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AUTOMOBILE TRANSPORT INFRASTRUCTURE IN THE SYSTEM OF MAINTAINING SOCIAL WELL-BEING

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Abstract

The paper considers the impact of road infrastructure on the system of forming and maintaining social well-being. Transport remains one of the few economic sectors that is involved into every social process. Each day billions of people use public and private transport to attain their own social goals, starting from covering distances and ending with career growth due to creation of a positive image. The authors focus their attention on the motor transport and the road infrastructure serving it for the reason that exactly this type of transport is mentioned the most frequently when discussing socioeconomic problems. Global motorization, air pollution, social conflict at automobile transport are just a few negative aspects of road infrastructure functioning in the system of maintaining social well-being. To reach a high level of social well-being the authors suggest a model for assessing the impact of the road infrastructure on the object under consideration. As result, they prove the necessity of forming road infrastructure within the concept of the sixth technological mode and technological platform Industry 4.0, as well as identify problems and prospective growth areas in maintaining social well-being.

Keywords: Well-being, transport, transport infrastructure, automobile transport infrastructure, system of maintaining social well-being.

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1. Introduction

In recent years, social well-being has become a very popular topic for scientific research. This is primarily related to the wide range of social problems among the modern world's population. Researchers are trying to identify a kind of ideal state for people's health, assigning great importance to one or another element of a given phenomenon (Fattore & Agostoni, 2016). This article focuses on automobile transport infrastructure as this element (Dementeva et al., 2016).

The special role of transport infrastructure in social well-being is determined by its functions, including smooth passenger and cargo transportation, the informational and communicative function, which accelerates the transfer of information through physical interaction, and also the productive function - transport infrastructure is vital to ensure high-quality transport, and this in turn is crucial for the process of production. These proposals underpin the functional approach to understanding the nature of "transport infrastructure". In addition, economics distinguishes between technocratic and value-based (i.e. investment-based) approaches. Advocates of the first approach to transport infrastructure understand the aggregate part of the engineering infrastructure that is required for passenger and cargo transportation. In the value-based approach, transport infrastructure is understood as a type of regional capital infrastructure capable of bringing not only economic benefit to the region, but also social benefit, its implementation bringing about a synergistic effect. Some economists, such as Kudryavtsev and Rudneva, suggest that to define the concept of the transport infrastructure of a region, it is more expedient to use a system comprising two approaches - both the functional and the value-based (Kudryavtsev & Rudneva, 2013).

The authors adhere to their systematic understanding but suggest using functional and technocratic methodological approaches as a basis for the concept. They base their reinforcement of this position on realising the Russian socio-economic reality. Transport infrastructure is primarily a complex of engineering systems that support uninterrupted communication; in Russia, this is quite difficult because of climate and geographical factors. The transport infrastructure in the different regions is specific, so it requires specialised personnel and technical adaptability - in these conditions, the emergence of a technocracy is inevitable. Secondly, as the transport infrastructure of the region was mentioned earlier - this is a set of special functions, including productive and organizational functions. In Russia, where there is a need to overcome serious distances, the transport and transport infrastructure for businesses, the region and the country represent a set of logistical processes on their own in the transport of materials and finished products; in other words, the contribution of the transport infrastructure to GRP is quite large. At the same time, the most important function of a region's transport infrastructure - emphasizing its social character - is regional interaction and the strengthening of inter-regional integration of the population (Loyko et al., 2015).

2. Problem Statement

The additions presented are specific to the study of Russian town-planning. Historically, other features have formed for Russia, one of which is the construction of towns on river beds, as a result of which it is necessary to cross them on water transport or use bridges or ferries. It is therefore possible to count part of the water and railway infrastructure as road transport infrastructure. Examples of these

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might be ferries, drawbridges or automobile rail cars used to cover distances away from highways. (Prokopenko and Selevich, 2016)

As a result, the need to take into account the dependence of the modern economy on multimodal transport, the historical factors in the regionalisation of the country and the use of foreign transport methodologies will all allow the formation of the very detailed map of the country's automobile transport infrastructure that is required for the implementation of the current state transport policy in the regions and at an inter-regional level.

All of the components presented are of strategic importance to establish a high level of social well-being because they all affect one or another social process. The most important task of the transport infrastructure in this case is to fulfil the population's demand for standardised methods of transport. In connection with this, it becomes unclear how to meet this need and how the transport infrastructure affects the establishment of social well-being (Lizunkov et al., 2016).

