythm of transportation of citizens on a fixed schedule. Here it is appropriate to recall the well-known patent for public transportation of Blaise Pascal from 1654, which is formulated as follows: "to Organize in Paris a regular movement of public passenger carriages on pre-announced routes and schedules, with a single tariff of 5 su" is still a universal form of existence of a public carrier [8].

## 2.3. Privatization of public transport

At the same time, it is possible to partially privatize public transport (the private sector works better than the state, at least in terms of reducing operating costs) in order to further upgrade the fleet of cars, to implement measures to improve the economic efficiency of its work. And no matter how criticized the current (small) practice of introducing dedicated lanes for public transport (in the capital cities), but it seems that they cannot do without (in conjunction with the other measures listed here, otherwise it makes no sense).

## 2.4. A restriction of parking and the prohibition of movement of cargo motor transport

A reasonable step in improving traffic will be the possibility of partial restriction of traffic and Parking of private vehicles. Another measure to combat traffic congestion is a complete ban on the movement of trucks in the city center and the prohibition of free Parking on the main streets in the daytime. The correct solution of Parking is to allow them only within the territories relating to residential buildings, commercial enterprises, offices, industrial enterprises, etc. [9].

## 2.5. Implementation of intelligent transport systems

At the same time, selective implementation of only carefully calculated on the model and really effective projects of construction, reconstruction (and/or modernization), local improvement of the transport infrastructure of the city should be carried out. The efforts and measures for the development of GLONASS satellite systems on public transport [10], the introduction of intelligent transport systems that help reduce the level of congestion of roads and increase their capacity, optimize the use of road transport and increase the availability of transport services [11] will complement the efforts and measures. It is also necessary to actively promote the work on computer modeling of transport situations and other innovations [12], fig. 1.

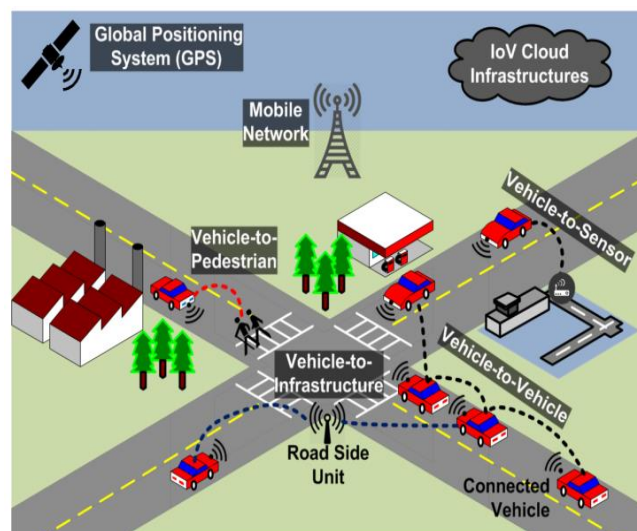


Fig 1. Intelligent transport system

## III. THE PROCESSES OF URBANIZATION AND THE TRANSPORT SYSTEM

At the present stage of development associated with the active development of technology and the acceleration of any interaction, a special role begins to play the functioning of the transport system as a set of technical, social and organizational components. The most important is the functioning of the transport system for cities, due to the presence of a large mass of the population in a limited area. Among the functions performed by the public transit system is the most important at the moment is urban [13].

The essence of this function is that the development and functioning of the urban transport system determines both the development and growth of the city and the distribution of economic objects and the population within the residential area (Fig.2).



Fig 2. Development and growth of the city and transport system

This influence is carried out by taking into account the total cost of the implementation of transport functions. The time spent on moving from one point of the urban area to

another is a determining factor, both for the location of commercial and social facilities, and when choosing a place of work and residence of the urban population. Trying to act rationally, a person, as a subject of economic activity, tries to minimize his time and financial costs for daily movement from place of residence to place of work, as well as for movement for social and cultural purposes [14].

#### IV. COMPREHENSIVE COST OF MOVING

The costs of these movements will be determined by a number of factors, such as [14]:

- The distance from the point of departure to the point of destination.
- Speed of movement from the point of departure to the point of destination.
- Travel time from origin to destination.

Consider each factor separately.

##### 4.1. Distance from population movement

The distance of movement will, in turn, be determined by the action of several factors.

- a) The Geographical location of the start and end points of delivery of the population.
- b) The Location of residential and industrial zones, places of attraction of cultural and leisure correspondences is influenced by the General context of urban development. The very same urban development will largely depend on the configuration of the road network. As a rule, new urban areas are developed on the basis of transport accessibility. Areas with a high degree of transport accessibility are becoming the most attractive for the location of socially important objects and commercial organizations. The exception will be large, city-forming enterprises, which are themselves an active subject of the formation of the street and road network.

c) Configuration of the road network. Street and road network is a collection of all the streets and roads of the city. It can have different types, such as rectangular, fan, radial-ring, free, mixed. At the same time, the main principle of building a road network of the city should be to minimize the distance.

The distance to be covered by the road network should be as close as possible to the shortest route from one point to another – the air distance. At the same time, the implementation of this principle is hampered by a number of circumstances, such as terrain, hydrological and environmental situation.

