

DETERMINATION OF FACTORS OF TERRITORIAL CONNECTION OF THE COUNTRY FOR DEVELOPMENT OF MULTIMODAL AIR TRANSPORT SYSTEM

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In modern economic realities, scientific and technical programs and innovative projects of a full cycle should become the dominant tools necessary for the effective implementation of the strategy of scientific and technological development of the Russian Federation. Specially created councils, the scope of which is related to the determination of priorities in the development of national science, should carry out the procedures for the formation and expert selection of innovative programs / projects of the full cycle. A list of complex scientific and technological projects proposed in the formation of the list of measures for 2020-2022 within the framework of the subprogram "Aviation Science and Technology" of the State Program of the Russian Federation "Development of Aviation Industry for 2013-2025" was compiled. A list of general goals of scientific and technological development of aircraft construction is presented. The most priority directions of scientific and technological development of modern civil aircraft construction have been determined. The authors considered the main goals, objectives and composition of the components included in the integrated air transport system. As a practical example, the formation of the appearance of a promising air transport system in terms of creating innovative technologies for existing and future aircraft, taking into account its integration into the multimodal transport system of the Russian Federation, is considered. The authors of the article propose a new approach to the development of a program / project of a complete innovation cycle based on the use of "gate" approach. The tasks of interaction with the Ministry of Transport of the Russian Federation on the creation of air transport system are considered.

Keywords: territorial connectivity of the country, strategic development programs, multimodal transport system, comprehensive scientific and technological programs, projects of complete innovation cycle, development of air transport system, development of territories, intelligent transport and logistics systems

1 INTRODUCTION

Currently, the Government of the Russian Federation faces an important and large task, which consists in the formation and implementation of a multi-component strategy aimed at the spatial development of the country. The process of preparing this strategy should be based on the principles of holistic, systemic and structural understanding of the country's space. It is necessary to identify a real spatial framework of the country, capable of involving the least developed territories into its orbit. To prepare a strategy for the spatial development of the Russian Federation and its implementation, it is necessary to create a national innovative ontological platform with the active involvement of leading Russian and foreign specialists. The main trends in modern spatial development are associated with concentration in a small number of subjects of the Federation, as well as in a certain inequality in terms of living standards and economic development [1, 2]. This trend of inequality is on the rise, and problems with infrastructure and efficient transport accessibility persist. At present, the organization of state planning in the field of ensuring territorial connectivity has a pronounced sectoral nature. State Program "Development of the Transport System" of the Government of the Russian Federation No. 1596 of 2017 refers to the need for the construction of various objects related to the transport infrastructure. Such objects include railways and highways, seaports, airports, large engineering structures, etc. As a part of the development of State Programs for the development of aircraft construction, it is proposed to develop the composition and structure of the air transport system, taking into account its integration into the multimodal transport system of the Russian Federation, including optimizing the fleet of aircraft, taking into account the prospects for the development of the route network, developing a promising model range and technologies necessary for its implementation [3, 4]. The purpose of the article is to determine the factors of territorial connectivity of the Russian Federation in order to organize the effective development of a multimodal transport system, which will ensure transport accessibility and territorial connectivity of the Russian Federation.

2 THEORETICAL BASIS

The priority of the departmental target program "Organizational, informational and scientific support for the implementation of State Program of the Russian Federation "Development of Transport System" is to respond to the tasks outlined in the Strategy for Scientific and Technological Development of the Russian Federation and consists in the need to effectively master and use vast spaces. Competent use of space is possible through the implementation of mechanisms to reduce the existing disproportion in the social and economic development of the country's territory. An important area within the framework of the Program is the consistent strengthening of Russia's positions in key

areas and areas related to the development and exploration of air and outer space, and the comprehensive exploration of the Arctic zone. The structural basis of fundamental decisions in the field of spatial policy is currently the priorities of the sectoral corporate level [5, 6].

