

Leading Information and Communication Transport Infrastructure in the Context of Digital Economics

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Abstract Despite understanding the importance and leading position of digital transformation of transport infrastructure as the fundamentals of health and safety, social and economic development of the state, the issues of technical, legal and financial regulation of relations of transport system digitalization, detailed assessment of the effect of digital technology in transport on social and economic process in modern society requires further and deeper research.

Our paper gives an estimate to the current state of information and communication transport infrastructure in the Russian Federation (RF) and outlines its development trends, strand of scientific and technological policy of Russian modern transportation industry for social and economic development of the RF and connectedness of its territories supported by effective international practices, inter alia, of the USA, Singapore, Japan, China, and Germany. The paper gives analysis of “regulatory sandbox” regime and the attempts of its legislative recognition in Russia and internationally.

Keywords: *leadership, information, communication, transport infrastructure, digital economics*

1 Introduction

Under the conditions of world globalization, integration and digitalization of the society timely and effective development of transport infrastructure is one of the top priorities of a contemporary state as it provides its competitiveness and respect on the global stage, social and economic growth and state security. Safe, high-quality, innovative transport services play an important role in the effective development of industry, business, social sphere, in realization of economic relations both domestically and internationally. To this date, Russian transport system is one of the most advanced in the world. Russia is the world’s third biggest for the stretch of railroad after the USA and China; and it is the world’s fifth biggest – for motor ways. The role of transport and logistic hub in Russian economics is crucial: in 2018 the sector provided 7,0% of gross added value. Currently, Russia has all modern transportation – pipeline, railway, water-borne, air-borne, automobile; the level of its transport communications meets the actual needs of the country. Information and communication technologies “support competitiveness and are the driving force of economic development” (Grebenkina et al. 2019a).

The analysis of worldwide trend in transport progress indicates permanent development of transport infrastructure, growing demand for development and operation of highly automated transport vehicles.

However, in spite of understanding of the importance of digital transformation of transport infrastructure as the fundamentals of health and safety, social and economic development of the state, the issues of technical,

legal and financial regulation of relations of transport system digitalization, detailed assessment of the effect of digital technology in transport on social and economic process in modern society requires hard research.

The goal of the present research is the assessment of the current state of information and communication transport infrastructure in the Russian Federation and determining vectors and prospects of its evolution for the provision of social economic development of the RF and connectedness of its territories supported by effective international practices, inter alia, of the USA, Singapore, Japan, China, Germany.

2. Literature review

Over the recent years, the Russian theory is signed out by overall research on issues of creation and development of digital economy in Russia where intelligent transport systems are outlined in general terms and isolated, without comprehensive review.

Moreover, Anglo-American school of thought contains more research, but they are mainly concentrated on military autonomous technology, autonomous aerial vehicle; but they are insufficient as for legal regime of autonomous motor vehicles and the impact of transport digital technology on public roads on modern society and economy (see e.g. Patrick 2014; Beard 2018; Grebenkina et al. 2019a; Grebenkina et al. 2019b; Lukashevich 2019).

3. Research methods

Our research is primarily based on the principles of systematic and comprehensive analysis of basic problems, inclusion of differently directed private and social interests, and operates on the principle of unity of theory and practice.

Comparative legal method in the research is put at the top of priorities. The authors analysed successful international practices of implementing of autonomous motor vehicles on public roads and statistical data of transport infrastructure in Russia and internationally. In the research process we employed the methods of weighing of interests, economic analysis of law, and legal axiology.

4. Current status of domestic transport industry

According to the Federal Statistic Service (GKS 2019), in 2018 the stretch of public roads in Russia grew by 21,600 km (by 1.4%) and made up 1,529,400 km. In 2019 more than 500 km of federal roads were constructed and modernized. Construction and modernization of 543.3 km of federal roads were completed, inter alia 188.5 km of federal roads via public and private partnership. As for regional roads, it was earlier reported that by the end of the year 2019 about 6,400 km were brought into compliance with legal standards. From more than 1,500,000 km of total length of roads in the Russian Federation federal roads account for 53,000 km. Therewith, nearly 83% of federal roads answer to specifications (Trans 2019).

