УДК 338.4.62.

PROBLEMS OF DEVELOPMENT OF THE GENERAL THEORY OF TRANSPORT SYSTEMS

Glushchenko V.
Professor of the Department of SMART Technologies, Moscow Polytechnic University, Russia, Moscow
https://doi.org/10.5281/zenodo.10975478

Abstract

The subject of the article is the methodological provisions of the general theory of transport systems; the object of the article is the transport system; the purpose of the article is to increase the efficiency of the processes of designing and restructuring transport systems; to achieve this goal, the article solves the following tasks: the theoretical provisions of the general theory of the development and functioning of transport systems (transportology) are developed; a comparative analysis of the organizational structures of innovative activities in transport engineering; the specifics of innovative entrepreneurship in the conditions of the global crisis are described; the provisions of the criterion approach in the theory of the firm are being developed; it is shown that the formation of clusters and technological platforms as new organizational forms of innovation development is associated with the need to decentralize decision-making and more fully take into account the interests of all participants in the innovation process, including individuals and small innovative firms; the research methods in the article are historical, logical and system analysis; synthesis; firm theory; theory of hierarchical systems; the scientific novelty of the article is connected with the formation of the methodology of design and restructuring of transport systems

Keywords: transport, science, analysis, innovation, structure, theory, firm, globalization, market, criterion, crisis, analysis, methodology

Introduction. The relevance of this article in 2023 is determined by the activation of the design processes of new and restructuring of existing transport systems under the influence of the global crisis.

The scientific hypothesis of this article is the assumption that in order to increase the efficiency of the processes of designing and restructuring transport systems, it is necessary to develop the methodology of the general theory of transport systems (transportology).

The purpose of the article is to increase the efficiency of the processes of design and restructuring of transport systems.

To achieve this goal, the following tasks are being solved:

- the concept, content and significance of the organization of innovation activity for the economy and global scientific and technological progress (STP) are investigated;

- research of trends and problems of formation of organizational infrastructure of innovation activity in Russia;

- development of methodology and comparative analysis of the effectiveness of organizational structures of innovation activity in mechanical engineering;

-formation of methodological provisions of the general theory of transport systems (transportology).

The object of the article is the transport system.

The subject of the article is methodological provisions of transportology, methods of comparative analysis of the effectiveness of organizational structures of innovation activity.

We will perform an analysis of scientific publications on the topic of this article. Scientists believe that in the conditions of the formation of a new technological order, the clustering of the economy is taking place [1, pp. 38-45; 2, pp. 435-440; 3, p. 2]. Analysts note the great influence of transport on socio-economic development [4, pp. 17-23]. This leads to the need of development of the theory of transport systems [5, p. 2] . Philosophers Express a point of view about the necessity of advancing the development of science [6, p. 2]. Scientists are conducting research systems of socio-economic processes [7, p. 2]. Analysts say the strong impact of risks on the socio-economic result of innovative projects [8, pp. 37 - 46; 9, p. 2]. To accelerate scientific and technological progress of the state and private companies to form programs of innovative activities [10, p. 2]. States develop the institutional system to support innovation [11, pp. 131-141]. Experts note a high level of risks in innovation activity [12, pp. 456-465]. The European Union is creating risk management programs in the field of innovation [13]. Scientists develop methods of risk identification [14, p.2]. With purpose of increase of efficiency of innovative activity in the European Union create a technology platform [15, p. 2]. In economic theory developing the theory of the firm [16, p. 2]. Analysts believe that corporations can be subjects of management geopolitical risk investment and innovation activities [17, pp. 201-212]. Scientists believe that in a crisis it is necessary to manage the risks of firms' activities [18, p.2]. Experts believe that the effectiveness of innovation activities can be improved by creating a system of strategic management of innovative activities of firms [19, p.2]. Analysts believe that enterprises should develop their own innovation policy and strategy [20, p.2].Experts note the important role of innovation finance [21, p.2]. Scientists create a general theory of scientific activity to solve problems of improving the efficiency of innovation [22, p.2]. Analysts are developing new ways to activate innovation activities [23, pp. 29-31]. University teachers and students form methods of designing the sphere of transport services [24, pp. 99-115]. Experts develop the theoretical foundations of

transport systems [25, pp. 4-12].The analysis of scientific publications carried out in this article confirms the relevance of the topic of this article.

Method. The object of this article is transport systems of all hierarchical levels (global, regional, national, local, corporate).