The Government of the Russian Federation is implementing a set of measures to support projects and programs focused primarily on cooperation ties and interaction of various companies, but in modern economic realities, many companies and production complexes are formed as self-sufficient. The exception is the aviation industry and the defense complex, while for products manufactured by civilian industries, it is necessary to create special economic macroregions designed to unite territories, to realize at the regional level the opportunities that long-term planning provides and to reorient the budget system from interbudgetary transfers to stimulate economic development of the economy of such regions [7-9]. We consider the barriers that, to a certain extent, hinder the cohesion of the territory of the Russian Federation and its spatial development:

1. The development of Russia is under the influence of a centripetal vector. The previously developed space is shrinking, the territorial space of cities, which are federal, regional and municipal centers, is compressed. It is necessary to approach the solution of the problem of preventing the transformation of huge territories (industrial and agricultural) into "depressed" economic zones in a qualitatively new way [10-12];
2. Interregional differentiation has reached a high level, which has led to changes in the quality and living standards of the population, its economic activity in cities located mostly in the European part of Russia, while in the Far East the trend is reversed;
3. Difficult geopolitical conditions make it difficult to protect the borders and, as a result, additional funds are needed to maintain border areas [13-15];
4. The level of communication gap that exists in spatial development has reached a critical state. The overwhelming majority of zones in the Russian Federation have limited transport accessibility.

3 MATERIALS AND METHODS

The materials for the study are the analysis of State Programs and methodological documents that establish the requirements for the procedure for the formation and implementation of complex scientific and technical programs and innovative projects of a complete innovation cycle. Various proposals are considered within the framework of the technological platform to improve the management mechanisms for the creation of a scientific and technical groundwork in aircraft construction based on the concept of territorial connectivity [16-18].

General goals of scientific and technological development of aircraft construction are the following:

1. Improving the integrated safety of development, production, technical and flight operation of aviation equipment;
2. Reducing the harmful impact of aviation and aircraft construction on the environment in the development, production, technical and flight operation of aircraft;
3. Reducing the cost of transport and other aviation works and services rendered using Russian-made aviation equipment;
4. Improving the quality of transport and other aviation work and services rendered using Russian-made aviation equipment;
5. Reducing the cost and duration of development, production, maintenance and repair of Russian aircraft;
6. Increase in production and sales of Russian aircraft products;
7. Provision of self-development, production, maintenance and repair of aviation equipment (as well as its components), critical for national security [19, 20].

4 RESULTS AND DISCUSSION

We consider the priority areas related to the scientific and technological development of civil aircraft:

- formation of integrated air transport system, which is a part of the multimodal unified transport system of the Russian Federation;
- "electric plane";
- supersonic passenger (business) aircraft;
- air taxi, transport unmanned aerial vehicles as a part of an integrated air transport system.

We consider the list of complex scientific and technological projects proposed in the formation of measures for 2020-2022 of the subprogram "Aviation Science and Technology" of the State Program of the Russian Federation "Development of Aviation Industry for 2013-2025" (Table 1):

1. Integrated air transport system. Development technologies, production and operation of aircraft (code "ATS");
2. Supersonic passenger / business aircraft (code "SPA / SBA");

3. Electric aircraft (code "EA");
4. Highly intelligent aviation systems of a new generation (code "HIAS");
5. Development of methods and tools for research and testing (code "Base");
6. International cooperation in the field of aviation science and technology (code "Monitoring").

Table 1. Planned Financing of Works

Group cipher name	Organization of work financing (million rubles) for 2020-2022			
	2020	2021	2022	Total
Code "ATS"	600	700	700	2000
Code "SPA / SBA"	1300	1600	1600	4500
Code "EA"	1100	1200	1200	3500
Code "HIAS"	500	500	500	1500
Code "Base"	600	600	800	2000
Code "Monitoring"	500	500	500	1500

