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Estimation of the transport services accessibility for the population of the region

In this article the change of parameters of physical and economic accessibility of transport services for the population of the Russian Far East is considered. The characteristics of physical accessibility include the change in the configuration of transport networks by mode of transport, changing the route network, etc. The assessment of economic accessibility considers relative changes in the purchasing power of per capita incomes of the population connected with the dynamics of average transportation tariffs for air transport (economy class), rail transport (long-haul and suburban transportation), etc. Based on the proposed approach, the author made calculations and presents the obtained estimates of the dynamics of individual indicators of accessibility of transport services, and their interpretation is given.

Keywords: transport services, accessibility of transport, the Far East, economic accessibility, transport infrastructure

Оценка доступности транспортных услуг для населения региона

статье рассмотрено изменение параметров B физической u экономической доступности транспортных услуг для населения Дальнего Востока России. К характеристикам физической доступности отнесено изменение конфигурации транспортных сетей по видам транспорта, изменение маршрутной сети и т. д. Оценка экономической доступности рассматривает относительные изменения покупательной способности среднедушевых доходов населения относительно динамики усредненных транспортных тарифов на воздушные перевозки экономическим классом, железнодорожный транспорт дальнего следования и пригородный и т. д. На основе предлагаемого подхода автором сделаны расчеты и представлены полученные отдельных показателей оценки динамики доступности транспортных услуг, дана их интерпретация.

Ключевые слова: транспортные услуги, доступность транспорта, Дальний Восток, экономическая доступность, транспортная инфраструктура. The level of transport infrastructure development which provides for the possibility of free movement of the population is an important indicator of the quality and comfort of living in a certain territory [1]. Transportation is a basic factor in the location of production and the formation of competitive product positions [2]. In these conditions, the improvement of vehicles and transport infrastructure of the national economy in terms of increasing the speed of travel, safety and comfort of the trip, allows to "squeeze" the space and expand the boundaries of effective economic interactions in the formation of markets including labor market.

Leaving outside the scope of this work transport conditions for producers, we will focus on the population. The study of foreign experience indicates an increase in the transport mobility of the population (the number of trips per person) in most economically developed countries. This is confirmed, for example, by the analysis of trends in the development of transport systems in key countries of North-East Asia [3].

However, in Russia, since the 90s of the XX century, there has been a tendency to reduce the transport mobility of the population. This indicator decreased by 2.5 times (from 326.7 to 130.5) for the period 1990-2015. Even deeper negative dynamics was observed in the Far East, where the decrease in the mobility index was 3.1 times (from 213.8 to 69.1).

The level of development and accessibility of the transport system is significant for the Far East for the following reasons: it is far from the centers of economic activity of the country; this region is characterizes by an extremely uneven distribution of economic activity and resettlement across the territory; it performs cross-border interaction with one of the most powerful economies of the world (China).

Transportation is one of the factors that form the level of comfort in this territory. In this regard, transport discrimination of the population can negatively affect the prospects for the overall economic development of the eastern part of the country. So without resolving the issue of creating a comfortable environment for people living in this region, we will not be able to implement the grandiose development plans widely declared now.

Decrease in transport mobility of the population is a negative factor for the development of economy [4] and can be caused by:

• reduction of labor mobility;

• changing the motives of people's transport behavior (for example, loss of family ties with people living in the central regions of the country, changing habitual places of rest, etc.);

• changing the availability of transport services.

In this paper, we will consider assessments of the change in the accessibility of transport services for the population of the Far East in the period 1990-2015. Leaving outside the framework of this material a broad discussion on the interpretation of the term "accessibility", we mean by this characteristic the possibility of using transport. From this point of view, the assessment of the availability of transport for the population of a particular territory may include the following aspects:

• Transport provision - implies an assessment of the actual availability of the transport network on the territory (using network density indicators, Engel coefficient, Uspensky coefficient, transport performance, etc.);

• Transport accessibility in space - characterizes the localization of the elements of the transport network in the territory;

• Transport accessibility in time - implies an estimate of the time required for the movement;

• Transport accessibility in time - considers the change in availability in a certain period due to the dynamics of key parameters of the transport network;

• Economic accessibility of transport - is associated with the assessment of the availability of transport services taking into account the transportation tariffs;

• Social transport accessibility - the possibility of using transportation services for people with disabilities;

• Transport discrimination - assessment of transport services that are not received by the population, etc.

Taking into account the aforesaid in the work we will consider two equivalent substantial blocks: change of physical availability of transport networks and change of economic availability of transport in the studied period. In fact it is estimates of dynamics of transport provision of the population of the region (in space and in time) and also dynamics of change of purchasing power of the population of rather transport services.

Over the past twenty-five years, there have been changes in the transport services of the population of the Far East, which have a largely negative character (Figure 1).



