Crowdsourcing and Platform Solutions in Transport: Opportunities for Development of «Digital Metro» in Russia

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ABSTRACT

An increase in importance of quality and quantity of services provided, the rapidly growing amount of data required to manage an enterprise and strengthen its competitive position in the market, require rethinking of management models. The article is devoted to development of digital metro in the context of global automation and digitalization of business models of organizations in order to improve quality of services and optimize business processes.

The objective of the research is to study the world and Russian experience in the use of digital and crowd platforms in transport and to develop an own model of metro management in modern conditions. To achieve the objective of the research, comparative and content analysis methods, benchmarking of successful foreign practices of using crowd and digital platforms in the transport industry, the method of generalization and conceptual and methodological modeling have been used.

The authors have analyzed global trends in development and use of digital technologies in the transport industry, conducted a comparative analysis of world and Russian practices of using platform and crowd solutions in transport, and revealed the advantages of integrating digital technologies for development of metro in Russia. Based on the results of the research, the authors proposed an «e-Platform», accumulating, analyzing and sorting data from the external environment for its subsequent transmission to the business metro control blocks and optimizing the process of generating and making operational decisions, and also developed a target model for moving from «analogue» data management in metro to a digital one based on integration of digital technologies on a virtual platform for managing business processes and a crowd-based platform for collecting ideas and proposals to develop metro.

Keywords: digital economy, digital metro, subway, underground, digitalization, railway transport, crowdsourcing.

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THEORY

Background. The world is on the verge of the fourth industrial revolution, the era of the digital economy has begun, which requires transformation of business models of organizations. Everywhere one can observe a digital transformation of economic sectors, development of digital technologies and revision of business development strategies in order to optimize business processes, improve quality and standards of living.

In this regard, the *objective* of the research is to study the world and Russian experience in the use of digital and crowd platforms in transport and to develop an author's model of metro control in modern conditions. To achieve the objective of the research, comparative and content analysis *methods*, benchmarking of successful foreign practices of using crowd and digital platforms in the transport industry, generalization, a conceptual and methodological modeling method were used.

According to estimates by *McKinsey Global Institute* and *IHS Markets*, the additional GDP growth from digitalization by 2025 will be from 6 to 10 %. In 2017, Russia ranked first in Europe and sixth in the world in terms of the number of Internet users. Mobile online banking applications are used by 10 % of Russian users, which exceeds the performance of EU countries. At the same time, Russian industries and transport lag behind European countries by 46 and 56 %, respectively [1].

In 2019, the Russian Federation has made significant progress in development of the digital economy. The significant advancement has been made with the approval of the departmental project on Digital Transport and Logistics, as a subprogram of state program on Development of transport system, Moscow Smart City municipal state program, etc.

In this context, metro is a highly sophisticated engineering and transport company, dynamically developing taking into account the prospects of expanding the boundaries of the city, with an ever-increasing passenger flow and integration into other public transport systems. With development of metro, the increase in passenger traffic load, the amount of processed information increases every year when managing production processes (or processes that ensure transportation of passengers), technological processes, which requires modification of technologies and management methods through digital transformation [2; 3].

The experience of metro of world megacities shows that digital technologies are effectively implemented and are aimed at automating traffic control, developing unmanned technologies, ensuring safety and security, technological innovations, identifying, implementing and developing promising digital solutions, developing transport infrastructure, and increasing the efficiency of the transport system.

Management of these business processes can be effectively carried out through the use of specialized virtual platforms [4].

Results.

International and Russian experience of using crowd platforms in the transport industry

One of key technologies in the digital economy is crowdsourcing. Crowdsourcing is a universal tool for solving complex problems based on mass collaboration of people and/or employees of an organization. The scientific community distinguishes several types of crowdsourcing, including commercial and social (non-commercial) [5, p. 49; 6, p. 75], which, in turn, may include the following subspecies: state, scientific, marketing, manufacturing, local, etc. Thematic crowd projects can be carried out on an open and closed basis. Open crowdsourcing involves participation in the project of anyone who wants (in the case of metro, of both passengers and metro employees). In closed crowdsourcing, only employees of the given organization have the right to participate. This type of crowdsourcing is most often called corporate crowdsourcing.