The development of the composition and structure of the air transport system should take into account its integration into the multimodal transport system of the Russian Federation, including the optimization of the aircraft fleet, taking into account the prospects for the development of the route network, of a promising model range and technologies necessary for its implementation. The key part of the air transport system is the aircraft. All efforts are focused on consistent improvement of its consumer and operational qualities [21, 22]. The key task is to optimize and improve air transport system as an environment for the functioning of an aircraft [23, 24]. All efforts are focused on improving the manageability of the system as a whole, increasing safety, accessibility and quality of services and reducing environmental damage. The relevance of the work is the following:

1. Significant reduction in the possibilities for improving the efficiency of the air transport system by improving the flight performance of aircraft using traditional methods;
2. The need to optimize the appearance of aircraft for new conditions of use and organization of the air transport system and its integration into a multimodal transport system;
3. The need for new approaches to ensuring flight safety with an increased role of onboard complexes and integrated control systems.

There are the following general objectives influenced by the project:

- ensuring transport accessibility and territorial connectivity of the Russian Federation;
- improving the quality of air transportation and aviation operations on the territory of the Russian Federation;
- improving flight safety;
- reduction in the cost of air transportation.

As a part of the development of an integrated motor transport system, joint work with the Ministry of Transport of the Russian Federation (State Corporation for the Organization of Air Traffic) is planned for the following tasks:

1. Formation of the appearance of a promising air transport system in terms of creating new technologies for existing and prospective aircraft, taking into account its integration into the multimodal transport system of the Russian Federation, building an air transport system on a decentralized basis within the framework of a unified information management environment and safe use in the air transport system of manned, optionally manned and unmanned aerial vehicles, which provide a solution to a complex of national economic problems within the system.
2. Formation of requirements for the ground infrastructure of the air transport system, including aircraft life cycle management system, air traffic control system, airfield network, etc. in order to ensure flight safety and reduce the cost of air transportation;
3. Formation of plans for the development of air transport system, taking into account the existing fleet of aircraft, ground infrastructure, targets, forecasts of the country's socio-economic development and conditions for the functioning of the transport system.

This interaction will make it possible to formulate the following tasks:

- to determine the requirements for aircraft of various classes, taking into account the peculiarities of the construction of the multimodal transport system of the Russian Federation and air transport system as its component, which solves the main tasks of ensuring the country's transport connectivity and the predicted conditions for the use of these aircraft;
- to form the appearance of promising aircraft, their subsystems and onboard equipment, taking into account the requirements for aircraft of the corresponding classes;

- to create technologies for "more electric aircraft";
- to develop new functions of onboard equipment based on new operating systems to ensure autonomous interaction of aircraft "board-to-board";
- built-in control, diagnostics and optimization of technical operation.

As a practical example, we consider the formation of the appearance of a promising air transport system in terms of creating innovative technologies for existing and future aircraft, taking into account its subsequent integration into the multimodal transport system of the Russian Federation in order to develop territorial connectivity. A promising project is the creation of a near-term supersonic business aircraft and the formation of the appearance of the 2030 aircraft, including engines and equipment and taking into account environmental requirements (Figure 1).

