Modern trends of development of transport infrastructure

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Abstract. Transport infrastructure is a system-forming element of the infrastructure complex of the Russian economy, which operates on a national scale as a single system. The results of the functioning of the transport infrastructure have an impact on the overall parameters of the country’s life. The features of infrastructure benefits are identified and the trends affecting the development of transport infrastructure are determined. Directions and problems of digitalization of transport infrastructure in Russia are identified, among them – the use of blockchain technologies. These trends indicate revolutionary changes in the way of life and the needs of society, which will affect the development of transport infrastructure. In turn, transport infrastructure is becoming not just an important factor, but to some extent the basis of a new way of active life, which determines its importance for economic development. The application of blockchain technologies in transport infrastructure is analyzed. The problems of blockchain technologies application in the development of transport infrastructure are revealed.

1. Introduction

The infrastructure complex is the most important system-forming element of the national economy. Infrastructure capital goods have a number of features [1]:

1. Significant capital intensity, high costs for the creation, operation and repair of infrastructure facilities.

2. Long-term investments and their payback period with an increasing level of technical and operational depreciation. Infrastructure facilities should serve for a long time, while with the increase in the life of the wear increases, and the additional costs of maintaining the facilities.

3. Long service life. The specificity of the current maintenance, repair, modernization of infrastructure facilities determines the specification of all ownership rights to them.

4. The overall social utility of infrastructure resources and services limits the competition of producers, effectively monopolizing local markets, infrastructure complexes and services.

5. The leading role of the state and organizations affiliated with the state in the creation of infrastructure resources and the formation of infrastructure capital.

6. Negative environmental consequences resulting from the construction and operation of infrastructure facilities and systems, as well as the provision of infrastructure services.

The highlighted features cause specific requirements for infrastructure: they must be strong, durable, must be designed taking into account future trends in the emergence of new technologies, new materials and new requirements from the users of infrastructure facilities. That is, they must be advanced and meet not only current but also future demands.
2. Materials and methods

Transport infrastructure in Russia plays a leading role in the infrastructure complex, providing connectivity and economic development of the country. While transport infrastructure does not meet the needs of the country's economy, according to the International competitiveness rating developed by the world economic forum, Russia is on the 64th place out of 144 rated countries in terms of the quality of transport infrastructure, with the worst position of the Russian Federation in terms of the quality of roads (123rd place). The Engel coefficient – density of the road network adjusted for population density – is significantly lower than in all BRICs countries. The share of high-speed roads (1A and 1B) in the total length of roads does not exceed 1% (5 thousand km). There are no high-speed Railways in Russia. The network of airports and airfields is extremely rare. Russia is in the third world cluster in terms of the quality of transport infrastructure [2].

The existing model of transport development is focused on meeting the transport demand of raw materials sectors of the economy, involves the financing of infrastructure projects on a residual basis and the development of backward technological bases. The level of expenditures of the consolidated budget on transport infrastructure over the past 10 years has been at the level of 2-2.5% of GDP, which is a high indicator relative to many OECD countries, but insufficient relative to countries actively developing transport infrastructure [2].

New technologies should be introduced in the transport infrastructure, taking into account the main trends of world development. Let us consider the technological trends that will determine the sectoral and infrastructural development of the national economic complex as a whole.

We will highlight the main technological trends and technologies developed in the world that will affect the development of transport infrastructure [2,3].

1. New concepts and technologies of cargo and passenger transportation: high-speed railway transport:
   - magnetic levitation transport, or Maglev; Actively developed and operated in the world since the 1980s, Technology is at the stage of concept
   - hyperloop (hyperpaths) — vacuum trains project. The technology is at the concept stage, being developed in the USA.

2. Unmanned passenger and cargo transport. The technology of unmanned trucks equipped with self-navigation systems, supported by artificial intelligence is still at the stage of improvement.

3. "Uberization" of passenger and cargo transportation.

4. SA Saevs (General Autonomous electric Vehicles).

5. The spread of satellite technology.

6. Create safer roads with electronic devices for drivers. Electronic log devices (fields) can have a significant impact on the transport industry in 2018, notifying drivers of the need for rest (limiting drivers' working hours to fifty hours a week, with two days off).

7. Conformity to standards. Commercial transport companies should keep abreast of the latest standards and regulations adopted, amended, replaced or by any local, state or Federal government, and monitor legislative developments in a timely manner.

8. Targeted delivery to end users, due to the growth of the e-Commerce market.

9. The use of digital technologies: the introduction of the Internet of things in transport, the formation and use of big data, the concept of Maas (mobility as a service), the introduction of blockchain technologies.

Let's take a closer look at the application of blockchain - a digital technology of a distributed register, i.e. a database without centralized control – is a new trend in the transport industry.

Select the direction of using the technology of the blockchain on transport.

1. In transportation. Ensuring the accuracy and truthfulness of records showing performance, service history and various other indicators of the vehicles used, the history of how the trucks and other vehicles were used.
2. Load capacity monitoring. One of the factors that determines the cost of transportation is the volume of cargo and its weight. OT IoT (Internet of things) can help determine the amount of space occupied by a particular load. This data can be used to calculate shipping costs. Storing this information in the blockchain system, a smart contract signed, will allow you to automatically make payments based on the amount of space occupied by the sent cargo.

3. Storage of reports that truck drivers fill out before and after the trip [4]. The report describes the condition of the vehicle, reflects the maintenance. A distributed register allows you to keep a complete history of trips and car maintenance operations throughout the life cycle. The same vehicle history database can be used for purchase and sale operations.

4. History of operations. Creating standards for the use of blockchain in the industry [5]. Allows potential customers to digitally assess the experience of the carrier. It will save the history of all payments and assess the real cost of transportation. Another register is proposed to describe the current load of trucks (“I will take a passing load”, etc.). A separate registry can store information about repairs. The Platon system [6] (the Russian system of charging trucks with a permitted maximum weight of more than 12 tons) could not record information in the database of the system operator, but in a publicly available distributed register. Even more interesting models are obtained, of course, if in the same register will be recorded information about the operation of the engine during operation, fuel consumption, etc. This will allow to build mathematical models for repair and operation.

5. Transport portal, IBM highlighted 3 main areas of application of the blockchain on transport [7]:
   - Reduction of paper documents circulation in global trade and replacement with signed electronic analogues.
   - Support of loyalty programs on the basis of preserving the history of customer actions and rewards for loyalty programs.
   - Storage of information on repairs and replacement parts
6. Logistics [8].
7. Insurance for transportation of goods, car insurance, with the use of smart contracts . [9].
8. Marketplace is a platform for transport data. On this platform, you can find a carrier, arrange insurance, etc. [10]. Technically, it is implemented on the Ethereum platform [11].
9. Data exchange and direct payments between transport companies. For this purpose, Toyota (ToyotaResearchInstitute) initiated the creation of a mobile blockchain consortium [12]
10. Global architecture of intelligent transport system based on blockchain and smart contracts. The theoretical description is given in [13].
11. The use of the blockchain for the sharing economy in Smart cities. sharedmobility – vehicle sharing. [14]

3. Conclusion

There are disadvantages of blockchain in comparison with the database-based model: the speed of data updating, the growth of requirements for available memory, the lack of a single data center. At the same time, decentralised solutions have the following advantages: reduction in cost, the inability to change the data, reducing the number of intermediaries.

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