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HOUSING INNOVATION MANAGEMENT: STRATEGIC DIRECTIONS OF DEVELOPMENT

Pavel P. Kornilov
Institute of Economics and Management, Vladimir State University, Vladimir, Russia

Dmitriy N. Lapaev
Institute of Economics and Management, Nizhny Novgorod State Technical University, Nizhny Novgorod, Russia

Olga N. Lapaeva
Nizhny Novgorod State Technical University, Nizhny Novgorod, Russia

ABSTRACT

The relevance of the study is due to the imperfection of the state policy in the field of innovative housing construction based on the introduction of organizational, managerial and technological innovations to provide citizens with comfortable and affordable housing with low operating costs for its maintenance.

The purpose of the study consists in analyzing foreign and Russian experience and current state in the field of innovative housing construction, as well as developing strategic directions for the development of innovative housing construction on its basis.

The research was carried out using the method of statistical analysis and expert assessments of Federal and regional legislation, as well as settlement development strategies that effectively stimulate the introduction of innovations at all stages of development of territories for housing construction. The statistics were based on a study of the system of urban planning, the existing capacity of construction industry enterprises, organizations, developers, and major factors affecting the development of housing, one of the average regions of the Central Federal district of Russia.

The article presents promising directions and specific mechanisms for implementing and stimulating the introduction of organizational, managerial and technological innovations in the framework of a public-private partnership to improve public policy in this area. The basic directions of program support of organizational, managerial and technological innovations in order to increase accessibility and improve living conditions of citizens, minimize utility costs of the population, the transition to housing with the low cost of its operation that is able to provide the industry's transition to the innovative vector of development.

The research was used in the development of a strategy for the socio-economic development of one of the regional cities of the Central Federal district of the Russian Federation, as well as in the targeted investment program for the integrated development of the infrastructure of settlements in the city district. The materials of the article can be applied in the process of developing new legislative acts by the authorities to encourage the introduction of innovations in the management and operation of the construction industry, they can be used in the activities of construction industry enterprises, design organizations and authorities to improve activities within the framework of public-private partnership, as well as the formation and development of innovative infrastructure of settlements.

Key words: managerial and technological innovations, innovative housing construction, housing policy

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1. INTRODUCTION

At the present stage of economic development, instability of world financial markets and falling real income of the Russian population one of the important issues is the search for new mechanisms for development and improvement of measures of social support of the population. At the same time, one of the most important state tasks is to improve the living conditions of citizens through the development and implementation of appropriate state policies. Therefore, effective management of this industry plays a critical role in the entire economy of the country and affects both the investment climate of the territory and the quality of life of citizens.

Construction is a major sector of the national economy, the product of which is the creation of civil, industrial, residential and other buildings. The state of the construction industry, in fact, characterizes the effectiveness of the development of the entire society. It is the engine of the economy and can have a significant multiplicative effect, both on the development of industries that accompany construction, and on all other aspects of society's life, including social ones.

With the development of science and technology, the construction process changes and improves. At present, along with the development of market relations and the emergence of a competitive environment, more and more attention is paid to creating favourable conditions for attracting additional investment in this industry, as well as increasing the share of innovations. The introduction of advanced construction methods, such as new forms of organization and management of construction processes, installation of structures, increasing the innovative and technical level, can significantly improve the efficiency of construction production technology (Mésároš, Smetanková & Krajníková, 2020).

Housing construction is one of the most material branches of the national economy, which consumes more than two hundred thousand items of materials and products in the process of completion. The cost of materials used directly for the construction of buildings and structures is more than half of the cost of construction and installation work and more than a quarter of capital investment (Malkov et al., 2019). Every year, the construction industry strengthens its position in the market, the volume of housing construction, commercial and industrial facilities is growing steadily, and small and medium-sized businesses are developing. Due to these factors, budgets of various levels are largely formed.

More than 10 other areas of the economy, from the financial sector to the labour market, participate in the process of functioning of the industry in one way or another. The development of construction contributes to the improvement of the financial system by expanding the number of funds issued for these purposes. In addition, one job in construction supports the employment of up to 10 people in related industries (Iaskova & Fomina, 2016). So, at present, 5439 thousand people are employed in construction in the Russian Federation, which is 8% of the 75 million economically active population. Further motivation for the development of housing construction will expand the investment capacity of the Russian economy. At the same time, 54% of all Russian investments in fixed assets are already directed to the construction of buildings and structures. The volume of work performed by the type of economic activity "Construction": in 2019, it increased to 8386 billion rubles (Federal Statistics Service, 2020).

An essential condition for the development of the housing construction industry is the modernization of its management at various levels of government, taking into account market conditions, new organizational forms and configurations with the use of innovations in the implementation of investment projects.