We agree to take into account the increasing influence of the methodology and organizational structures of science and innovation on the pace and efficiency of the development of the national transport system in the context of the global crisis, sanctions. From the point of view of philosophy in the field of technology, the transport industry currently requires (taking into account the acceleration of scientific and technological progress) the transition to an advanced model of the relationship between science and technology. Such an advanced model of the relationship between science and technology is characterized by the fact that the initiative to introduce innovations should come not from engineers (or inventors), but from scientists. This approach ensures the transformation of scientific knowledge into technical tools [6, pp. 24-25]. The model of advanced development of science should be reflected in the methodology and organization of science. The need to develop and improve a new scientific discipline, the object of study of which is the transport system, is associated with the following factors:

- the increased importance of the transport system for the world economy, state, economy and society in the context of globalization;
- changes in the nature and topological structure of the economy as a result of the global crisis, which will lead to the redistribution of freight and passenger flows, and therefore to the need for restructuring and further development of the entire transport system;
- the expected emergence of new and hybrid modes of transport, the use of known modes of transport for new purposes;
- increased competition between different modes of transport in a crisis of customer solvency;
- the need to develop ecological (green) transport;
- the need to increase the level of complexity in providing transport services to customers;
- the growing importance of the transport system for the competitiveness of corporations in the context of the global crisis and much more.

The study of the innovation management system can be considered as one of the effective tools for improving the efficiency of innovation. The structure of the management system is called the way of its organization, a set of elements, departments and links between them [7, p. 191].

The design and study of the organizational structure of innovation activity should be based on the study of its departmentalization - a way of dividing an organization into relatively independent units. Two principles of departmentalization are considered the most important, namely, the allocation of divisions in the organization and their grouping around the work or result (product) [7, p. 191].

In a market economy, the methodology and organizational structure of scientific and innovative activities in the national transport system should cover and allow for effective coordination of all the necessary elements of an innovation project, up to the desired practical social and economic result. Such an organizational structure should allow solving scientific, technical, financial and other problems inherent in an innovative project in a systematic unity and effectively. These problems of an innovative project can be considered as a set of risk events inherent in an innovative project in mechanical engineering. The analysis and assessment of the impact of various risks on the financial result of an innovative project is carried out in the article [8, pp. 45-46]. In the future, in this article we will proceed from the fact that the study of the methodology and organization of innovation activities in the national transport system should focus primarily on whether the current methodology and organizational structure of science and innovation management correspond to the tasks they solve or not [7, p. 191].

In the process of comparative analysis of organizational structures of innovation activity, it should be taken into account that corporations are currently the most economically significant form of innovative entrepreneurship (business). Transnational and national corporations perform a set of functions and play a set of roles in modern globalization, including innovations, STP.

The innovative activity of corporations is so important for scientific and technological progress (STP) that it can be considered as one of the motives for the development of globalization. Earlier studies have shown that one of the reasons for modern globalization may be the increase in the resource intensity of innovation. Therefore, in order for resource-intensive innovations, for example, the development of the Airbus A-380 (which, according to media reports, cost $ 10 billion before entering flight tests), a global market is needed. This allowed us to put forward an innovative hypothesis of the nature of modern globalization: globalization is associated with an increase in the resource intensity of innovations and the need to increase the capacity of markets to obtain positive financial results from these innovations. 9, p. 61. The hypothesis of the innovative nature of globalization is confirmed by world statistics and practice. At the beginning of the 21st century, corporations account for more than a quarter of the global production of goods and services, and three hundred of them owned 25% of the total capital used in the global economy and provided 70% of foreign direct investment [9, p. 14].

На долю научно-технического прогресса в развитых странах приходится до 70-80% прироста ВВП [10, с. 15]. Инвестиции в США в НИОКР, финансирование технологий и науки составили в 1998 году 221 млрд. долл. США, в 1999 году они составляли уже 236 млрд. долл. США (рост на 7% в год) [10, с. 11]. При этом глобальные финансовые результаты таковы, что корпорации США получили из-за рубежа только в виде роялти и лицензионных вознаграждений в 1996 году $ 129,8 млрд.

Поэтому, инновации выступают не только как объект инвестиционной деятельности, но и как фактор конкурентоспособности продукции, источник

финансирования развития корпораций и государств, стимул к инвестиционной деятельности. Это создает экономическую основу для развития частно - государственного партнерства в сфере инновационной деятельности в национальной транспортной системе. В связи с этим были исследованы направления и критерии совершенствования институциональной системы государственной поддержки инновационной деятельности [11,с. 131-141].

The share of scientific and technological progress in developed countries accounts for up to 70-80% of GDP growth [10, p. 15]. Investments in the USA in R&D, technology and science financing amounted to 221 billion US dollars in 1998, in 1999 they were already 236 billion US dollars (an increase of 7% per year) [10, p. 11]. At the same time, the global financial results are such that US corporations received $129.8 billion from abroad only in the form of royalties and licensing fees in 1996.

Therefore, innovations act not only as an object of investment activity, but also as a factor of product competitiveness, a source of financing for the development of corporations and states, an incentive to investment activity. This creates an economic basis for the development of public-private partnership in the field of innovation in the national transport system. In this regard, the directions and criteria for improving the institutional system of state support for innovation were investigated [11, pp. 131-141].

The motivating reasons for the intensification of innovation activities in public and private corporations may be such considerations.

Firstly, it became clear that the shortcomings of the development of the investment and innovation sphere of the national transport system can be a serious restriction on the freedom of investment and price decisions by corporations.