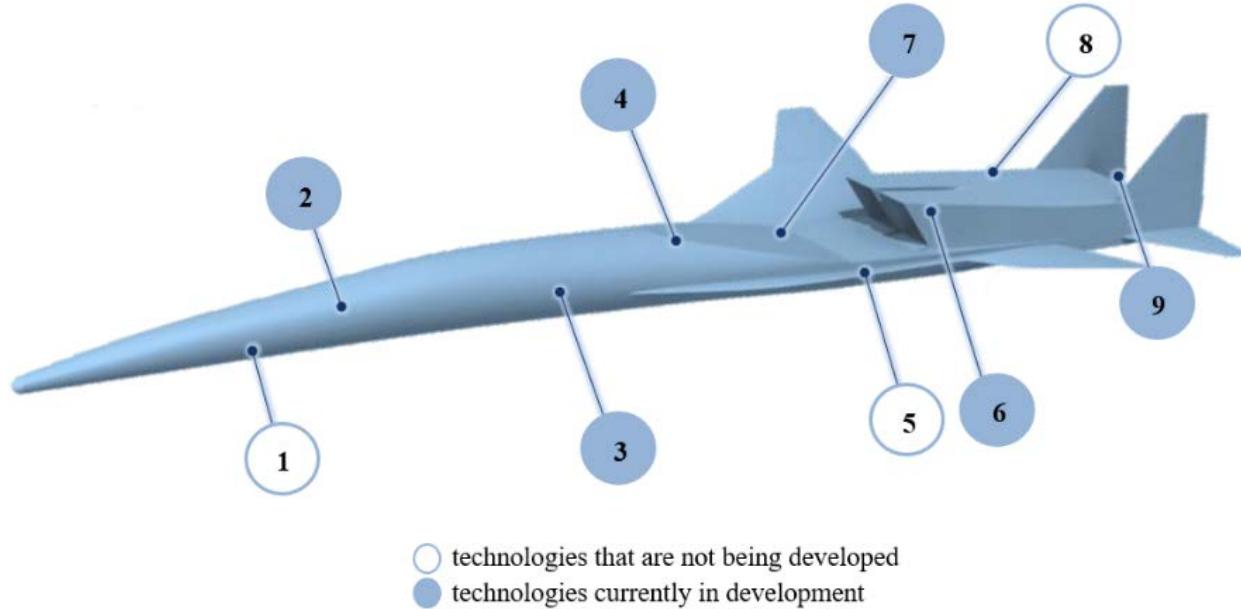


Fig. 1. Innovative project of a supersonic Russian aircraft. Source: Proposals of The National Research Center "Zhukovsky Institute" on the formation of complex scientific and technological projects in the field of aircraft construction

We consider the structure of the components from the Figure 1:

1. Complex "Airborne radio-electronic equipment" and new generation life support systems. Developer: State Scientific Research Institute of Aviation Systems, United Aircraft Corporation, Concern Radio-Electronic Technologies, Technodinamika;
2. Cab with technical "vision". Developer: State Scientific Research Institute of Aviation Systems, Concern Radio-Electronic Technologies;
3. Optimized airframe design (bionic frame). Developer: Central Aerohydrodynamic Institute, United Aircraft Corporation;
4. Working documentation and certification. Developer: Central Aerohydrodynamic Institute, Baranov Central Institute of Aviation Motor Development, State Scientific Research Institute of Aviation Systems, United Aircraft Corporation, Federal Air Transport Agency;
5. "Black" wing with adaptive wing mechanization. Developer: Central Aerohydrodynamic Institute, United Aircraft Corporation, Technodynamics;
6. Efficient air intakes. Developer: State Scientific Research Institute of Aviation Systems, Baranov Central Institute of Aviation Motor Development, United Aircraft Corporation;
7. Layout with a high level of aerodynamic performance and a reduced level of sonic boom. Developer: State Scientific Research Institute of Aviation Systems, United Aircraft Corporation;
8. Optimized engine for supersonic business aircraft. Developer: Baranov Central Institute of Aviation Motor Development, United Engine Corporation;
9. Flat nozzle with noise reduction. Developer: State Scientific Research Institute of Aviation Systems, Baranov Central Institute of Aviation Motor Development.

Creation of scientific and technological groundwork to ensure the creation of a near-term supersonic business aircraft and the formation of the appearance of 2030 supersonic business aircraft, including engines and equipment and taking into account environmental requirements. There is the need to form an integrated scientific and technical groundwork to ensure the creation of a supersonic business aircraft (including aircraft engines and on-board equipment), in the long term - supersonic passenger aircraft, ensuring an acceptable availability and quality of

services, acceptable level of environmental impact and flight safety. General objectives influenced by the project are the following:

- improving the quality of transport and other aviation works;
- increase in production and sales of Russian aircraft products;
- provision of independent development, production, maintenance and repair of aviation equipment.