Table 1 presents the results of an analysis of the development opportunities for organization of the transport industry based on introduction of crowdsourcing technology into the existing business model.

In 2013, Elon Musk, the creator of the concept of *Hyperloop* vacuum train, organized a crowdsourcing project based on the social network Twitter, namely, it was implemented under the form of crowd recruiting [7]. The aim of crowd recruiting is to select highly qualified specialists based on the analysis of the labor activity of candidates (crowdsourcers) in the process of implementing a crowdsourcing project on a specialized virtual site on the Internet. The project, organized by Elon Musk, involved collection and analysis of ideas proposed by the community to put the vacuum train concept into practice. The winners were invited to join *Hyperloop* project team as a reward.

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Table 1

Opportunities for development of a transport organization using crowdsourcing technologies

Commercial		Non-commercial	
Marketing	Industrial	Scientific	Social
service promotion	search for ways to reduce costs	transport innovation development	participation in social programs
brand development	improving quality of services	introduction of new technologies	organization of social events
expansion of loyal passenger pool	solving tasks of related fields	–	consumer assessment of service quality

Source: compiled by Yu. M. Polyakova.

Today, the practice of crowdsourcing projects in the transport industry is actively expanding in the world. One of the trends is introduction of crowdsourcing transport platforms. European Crowd project, CIVITAS, is an intelligent platform for collecting innovative ideas and proposals for modernization of urban transport in more than 80 cities in Europe. The project has an ecological and innovative character, as it is aimed at using environmentally friendly fuels and vehicles, developing collective passenger transport, developing demand management strategies, integrated planning, providing security and protection based on digital technologies, etc. [8].

In 2016, the Public transport crowdsourcing concept appeared, that included six main areas:

1) Crowdsourced public transport mapping.

2) Crowdsourced real time status information.

3) Crowdsourced reporting and suggestions.

4) Public transport act! (compliance with public transport rules).

5) Public transport collaborate.

6) Public transport games [9].

Crowdsourced mapping was approved by the World Bank as part of its transport activity. The collaboration of several universities within the international Digital Matatus project[1] allowed then to develop special mobile applications for replenishing crowdsourcing maps by public transport users. As part of real-time tracking of public transport status in September 2016, in Boston (USA), *Massachusetts Bay Transportation Authority* accepted a single application[2] with a full range of passenger services *Transit App*. The application developed by Transit App developers group allows to aggregate data received from users about the situation on the roads, which allows to more accurately forecast information about arrival of public transport in real time[3]. As a result, real-time data became available to the public transport users from several countries of four continents, e.g. of public transport in New York, including metro.

«Crowdsourced reproting and suggestions» area provides suggests an opportunity for users to submit ideas on development of public transport, as well as report on identified problems. As part of encouraging passengers to observe the rule of law on public transport and to help preventing various kinds of violations, several applications have been developed in various fields with monetary rewards.

In order to collaborate with public transport in the field of solving complex tasks based on mass collaboration, three types of applications have been developed: *engagement* (*Green City Streets* forum — joint development of solutions and reporting problems), *training* (*ConnectSF Subway Vision Map* — long-distance transportation *planning*) and *process* (*CoAXs* — a tool that allows users to design and test changes in transit networks).

The last, no less important area is Public transport games, which is necessary for training passengers and developing their engagement in the planning process. As an example, one can cite such popular games on public transport as: *Bus Meister Game* (training people in the specifics of public transport), *Brand New Subway* (a game to create a network of new metro lines in New York), *Chromaroma* (tracking of movements of passengers when using public transport) [10; 11].

Russian practice of using crowdsourcing technology in comparison with foreign is not so great. However, already in 2015, the Directorate of Railway Stations of JSC Russian Railways, together with the crowdfunding company *Witology*, organized crowd projects «Services provided at large railway stations of the Russian

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[1] [Electronic resource]: https://www.digitalmatatus.com. Last accessed 01.03.2020.

[2] [Electronic resource]: https://blog.mass.gov/ transportation/mbta/mbta-names-transit-app-best-public-app-winner. Last accessed 01.03.2020.

[3] [Electronic resource]: https://transitapp.com/about. Last accessed 01.03.2020.