Secondly, the urgency, the need to develop investment and innovation activities in the national transport system is explained by the possibility of introducing restrictions in the context of the global crisis.

Thirdly, the high level of depreciation of fixed assets.

Fourth, the lag of the transport industry in the field of innovation and high technology from other countries.

Fifth, the relevance of the implementation of plans to create new high-tech jobs.

Sixth, the level of technological development of transport affects the direction of investment flows in the global economy in such a way that 80% of investments are cross-investments of economic entities of developed countries. Therefore, countries need to diversify their economies and develop innovations in order to attract foreign investment.

A change in the approach to the methodology and organization of innovative activities in the transport system is required. The transition to the entrepreneurial paradigm and public-private partnership in innovation activities in the national transport system is necessary.

Innovative entrepreneurship in the transport system is the regular activity of market entities, financial and economic activities aimed at: the search for undetected or unsatisfied public needs in the field of transport; the implementation of a set of innovative projects (innovation basket) in the national transport system aimed at satisfying the transport needs of the economy. The goals of innovations in the field of transport can be: fuller satisfaction of public needs for transport services; profit; ensuring capital growth; improving the competitiveness of corporate organizations and the national economy.

The goals of innovative entrepreneurship at the level of a transport organization are: fuller satisfaction of public needs for transport services, maximizing profits (in the short term); maximizing the value of the company (in the long term).

The goals of innovative entrepreneurship in the national transport system at the state level should be recognized as the creation of more comfortable and safe conditions for the population to receive transport services.

In the process of state regulation and financing of innovative activities in the national transport system, the following specifics of innovative entrepreneurship should be taken into account: in the process of such entrepreneurship, a systematic unification of scientific potential, financial, technological and natural resources takes place; intangible assets of the organization are much more important and influential (than in ordinary entrepreneurship); as a result of the implementation of innovative entrepreneurship, an increment occurs scientific knowledge of the company and intangible assets of the organization; a high level of risks and uncertainty of the results of innovative entrepreneurship in the context of globalization.

The object of innovative entrepreneurship in the transport system is innovative projects aimed at improving existing or creating new goods and services, technologies for their production and consumption. The main problem of innovative entrepreneurship in the regional transport system is the ability of a team of innovators to design and implement new goods or services on the global and/or regional market that can more fully satisfy public needs for transport services and bring profit.

At the same time, at the beginning of the 21st century, in innovative entrepreneurship in the transport system, industrial (from need to its satisfaction) and post-industrial approaches can be distinguished (from technical capability to the creation of a new need and its subsequent satisfaction due to this new technical capability).

One of the most important methodological problems of organizing the commercialization of knowledge and innovation in the transport system can be called the underdevelopment of innovative organizational philosophy, culture and organizational structure based on market principles (freedom of competition and transactions, actions in their own interests, equal access to information, etc.).

The infrastructure of innovative entrepreneurship in the transport system consists of: inventors (know-how), scientific organizations (research institutes and design bureaus), venture investors (funds), technology

parks, business angels, business incubators, accelerators and more.

As you know, venture (risk) funds are financial institutions whose specialization is portfolio investment (a typical investment ranging from 1 to 5 million dollars per project) in innovative enterprises with the aim of rapid growth in the cost of capital (but not profitability). As a rule, 70-80% of projects do not provide capital growth, but the increase in the value of the shares from the remaining 20-30% of investments recoups all losses from unsuccessful investments in innovation.

Business angels focus their business activity on financial investments in companies at the earliest stage of development. The invested amount is from 50 to 300 thousand dollars. US dollars in the project.

It should be noted that successful innovative entrepreneurship sets the task of harmonizing relations between all infrastructural elements of this entrepreneurship and the process of commercialization of innovations. At the same time, almost all Western accelerators of innovative entrepreneurship are financed by individuals and companies. For example, Techstars reports on its website that it is funded by more than 75 venture funds and business angels. Abroad, competition among business angels for promising innovative projects and businesses is great. Foreign leading players in this market seek to gain access to potentially successful innovative organizations at an early stage, when such organizations are too small for them.

Mentoring provides an innovative entrepreneur with methodological, moral, and psychological support in key decision-making situations. In essence, we are talking about the "umbrella" mode of operation of small innovative firms at corporations (for example, in Japan) interested in the development of relevant innovations.

Mentoring in the form of increased attention (from the state, society, business associations, corporations) to innovative business, its problems reduces the risks of such entrepreneurship, increases the likelihood of timely solving the problems facing the entrepreneur, increases the psychological stability of the innovative entrepreneur in the process of solving problems.

Foreign statistics show that in the early 1990s, the share of successful innovative projects in Japan was 60%, in the UK - 54%. At the same time, the total share of commercially unsuccessful projects has remained steadily high over the past decades: from 40 to 60% [12].

Mentoring, connections in industrial and financial circles make it possible to optimize the "development trajectory" of an innovative enterprise, minimize costs and risks when creating a financial, technological, trade infrastructure of an innovative business.

