The European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com

e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2020.10.03.164

ICEST 2020

International Conference on Economic and Social Trends for Sustainability of Modern Society

SPATIAL APPROACH: INVESTIGATION OF THE CONCEPT CONNECTIVITY OF A TERRITORY

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Abstract

The etymology of the term «connectivity of a territory» (infrastructure development level) in the framework of the spatial approach to the regional economy is considered. The main approaches to assessing the qualitative characteristics of the socio-economic development of the territory on the basis of classical foreign theories and theories of territory quality assessment developed by Russian scientists are analysed as well. We compared the existing systems for assessment and offered own system. Authors proposed indicators for assessing the territorial connectivity based on the studied statistical indicators. This system consists of a number of indicators for the infrastructure development, which are aggregated into the following groups: transport infrastructure, information and telecommunications infrastructure, equability distribution of resources. The developed system of indicators for assessing the connectivity of a territory is based on statistical indicators. The author's system of indicators permits to complement the spatial approach in order to investigate socio-economic development level of the regions.

Keywords: Connectivity of a territory, spatial approach, infrastructure development.

https://doi.org/10.15405/epsbs.2020.10.03.164
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Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

In modern time Russian scientists conduct research within the integrated scientific and technological program «Connectivity of territories». These researches are connected with more technical scientific fields, which are related to R&D or applied research in priority science fields (space technology, aircraft construction, rational nature management, etc.). Russian Academician Poghosyan (2018) notes that the connectivity of territories is a means of solving two strategic problems: overcoming internal socio-economic imbalances in the regions and strengthening Russia's foreign economic and foreign policy positions. In terms of a theoretical part, in particular the regional economy (spatial economy), attention should be paid to the development of scientific approaches to the study of the state of productive forces and the socio-economic state of territories, regions. Currently, there is no unified system for assessing the connectivity of a territory level using statistical indicators. Therefore, difficulties arise in the integrated modelling, evaluation and forecasting of economic processes in the region. It is necessary to have an integrated system of quantitative indicators for a more complete assessment of a level of the connectivity of a territory. In addition, when developing a system of indicators, it is advisable to use a system of criteria for selecting indicators. It is advisable to consider the connectivity of a territory as a quantitatively measured degree of intensity of economic development, including the development of infrastructure.

The characteristic features of the Russian economic space are a wide variety of climatic zones, geographical, socio-economic conditions. However, there are problems with the regional typology for successful state policy. Some regions have a small amount of budget expenditures, but a significant tax base (for example, a developed service sector and production). On the contrary, others regions have historically undeveloped industrial potential and need government subsidies (Astakhova & Vannikova, 2016; Teryok, 2015). The heterogeneity of the economic space of Russian regions is determined by historical, demographic, political, industrial and other objective reasons. All these factors make it necessary to take into account the heterogeneity of the economic space for more comprehensive investigations of socio-economic relations (Bukharova & Samusenko, 2012). Russia's active involvement in global economic processes requires a more thorough study of the characteristics of the country's economic space.

The effect of the rarefaction of space, the focal type of development of the industrial complex, its raw material orientation (the economy is focused only on the extraction of crude oil and gas without further processing), etc. All these factors slow down the growth of the economy. For a long period of time, regional science mainly solved the issue of the rational distribution of productive forces and achieving maximum efficiency from the implemented industrial policy. Today it becomes obvious the need to shift the emphasis from the issues of the distribution of productive forces within the territorial complexes towards the identification of spatial development paths.

The multidimensionality of the economic space determines its interpretation through a combination of properties, one of which is connectivity of a territory. It determines the economic space unity of the Russian Federation. Also, it affects the effectiveness of the implementation of integrated economic policies in the presence of different types of regions.

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2. Problem Statement

Currently, the investigation of the socio-economic space properties and the degree of its development is a priority for most mathematicians and economists. Solving the task of connectivity of territories is able to create a unified group of indicators of connectivity of territories within the framework of applying the digital technologies. This unified group permits to complement the existing approaches for studying the processes of socio-economic development of regions, the distribution of productive forces and the typology of regions according to the level of connectivity. The investigation of the connectivity of territory permits to advance in resolving issues the asymmetry of regional development. The asymmetry is defined by the following criteria such as resettlement people, capital allocation and the movement of migration flows (centre-periphery problem, metropolis-province problem), production location (the problem of imbalance between geographical areas, for example North-South), etc. The spatial dimension exacerbates the contradictions that arise from the implementation of sustainable development, in particular the contradictions that are likely to appear between logic of sustainability and logic of competitiveness (Zuindeau, 2006).

2.1. The connectivity of the territory in the context of the spatial approach

Connectivity is an indicator of the intensity of economic relations between elements of the economic space. It is determined by the development of transport links and communication networks. This indicator determines how intensively and interconnected the economic processes occur between objects taking into account both the speed of one process and the frequency of occurrence of economic processes. The connectivity of a territory largely depends on transport and information infrastructure development: the higher the throughput capacity of internal transport routes, the more goods can be transported per unit of time. The processes of economic activity of territorial objects are inextricably linked with the constant movement of resources between objects: raw materials - materials - components - finished products. Therefore, the indicator of the capacity of the transport network directly determines the limit value of cargo turnover within the space. Most of the natural resources are concentrated in remote northern regions of in Russia. Thus, the transport isolation problem of these territories significantly complicates the further development of raw materials industries.