It is good to know that since 2016 to nowadays Moscow steadily ranks third among world megacities in the development of transport infrastructure, according to the research of experts from Moscow State University named after Lomonosov. Tokyo (Japan) ranks first, then comes London (Great Britain). New York (USA) and Singapore rank in the top 5 and are rated the fourth and the fifth, respectively. Shanghai, Saint Petersburg, Hong Kong, Istanbul and Mexico rank from sixth to tenth. Rating indicator includes four categories: quality and accessibility of transport services for general public, effectiveness of freight logistics, road-traffic safety and environmental impact of transport. The length of underground system in the country grew from 541.8 km to 581.9 in 2018, largely owing to the construction of new lines of Moscow Metro. Due to shutdown of several routes, the length of tram and trolley-bus lines was downsized by 23.3 km and 100.8 km respectively. Railroads in Russia increased by 79.9 km and reached 86,600 km. The length of main oil pipeline remains on the level of 2017 and made up 53,400 km. Waterways on the territory of the country stay the same – 101,500 km (Regum 2019).

If one refers to research results of Ernst & Young at the year end of 2018– beginning of the year 2019, the position of transport system in Russia worldwide is as follows (EY 2019):

- The length of public railway lines – third place in the world, 86,000km. (Russia is marked by high figure of average length of haul by railway vehicles as the main consignors are located in the centre of the country while the main proportion of freight traffic runs for export. The figure in India and China is three times lower);
- The length of motor roads – the fifth place in the world, 1,529,000 km (despite significant extent of the territory of Russia west-to-east, overland shipments are chiefly carried out for small distances. Russia, the USA and China show comparable figures of motor transport in the structure of shipping dimensions (~60–75%), though the share of motor transport in the structure of cargo turn-over in Russia is much lower (about 5% against 40% in the USA and 34% in China);

- The largest port by volume of trans shipments (Novorossiysk) takes the third place in Europe, 155,000,000 tons. (Despite heady growth rates of Russian stevedoring, cargo turn-over of Russian seaports is far off world leaders. The volume of trans shipments in the USA ports is three times more than in Russian ports, and the volume of trans shipments in Chinese ports goes ten times beyond Russian figurers);
- The length of inland waterways – the second place in the world, 101,000 km. (In Russia, water transport (both seaborne and river-borne) has small proportion in cargo turn-over (about 2%), while in China it provides about a half of cargo turn-over and in the USA – about 10%) (Analytical Centre for the Government of the Russian Federation 2019).

In January–September of 2019 all types of transport vehicles carried 8,677,800 passengers, of them by automobile (bus) transport – 7,665,000 passengers, by inland water transport – 9,362,000 passengers, by maritime transport – 4,820,000 passengers, by air transport – 99,143,000 passengers, therefrom: inland transportation – 56,300,000 passengers, railway transport – 899,500,000 passengers, therefrom: communication service (including intracity) – 809,100,000 passengers ().

In January – September 2019 all types of transport vehicles carried cargo in volume of 6,097,600 tons, among them by railway transport – 957,600,000 tons, by automobile transport – 4,182,500 tons, by maritime transport – 14,361,000 tons, by inland water transport – 85,310,000 tons, by air transport – 822,200 tons, by pipeline transport – 857,000,000 tons. Russia effectively employs innovative technologies providing customers with full information on the product, among them such software as:

- GPS system - automatic global satellite system for the determination of latitude and longitude of vehicle location;
- GLONASS system - Russian made providing the exact positioning of an object over a distance with minimum error which serves for operative time and navigation support for unlimited number of users of land, sea, air and space basing;
- EspaceCat system - informs the users of the characteristics of carried goods and provides their configuration plan in the vehicle body, modelling this information as 3D-graphs” (Mintrans 2019).

One may observe positive changes in the transport industry, partly owing to realization of innovative projects “Ecology”, “Safe and good-quality highways”, making complex arrangements for modernization and development of trunk infrastructure – federal projects “Europe – Western China”, “Russian sea ports”, “Northern Sea Route”, “Railway transport and transit”, “Communication amid centres of economic growth”, federal project “Development of regional airports and routes”, “Inland waterways”, “Transportation system development”.

5. Scientific and technological policy of modern transport industry

Autonomous motor vehicles have already made their appearance and become trends in the majority of economically developed countries (Singapore, the USA, Japan, China, Australia, the countries of continental Europe, and in the first instance – the Netherlands, Germany).

Realizing the advantages and dangers of autonomous motor cars, nowadays the authorities of the countries are actively devising legislation in the sphere of their application. The task of our state is to keep up with the advanced countries, to develop advanced technologies and to adjust legislation providing all advantages of intelligent transport systems, legislation that can prevent new safety risks on Russian roads in the context of the development of modern technologies.