A certain methodological problem of innovative entrepreneurship can be recognized as the lack of systematic scientific and methodological support for innovative business. At the same time, as part of the development of the theoretical foundations of innovation, the experts of the European Community pay great attention to risk management in the implementation of innovative projects. European experts formulate concepts that combine the theories of innovation management and risk theory [13].

At the beginning of the 21st century, scientists are actively engaged in the problems of studying the organizational risks of innovative projects and assessing the impact of these risks on the success of an innovative project. Considering the risks of innovative projects in a strategic context requires a special attitude to the organizational aspects of the processes of development and introduction of new products [14, p.6].

The additional relevance of the organization of risk research, the development of this particular area of methodological support for innovations in the national transport system in a global market is increasing due to the fact that, as is known, the global financial crisis broke out in 2008. For the organization of innovative activities in the national transport system, such a crisis is characterized by additional risk factors: an aggravation of the global struggle for resources, including financial and intellectual resources that have come to the fore; a tightening of the struggle for product sales markets; attempts by national governments to limit the offshore business of corporations (political risk); an increase in inflation and currency risks; an increase in geopolitical and political risk (sanctions, etc.).

At the same time, the theoretical understanding of the essence of the organization of innovation and the place of corporations in the field of innovation, the expression of this essence in the form of a scientific theory of the firm, is also relevant. Innovative entrepreneurship is more developed in the following types of corporations: consortia, trusts, financial and industrial groups.

The methodology of comparative analysis of organizational structures of innovation activity should be based on the study of factors and properties of a certain corporate, organizational structure that affect the very possibility and results of innovation activity.

The consortium is a temporary corporate association of legally independent organizations in the interests of developing a new innovative product, reducing the costs of such developments. For example, Airbus began as an association (consortium) of organizations from 10 European countries. Currently, the Renault-Nissan automobile consortium (France-Japan) is known. Such an association allows its participants to: reduce the total costs of new developments; unify platforms, nodes and aggregates, and more. All together, this generates the effect of reducing costs per unit of production with an increase in production volumes (the "scale effect" works).

A trust is a corporate association of organizations engaged in the development, production and sale of similar types of products. The organizational structure of the trust makes it possible to implement programs for the unification of parts and assemblies of similar goods, increase their output and use the scale effect of production to increase financial results (profit).

The Financial and Industrial Group (FPG) is a vertically integrated business structure that allows you to implement the entire cycle of development, testing, production of innovative goods and services, starting with the extraction of raw materials and ending with finished products.

Trusts and FPG can be created by exchanging shares between their member organizations, creating one legal entity, etc.

At the beginning of the 21st century, technological platforms are being formed in the European Union. A technological platform is understood as a communication tool aimed at: attracting new resources; commercialization of knowledge and technologies; improving the regulatory framework for innovative development; creating new products based on the participation of all stakeholders (government, business, civil society) [15]. At the same time, technology clusters are being actively created in the USA and other countries.

In organizing the processes of innovation development in the country, it is also important to understand that the most economically and socially significant experiences of small innovative entrepreneurship lead to the creation of global high-tech corporations.

Effective organization of innovative activity of subjects of the national transport system should be based on a more general theory (theory of the firm). It is known that R. Coase put forward the theory of a firm (corporation) as a way to reduce transaction costs of economic activity within a group of enterprises (firms). R. Coase defined the firm as follows: "A firm ... is a system of relations when the direction of resources begins to depend on the entrepreneur" [16, p.205].

Within the framework of a systematic approach in economic theory, it can be said that the entry of a separate enterprise into a corporation can allow such an association of enterprises within the transport system to achieve the following results: to ensure the complexity of transport services provided; to increase the economic efficiency of joint activities of several organizations (enterprises), reduce their total costs, risks, increase liquidity or reduce the execution time operations; reduce the financial cycle of the aggregate corporate structure [17, pp. 201-212]. Based on the study of the roles of corporations , such a definition can be given: "A corporation is a complex subject of financial and economic activity, in the conditions of globalization, performing the roles of: globalization of the economy, information space and socio-cultural life; concentration of capital; optimization of intersectoral and sectoral distribution of capital; strengthening the processes of differentiation, division and specialization of labor; increasing the market stability of the corporate structure when the market conditions change; unification of requirements and cross-country staff migration; integration of fictitious and real capital; integration of entrepreneurship and management; differentiation and decentralization of management; making profits and excess profits on the basis of monopolization of markets; innovative activities to create new goods, technologies and services; protection of enterprises included in its structure from tough acquisitions and mergers; development of small and medium-sized businesses; development of demographic processes; formation of social structures of society", etc. At the same time, the corporation is an association of a number of legal entities, taking into account the distribution of functions and roles in technological and economic activities [9, p. 203].

This article develops a "criterion" approach to the study of the essence and competitiveness of corporations (firms) in the regional transport system, adopted in [18, p. 63]. With this approach, the criterion can be considered in two ways: as a quantitative reflection of the degree to which an economic entity or object has achieved its goals; as a rule, the choice of the best course of action (including investment and innovation) from a number of possible ones in a certain criterion sense. Economic indicators used in the formation of performance evaluation criteria affect the behavior of economic entities [9, p. 70]. Based on the set of effect parameters (income, costs, liquidity, time, risks) included in the criterion for evaluating the effectiveness of any corporation in the regional transport system, we can say the following.