The great importance for the connectivity of a territory is a degree of applying information and communication networks. Internet penetration in Russia does not reach 100% even in large cities, and in most rural areas only some state and administrative institutions have access to the network. A large part of the territories is an «informational desert» where there are no roads, satellite communications, or large settlements. Obviously, without proper infrastructure and communications, any economic processes will proceed very slowly or not at all. In modern conditions, approaches to understanding the «connectivity» parameter have changed. The connectivity of a territory the greatest extent depends on the degree of the information and communication networks of territories. The concept of «connectivity of territories» from a geographical category was transformed into an information category. The presence of Internet technologies to a large extent solves the problem of the dispersal of business entities in the territory, providing operational communication between business structures.

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2.2. The place of the concept of «connectivity of a territory» in the spatial approach from the position of classical foreign theories

In the XX century, the concept of the role of territorial factors in the development of the economy was recognized among theoretical scientists, economists and philosophers due to fundamental researches by W. Isard, A. Weber, A. Loesch, P. Converse, P. Krugman, P. Samuelson and etc. It was then that regional problems were studied, theoretical provisions were developed on understanding spatial distribution, the distribution of productive forces and labour activity, and theories of central places and polarized space were formulated. According to a classical theory of assessing the quality of space (industrial Standort theory, from the German language «Standort» - «locality»), Weber (1929) described main parameters for assessment territory - these are transport costs and human labor (Stolper, 1956). These parameters permit to form an urban agglomerations process. The Japanese economist G. Shibusawa supposes that the connectivity of a territory is determined through information flows. Therefore, it can be interpreted as some commercial part of the Internet that manages the flows of manufactured goods. A significant stage in the development of regional science was the work of W. Reilly and P. Converse on identifying zones of influence of cities using gravity models. The works of W. Reilly and P. Converse devoted to the study of the commercial attractiveness of cities. They describe the city as a complex organization of production and economic relations: a city-market, a city-supplier (as cited in Baransky, 1946; Biyakov & Kolomarova, 2012). In their opinion, the city as an economic unit is a component of the skeleton of the economic system. It should be added that in the works of Kristaller and Thunen similar models of urban development are also considered, a special place is given to infrastructure, because the availability of roads minimizes transport costs (as cited in Sergeevich, 2014; Straka et al., 2015). The term «connectivity of a territory» itself does not sound in their works, but it has a synonym for the presence of transport and other infrastructure in a certain territory.

2.3. The place of the concept of «connectivity of a territory» in the spatial approach from the point of view of the Russian regional economy

Features of the formation of the economic space are considered in the researches by A. I. Gavrilov, T.A. Korol, V.A. Kryukova, G.M. Lappo, V.E. Seliverstova and others. An estimation of territory is considered in the scientific papers by A. N. Avramchikova, A. G. Granberg, L. N. Bulgakov, A. A. Rumyantsev and N. V. Rodionova. The most important structural forming properties of space or territory (quality of space) Granberg (2006, 2011, 2015) relates density, placement, and connectivity.

Each region or territory has an internal space and connections with external space (Seliverstov, 2014). These relations can be considered not only from the point of view of politics, but also from the point of view of space exploitation by transport nodes, information and telecommunication networks, postal services, etc. (Avramchikova et al., 2019; Goloshchapova, 2018). However, an urgent problem to assess the level of connectivity of a territory is the accurate selection of quantitative indicators and the creation of integrated systems in the form of mathematical models that can comprehensively assess the quality of infrastructure development (connectivity of a territory).

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3. Research Questions

1. What is the meant by the term «connectivity of a territory»?
2. How is this concept interpreted by foreign and Russian scientists?
3. What quantitative indicators can be used to build a system for assessing the connectivity of a territory?

4. Purpose of the Study

There is an investigation of the concept of «connectivity of a territory» and its main components. Authors offer a system of indicators for assessing the connectivity of a territory based on the analyzed statistical indicators. Data for analysis was taken from website of the Russian Federal State Statistics Service. As a result, the system of indicators for assessing the connectivity of a territory will complement the spatial approach in a practice.

5. Research Methods

Connectivity of a territory is characterized by the level of development of various economic connections in a region: trade, communication, cooperation, transport, etc. These approaches use a statistical analysis of economic activity, using correlation and regression, variance, system analysis, etc. for finding the economic relations between administrative units. Russian scientist Rodionova (2014) proposes to use of the following statistical indicators to assess of connectivity of a territory (region) (Table 01).

Table 01. Existing indicators system for assessing the connectivity of a territory was suggested by Rodionova N. D.