Formation of a scientific and technological program for a full cycle of innovations "Territorial connectivity of the Russian Federation" can be considered as "gate" approach. This type of approach is often used by Western high-tech corporations and has already proven itself well. It provides a certain opportunity in organizing the coordination of various scientific research, i.e. organizes their implementation in several successive steps, while the concentration is usually on the final effect. The implementation of the above project of shaping the appearance of a promising air transport system in the field of creating innovative technologies for existing and future aircraft can be implemented based on the application of this approach. To do this, in the project, it is necessary to highlight the stages and set special requirements, then after passing each stage, we can make a detailed analysis of the data and then make the right and effective management decision [25, 26].

In case of identification of certain deviations, the subsequent implementation of the project is possible only after certain improvements and adjustments have been made. In case of critical deviations in the project, it is possible to send it for revision or complete termination of all work. This organization of scientific activity will, to a certain extent, facilitate closer interaction between various research and scientific and technical programs. The Figure 2 shows the development of a program / project of a complete innovation cycle based on "gate" approach.

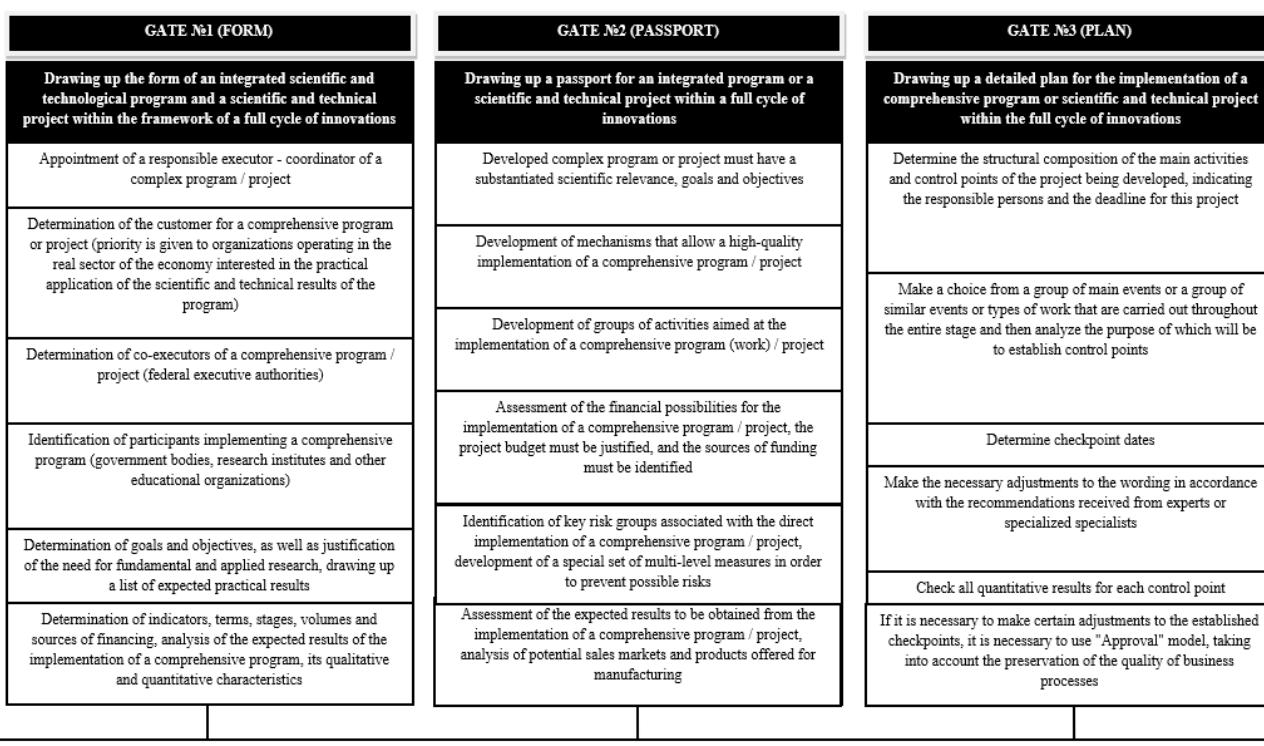


Fig. 2. Development of a program / project of a complete innovation cycle based on "gate" approach