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Federation» and «Quality of service at large railway stations of the Russian Federation»[4]. The aim of the projects was to obtain information about the needs of passengers and visitors to stations regarding the range and quality of services, as well as to study the requirements and wishes of passengers and visitors regarding quality of service at large railway stations of the Russian Federation. In both projects, 4692 people took part, 3148 proposals were received, 667 passenger needs were identified, and 419 concepts for assessing quality of services offered at railway stations of the Russian Federation were proposed[5].

In 2015, Aeroflot Airlines implemented three crowd projects aimed at improving quality of services, provided before and after the flight, and on board, improving loyalty program «Aeroflot Bonus». According to the results of implementation of crowd projects more than 42 thousand ideas were received and published, and projects' audience attained some 17 thousand participants [12].

Platform solutions in transport and proposals for improving the existing Metro management system

Digital platforms in transport are a rather rare but promising solution to the issues of digital transformation. The existing digital platforms in the transport industry are designed to meet the specific needs of companies and perform a different set of functions. For example, *Uber* digital sharing service platform for taxi services is designed to directly connect a client and a driver, if the company does not have its own fleet of vehicles [13, p. 531].

Another platform *Moovit* aims to help suburban and disabled people move around the city and beyond. The platform combines data on trips with interchanges between several modes of transport, transport infrastructure, received from 550 thousand passengers, putting data on a map available in the mobile application. In this case, the company integrated the capabilities of platform solutions and crowdsourcing for a more efficient service delivery process [14].

In addition, digital platforms are used for booking and reserving bus seats in special

transfer services that connect high-density routes (*BRIDJ, SHUTTLE, DiDi,* etc.), as well as booking bicycle taxis and tuk-tuks in Latin America and Asia (*GoJek, BIKXIE, GRABBIKE, goBIKE, G-Auto,* etc.).

It is also noteworthy for Russia that JSC Russian Railways accounts for about 20 % of the world's railway transportation, which is why the company strives to become a digital leader in its industry. At SPIEF-2019, representatives of JSC Russian Railways announced that the company is developing eight digital platforms with different functionalities: from the possibility of ordering cargo transportation in just a few minutes to multimodal transportation and creating own digital ecosystem.

An analysis of foreign and Russian practices of using crowdsourcing and platform solutions in transport made it possible to propose an authors' model of metro management, which means a set of measures, means, tools and actions aimed to support operating condition of an enterprise, to optimize business processes and to improve quality of passenger transportation services based on mass introduction of digital technologies. This model shall have the following characteristics:

• use of modern digital technologies on most metro facilities (*BigData, IoT, IIoT, BIM, Cloud Computing, Cloud Storage*);

• availability of *DATA*-center for information storage;

• application of artificial intelligence and machine learning technologies for data analysis and development of operational decisions.

The authors' model of metro management includes a multi-functional «e-Platform» of metro with the aim of increasing the overall digitalization level of Russian metro as a part of solving the tasks of the national program «Digital Economy of the Russian Federation», as well as a crowd platform aimed at solving problems in the field of metro development as a modern and innovative element of the city's transport system.

1. «e-Platform» automated metro control.

The proposed «e-Platform» is a virtual space that is designed to collect, store and analyze data received from the external environment.

The autonomous activity of a virtual platform for performing these functions can be carried out only if a certain set of digital technologies is available: Internet of things (equipping trains and other infrastructure with sensors that transmit data to the control center), big data

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[4] [Electronic resource]: https://witology.com/clients_n_projects/219/. Last accessed 01.03.2020.

[5] [Electronic resource]: https://witology.com/clients_n_projects/2324/. Last accessed 01.03.2020.

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Pic. 1. «e-Platform» for automated management of metro business blocks and processes. Source: compiled by the authors.
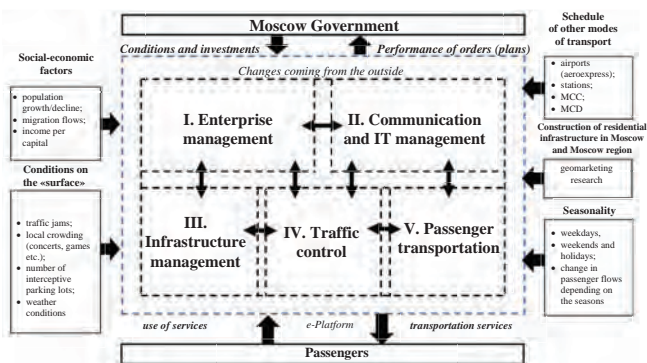
(processing of large volumes of data in a short time), artificial intelligence and machine learning (analysis of data received on «e-Platform» and the possibility of independent decision-making/development), cybersecurity technologies (protecting data and systems from cybercriminals on the Web) [15–17].