A corporation can be competitive if it surpasses similar data of another (competing) organization in at least one of these parameters.

The dominance of the organization of the regional transport system over its competitors is expressed in the fact that this corporation has the best indicators for all the above-mentioned parameters of the effect of other organizations (income, costs, risks, liquidity and time) [9, p. 70].

Based on the income parameter, the theory of the firm can be formulated as follows: "A corporation (firm) is a system of relations when the allocation of resources to a new enterprise (production) begins to increase overall profitability (or profit)." If, within the framework of the criterion approach to the analysis of the essence of a corporation, the understanding of competition as cost reduction is taken as a basis, then the theory of the firm (corporation) can be formulated as follows: "A corporation (firm) is a system of relations when the inclusion of a new enterprise (production, division) in it reduces the overall costs of the organization to achieve the goal" (minimizing transaction costs according to R. Coase).

Based on the liquidity parameter, we can say: "A corporation (firm) is a system of relations that allows you to increase the liquidity of an organization in the process of achieving its goals."

Within the framework of the criterion approach to the study of the essence and competitiveness of corporations of the national transport system, it is rational to include the time factor among the considered parameters of activity. It is known that any organization (regardless of its nature and purpose) has its own internal space and time. The pace of the passage of time in the corporation of the national transport system should be related to the speed of: firstly, changes in the external environment of the organization; secondly, the speed of processes within the corporation, including exchange of information processes, between the system and its subsystems. The management that ensures the finding of an object of innovation and/or investment activity in the field of controlled states with a probability higher than a given one will be called real-time risk management [9, p.70].

A comparative analysis of the time indicator (duration of the production cycle) allows us to conclude: "A corporation (firm) is a system of relations when the

inclusion of a new enterprise (production, division) in it reduces the total time spent on achieving the set goal of the entire corporation."

Within the framework of the "risk" theory of a corporation, we will argue that a corporation (firm) is a system of relations when an entrepreneur is still able to control (manage) the entire set of risks (and damages) associated with the business (businesses) being carried out, including innovative projects. An excessive number of divisions, areas of activity or markets in which the corporation operates causes an increase in risk and the transition of risk into the category of catastrophic risk. In other words, within the framework of the risk theory of the firm (corporation), it can be argued that the boundaries of the firm are determined by the ability of the organization's management to manage the total risk of activity (including innovation), providing acceptable levels of entrepreneurial risk in the management process.

The risk of an innovative project can be divided into external and internal. The external (wars, embargoes, etc.) risk of an innovative project may be fundamental, which means that the corporation does not have the ability to manage this risk.

The criterion approach creates conditions for a comprehensive analysis of the activities of the firm (corporation) of the national transport system. At the same time, each of the effect parameters can be considered as a direction for improving the corporation's activities.

To ensure the competitiveness of the company, it is necessary to manage such indicators of its efficiency as income (profit), costs, process time, asset liquidity, risks. A strategic approach in the management of innovative projects and the formation of an organization's innovation policy can improve the efficiency of innovative project management [19, p.5; 15, p. 3].

The policy of innovative entrepreneurship can be called a set of measures aimed at achieving a positive social, financial result of an innovative project. Consensual and confrontational approaches are possible in the policy of innovative entrepreneurship. The methodology for the formation of an entrepreneur's innovation policy is formed in the work [20, p.19].

Organizational and innovative activities cover not only scientific, technological, design problems, but also finance. The peculiarities of distributive monetary relations in innovation have caused the need for the formation of innovation finance. Monetary distributive and redistributive relations consisting in the formation and use of funds of funds in the process of innovation activity are called the finances of innovation activity [21, p.60].

To plan and evaluate financial results taking into account risks in innovative entrepreneurship, it is possible to use the methodology proposed in the article [8, pp. 38-46]. As already noted, since 2008, new organizational forms of innovation activity have been intensively developing abroad with the support and regulation of states: clusters and technological platforms.

"Cluster" is an institute for the development of innovation activity based on the concentration of companies, research institutes, universities, public organizations, mentoring groups, technology parks, innovation incubators and other organizations working on the same topic in a certain territory. In the cluster, the synergetic effect of a disproportionately large increase in the efficiency of innovation activities is provided by a large concentration of organizations, creative people working in the same industry. On the basis of competition and concentration of interconnected economic entities, new ideas, services, products, companies and new skills can arise. This synergistic effect can arise as a result of the effect of collective generation of ideas. Research has shown that collective idea generation provides more useful ideas than independent research [22, p.27].

It is proposed to build hierarchically and functionally interconnected scientific platforms in the regional transport system for greater product orientation (reorientation from resource orientation to product orientation). These scientific platforms in the regional transport system (machine-technological, operational, information, etc.) should be responsible for the efficiency of spending allocated resources (including budget financing) in the interests of achieving scientific and practical results of scientific research and innovative projects (product orientation).