It should be noted that the vast majority of old Russian cities were built on rivers and had a radial-ring structure of development, which was optimal for defense purposes. which later transformed into free In this regard, the implementation of the principle of approaching the distance on the road network to the air distance is difficult to observe [15].

##### 4.2. Travel speed

Within the urban area, the speed of movement will also be determined by a number of constituent factors [16].

a) Configuration of the road network. Straight sections of roads can be safely overcome at a greater speed than sections with sharp turns, as well as areas where the burly situation is poorly visible.

b) The quality of the roadway. The better the road surface, the more smooth it is, the greater the speed can be developed by the vehicle.

c) Characteristics of vehicles used in a particular urban transport system. Each type and type of transport corresponds to its speed limit. This is particularly striking in the case of urban public passenger transport. Rail public transport (metro, tram) develops greater speed than the railless (bus, trolley bus), transport on an internal combustion engine faster than transport on an electric motor. The size of the vehicle and its connection to infrastructure such as power lines are of great importance.

For personal individual transport, these differences are not so significant, but they take place and will be associated with both the size of vehicles and with age and their technical condition.

##### 4.3. Travel time

a) Travel time is a complex concept that will have differences for urban public passenger transport and personal individual. The common thing for these transport systems is that the time of movement cannot be considered as a function of distance and speed, as it is necessary to take into account. the loss of time associated with the organization of the functioning of the urban transport system.

b) The time required to access the urban transport system. For urban public passenger transport – this is the time of approach of the resident from the place of residence to the bus stop complex, for a person using individual transport – the time of approach from the place of residence to the location of the car, the time of its preparation for operation.

c) Time of entry into the urban transport system. For the passenger of public transport, this time will be the time of waiting for the necessary vehicle at the bus stop in the amount of the time of boarding the vehicle. For the user of personal individual transport is the time of departure to the street and road network of the city and integration into the General traffic flow.

d) Travel time from the point of entry into the transport system to the point of destination. This time will consist of the time of the trip itself, determined by the distance and speed of movement, and the time of delays. Delays in movement are caused by two main reasons – the organization of the urban transport system (the presence of traffic lights, road signs, and pedestrian crossings) and the presence of traffic congestion. For the passenger of urban public passenger transport, this time refers to the time built in the idle time at bus stops, as well as the time for transfer to other public transport vehicles, if any, are carried out.



e) Time to exit the transport system and approach the destination. For the passenger of public transport is the time of exit from the vehicle and a hike from the bus stop to the destination of his trip. For a person using personal individual transport – this is the time spent on Parking, as well as on the approach from the Parking lot to the destination of his correspondence.

## V. BUILDING A ROUTE SYSTEM

Another important aspect of minimizing the distance is the construction of the route system. Taking into account that in modern Russian cities the majority of the population still sells their correspondence using urban public passenger transport, the minimization of the distance of their movements will be carried out not by the criterion of the length of the street and road network, but by the existing route system. The route system represents the whole set of urban public passenger transport routes (Fig.3).

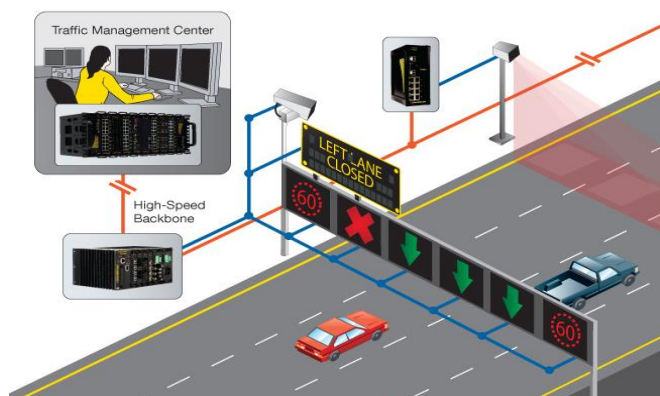


Fig 3. Building a route system

Unlike the road network, the route system cannot be optimized to the air distance, as it can only be laid within the existing road network. In this case, it is necessary to talk about the approach of the distance to be overcome on the routes of urban public passenger transport, between two points of residential territory to the shortest path between them on the street and road network.

Therefore, it is important to consider parameters such as speed and travel time.

## VI. CONCLUSION

In general, the most advanced in the world is now considered the concept of "City convenient for life" (for all citizens, not only for motorists).

Within the framework of this concept, the authorities exclude "free breakfasts" for motorists – when taxes paid by all citizens go to roads and Parking lots, i.e. to preferences for motorists, and for office owners (purely Russian specifics – when expensive urban land is provided free of charge for Parking to individual institutions and organizations).

In the short term, a number of measures can be proposed to solve transport problems:

- constant monitoring of the effectiveness of traffic light control settings, the use of non-standard methods (including

the phases of pedestrian traffic every other time, as sometimes not enough for a few seconds for a more successful adjustment of traffic through the intersection, etc.);

- possible installation of fences on the road network of the city, if necessary, taking into account the convenience of cleaning;

- optimization of placement of public transport stops, change of road marking, possible change of the scheme of circular movement in the city, jointing of bottlenecks at intersections and overpasses, etc.

All this does not require large financial costs can have a positive impact on the transport infrastructure of the city.

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