

# Transport industry as a business infrastructure: modern stage and prospects of development

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**Abstract.** The condition of the motor transport industry largely defines the progressive socio-economic changes in any country. It also serves a basic index of state development from the perspective of standards of living and healthy environment for economic growth and business activities. The motor transport industry reflects efficiency of the state policy, which also includes effective budget funding of the industry. The most developed countries make a considerable effort to maintain the motor transport system infrastructure and to stimulate development and integration of innovation technologies, which meets the goals of the national economy's sustainable development. Paper analyzes some modern patterns and prospects of transport industry development on the examples of Asia and Russia economical systems.

## 1 Introduction

The significance of the motor transport industry for a multitude of other industries proves its research relevance in terms of the transformations taking place in the national economy. Recently, the road condition has shown tangible improvement; nevertheless, the overall situation remains critical. The motor transport industry viewed as a strategic industry of the national economy requires focusing on the innovation development, which involves the major global trends in the digital economy and the strategic imperatives of sustainable development. Taking into account Asia's and Russia's transit potential, the motor industry infrastructure recovery and modernization are the first steps on the way to the long-term reforms. Their primary goal is to achieve the definitive reliability and performance of the motor transport industry targeting the relevant economic transformations: innovative, business and social ones.

It is noteworthy that the digital transformation of the national economy is related to the growing impact of both the information and communication and transport systems in all the industries as well as to the growing human mobility, advancements in passenger and cargo traffic (shipment upgrade) and building deeper connections between the territories, the economic actors and the infrastructure creating modern living environment. Hence, in real life the digital integration of the motor, rail, sea, inland water, air, urban, commuter and

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inter-city transport systems has acquired particular relevance, such systems becoming the major drivers of transition to the digital economy [1].

Therefore, the current study correlates with the multifunctionality of the transport industry and rationalizes the need for the advanced regulation of its development in the conditions of the national economy's transformation while following the course of the progressive global trends of transport digitalization geared by continuous innovation.

The transport system, being one of the major agents of the efficient development of the national economy, remains at the core of the scientific research since the important findings in the area contribute to the implementation of the innovations at the level of the subsystems and, consequently, enhance the progress of the transport system along with its subunits as well as the progress of all the affiliated socially-oriented industries. Such transport system-dependent industries include almost all spheres of public life due to the fact that transport functions as a unique accelerator providing for the livelihoods and sustainability of the economic complex and socio-economic sphere

Taking into account the abovementioned factors, it is important to define the major theoretical and methodological foundation providing for the functioning of the transport system at different levels while keeping in mind its multifunctionality and centuries-long history as well as to carry out the impact analysis of this infrastructural industry of paramount importance with the purpose of finding the main trajectories of its development. Essentially, the transport system can be considered a multifunctional, multilevel, permanently integrated complex of various types of transport, transport networks and labor forces which, being constituent parts of the integrated national socio-economic system, interact and provide for the optimal cargo and passenger traffic as well as the national security in the pursuit of the community wellbeing [2].

The recommendations on the development of the transport system should be based on both traditional and up-to-date tools which are bound to efficiently reflect the nature of the phenomena and processes ongoing in the researched area. Complete understanding of the constituents and patterns within the transport system requires elaborating its institutional and functional structure. The institutional structure of the transport system includes the establishments which provide transportation service, consume such services or regulate the relationships between the agents. The functional structure of the transport system reveals the range of activities and responsibilities taken up by the agents when satisfying the need for consumer-oriented transportation.

It should be noticed that consumers take up the role of proxy regulators of the transport system and are capable of influencing the quality of the transport services due to their consumer behavior and multiple forms of self-organization. Eventually, civil society has its own instruments of influence on the public policy and administrative decision-making which also concern the problems of transport viewed as the central ones due to the social impact of the transport system.

## **2 Materials and methods**

The impact evaluation of the transport development allows for the multifaceted approach to the problem. The understanding of the effects the impact factors have allows the following:

- to identify its reaction to the impact factors, i.e. its destruction, transformation, adaptation or resistance;
- to identify the effects of the interaction between the impact factor and the target on the impact factor, i.e. its destruction, modification or levelling;

- to reveal the mechanism of impact factors regulation depending on the purpose, also within the system regulating strategic development of the target (here, the motor transport complex).

The impact evaluation within the framework of the motor transport complex makes for the application of the economic and mathematical analysis – correlation analysis, regression analysis, factor analysis, etc. Notably, the approaches to the analysis can vary:

- a) internal impact factors: occurring due to the interaction between the elements of the transport complex;
- b) external impact factors:
  - as related to a separate element of the transport complex;
  - as related to the interplay between the transport complex and the economy;
  - as related to the interplay between diverse environments and the transport complex.