Scientific and technological policy of transport industry in RF suggests the development of science, innovation technologies and talent development framework in all the directions mentioned above, among them:

- stimulating development and application of innovative technologies in construction, reconstruction and content of transport infrastructure;
- producing effective patterns and systems of forecasting and transport planning on the basis of transportation economical balance;
- stimulating development and application of innovative transportation logistic technologies, technical equipment and systems providing high accessibility and quality of cargo and passenger transportation;
- stimulating development and application of innovative intelligent transport systems providing effective management of transport flow and motor vehicles as well as quality upgrading of transportation services;
- advance of scientific research in the sphere of higher safety of transportation system;
- implementation of fundamental and applied scientific research in the sphere of environmental impact reduction of transport and energy saving upgrading of transport;

- maintenance and development of industry-based scientific schools as well as workforce capacity of the industry, development of industry staff training and retraining inter alia in the sphere of safety and ecology (Russian Government 2019).

The apparent advantage of highly automated vehicles is the increase of quality index, accessibility, speed, safety and ecological compatibility of transport services. For the provision of common use of autonomous motor vehicles on public roads all over Russia on federal and local levels the following issues are to be carefully explored:

- Drafting relevant legal framework regulating engineering (Lukashevich 2019) and application of autonomous motor vehicles on public roads, relevant technical rules for autonomous motor vehicles, statutory provisions on legal regime for autonomous motor cars, amending civil law, insurance, criminal and labour regulations, social security law, laws on personal data, information, information technologies and data protecting;
- Design and construction of motor roads with correct highway striping for autonomous motor vehicles, making integrated and transport space nationwide including federal, regional and local levels. “In the tideway of digitalization of transportation industry a national project was accepted targeted at the construction of safe motor roads of good quality that started in 2019; the project provided for setting of 387 automated stations for weight and dimensional control on federal motor roads and identical stations – on 75 motor roads of the subjects of the Russian Federation; the project also arranged to start traffic of autonomous motor vehicles. Under the project 80 segments of federal motor roads and 40 segments of regional motor roads were equipped with ITS elements serving for automatic control flow of road traffic.

It is also planned to create a block chain for new and advanced industry technologies, materials and arrangements, database necessary for inserting of specific constructions, technologies and materials into design specifications and estimates. FAO “ROSDORNII” through the offices of “Rosavtodor” and GC “Avtodor” is assigned to perform the work:

- Providing effective means for cyber defences during operation of highly automated vehicles;
- Improvement of the existing and development of new information and telecommunication infrastructure providing autonomous motor vehicles with required services and information;
- Expansion in the number of charging infrastructure for further development of electrification of highly automated autonomous motor vehicles;
- Development of technologies for wireless data transmission for the provision of the quickest possible (prompt) information interchange amid highly automated autonomous motor vehicles and with the infrastructure objects.

6. Prospects of integration of autonomous motor vehicles on Russian public roads

The digital economy determines the digital transformation of all spheres of life, providing them with significant economic and social opportunities. It, in turn, opens new opportunities for the development of entrepreneurship. Digital technologies are developing rapidly. They penetrate traditional business, causing the emergence of new types of digital products and services. The constant use of online channels leads to the restructuring of business processes, the transformation of business models, marketing management systems and changes in consumer behaviour (Greibenkina et al. 2019b).

“According to the research findings of “National technological initiative ‘Avtonet’ 2019, among the advantages of autonomous motor vehicles 30% of respondents marked safety of the vehicles, 55% noticed possibility to engage in other activities whilst driving. Among disadvantages 29% of respondents registered inability to influence the situation, 16% - hacker attack and 51% - technical slip-up. ‘Avtonet’ informs that by the year of 2030 the market volume of private autonomous motor vehicles worldwide will make up \$ 60 bln. At this the share of Russia will total 5%. Turnover of the world automotive industry will grow as a result of additional services in the motor vehicles. “According to estimates, in 2014 about 60 mln. of electric carts will be sold worldwide which amounts 55% of motor-car market. Growth drivers: requirement strengthening to exhaust emission, subsidizing of motor-car purchasing, differential taxation on the basis of fuel saving or leaked amount, privileges (favourable parking, toll roads, priority lanes) and stimulating the development of charging infrastructure (investments, tax benefits)” – is reported in the NTI research (IZ 2019).

Aside from that, by the end of the year 2020 there will be more than 6 mln. motorcars with emergency response system ERA-GLONASS and about 3 mln. usage-based insurance customers on Russian roads (Eraglonass 2019).

According to Yandex’s earlier reports, autonomous motor vehicles may appear in Moscow in four-seven years. Company representatives informed that autonomous cargo trucks will set going between cities and autonomous taxis will carry passengers. Robotic delivery agents will also become available.