Pic. 1 shows the model of «e-Platforms» of metro, the purpose of which is to manage the activities of the enterprise *online* based on digital technologies. The introduction of this platform will improve transport security and traffic safety, quality of passenger transportation and optimize all related business processes [18]. «e-Platform» provides complete synchronization of incoming information from the external environment with metro business blocks.

The incoming information from the external environment to «e-Platform» is defined as factors affecting the activity of metro, and is divided into seven categories:
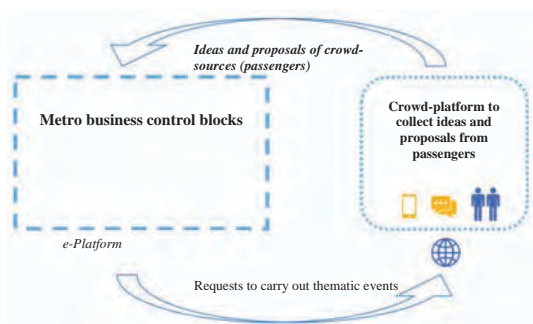
1) political;
2) social-economic;
3) conditions on the «surface»;
4) traffic schedule of other modes of transport;
5) construction of residential infrastructure in Moscow and Moscow region;
6) seasonality;
7) passengers.

The influence of political factors on metro is explained through development of a legislative framework that regulates the processes associated with organization, implementation of government orders and subsidies. Social-economic factors include key indicators such as population growth and decline, migration flows, which directly affect the size of passenger flows and the changing load on transport infrastructure. Conditions on the «surface» are various situations on highways and city streets that affect the change in passenger flows in metro (weather conditions, accidents,

traffic jams, crowds in shopping centers, theaters, museums, stadiums, etc.). The size of passenger flows is also affected by the traffic schedule of other modes of transport connected to metro, airport express trains, central railway diameters, suburban trains, as well as by loading of train stations (interchange hubs). An important role in managing passenger flows is played by construction of residential infrastructure in Moscow and Moscow region. Today, the population of Moscow and surrounding areas (Khimki, Mytishchi, Podolsk, New Moscow, Lyubertsy, etc.) is growing. This should also be considered when planning passenger transportation.

There is an urgent need to increase residential complexes both near Moscow Ring Road and beyond. The load on terminal metro stations is increasing, and therefore there is a need to increase the number of stations in Moscow region. The change of seasons also affects the change in the load on metro (number of trains, train schedules, etc.). For example, in summer, part of the population travels outside Moscow, the school year begins in autumn (the maximum passenger flow), in winter during the holidays, passenger flows decrease again, and in spring they grow.

We have identified another block of factors called «passengers». Passengers are users of the services that metro offers, and can be active in participating in development of this mode of transport. This can be expressed in prevention of emergencies using mobile applications with the ability to communicate online with metro employees and notify about unusual situations at stations and trains, as well as through submitting ideas and proposals for improving individual business processes and overall development of metro in order to improve quality of rendered services based on crowd technologies.

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Pic. 2. Integration of e- and crowd-platforms for development of «Digital metro». Source: compiled by the authors.

Due to the fact that the «e-Platform» should provide online interaction between government authorities, the main metro management HQs, employees of metro services and divisions and passengers, it is possible to organize crowd projects based on «e-Platform» of metro [18].

Passengers must have limited access to «e-Platform» through a specially designed mobile application, the key functions of which are:

1. Purchase/return of electronic tickets;
2. Routing;
3. Ordering a service of assistance in metro;
4. Ability to report problems using metro map online;
5. Crowd platform for discussing problems, possible solutions and metro development.

The need to introduce an electronic ticketing system is confirmed by a 2015 survey of JSC Russian Railways, the analysis of which showed that the share of railway passengers using electronic registration was 80 % [19, p. 61]. The ability to build routes and order assistance services in metro *online* is a key factor in reducing travel time. One of the promising directions for development of metro is introduction of crowd platforms that are aimed at involving passengers in joint activities to develop proposals and ideas for modernization of individual business processes and quality of services provided.