The scientific platform can be called a systematic combination of scientific knowledge from various branches of science, technology and technology that participate in the formation and implementation of the idea of safe and economical creation during innovative projects and the implementation of the full life cycle of mechanical engineering products [22, p.67] and the production of services in the regional transport system.

Each scientific platform is a system-forming and coordinating top of the "scientific (innovation) pyramid", which includes the following levels:

- the "production (technological)" platform represents a set of organizations involved in the preparation of production and the implementation of the production of innovative means of transport;
- "circulation platform (trading platform)"- this is a set of organizations that are responsible for the development, promotion and implementation of innovative transport services;
- "operational platform (after-sales service platform)" unites organizations that provide after-sales service of means of transport and infrastructure in the transport system;
- an accompanying service platform providing information and other types of services related to the provision of transport services to consumers;
- the "recycling platform" includes organizations that carry out the disposal of vehicles that have worked out their assigned service life (resource) [22, p.54].

These organizationally flexible entities in the national transport system function in cooperation with scientific public organizations (civil society) within the framework of the concept of crowdsourcing, which makes it possible to increase the role of fundamental science in choosing priorities, selecting project participants and solving other tasks of innovative activity [23, pp. 29-31].

The objective need to expand the public (social) intellectual base of innovation activity in the regional transport system beyond the narrowly professional community is explained by the importance of transport for society and the economy, the complexity of the process of formalizing social needs and ways to meet them during innovation activities against the background of limited intellectual resources of the professional academic community.

Unlike corporations with their rigid administrative hierarchy and innovative culture, it is clusters and scientific platforms that allow for more flexible incorporation of participants who have the necessary in a particular innovative project and on this basis more successfully solve the problems of innovative projects.

A comparative analysis of the organizational features of clusters and technological, scientific platforms suggests that the emergence of clusters and technological platforms abroad as new organizational forms of innovation development is associated with the need to expand the public intellectual base of innovation, decentralize decision-making and more fully take into account the interests of all participants in the innovation process, including individuals and small innovative firms.

It is probably these organizational features of clusters and scientific and technological platforms that create a strategic competitive advantage for them in relation to all types of corporations in the future. At the same time, the very concept of organizational structure in clusters and scientific and technological platforms is transformed into the concept of "architecture of innovation activity".

The architecture of modern scientific and innovative activity in the transport system can be called conceptual (based on the understanding of the innovation system) the structure of scientific and innovative activity, which determines the sequence of solving scientific problems, conducting information processing and including methods of obtaining information and converting it into data and principles of interaction of project participants (personnel), hardware and software in the implementation of scientific and innovative projects in the transport system.

Based on the results of the research in this article, conclusions can be drawn that due to the changes taking place in scientific and technological progress, the scientific sphere, the change of strategies in the markets (the transition from a sales strategy to a marketing strategy), a change in organizational forms, the architecture of scientific and innovative activities is required [22, p.53] and in the transport system. When building the architecture of the innovation component (subsystem), the features of the transport system should also be taken into account.

We will agree to call the transport system a set of all types of transport that ensure the connectivity of the economic and social structure of a region (or state) in the process of their functioning and development through the provision of transport services. Transport services consist in the movement of people and/or goods with specified safety, reliability and quality indicators. The methodology of designing the sphere of railway transport services is reflected in the work [24, p.99-115].

It is also important that the transport system belongs to the category of large systems and has the following properties:

1) heterogeneity and a large number of elements of the transport system (types of transport: aviation, automobile, railway, sea, river, pipeline; various vehicles; infrastructure; personnel; resources; energy supply, legal regulation, etc.);

2) emergence - irreducibility of the sum of the properties of the transport system as a whole to the properties of its individual elements (for example, no single mode of transport or vehicle can replace the entire system as a whole);

3) hierarchy - the presence of several levels (global, regional, national, local, corporate, etc.) of the transport system and ways to achieve the goals of the corresponding levels, which can generate intra- and inter-level conflicts in the transport system;

4) aggregation - combining several parameters of a lower hierarchical level transport system into parameters of a higher hierarchical level transport system (lower level parameters are reflected in the aggregated parameters of the higher level);

5) multifunctionality - the ability of a large transport system to implement a certain set of functions on a given structure, which manifests itself in the properties of flexibility, adaptation, survivability;

6) flexibility - the property of a transport system to change the purpose of its functioning depending on the external operating conditions or the state of its subsystems;

7) adaptation - changing the objectives of the functioning of the transport system when the external conditions of operation change;

8) reliability is the property of a transport system to implement specified functions for a certain period of time with specified quality indicators (parameters);

9) safety - the ability of the transport system not to cause unacceptable impacts to technical facilities, personnel, and the environment during its operation;

10) durability - the property of the transport system to perform its functions when the parameters of the external environment go beyond certain limitations or tolerances (for mechanical systems, they talk about a margin of safety);

11) vulnerability - the ability of the transport system to receive (or not receive) damage when exposed to external and/or internal damaging factors of various nature;

12) survivability is the ability of a transport system to change the purpose of functioning in case of failure and (or) damage to elements.