→ Road → Inland waterway → Air → Maritime → Railway Fig. 1. Volumes of passenger transportation by the transport complex of the Far East of Russia [5]

Note: railway (defined on the right scale), inland waterway, air, maritime transports are calculated in million people; road transport is calculated in billion people.

So, the system of regular sea passenger transportation, which had been tuned earlier, was lost. The maritime transport of the region facing the Pacific Ocean has practically ceased to carry out mass transportation; most of the coastal lines that previously connected the coastal settlements of the eastern part of the country do not operate.

In the region there is no full-scale roads network; many localities do not have whole-year surface transportation with central settlements, main transport routs and also with each other. The existing roads including federal are in inadequate condition and need repair (only 55% of the roads of the Far East correspond to the normative indicators [6]).

A difficult situation has arisen in the part of the air transport of the region. Over the past twenty years, the number of airfields in the Far East has decreased 3.6 times. Such a significant reduction occurs both because of actual termination of work, and because of a change in status due to the transfer of airfields to the landing sites.

Less than half (49%) of the region's airfields had an artificial runway in the year 2015. The rest ones (51%) had ground runways. The absence of a band with artificial cover makes it impossible for regional airfields to operate during off-season periods. In addition, the level of wear on the airfield equipment is extremely high.

The State authority realizing the importance of air transport for the Far East takes measures to support the regional airport network at the expense of budgetary funds. The Program for the creation of Federal State-Owned and State-Financed Enterprise (FCO SFE) on the basis of airports of regional and local importance has been implemented since 2006 [7]. To date, in accordance with the decisions of the Government of the Russian Federation in the Far East five FCO SFE assigned to the jurisdiction of the Federal Air Transport Agency have been created: "Airports of the North"; "Airports of Kamchatka"; "Airports of Chukotka"; "Sakhalin Airport"; "Airports of the Far East".

The air passenger transport support is also provided through direct subsidies. The centralized subsidies have been provided to air carriers from federal funds for the transportation of certain categories of passengers for routes chosen for participation in this program since 2009. Three programs of state subsidies were implemented in the tear 2016. In addition, subsidies from regional budgets also operate for a number of air routes. These subsidies are applied to air transportation in local communication for non-alternative social routes (when there are no alternative modes of transport capable of providing transportation between two settlements of the region). Thanks to the measures taken, the number of passengers carried by air transport in the Far East has been increasing since 2009 [8].

The network of railways on the territory of the region does not practically change along the length of the railway lines. Only 7.5 km of new lines were introduced for the period 2000-2015 [5]. The railway infrastructure development plans and current projects are mainly related to the construction of roads to raw materials fields and the subsequent transportation of the products extracted for

export. The change in the system of suburban passenger transportation also did not have a significant positive effect. At present, the "Express Primorye" and the "Passenger Company "Sakhalin" operate on the territory of the Far East. The number of suburban routes in recent years has decreased. The long-haul transportation is carried out by JSC "Federal Passenger Company".

Bottlenecks in the functioning of the transport complex in the region have a negative impact on reducing the attractiveness of the Far East as a place of permanent residence contributing, among others. depopulation of the population (for the period 1990-2015 the population of the Far Eastern Federal District decreased from 8.0 to 6.3 million people, the outflow trend persists).

Considering the change in the physical accessibility of transport services for the population, it was important to analyze how the following factors affected the availability of transport: the change in the length of the networks for certain modes of transport (the increase in roads, the reduction in the length of railways), the termination of the operation of airports and landing sites of regional importance, transport, reducing the directions of suburban rail transport, reducing intercity bus services reduction of the number of inland navigation voyages, a reduction in the scale of coastal maritime traffic and so on.

To solve this task we used indices of the "development of transport infrastructure" calculated for each administrative subjects of the Far East for certain types of transport. Since to us the comparative estimations were important the squares of the Euclidean distance were used for the calculation of the indices, taking into account the minimum and maximum parameters of each characteristic from the given scores. The indices are normalized in the interval from zero to one. Given the limitation of the format, it is not possible to present the result for all modes of transport, so we will consider in detail only one of them - automobile.

The change in the accessibility of the region's automobile network to the population was analyzed in two conditional directions: 1) "in time"; 2) "in space". The first assumes an assessment of the change in physical accessibility for the population of the automobile network for the period 1990-2015. The results of calculating the indices obtained are shown in Figure 2.



Fig. 2. Dynamics of the physical accessibility index of the automobile network of the Far East "in time"

Considering the change in accessibility in time we can be note that a reduction in the automobile network was recorded for the Magadan Region and the Chukotka Autonomous Area as compared to the 90s and 2000s.

It is interesting to analyze the unevenness of the temporary development of the process in relation to the subjects of the Russian Federation: the decline in the index for many subjects in the period 2001-2010. This period can be characterize as financing of construction, maintenance and repair of roads was reduced. The main reason was the liquidation of Road Funds (abolished in 2001 and reestablished in 2011). In this case, the degree of the coefficient drop significantly varies by subject.