2. *Crowd platform for metro development.*

Two alternative solutions are proposed for introducing crowdsourcing technology into the organization's business model: creating a platform based on the existing information infrastructure and own servers or using the services of third-party companies that assist in preparation and conduct of crowd projects and provide the platform for temporary use (LLC Witology).

The crowd platform is a virtual space designed to collect and develop ideas and proposals by community members, which in this case can be both metro employees and passengers. The work of crowdsourcers (people who offer ideas) is supervised by a specially trained employee (facilitator), whose responsibilities include all the functions of organizing and maintaining a crowd project on the platform. It is possible to carry out several thematic crowd projects at the same time, the data on which are transmitted to «e-Platform». Thus, all incoming information from passengers is analyzed and sorted using big data and artificial intelligence technologies and transferred to the appropriate business blocks.

Pic. 2 presents the target model for managing data flows, which must be enabled to ensure sustainable development of both metro and the transport industry as a whole [20].

The introduction of crowdsourcing technologies in conjunction with «e-Platform» will help increase the efficiency and productivity in development of «Digital Metro» strategy due to the possibility of collecting innovative ideas and solutions from metro users. In addition, crowdsourcing will increase the level of passenger safety and transport security of the enterprise, as employees and passengers can report malfunctions and incidents in real time to develop operational solutions.

When implementing the authors' model of metro management, growth of demand in services of the leading business integrators for adaptation and application of the said digital technologies (*BigData, IoT, IIoT, BIM, Cloud Computing, Cloud Storage* etc.) at all levels of enterprise management (from linear operations to strategic planning) is forecasted.

Thus, the proposed model of metro management makes it possible to achieve not only social, but also economic effects, which can be expressed as follows:

• increase in efficiency of energy consumption (cost reduction by 5–10 %);

• reduction of overhead costs of an enterprise thanks to introduction of the technology of

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equipment service «according to current technical condition»;

• reduction of the need for space for arrangement of devices of telemechanics and automation, signaling, communication and safety;

• optimization of the personnel of operational services and freeing of space (relax rooms for drivers, medical point and other premises at the stations) following automation of enterprise business processes;

• increase in efficiency and performance of personnel due to automation of some business processes.

Conclusion. World and Russian practices have shown that digitalization and automation constitute together the trend of the present, and this process will continue and upscale. A special role in accelerating the processes of digital transformation is played by digital ecosystems, virtual platforms and crowd technologies, which, when integrated into a single system, allow to obtain high results in the shortest possible time.

The observed trend in creation of digital ecosystems and introduction of key digital technologies in the organization's business model for leading Russian transport companies indicates the need to develop this area and adapt the solutions of large companies to medium and small business levels. The model of integration of virtual platforms and crowdsourcing technology, proposed in this paper, allows to solve one of the acute problems that any organization faces today and which is associated with an exponential increase in information and an increase in the number of external factors affecting the enterprise.

REFERENES

1. Digital economy of Russia [*Tsifrovaya ekonomika Rossii*]. [Electronic resource]: http://www.tadviser.ru/index.php/Статья: Цифровая_экономика_России. Last accessed 28.01.2020.

2. Kupriyanovsky, V. P., Evtushenko, S. N., Dunaev, O. N., Bubnova, G. V., Drozhzhinov, V. I., Namiot, D. E., Sinyagov, S. A. Government, industry, logistics, innovations and intellectual mobility in the digital economy [*Pravitel'stvo, promyshlennost', logistika i intellektualnaya mobilnost' v tsifrovoi ekonomike*]. *Modern information technologies and IT education*, 2017, Vol. 13, Iss. 1, pp. 72–94.

3. Lapidus, L. V. Digital Economy: E-Business and E-Commerce Management: Textbook [*Tsifrovaya ekonomika: upravlenie elektronnym biznesom i elektronnoi kommertsiei: Uchebnik*]. Moscow, Infra-M publ., 2018, 479 p.

4. Lapidus, B. M., Misharin, A. S., Makhutov, N. A., Fomin, V. M., Zaitsev, A. A., Macheret, D. A. About the scientific platform of Strategy for development of railway transport in Russia until 2050 [*O nauchnoi platform*

Strategii razvitiya zheleznodorozhnogo transporta v Rossii do 2050 goda]. *Bulletin of Joint Scientific Council of JSC Russian Railways*, 2017, Iss. 2, pp. 1–20.