When creating a scientific, innovative platform in the national transport system, a certain methodological basis is required. Such a methodological framework should cover all scientific problems (quite diverse: marketing and design of transport services, transport engineering, design, finance, monetary relations, etc.) of an innovative project in the national transport system. Due to the rapid complication of the content of innovative projects, the development of a new, broader

scientific, methodological basis of the modern national transport system - transportology - is becoming extremely relevant.

Let's agree to call transportology the science of the creation, innovative modernization and functioning of the national transport system, which covers a complex of scientific problems, including philosophy, ideology, politics, motives, methods, methods, tools, technologies for the creation of the national transport system, its elements, their circulation and use in the provision of transport services up to the moment of their disposal, and there are also methods for assessing the impact of the national transport system on the economy and society.

We will describe the scientific method, object, subject, functions and roles of transportology. The scientific method in transportology will be called a system of principles and techniques by which objective knowledge of the processes and socio-economic results of innovation, design, creation, circulation, use, modernization, utilization of elements of the national transport system is achieved.

The functions (from the word "I perform") of transportology are that within the framework of transportology can be done in the geopolitical, political, social, economic, technological, ecological subsystems of the state and society.

The economic and social role (significance) of transportology is determined by the effectiveness of the performance of those functions that it performs in relation to meeting the needs of society.

The main functions of transportology will be considered: methodological, cognitive, instrumental, legislative, optimization, prognostic, preventive, psychological functions, the function of socialization of knowledge, minimization of technogenic and environmental risks.

The methodological function of transportology consists in the formation of a conceptual apparatus, theoretical foundations and methodology for the study of phenomena and processes, the formulation of laws and categories of the transport system, the development of tools for managing the life cycle of the transport system and its elements in order to maximize the effectiveness of their use, minimize damage from man-made risks and ensure the effectiveness of policies (systems of measures) in the development of national transport systems.

The cognitive function of transportology integrates the processes of accumulation, description, study of the facts of reality in the transport system at various levels (global, national, sectoral, regional, etc.), analysis of specific phenomena and processes in the cancers of the life cycle of the transport system and its elements, identification of the most important problems and sources of development of the transport system, justification of individual measures and development programs transport system.

The instrumental (regulatory) function of tranportology reflects the practical nature of this science, and consists in: developing tools for managing the life cycle of the transport system and its elements; developing practical recommendations for government agencies, experimental design (R&D) organizations, machine-building industries that produce products for the transport system and its components; preliminary assessment of the effectiveness of R&D, R&D, production and operation, modernization and disposal of products (goods and services) within the transport system.

The legislative function of transportology manifests itself in the process of substantiating the need and developing certain legal norms that contribute to the development of the transport system, forms of liability for damage to third parties, personnel and society as a whole at all stages of the life cycle of the transport system and its elements, etc.

The optimization function of transportology consists in choosing the best methods and techniques for implementing both individual stages and the entire life cycle of services in the transport system and its technical and technological elements.

The prognostic function of transportology includes an assessment of the state of the transport system, economy and society in the future from the point of view of the possibility of developing certain areas (subsystems and elements) of the transport system, reducing dangerous levels of functioning in the transport system, modeling social and economic processes in the transport system and their changes under the influence of scientific and technological progress and information technologies.

The preventive function of transportology can find its expression in carrying out proactive and preventive measures based on the results of forecasting the possibility of the development of technical and economic crises, man-made disasters, technological crises and other types of negative phenomena arising from the development of global, regional and national transport systems.

The psychological function of transportology consists in the orientation of citizens to the continuous development of innovation and scientific and technological progress in the field of the transport system, the orientation of society to the sustainable nature and effective management of scientific and technological progress in the transport system.

The function of socialization of knowledge in the field of transportology is to disseminate knowledge about the transport system and the need to take effective measures to develop the transport system among the general population. The implementation of the function of socialization of transportology is important to ensure the sustainability of development and progressive legal support for the development and functioning of the transport system and its elements.

The roles of transportology are proposed to be recognized: firstly, optimization of the processes of development of scientific and innovative support of the transport system; secondly, reduction of risks in the development and functioning of the transport system, implementation of innovative projects; thirdly, increasing the financial results of functioning and innovation in the transport system.

Let us agree to call the laws of transportology stable cause-and-effect relationships, the interaction of

parts and relationships that arise in the process of functioning and development of the transport system. The following laws of transportology can be formulated:

1. The development of the transport system in the 21st century leads to an increase in the complexity and, accordingly, the resource intensity of innovative projects;

2. There is a reduction in the development and implementation of new innovative projects in the transport system;

3. The pace of scientific and technological progress in the national transport system is accelerating;

4. The main directions of improving the services of the transport system in the 21st century are: expansion of the functional completeness of transport services, fuller satisfaction of the needs of buyers, ensuring cost reduction, greater convenience and safety of transport services for users and staff.