Aviation transport significantly affects the regional transport system, which has been discussed a lot of times in scientific articles of Russian and foreign authors, i.e. there are reasons and factors that have a certain deterrent and do not allow the development of airports and socio-economic processes in the region. In order to solve these problems, it is necessary to begin as soon as possible the formation of strategic programs aimed at a planned increase in the current indicators of the competitiveness of air transport, this is especially important for regional airports, which are mechanisms for the development of territorial connectivity of the Russian Federation. The most promising ways of solving the problems of territorial connectivity are currently the following development concepts (Figure 3).

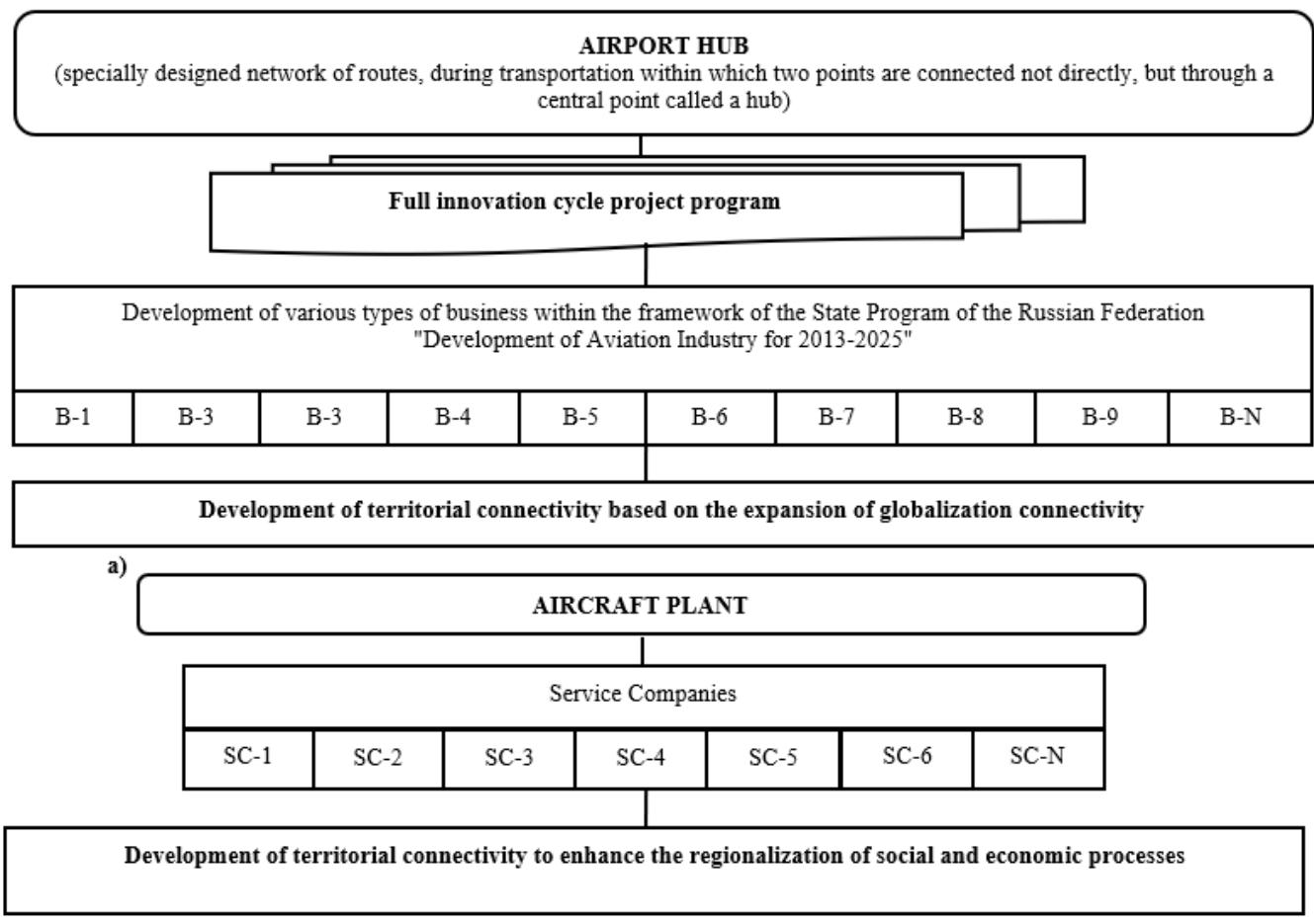


Fig. 3. Development algorithm: a) territorial connectivity based on the creation of aerotropolises; b) territorial connectivity based on the creation of unique aviation clusters

The first concept involves the use of clusters to create unique air transport systems. The concept is based on the fact that the clusters created will represent special regional forms necessary for the effective organization of production, which in turn will be priority objects of state policy, which is aimed at a comprehensive increase in the main indicators of the competitiveness of the national economy of the Russian Federation. The approved strategic concept of long-term development assumes that by 2022 the transition to an innovative-social type of economic development will be fully implemented, within which it is planned to create a unique model of spatial development of territories, i.e. creation of production clusters that will realize the existing potential of the territories. A core is being created, around which an aviation cluster is built. Its center should be an aircraft building enterprise, and airports, airlines, research and educational institutions and government bodies should serve as the main components.

The second concept of the consistent strategic development of regional air transport systems is to create innovative aerotropolises, which are a form of organization of territorial development and are characterized by the creation of urban sub-regions, in which all socio-economic and other processes are concentrated around hub airport. The aeropolis includes the core of a multimodal, multifunctional airport city, departing from this core transport routes connecting with it and with each other territorial production associations, enterprises, which, in turn, are associated with the aviation business, as well as housing complexes.

5 CONCLUSION