Moreover, by the end of the year 2019 – beginning of the year 2020, 35 autonomous motor vehicles have been driving along the roads of Moscow and Tatarstan. As an experiment, operation of autonomous motor vehicles is permitted on the roads of Moscow and Tatarstan on condition that there will be a driver on the driver's seat who can take over handling a vehicle should anything happen. Until recently, these autonomous motor vehicles underwent trial in Skolkovo (Moscow) and in Innopolis (Tatarstan) as taxis. But now the vehicle park has grown, and they are being tried on other regional motor roads” (RG 2019).

For instance, in December 10, 2019, autonomous motor vehicles final UpGreat ‘Winter City’ 2019 took place in Moscow suburbs trial ground, the organizers – “RVK” company, “Skolkovo” fund, and Strategic Initiative Agency. The technological barrier of the technical competition UpGreat ‘Winter City’ was not cleared, but final trial results demonstrated that Russian technologies have all chances to compete on the autonomous motor vehicles market. StarLine team showed the best results in heats – their autonomous motor vehicle did the distance of 50 km in 2 hours 47 minutes (Bespilot 2019).

7. Legislation and “regulatory sandbox” regime

Russian Federation, as well as the majority of advanced jurisdictions (USA, Great Britain, Singapore, Germany, Israel, Japan, etc.) apply “regulatory sandbox” regime, in particular trial heats of autonomous motor vehicles are run at the sites of Innovative Centers “Skolkovo” (Moscow) and Innopolis (Kazan). At present, the RF Ministry of Economic Development and Trade drafted federal legislation “On experimental legal regimes in the sphere of digital innovations in the Russian federation” that covers what is called “regulatory sandboxes”, i.e. organizations and territories that apply special methods of legal and regulatory regime for the production, business and other forms of activities aimed to stimulate digital innovations. The legislation sets forth the way of initiating, establishment, realization, monitoring of realization and impact assessment of experimental legal regimes in the sphere of digital innovations (Bokova 2019).

“Under digital innovation the legislation understands new instruments supporting application of digital processes, resources and services, or a new system of such instruments on the basis of big data technology, neuroethology and digital intelligence, block chain system, quantum technology, new manufacturing processes, industrial Internet, elements of robotic technology and sensory, Bluetooth technology, virtual and augmented reality technology as well as other technologies enshrined in legal norms of the Russian Federation as technologies referred to the category of digital technologies or to the sphere of digital economics, or a new form of application of the existing instrument or the existing system of instruments” (D.RUSSIA.RU 2019).

For the establishment of experimental legal regime it is sufficient for an authorized body (federal executive body assigned by the government and charged with functions of setting experimental legal regimes) to approve the program for experimental legal regime. The program shall stipulate legal regulation of experimental legal regime, assessment of experimental results as well as include approval memorandum with the subjects of experimental legal regime. Following the results of the experiment, the authorized body renders a decision on practicability of amending common rules for regulatory framework.

“Regulatory sandbox” regime is a special legal regime providing an opportunity for legal entities engaged in the development of new financial products and services to carry out experiments on their implementation in confined environment, without risk of breaking current law.

Because of complicated certificated systems on motor roads in the RF, only 35 of highly automated automobiles undergo trial, some of them are driving on the territory of Skolkovo. In the USA, 1.500 such automobiles have undergone trial, in China – 400, in Russia – only 35 ().

It is important to bear in mind the impossibility of implementing new technologies without trial, approbation in conditions most closely resembling reality. Therewith, experimental procedure may not comply with the norms of current laws and results in negative legal implications. Consequently, domestic legal system in the age of digitalization requires early adoption of the legislation named above, that increases effective legal regulation of experimental legal regime for autonomous motor vehicles.

By comparison, since 2016 the world’s first autonomous taxis have been driving in the Singapore business centre, and in February 2017 the Road Traffic (Autonomous Motor Vehicles) Rules 2017 came into operation (AV Rules). They specify legal regime of future-orientated technologies for autonomous motor vehicles, and trial rules for such motor vehicles. The Rules were formed and adopted as a separate Chapter to Road Traffic Act with amendments of 2017. Chapter 276 of Road Traffic (Autonomous Motor Vehicles) Rules came into force on August 24, 2017”. “These Rules do not apply to or in relation to any autonomous motor vehicle for which a special purpose license has been issued before 24 August 2017. AV Rules and general legislative provisions empower the Authority effectively to administer implementation of “regulatory sandbox” regime for autonomous motor vehicles trial. Therewith, within the frame of general provisions of the Rules the LTA has authority to agree additional

individual terms for issuing special licenses to companies participating in the AV trial, as well as stating the geographical area in which the approved trial may be undertaken, or in which the approved special use may be carried out” (SSO 2019).