3. Research Questions

The authors assume a correlation between the functioning of the transport infrastructure and the establishment of a level of social well-being. Assuming this, it becomes necessary to evaluate this link using various indicators of the development of the country's transport infrastructure.

4. Purpose of the Study

The aim of this study is to build a system (model) for the integrated assessment of the transport infrastructure as a factor ensuring social well-being. The authors set themselves the task of analysing how this kind of infrastructure influences the establishment of the highest level of social well-being; in other words, we attempt to estimate the percentage to which the transport infrastructure fulfils its functions regarding the social well-being of citizens.

5. Research Methods

In applying this model, standard mechanisms of semantic information retrieval and estimation of indicators were used. The calculations used regression and correlation analysis of data and factor analysis, along with the methods of cluster analysis and multidimensional scaling.

6. Findings

As already indicated, the first constructive element in this system is the full cycle of the formation of the transport infrastructure and the presence of a complete list of objects necessary for the population. An insufficient number of elements will lead to the transport infrastructure and the transport included in it being undermined, which will adversely affect all socio-economic processes in the country, affecting the social well-being of the population (Blaginin, 2016).

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The second constructive element is the correspondence of the quality of the automobile transport infrastructure to the standards of the sixth technological revolution and the Industry 4.0 platform (the fourth industrial revolution). Let us consider in more detail the theoretical concept of the cyclical nature of the economy - the flagship of the new paradigm of economic science (Lizunkov, Marchuk, & Podzorova, 2015).

It has long been noted that socio-economic development is associated with changes in industrial revolutions and technological structures. The first step in the development of this theory was the work of prominent economists Kondratiev (2002), who established the theory of cycles in the economy, Glazyev and Lvov, who continued the analysis of these cycles and worked on a concept of long waves (i.e. technological structures). Academics understand this concept to include "all technologies characteristic of a certain level of development in production; in scientific, technical and technological progress, there is a transition from less advanced practices to more advanced, progressive ones" (Glazyev, 2012).

The level of production is also characterised by an industrial revolution, i.e. the historical stage of introducing technical and scientific developments into production. The first industrial revolution was associated with the invention of steam engines. At the present moment, scientists define the functioning of economic and social systems in the framework of the fourth industrial revolution (Industry 4.0); some Western European and Asian researchers imagine a transition stage to the fifth industrial era (When we come to the Industrial Revolution 5.0?, electronic resource).

Transport is one of the few branches of economic management that interact in the process of production with all other actors in economic management and with social elements. The social well-being of citizens depends on the whole on the level of technical development of transport; this well-being depends to a considerable extent on social problems and conflicts on transport (Animitsa Ratner, & Sharygin, 1992).

From this point of view, there is a need for state regulation of the physical distribution of elements of transport infrastructure to take into account the rapid manifestation of socialisation and Industry 4.0 (Berger, 2014). At the moment, everybody understands the possibility of modelling the spatial planning of objects, but only a small number of specialists do this while taking into account the transition to the sixth technological revolution and the fourth industrial revolution.

Long-term forecasting will allow the importance of a number of components in transport systems to be reassessed in favour of new solutions aimed at increasing social mobility and well-being in general. They include:

– hydrogen fuel and electric vehicles (doing away with internal combustion engines will require a change in the system supporting means of transport; these include petrol stations, repair shops and service stations);

– artificial intelligence (this primarily concerns the car's independence of the driver, its conceptual transition from a component in production to a body of control) (Asaul Malygin, Komashinskiy, 2016);

– cognitive information-control systems (these systems are a symbiosis of 'intelligent car/intelligent road').

The manifestation of the new industrial revolution has very characteristic features in the sphere of transport. Despite the global scale of the deployment of Industry 4.0 and especially within the framework

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of national politics, it is becoming clear that it will lead to significant changes in the traditional production paradigm (Bauer, 2014). There is a gradual transition from the traditional understanding of transport infrastructure towards intelligent transport. Automobile transport infrastructure must very quickly adapt to technological change through exogenous intervention, which must be adjusted to ensure the proper development of the industry and all others along with it. Automobile transport infrastructure under the influence of a change in practices becomes the basis for a prosperous population, which is a symbol of the level of technological and economic development. These positions confirm the necessity of studying the influence of the transport infrastructure on the system providing social well-being for the populace (Politsinskaya et al., 2016).

The third component of a functioning automobile transport infrastructure is ensuring that the mobility of the population is accelerated as it moves away from municipalities. This requires an iterative analysis of the average speed of movement using road transport. The first iteration is to estimate the average speed of passenger and cargo movement in individual areas of the municipality. The second step is to analyse these indicators in large cities and so on in accordance with the figure (Malushko et al., 2016).