Russian Federation should become not only key logistics and transport hub of the planet, but also one of the world's centers for storing, processing, transferring and reliable protection of information arrays (big data). It is imperative to take into account global technological changes, to include in projects specific solutions that will allow combining infrastructure with unmanned vehicles and digital sea and air navigation and organize logistics using artificial intelligence. Spatial development problems are design-level ones, and all those decisions that are determined and set by various strategic planning documents, and, unfortunately, these circumstances are taken into account to a very small extent.

In modern Russian realities, for the successful development of a multimodal air transport system based on the gate principle, involving the creation of various specialized projects, such as aerotropolises and aviation clusters, it is necessary, first of all, to successfully solve the problem in the field of management (to overcome institutional barriers).

First, there is no mechanism that allows to properly assessing the performance of airports at the level of economic and social development of different regions. An objective assessment, according to the authors, is possible only when organizing an annual analysis of airport activities, in order to collect data, which will then be used to develop and adjust various groups of goals and criteria within the framework of the social and economic development strategy of the region, as well as to increase the investment attractiveness of air transport systems.

Secondly, there are no "correct" indicators in the specialized system of state statistical reporting, which in turn requires the introduction of certain institutional changes to the current system of statistical reporting. This can be done in the form of developing fundamentally new methods and indicators or forms necessary for reporting, detailing and differentiating objects, as well as structural organizational changes corresponding to them.

Third, now there is no clear specialization in the branch organization of the Russian aircraft industry, which serves the needs of the military-industrial complex and civil aviation. It is necessary to form special aviation clusters, which will require the separation of processes in military and civil aviation, as well as the introduction of the principle of transparency of activities and new reporting system for aircraft manufacturing enterprises operating in the field of civil aviation. In order to overcome the problems of territorial connectivity, it is necessary to create aviation clusters at the regional level, but it will not be possible without the implementation of institutional reforms in the aircraft industry.

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Paper submitted: 25.10.2022.

Paper accepted: 22.11.2022.

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