5. Howe, J. Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business. Trans. from English. Moscow, Alpina Publisher, 2014, 288 p.

6. Lapidus, L. V., Polyakova, Yu. M. Gigonomics as a new socio-economic model: development of freelancing and crowdsourcing [*Gigonomika kak novaya sotsialno-ekonomicheskaya model': razvitie frilansinga i kraudsorsinga*]. *Bulletin of the Institute of Economics of the Russian Academy of Sciences*, 2018, Iss. 6, pp. 73–89.

7. Polyakova, Yu. M. Crowd-technology: nature, essence, effects [*Crowd-tekhnologii: priroda, sushchnost', effekty*]. *Digital Economy: Trends and Prospects of Business Transformation. Proceedings of V Interfaculty Scientific and Practical Conference of Young Scientists*. Ed. by L. V. Lapidus. Faculty of Economics, Lomonosov Moscow State University, Moscow, 2019, pp. 103–109.

8. Collective Intelligence Systems. [Electronic resource]: http://ci-systems.ru/clients. Last accessed 28.01.2020.

9. Public Transport Crowdsourcing. [Electronic resource]: https://crowdsourced-transport.com/crowdsourced-public-transport/. Last accessed 28.01.2020.

10. BusUp. [Electronic resource]: https://www.busup.com. Last accessed 28.01.2020.

11. Pan, Sh.; Chao, Chen; Zhong, R. Y. A crowdsourcing solution to collect e-commerce reverse flows in metropolitan areas. *IFAC-PapersOnLine*, 2015, Vol. 48, Iss. 3, pp. 1984–1989.

12. Aeroflot announced winners of the third stage of the Russian competition of ideas «PolyotMysli.RF» (in Russian). [Electronic resource]: https://www.aeroflot.ru/ru-ru/news/54937. Last accessed 28.01.2020.

13. Konina, N. Yu., Nozdreva, R. B., Burenin, V. A. [*et al*]. Modern problems of management, marketing and entrepreneurship: Monograph [*Sovremennie problem menedzhmenta, marketinga i predprinimatel'stva: Monografiya*]. Ed. and foreword by N. Yu. Konina. Moscow, MGIMO-University, 2018, 626 p.

14. How Moovit improves its application, helping people with disabilities to use vehicles confidently [*Kak Moovit uluchshaet svoe prilozhenie, pomogaya lyudyam s invalidnostyu uverenno polzovatsya transportom*]. [Electronic resource]: https://news.microsoft.com/ru-ru/features/moovit/. Last accessed 28.01.2020.

15. Krantz, M. Internet of Things: A New Technological Revolution. Trans. from English by Z. Mamedyarov. Moscow, Eksmo publ., 2018, 336 p.

16. Weigend, A. Big Data. All technology in one book. Trans. from English by S. Bogdanov. Moscow, Eksmo publ., 2018, 384 p.

17. Sutherland, W., Jarrahi, M. H. The sharing economy and digital platforms: A review and research agenda. *International Journal of Information Management*, December 2018, Vol. 43, pp. 328–341. DOI: 10.1016/j.ijinfomgt.2018.07.004.

18. Baranov, L. A., Kulba, V. V., Shelkov, A. B., Somov, D. S. Indicator approach in safety management of railway transport infrastructure facilities [*Indikatorniy podkhod v upravlenii bezopasnostyu ob'ektov infrastruktury zhelezno-dorozhnogo transporta*]. *Nadezhnost'*, 2019, Vol. 19, Iss. 2, pp. 34–42.

19. Lapidus, B. M., Lapidus, L. V. Railway transport: philosophy of the future [*Zheleznodorozhniy transport: filosofiya budushchego*]. Moscow, Prometei publ., 2015, 232 p.

20. Lapidus, B. M., Macheret, D. A. Methodology for evaluating the effectiveness of innovative transport systems [*Metodologiya otsenki i obespecheniya effektivnosti innovatsionnykh transportnykh system*]. *Ekonomika zheleznykh dorog*, 2016, Iss. 7, pp. 16–25. ●

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