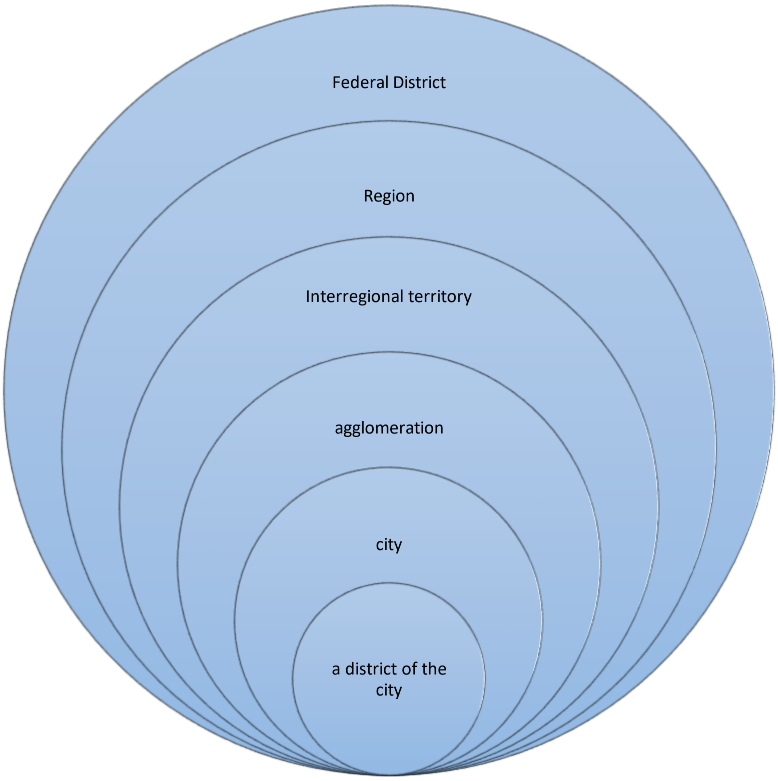

Figure 01. Iteration model of mobility analysis in the region

Road transport infrastructure built into a socially prosperous region increases the population's mobility in socio-economic processes by accelerating both material and interpersonal connections (transfer of information). In the iterative model, if there is a decrease in speed at one of the stages or a trend slows down, it can be assumed that social well-being is being disrupted because no effective social mechanism can be provided (Trifonov et al., 2016).

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Therefore, in order to fully assess the contribution and effectiveness of the transport infrastructure on the social welfare system, in the opinion of the author, three basic prerequisites must be fulfilled:

- all elements of transport infrastructure must be provided in the territory;
- the elements must meet the requirements of the Industry 4.0 technological platform;
- the transport infrastructure must ensure that passenger and cargo mobility is accelerated as the scale of movement increases;
- the contribution of road transport to macroeconomic and mesoeconomic socio-economic indicators must be sufficiently large.

To approbate the model, the authors used the Russian experience and indicators from the Ural Federal District and the Sverdlovsk Region in particular.

As with many others, the indicators of the region's social well-being and their threshold values are formed using a system of expert assessments. We will evaluate the transport infrastructure of the Sverdlovsk region from a social well-being perspective.

Regarding the first group of indicators, as indicators for assessment, we will outline the main three: the availability and additional formation of special lanes, the length of highways in dynamics, the length of fencing structures on regional routes. Data on the Sverlovsk Region are presented in the table 01.

Table 01. Indicators of the provision of new elements of the transport infrastructure of the Sverdlovsk Region

Indicators	2010	2011	2012	2013	2014	2015	2016
Length of public roads with hard surface (at the end of the year), km	10874	11983	12746	18101	22649	23528	23840
Length of allocated special lanes, km	98	109	127	131	148	174	211
Length of fencing structures on regional routes, km	430	499	556	604	687	702	741

As can be seen from the calculations in the Sverdlovsk region, according to these criteria, we observe constant growth, although in some periods there is asymmetry (dynamic failure).

The next group of indicators corresponds to the Industry 4.0 platform. For convenience of analysis, the authors selected the following internal criteria: the number of charging stations for electric cars, the availability of intelligent auto-marketing, presence of an intelligent traffic light system, the number of registered electric cars, the number of people who were involved, and killed, in road accidents (table 02 and 03).

Table 02. The number of road accidents per 100,000 population in the Sverdlovsk Region, pcs.