Many scientists take an interest in the role of the impact factors in the transport infrastructure conditions, roads in particular [3].

The evaluation of the internal impact factors often targets the factors showing technical features of the transport facilities and state of the transport infrastructure in terms of human resources [4].

Undoubtedly, the main focus of the impact factors research is on the innovation processes.

The digitalization of the industry, which is currently becoming its integral feature, plays a major part in the development of the transport infrastructure and, hence, defines the approaches to the regulation of the industry’s strategic development. While interacting with the environment, the transport complex may cause both transformations in the relief and pollution (including noise pollution) which result from the traffic and transportation activities, including use of special-purpose vehicles, anti-dust products, ice melts and materials for vehicle and road repairs [6, 7].

These and other aspects provide for an absolutely different extent of the ecological impact on the industry. Another important factor is the spatial aspect. Specifically, it refers to the city-planning factors which are directly connected with the development of transport and its infrastructure.

Thus, the parameters of the impact evaluation of the transport complex can vary. This study mainly focuses on the impact evaluation from the point of view of the influence the economic and innovation development has on the transport, in particular, on the infrastructure and demand parameters for the transportation service (cargo and passenger traffic).

Herewith, the applied method of regression analysis allows building a model that represents the interaction between the evaluated objects. The method of least squares is taken as a standard approach in regression analysis in order to find linear solution for the values of  $x$  and the dependent variable of  $y$  and is reflected in the equation below:

$$Y = m_1x_1 + m_2x_2 + m_nx_n + b \tag{1}$$

where  $Y$  is the dependent explained variable;

$x_1 - x_n$  are the independent explained variables;

$m_1 - m_n$  are unknown, and the main idea behind the linear regression is to use these determined values for the purpose of evaluating the impact on the independent value in real time;

$b$  is a random error which, in most cases, depends on the independent variables and whose expected value equals zero.

Apart from building regression models which explain the tendencies of development defined by the impact factors, we have also attempted making forecasts in the short run. The

current conditions do not allow making precise forecasts in the long run since the economic development shows rapidly changing patterns and is greatly dependent on the geopolitical environment.

For this reason, the forecasts in the short run (for the nearest 5 years) add to the prioritizing of the regulation and strategic planning for the purpose of the industry's development.

The main tools of the economic forecasting are indispensable when carrying out the scientific analysis of the socio-economic and R&D processes and development tendencies; when estimating the cause-and-effect relations between socio-economic phenomena in the specific historical background and under the influence of the external environment; when finding alternative possibilities of development and their evaluation; when analyzing and evaluating conditions of the domestic and international commodities, resource and finance markets; for early detection of contradictions which require elimination.

As of today, the range of tools used for economic forecasting is vast, varied and includes the following methods: formal methods (extrapolation and mathematical modelling in economics, the composite leading indicator, etc.); expert methods (brainstorming, Delphi, matrix, etc.); analytical methods (neural network forecasting based on the artificial neural network) and others.

Forecasting in the current research is based on data approximation according to the method of least squares reflected in the polynomial trend line equation below:

$$Y = b + C_1 x + C_2 x^2 + \dots C_n x^n \tag{2}$$

where  $b, C_1 - C_n$  are constant values.

The equation below reflects the way of finding solutions:

$$\begin{cases} K \sum_{i=1}^n x_i^2 + b \sum_{i=1}^n x_i = \sum_{i=1}^n y_i x_i \\ x, x \geq 0 \end{cases} \tag{3}$$

The methodology of the impact evaluation in the process of the motor transport system development allows finding a complex approach to the existing problems, which also includes forecasting the industry's reaction to the impact factors (its destruction, transformation, adaptation or sustainability), measuring the reaction of the impact factors following their interaction with the industry (their destruction, modification or levelling) and elaborating the mechanism of impact factors regulation depending on the purpose, which also concerns the system of the industry's strategic development regulation.

Building response regression models reveals which factors can be regulated to create a positive effect of the transport complex on the economy, and vice versa.

The logical conclusion in the framework of the complex evaluation is the elaboration of the Motor Transport Infrastructure Performance Improvement Plan in accordance with the needs of the region. The ultimate goal of the motor transport infrastructure development is to satisfy the needs of the region in terms of the transportation and economic network through its replenishment with infrastructural elements. Thus, the elaboration of the Motor Transport Infrastructure Performance Improvement Plan is not only necessary for the regions with poor motor transport infrastructure failing to provide for the needs of the region, but also for the regions with efficient and well-developed motor transport infrastructure as well as for the regions showing excess supply in the motor transport infrastructure elements.