At the same time, a large number of problems in improving the living conditions of citizens, moving out of dilapidated housing, providing comfortable and affordable housing with low operating costs for its maintenance still remain unresolved (Meshcheryakova & Stepantsova, 2016).

In many ways, the solution to these state tasks is implemented by improving the management system of the industry. These circumstances determine the search for ways to improve public policy, management strategy and applied mechanisms to stimulate innovative housing construction. However, based on rapid scientific and technological development and accumulation of extensive theoretical and empirical experience in the field of organization management processes of key importance in the modernization of the industry it is to improve the management of innovation and development on their basis of specific mechanisms for implementing state policy.

2. LITERATURE REVIEW

Current trends in the development of society, due to the influence of scientific and technological progress, the use of new forms and methods of construction, organization and management of industrial and technological processes, impose special requirements for the management of innovations. The importance, specificity and complexity of innovative management highlighted innovation management as a separate scientific discipline (Bessant & Phillips, 2013). In most cases, in the domestic and foreign economic literature, the concepts of "management" and "administration" are identical, since in the literal translation from English "management" means "management" (Ermolaev, Sborshchikov & Putnina, 2014).

IIn modern literature, the concept of "innovative management" is generally defined as the management of innovations, the innovation process, and the relationships that appear during the development and application of innovations (Birkinshaw, Hamel, & Mol, 2008).

Taking into account scientific approaches to the interpretation of the concept of "innovative management", the latter will be understood as a set of management processes aimed at translating the system into a new, more improved state through the development and implementation of various innovations and by purposefully influencing the elements of the system to increase their efficiency and achieve a useful effect.

Currently, in most developed countries, especially in Japan, Germany, the United States and other EU countries, the level of implementation of innovative ideas is

becoming one of the main indicators that characterize the state of specific sectors of the economy.

These trends over the past decade have been reflected in a number of areas of the Russian economy, including housing construction. The degree of penetration of innovative ideas and their practical implementation increases every year. In many ways, innovation is becoming a key aspect of economic growth, both in individual regions and in the country as a whole. The study of the experience of developed foreign countries shows that significant changes in the sphere of production in the context of the scientific and technical revolution, rapid transformations and full-scale introduction of innovations are increasingly penetrating the construction industry.

In a highly competitive global environment, it is extremely important for the Russian Federation to develop its innovative potential, including for creating high-tech products and occupying a number of niches in international markets, including construction. This circumstance is due to the following factors: the development of global competition against the background of market relations, the need for full-scale radical transformations in all sectors of the Russian economy in order to achieve a stable positive dynamics, including in the field of housing construction, and ensuring the necessary level of quality of services and products.

Currently, the country is experiencing an inefficient use of resources for the production of a unit of production. Studies conducted by experts have shown that in Russia, the production of a unit of production requires several times more energy than in developed countries, such as Japan, Germany, and the United States. These circumstances characterize the extremely costly level of the Russian economy, especially in the construction industry (Larionov, 2014).

It should be noted that the need for innovation in housing construction is due to the following reasons:

- Increasing the level of competition and the need to function in a constantly tightening competitive environment, both at the global level and in a specific country and region.
- The rapid development of progress in various areas of the world economy against the background of stricter environmental requirements.
- The development of trends to minimize energy costs to create a unit of product or service.
- Increasing requirements for environmental friendliness and efficient use of resources, including energy, in the operation of housing.
- Solving social problems of balanced economic development, including by creating conditions for providing citizens with affordable and high-quality housing.
- Increasing interest in housing autonomy and the use of "green" technologies to reduce the cost of maintaining buildings.

These reasons, combined with other circumstances, motivate countries, as well as specific participants, to take steps to promote and implement various innovative forms of organization and process management, design and engineering solutions for housing construction.

Thus, a comprehensive analysis of foreign and Russian methods of improving the strategic management of the industry based on the introduction of various innovations allows us to present the following main directions of policy implementation in this direction, presented in Table 1.