Region	2005	2010	2011	2012	2013	2014	2015
Sverdlovsk region	214.3	143	127.8	124.9	110.4	93.4	81
Tyumen region	225.2	175.7	180	190.4	177.5	169.1	146.4
including:							

Khanty-Mansiyskiy Autonomous district - Ugra	206.1	161.9	163.1	156.6	149.9	131.4	125.5
Yamal-Nenets Autonomous district	155	117.1	129.1	137.8	123.6	118.2	114.7
Tyumen region without autonomous districts	274.1	214.4	219.3	249.8	229.8	231.1	181.7
Chelyabinsk region	151.6	144.3	143.8	141.4	138.2	144.3	130.9

Table 03. The death toll in road accidents per 100,000 population in the Sverdlovsk Region, pcs.

Region	2005	2010	2011	2012	2013	2014	2015
Sverdlovsk region	24.4	16.2	17.4	19.4	15.7	14.7	12.1
Tyumen region	25.3	19.2	18.6	22.1	20.5	17.4	14.7
including:							
Khanty-Mansiyskiy Autonomous district - Ugra	23.3	18.6	15.8	19.6	18.7	17.4	15.1
Yamal-Nenets Autonomous district	15.1	13.5	15.8	15	14.4	12.8	10.8
Tyumen region without autonomous districts	31.4	22	22.9	27.7	24.8	19.2	15.8
Chelyabinsk region	22.1	17.9	17.4	18.4	18	18.1	15.4

According to 2016 statistics in Sverdlovsk Region, there is 1 charging station, 28 electric cars are registered, and there is no intelligent cognitive system.

This picture is typical throughout Russia; the country has only recently entered the fifth technological wave. This is unsatisfactory and undermines the effective functioning of the social welfare system, while Germany is a model for Industry 5 (the fifth industrial revolution), leading the field in transport technology (Loshchilova et al., 2015).

Iterative indicators of mobility acceleration in Sverdlovsk are presented in the final table, which contains the iterative assessment of the effect of road transport infrastructure on citizens' social well-being.

We will determine the contribution of road transport infrastructure to macroeconomic and mesoeconomic indicators using the following indicators:

– proportion of GRP represented by road transport (in other countries, this is about 6.5%);
– proportion of employed population using transport;
– percentage of successful collection of transport tax;

In the region investigated, road transport forms just 0.9% of the gross regional product, and the proportion of employed people is 3.7%. The percentage of successfully collected taxes in the territory is just over half of the total possible.

7. Conclusion

The final comprehensive assessment of the region is presented in the last table. The hypothesis that transport infrastructure has a great influence on the social well-being of the population is confirmed. In Sverdlovsk, to take a numerical equivalent, 73.68% of the maximum possible level of social well-being and prosperity is reached. The main problem is revealed to be inconsistency in the infrastructure with

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today's global level of technological development. This is becoming one of the main causes of various kinds of social conflict. To solve this problem, effective practical measures must be formulated to develop transport infrastructure and its interaction with society.

Table 04. System assessment of the impact of automobile transport infrastructure on the social well-being of the population of the Sverdlovsk region

Indicator Group	Indicator	Meaning	Threshold Value	Indicator Weight	Point
Composition of elements of automobile transport infrastructure				0.25	*0.25*
	Length of public roads with hard surface (at the end of the year), km	increase	increase	0.33	0.33
	Length of allocated special lanes, km	increase	increase	0.33	0.33
	Length of fencing structures on regional routes, km	increase	increase	0.33	0.33
Requirements of the technological platform Industry 4.0				0.35	*0.0868*
	Number of gas stations	1	10	0.20	0.02
	Availability of intelligent auto-marketing	0	1	0,20	0
	Presence of a system of intelligent traffic lights	0	1	0.20	0
	Number of registered electric cars	28	200	0.20	0.028
	Number of injured in road accidents	decline	decline	0.10	0.10
	Death toll in road accident	decline	decline	0.10	0.10
Mobility level				0.25	*0.25*
	Average speed of automobile transport in the district of the city	14			
	Average speed of automobile transport in the city	17			
	Average speed of automobile transport in the agglomeration	29			
	Average speed of road transport in the interregional territory	54			
	Average speed of road transport in the region	73			
	Availability of speed increase	+	+	1.00	1.00
Contribution to other indicators				0.15	*0.15*
	proportion of GRP represented by road transport	0.9	6.5	0.33	0.33
	proportion of employed population using transport;	3.7	8	0.33	0.33
	percentage of successful collection of transport tax	52	100	0.33	0.33
The level of social well-being, %					**73.68%**

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