5. Scientific and technological progress in the transport system is continuous, but may be accompanied by qualitative leaps, which most often occur in the time periods between the so-called "technological generations" and "technological modes";

6. There is a so-called "technological pyramid" in the transport system, at the top level of which there are companies synthesizing new technological principles, then there are companies implementing these principles in their new developments, producing vehicles in transport engineering, after that there are companies producing transport services for other sectors of the economy using vehicles and societies.

6. In the process of providing transport services, there is both cooperation and competition between different modes of transport.

7. Technologies for the provision of transport services belong to the category of multi-link technologies, closely integrated with information technologies.

8. The risks of competence of personnel and/or project participants significantly affect the safety, reliability of the transport system and the financial result of an innovative project in the transport system.

9. The list of laws of transportology is not closed and is updated based on the results of the development of the transport system and discussion of their scientific and technical community.

Discussion. Further development of the general theory of transport systems will allow: to increase the efficiency of innovation activities in the creation and restructuring of transport systems of various hierarchical levels (global, regional, national, local, corporate); to more accurately predict the development of transport systems; to synthesize ideas of innovative projects and more.

This article proposes to develop and clarify the interpretation of the concept of "scientific platform in the transport system". It is proposed to call the scientific platform in the transport system a systematic association of scientific knowledge from various branches of science involved in the formation and implementation of the idea of safe and economical creation during innovative projects and the implementation of the full life cycle of products in the transport system. The list of scientific directions that participate in the implementation of an innovative project in mechanical engineering reflects the data obtained on the basis of an analysis of the work performed during the innovation project 8,pp. 37-46. Within the framework of transportology, when implementing innovative projects, not only technical problems are scientifically solved, but also problems of global competition, scientific and technological progress, the forecast of monetary policy, etc. All these problems are in system connection with each other and technical problems of the project. This fundamentally complicates the work of the participants of the innovation project, who must take into account these systemic connections when making decisions.

- The architecture of the scientific platform in the national transport system and transport engineering should be aimed at providing scientific support for an innovative project to the full depth of the life cycle of an innovative project. Therefore, the scientific platform in the national transport system should include scientific platforms at the stages of development of transport services, innovative products of transport engineering, production of these products, their operation and disposal.
- The essence of the scientific platform in the national transport system can be studied from several points of view. From an organizational point of view, a scientific platform is a set of scientific organizations (or their divisions) – its structural elements and links between them.
- From an institutional point of view, a scientific platform in the national transport system is a set of relations (rules of the game) that arise between participants of innovative projects in the process of solving scientific problems related to this project.
- From the point of view of personnel management of the innovation project, the scientific platform should include methods for assessing the competence of participants in the innovation project. The development of transportology as a methodological basis for creating a scientific platform for the development of innovative activities in the national transport system will reduce the risks of competence.
- Competence risk is the risk of financial losses due to reasons related to the lack of competence of personnel engaged in the implementation of innovative projects. During the functioning of the scientific platform of innovation in mechanical engineering, it is necessary to constantly analyze and improve the competence of participants in innovation activities.
- Competence is usually understood as having a certain competence - knowledge and experience of one's own activities. The competence of a participant in innovation activity can be understood as the possession of a certain competence as a system of knowledge and practical experience necessary for the creation of a competitive innovative product or service by a team of participants. The competence structure of the participant of the innovation project is proposed to be called the systemic unity of his competencies that allow him to solve the problems of the project that are in the sphere of his responsibility.

• The qualification requirements for the project participant include the competencies that he must possess in order to successfully solve the project tasks assigned to him within the framework of this project.

Within the framework of transportology, a project team participates in an innovative project, which must solve the whole set of marketing, design, technological, organizational and financial tasks arising during an innovative project.

The innovative project will be successful, provided that the project team can solve a number of interrelated scientific, technical, technological, economic problems. In order to solve the totality of problems, the team of participants in an innovative project must work harmoniously as a whole and solve specific scientific problems of this innovative project in the context of the goals and objectives of this innovative project.

The competence analysis of an innovative project participant is the establishment of logical links between the assessment of the competence of a project participant and the observed, obtained technical, technological, and financial characteristics of the project.

Competence analysis should be carried out taking into account the hierarchical position of the project participant (specialist, head of technical direction, project manager) who are in various functional and job positions in the project.

Conclusion. This article develops the methodological provisions of the general theory of the functioning and development of the transport system (transportology) and its innovative component, conducts a comparative analysis of the organization and architecture of innovation, innovative entrepreneurship, examines the problems and specifics of the organization of innovative entrepreneurship in a global crisis, develops a criterion approach to the analysis of the essence and competitiveness of a corporation (firm) and risk theory firms, suggested and justified, that the emergence of clusters and technology platforms abroad as new organizational forms of innovation development is associated with the need to decentralize decision-making and more fully take into account the interests of all participants in the innovation process, including individuals and small innovative firms.

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