The Rules (and other parts of Road Traffic Act) set forth exhaustive list of requirements and conditions for authorization to persons intending to undertake trial of autonomous motor vehicle.

Particularly, under AV Rules a person shall make an application to undertake any trial of an autonomous motor vehicle or to use an autonomous motor vehicle on any objects of public transport infrastructure to the Land Transport Authority in Singapore (LTA). The main provisions of the Rules concern implementation and regulation of trial regime for autonomous motor vehicles, procedure of participation in such regime and requirements to persons intending to participate in any trial of an autonomous motor vehicle. Application to undertake trial of automated vehicle technology or autonomous motor vehicle on any road is submitted to the Land Transport Authority in Singapore (LTA). Such an application shall:

- 1) be made in the form and manner required by the (LTA)
- 2) be accompanied by any information that the Authority requires to decide on the application, including any of the following:
 - a. the objectives of the trial, and a brief outline of how the trial is proposed to be conducted;
 - b. the type or types of autonomous motor vehicles, or automated vehicle, to be used in the trial;
 - c. the number of each type of autonomous motor vehicle and the details concerning each vehicle to be used in the trial;
 - d. the autonomous system to be employed in each autonomous motor vehicle to be used in the trial;
 - e. if an autonomous motor vehicle is to be modified for the trial, the nature of the modifications;
 - f. any supporting documents concerning any autonomous motor vehicle to be used in the trial and the autonomous system to be employed in the trial, stating that the vehicle and autonomous system are safe for use in the intended manner in the trial.

The job of a person authorized to carry out the approved special use is to maintain the autonomous motor vehicle in the state of good condition, to record and store data from recording systems and other data-collection systems of the autonomous motor vehicle, to keep records, to notify the Authority of any incidents and accidents in course of the approved trial. The Authority also requires performing periodic technical trial of autonomous motor vehicles approved to undertake trials.

In addition to the Road Traffic Act and AV Rules, otherwise use of autonomous motor vehicles may be limited (prohibited) on specified territories and in specified regions according to other legislation such as Infrastructure Protection Act (adopted in late 2017 and not enacted yet) and Protected Territories and Protected Sites Act” (SSO 2019).

In 2017, a few projects on autonomous motor vehicle trials in “sandbox” regime were announced in Singapore. Among participants of the trial were organizations engaged in autonomous buses and autonomous freight traffic technologies, tourist auto transportation, etc. Among key projects realized in the frame of “regulatory sandbox” regime are:

- 1) August 2015: setting up fields for autonomous motor vehicle trials (AV) and car-to-car communication systems (V2V) and automobile-infrastructure (V2X) in segment of public auto route One North.
- 2) May 2016: trial of formation and guidance technologies for motorized columns of autonomous trucks on specified segment of public road West Coast Highway.
- 3) April 2017: conducting research and development and field trial of autonomous passenger buses on specified routes of intracity and suburban transportation.
- 4) Spring 2018: opening of Best Practices Centre on Trials and Research of autonomous motor vehicles (CETRAN). The statutory mission of the Centre is the development, approval and further international promotion of national standards in the area of AV trials as well as their certification.
- 5) A number of other projects on AV trials, development, standardization and field trial of V2X infrastructure, etc” (ITUT 2019).

The government of Singapore announced that since early 2020 autonomous motor vehicles will undergo trials on public roads in all west country. In addition to existing sites – Buona-Vista, Jurong Island, Nanyang technological university and Sentosa – the companies will be provided with more than 1,000 km of real roads for driving in the regions of Bukit Timah, Clementi and Jurong.

8. Conclusions

All in all, our research allowed us to perform the assessment of the current state of info-communication transport infrastructure in Russia and to define the key vectors and its prospects for socio-economic development of the Russian Federation, and the continuity of its territory, analyse successful foreign experience, in particular, the United States, Singapore, Japan, China, and Germany.

The study of positive international practices of legislation improvement in the sphere of trials of highly-automated autonomous motor vehicles on public roads and considering specific character of current Russian public order as well as public and economy needs will give an opportunity successfully and at minimum risk to meet the new challenges of global digitalization including digitalization of transportation industry as well as to capture the full benefits thereof.

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