The results of the assessment of the change in the availability of regional automotive networks "in space" are no less interesting. In this case, the indices allow one to assess how the relative accessibility of this type of transport in the context of the subjects of the Far East relative to each other has changed (Fig. 3).



Fig. 3. Dynamics of the physical accessibility index of the automobile network of the Far East "in space"

This index makes it possible to trace the changes in the priorities of state policy regarding the development of the region's automobile network. It fixes for each period the relative level of availability of the network in each of the constituent entities of the Russian Federation. For example, the stage of active development of highways in Yakutia (1997-2008) is very clearly marked out; activation of road construction in the Primorsk territory on the eve of the APEC summit (since 2009) etc. The index unambiguously records lower estimates for most of the northern subjects: the Chukotka autonomous region, the Kamchatka territory, the Sakhalin region and the Magadan region.

The similar indices allowing assess the change in the physical accessibility of transport services, were calculated for other modes of transport.

In addition, we assessed the change in the economic accessibility of transport services for the population of the Far East. The population's expenses for payment of transportation services in the structure of the population's expenditures are the second after the housing and communal services. By the end of 2016, 11.7% of the Far Eastern population's expenditures accounted for the payment of transportation services (with an average Russian rate of 8.6%).

The change in the economic accessibility of transport services for the population in the first approximation can be estimated through the relative dynamics of per capita income in comparison with the dynamics of the average tariffs for passenger transport by certain modes of transport. In the calculations, we considered the parameters of air transport, rail transportation in long-distance trains (coupe and reserved seat), suburban rail transport, intercity bus transport, transport in the urban transport system (commercial and municipal buses). For example, consider the results obtained in analyzing changes in the economic accessibility of air transport and rail transport (Tables 1, 2).

Territory, subject of the	2003	2016	2016/2003
Russian Federation			
Russian Federation	2.1	6.1	2.9
Far-Eastern Federal District	4.7	9.4	2.0
Republic of Sakha (Yakutia)	5.2	6.6	1.3
Kamchatka Territory	8.3	18.3	2.2
Primorye Territory	3.9	18.8	4.8
Khabarovsk Territory	4.8	9.2	1.9
Amur Region	3.2	10.5	3.3
Magadan Region	5.0	7.1	1.4
Sakhalin Region	7.1	31.5	4.5
Jewish Autonomous Region	<u>3.4</u>	8.5	2.5
Chukotka Autonomous Region	9.3	8.4	0.9

The change in the purchasing power of average per capita income when flying by the economic class (per 1000 km of track)

Note: calculated by the author on the basis of EMISS data. URL: https://www.fedstat.ru/

The average per capita income of the population of the Far East in most of the subjects was not enough to make an economy class flight to Moscow in 2003. Exceptions were Yakutia, Kamchatka, Sakhalin and Chukotka Autonomous Area. In 2016, the purchasing power of average per capita income of the population of the region increased. During this period, the population of most of the constituent entities of the Russian Federation as part of the Far Eastern Federal District (except for residents of the Khabarovsk Territory, Magadan Region and the Chukotka Autonomous Area) already had sufficient incomes to fly to the center of Russian Federation and back. At the same time, the change in the purchasing power of average per capita incomes for a flight by the economic class averaged 2.9 times in Russia over the period 2003-2016 and the increase in purchasing power in most subjects of the Far East was recorded in a smaller amount.

Table 2

Territory, subject of the Russian Federation	2003	2016	2016/2003
Russian Federation	12.8	18.5	1.6
Far-Eastern Federal District	22.6	40.9	1.6
Republic of Sakha (Yakutia)	31.9	35.3	1.2
Kamchatka Territory	no	no	no
Primorsk Territory	17.7	36.5	2.1
Khabarovsk Territory	22.9	47.4	1.7
Amur Region	14.4	35.6	2.1
Magadan Region	no	no	no
Sakhalin Region	no	n/d	n/d
Jewish Autonomous Region	15.6	26.5	1.8
Chukotka Autonomous Region	no	no	no

Passage in a reserved car of a fast plain long-distance train (per 1000 km of track)

Note: "no" - is absent; "n/d" – no data; calculated by the author on the basis of EMISS data. URL: https://www.fedstat.ru/

More positive changes in the economic accessibility of transport occurred relative to rail transport. The purchasing power of average per capita incomes in almost all constituent entities of the Russian Federation in the Far-Eastern Federal District (excluding Yakutia) exceeds or is at the level of the average Russian indicators.

We understand that the proposed approaches and assessments are largely controversial. Outside the scope of work remain such important aspects as the degree of satisfaction of the population with transport services; the impact of transport services on the solution of social problems of regional development, the structure of the use of working time; the impact of transport on the improvement of the qualitative structure of the workforce, etc. However, the presented approach can be the basis for further analysis with inclusion in the problem field in addition to statistically taken into account values some difficult quantified values in the future.

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