In the first case, the strategy of the Plan should target improvement of the infrastructure performance according to the needs of the region in terms of the transportation and economic network.

In the second case, the Plan's strategy is to achieve sustainable compliance with the needs of the region in terms of the transportation and economic network.

In the third case, the Plan should focus on maintaining the efficiently developing motor transport infrastructure of the region.

### 3 Results

Boston Consulting Group carried out the evaluation of the influence of the digital technologies on different industries with the purpose of defining the general tendencies of digitalization. According to the company's research, the media industry is the one most subject to transformations in digital technologies; such transformations happen at a much slower pace in the industries largely relying on infrastructure and complex technologies.

Transport belongs to the third category where the level of digitalization is hard to define and improve since the industry requires inclusive modernization of the technology and operational infrastructure. Hence, in Industry 4.0 the transport industry is characterized by certain features which also serve as the indicators of the digitalization processes mentioned below [5]:

1. Big data and cloud technologies use.
2. Spread of the Internet of Things.
3. Robotics development.
4. Spread of the 3D printing technologies.
5. Blockchain.
6. Crowdsourcing.

Within the framework of the Digital Agenda for Europe, the European Union adopted the Digital Single Market Strategy meant to bring about the opportunities offered by digital technologies for individuals and businesses as well as to maintain Europe's position of a world leader in the digital economy [9]. The strategy includes the investment plan of 300 billion euros for seven years. For the purpose of visualizing the digital processes in Europe's economy, a digital display was set up to measure the productivity of the EU and its member-states in the wide range of industries, starting from communication technologies and digital skills in business digitalization up to social services. The data that appear on the display include DESI (The Digital Economy and Society Index) and data from EDPR (Europe's Digital Progress Report).

Among the EU members, Germany remains the leader in the transport digitalization and considers the strategy of transport digitalization as a constituent element of Industry 4.0 while focusing on four major aspects:

1. Digitalization of the transport infrastructure and logistics chains (warehouses, logistics centers, roads, etc.):
  - a) providing for the intelligent automation of the transport infrastructure (Logistics 4.0) which includes warehouse automation and job management automation in accordance with the principles of lean production;
  - b) logistics management optimization through the automated transport system providing for the autonomous interaction between the elements of the logistics chain and order consolidation departments, which contributes to the cost and lead time reduction [6].

2. Robotic process automation as a factor guaranteeing autonomous warehouse and logistics performance. One of the ways to enhance the process is to install robot manipulators into the automated transport elements.

3. Automated management systems. This principle presupposes introduction of a fundamentally new set of requirements into the management systems. Thus, electronic assistants are expected to control decision-making. For instance, SAP Company offers software and provides for the interaction between the planning system and materials management system through wireless means of communication, which makes a perfect combination and ensures resource supply. This improvement also concerns making record of vehicles, monitoring of the efficiency of vehicle operation and vehicle health, etc. [7,8].

4. Platooning based on the autopilot system when a group of vehicles (up to 10) is driven together in the autopilot mode via Wi-Fi communication. For example, on 25th June 2018, a semi-autonomous tow tractor caravan started carrying cargo on a 145-kilometer-long experimental stretch of road. The funding of the pilot project amounted to 2 million euros. Today, the digitalization has become not only a pan-European, but a global process and almost all the countries in the world identify it one of the priorities of their development. For the time being, 15 countries have been implementing national programs of digital economy.

The most advanced countries in terms of promoting digital economy are China, Singapore, New Zealand, South Korea and Denmark [9].

China's Internet Plus integrates digital industries with the traditional ones; Canada is working on the ICT hub in Toronto; Singapore is developing Smart Nation geared by ICT; South Korea's Creative Economy focuses on human capital development, entrepreneurship and spread of the ICT; Denmark's goal is digitalization of the public sector [5,10].

Within the framework of the digital economy, Singapore's Smart Nation Project defines three fundamental trends in transport digitalization:

- operational planning;
- resource optimization;
- access to the corresponding information in real time.