Common name of the indicator block	**Indicators**	**Units**
I. Cost economic transactions	The average cost of cellular services for enterprises	Ruble (rub)/minute
	Average cost of landline services telephone connection	Rub/month
	Average cost of landline services telephone connection	Rub / month for one enterprise
	The average cost of postal services (letters, parcels): - Russian Post; - private postal services	 Rub / letter Rub / kg parcel
	Shipping costs for legal entities	Rub / thousand Km
	Cost of information services for legal entities	Rub / transaction
	The cost of legal services for accompanying economic transactions	Rub / transaction
II. Costs time for the implementation transactions	Average time for cell phone calls	Minute / transaction
	Average time to negotiate urban telephony	Minute / transaction
	Average time for intercity telephone calls	Minute / transaction

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	Average time for mail and freight transportation	Minute / transaction
III. Security of the transaction infrastructure	Security with objects (towers) of Cellular communication	Units / km Units / 1000 people
	Landline phone availability	Units / 1000 people
	Internet infrastructure	Units / 1000 people
	Provision of freight transport facilities (by mode of transport)	Units / 1000 people
	Provision of facilities providing legal and consulting services	Units / 1000 people
	Provision of facilities providing information services	Units / 1000 people

According to Rodionova (2014), the main problem of this system of indicators is a lack of statistical indicators: "Only some of the 128 indicators can be calculated on the basis of official data from the Federal State Statistics Service and regional units». Including indicators of block «I. Cost economic transactions», this depends on the economic situation in the country. In turn, the indicators of this block are constantly changing, which affects the overall assessment of the connectivity of a territory. In this case we presume that these factors from the first block should not be applied for the following investigation.

We conducted the following investigation for supplement the existing systems for statistical assessment of infrastructure connectivity or connectivity of a territory. The indicators system which characterizes the concept of «connectivity of a territory» was specified that by specialists in the field of public administration and statistics (20 participants) based on expert assessments. Questionnaires were proposed to the experts, where the authors of this paper randomly proposed a choice of statistical indicators that characterized the level of infrastructure development. In turn, the experts needed to sort out the necessary indicators, which, in their opinion, were more related to determining the connectivity of a territory. The experts were offered a scale from 1 to 5, where 5 is an indicator that characterizes the significance of the connectivity of a territory to a greater extent, the smaller the number, the lower the degree. Then we used a ranking matrix in order to identify the most acceptable indicator for inclusion in our assessment system. The calculation of the coefficients of the weight of the parameters determined which statistical indicators to a greater extent characterize this definition. We also grouped indicators in 3 directions, so that in further research it would be easier to formulate a mathematical model in the form of an integral indicator for assessing the connectivity of a territory. The result was the following table 02.

Table 02. There are indicators for assessing the connectivity of a territory

Indicator Group Name	**Description of indicators**	**Units**
Transport infrastructure	1. Density of communication lines	Kilometre of roads / 1000 km^2 of a territory
	2. Length of communication lines by mode of transport	Thousand km
	3. Transportation of goods by mode of transport	Billion tons
	4. Freight turnover of public transport	Billion tons/km.
	5. Passenger traffic by mode of transport	Million

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	6. Passenger turnover of public transport	Billion pass / km
Information and telecommunication infrastructure	1. Number of Internet users	Thousand people per 1 km^2
	2. Number of mobile phone users	Thousand people per 1 km2
	3. Number of personal computers in organizations	Thousand pcs
	4. Use of special software in organizations	% of the total number of organizations
	5. Costs of organizations for information and communication technologies by type of economic activity	Million rubles/year
Resource allocation equability	1. Number of mobile subscriber devices connected to networks per 1000 population	Pcs
	2. The number of residential telephone sets of the public network per 1000 population	Pcs
	3. The proportion of telephones that have access to an automatic long-distance telephone exchange, in the total number of telephones	%
	4. The presence of mailboxes per 10 000 people	Pcs
	5. The number of postal delivery sites	Pcs
	6. The number of active subscribers of fixed access to the Internet	Thousand people
	7. The number of active subscribers of satellite access to the Internet	Units
	8. The number of subscriber devices of mobile radiotelephone communication per 1000 population	Pcs

Thus, we have received 3 groups of quantitative indicators characterizing the definition of «connectivity of a territory», which will subsequently take part in the development of a mathematical model for assessing the level of infrastructure development. According to the indicators, there is enough information to carry out the calculations.

6. Findings

The content of the concept of the connectivity of a territory, its main components is studied. The content of the concept of the connectivity of a territory, its main components is studied. The system of indicators for assessing the connectivity of a territory based on the analyzed statistical indicators is suggested by authors. This system consists of 3 aggregated groups of statistical indicators. There is transport infrastructure, information and telecommunication infrastructure, resource allocation equability. The proposed system of indicators for assessing the connectivity of a territory will complement the spatial approach in a practice.

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7. Conclusion

In general, the proposed system of indicators for assessing the connectivity of a territory (infrastructure development level) seems rather transparent and logical. The proposed system of indicators makes it possible to assess in detail the state of the infrastructure complex of different types of regions, as well as to supplement with practical recommendations a space (territory) assessment system in terms of the spatial approach.

Acknowledgments

Research is supported by a grant from the President of the Russian Federation for young scientists - candidates of sciences No. MK-1954.2020.6. Agreement No. 075-15-2020-044 from 03/18/2020.

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