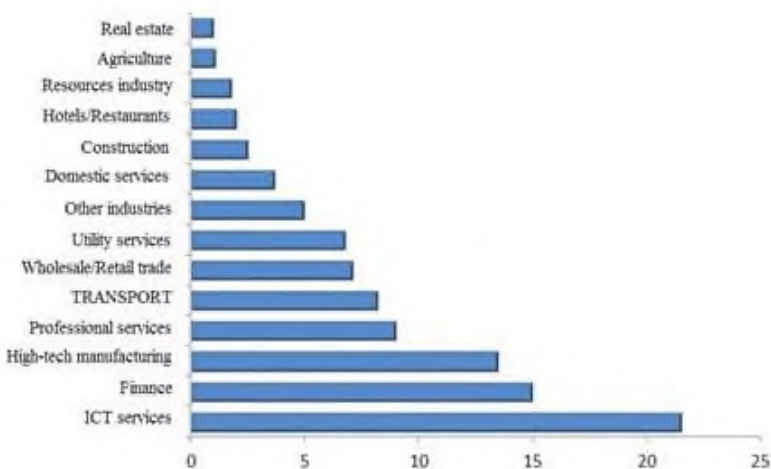
The set of the proposed tools includes demand management, simulation, predicative and multimodal analytics. At the core of the digital transport system there will be driverless trains, automated lift trucks, autonomous truck caravans, autonomous taxis and buses, car and bike sharing and personal mobility devices. The major challenges include the problems of safety, anonymity, re-identification, usability and aggregation [2].

The statistical data from Table 1 reflect Russia's position in the rating of digital economy development and its falling behind on the key indices definitely has an overall negative effect on its further development [3, 11].

**Table 1.** International indices of the digital economy development.

Index	Commentary
ICT development index	The index defines the ICT infrastructure development and its relevance for the population. It is applied to estimate the digital divide between the developed and developing countries.
E-government development index	The index shows the degree of a country's preparedness for implementation and use of e-government services.
Network Society readiness Index	The index characterizes conditions of ICT development and spread from the point of view of socio-economic development.
Global cybersecurity index	The index defines the level of cybersecurity in the country.

According to various researches, transport takes the fifth position in the rating of industries as per the digital technology integration (Figure 1).



**Fig. 1.** Levels of consistency in digital technology integration % GAV, 2018 [7].

Russia’s market has been going through economic recovery and the number of vehicles owned by businesses and individuals has been growing, which, consequently, results into rapidly going up cargo and passenger traffic. However, the current condition of the transport infrastructure does not meet the expectations and needs of the transport service consumers. Table 2 shows dynamics and forecast of the total freight volumes in Russia.

**Table 2.** Dynamics and forecast of the total freight volumes in Russia, in million tons [7].

Modes of transport	2000	2005	2007	2010	2015	2020	2030
Road	17.9	33.1	40.3	50	65	80	110
Rail	170.8	242.3	297.6	264	247	228	202
Sea	159.6	367.4	388.7	466	685	770	882
Air	0.05	0.06	0.08	0.12	0.2	0.35	1.05
Inland water	5	7.7	8	12	18	28	35
Total	353.35	650.56	734.68	792.12	1015.2	1106.3	1230

The indices of Russia’s transport infrastructure development are introduced in Table 2. The data from this table clearly shows that over the last five years the length of the railway tracks for public use has not changed whereas the length of the railway tracks for private use has been reduced. The length of the motorways has considerably increased (by 47.3%) as many roads for public use have been built. The length of the surfaced roads has greatly increased mostly due to the construction of the local motorways [12,13]. Nevertheless, the share of the federal, regional and municipal dirt roads still amounts to 7.3% whereas almost one third of the motorways is made up by gravel, macadam or cobblestone roads.

The condition of the transport infrastructure is dependent on the major productive capacities of the transport segment. According to 2016 – 2018 statistics, the following infrastructural elements were put into operation: 162.1 km of railways, 6.4 km of surfaced motorways, 46.5 km of subway double-track lines, 4.4 thousand running meters of marine terminals and 0.7 thousand running meters of river terminals, 1528.1 km<sup>2</sup> of runways with man-made surface and 50.6 km of oil pipelines [14,15]. Work was also done in the areas of railway electrification and airport terminal construction and modernization [16].



Nevertheless, the transport productive capacities are not yet on a par with the needs of Russia's economy.

## 4 Conclusions

The transport complex has been developing in the dynamically changing conditions of indefinite exposure to the internal environment (breaking logistics chains and other negative consequences caused by COVID-19 pandemic) and of competitive challenges coming from the external environment (globalization processes, sanctions). The present reality characterized by the extensive funding of motorway repairs and motor transport infrastructure development gives hope for a positive change towards further development, which is also confirmed by the forecasts based on the current dynamic changes. The short-term forecast allows making strategic priorities in the transport complex development within the framework of the national economy structure for the nearest 5 years [17,18]. From our point of view, such priorities should include short-term strategic planning since the implementation of the previous long-term programs and strategies showed poor efficiency.

Thus, the short-term strategy and programs of its implementation should be the primary objectives of the public legal and regulatory mechanisms of the strategic development of transport complex.

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