Table 1 Literature analysis of the implementation of innovations in the construction industry

Innovation scope	Author / Year	Methods	Results
Building materials and innovations in internal communications of residential premises	Jayasinghe, Fonseka & Abeygunawardhene (2016) Li, Froese & Cavka (2018) Cazacova & Bait Farhan (2018) Erika, Martina &. Miriam (2018) Ma, Ren & Lin (2019) Mudjanarko et al. (2019) Cruz et al. (2020)	The introduction of new building materials characterized by increased technical and operational properties. The use of autonomous systems for generating energy from alternative sources	Improving the technical, operational and environmental characteristics of housing under construction, reducing construction time, reducing the cost of housing and utilities, and improving energy efficiency
Building technology, modular and 3D designs	Blayse & Manley (2004) Lawson & Richards (2010) Badin & Sychev (2013) Wu, Wang & Wang (2016) Kornilov (2016) Chen et al. (2017) Sakin & Kiroglu (2017) Tay et al. (2017) Lacey et al. (2018) Rajan et al. (2018) Niemelä et al. (2019) Wawrek (2019) Xu, Zayed & Niu (2020)	Introduction of new structures: frame, modular, interchangeable in residential construction, use of new construction methods, including using 3D technologies for building houses	Increasing the volume of housing being built, reducing the time for construction and installation, improving the ease of maintenance and replacement of residential modules and communications, reducing the cost of construction and maintenance of residential buildings
Design & modelling, BIM technologies	Jaillon & Poon (2014) Elmualim & Gilder (2014) Bonenberg & Wei (2015) Hammad et al. (2019)	Automation of building data management processes at all stages of its construction and further operation by creating an information model of the building that includes the entire volume of data about the building at all its stages: from design and construction to operation	Creating a unified building information model that all stakeholders can work with throughout the building's life cycle
Improving the organization and management of construction processes	Akintoye, McIntosh, & Fitzgerald (2000) Bossink (2004) Blayse & Manley (2004) (2004) Birkinshaw, Hamel & Mol (2008) Arutiunov (2013) Bessant & Phillips (2013) Al-Ansaari, Pervan & Xu (2014) Li, Shen & Xue (2014) Bygballe & Ingemansson (2014) Ermolaev, Sborshchikov, Putnina (2014) Ias'kova & Fomina (2016)	Application of new forms and methods of organizing economic relations between all participants in the construction process: from investors, developers and designers to the suppliers of goods and services, as well as other parties involved in this process. Using the latest achievements in the field of scientific and technological progress for the formation of highly effective ways of interaction, decision making and achieving the result	Improving the efficiency of interaction and functioning of the system of participants in these economic relations. Cost reduction at all stages of the residential development project
State policy and strategy of companies in the direction of energy efficiency and greening	Pujari (2006) Albino, Balice & Dangelico (2009) Goncharenko (2014) Larionov (2014) Kulapov, Sidorov & Karasev (2015) Huang, Mauerhofer, & Geng (2016) Braulio-Gonzalo & Bovea (2020) Killip, Owen & Topouzi (2020)	Improving legislation to encourage the development and implementation of energy-efficient technologies, simplify the certification of new products, and create new organizational, managerial, and technological relationships between all participants	Stimulating and supporting the development of innovative ideas and solutions. Increasing the autonomy of housing under construction, stimulating the development of remote areas, reducing harmful emissions and costs of residents, and improving energy efficiency

Thus, in the course of the research conducted in this area, the works of foreign and Russian experts found that the main proposals of the authors to improve the innovative development of the construction industry are focused on the following areas:

- Development of promising low-energy, energy-efficient, unified materials for production with improved properties in the field of environmental friendliness and operation.
- Development of promising low-energy, energy-efficient, unified materials for production with improved properties in the field of environmental friendliness and operation.
- Development and creation of advanced forms and methods, as well as applied hardware and software systems for precision design, construction, modelling and construction of residential buildings and structures.
- Reduction of financial and time costs for construction, including through automation of design and technological processes, processing and use of construction waste and alternative raw materials, and reduction of construction time.
- Improving the organization and management of innovative housing construction in order to optimize the operation and increase the efficiency of all elements of the system.
- Introduction of mechanisms for legislative stimulation of the market for innovative construction, support for innovators, and reduction of time for the practical implementation of innovative ideas and solutions.

However, most of the authors of these studies are focused on solving specific tactical problems of innovative development of the construction industry. At the same time, the development of a problem for the formation of a comprehensive policy of innovative development of the construction industry, which can accumulate all promising areas of innovation in order to improve the mechanisms of strategic management of this economic system, is often left to the sphere of interests of Russian and foreign researchers. These circumstances make it necessary to develop methods and applied tools for implementing state policy to stimulate the innovative development of this sector of the national economy.

3. MATERIALS AND METHODS

As part of the study, foreign and Russian methods for developing innovations in the construction industry were studied in detail. Thus, most countries of the European Union, North and South America, as well as Australia, Japan and a number of Asian countries, realizing the importance and prospects for the development of innovative housing construction, have established the necessary management structures in their authorities. In particular, in the framework of international agreements, green building councils have been set up with headquarters in the UK (Fig.1, International Green Building Councils, 2020).

The main task of these structures is to promote the introduction and implementation of innovations in the construction industry. At the same time, the interaction of these structures in the form of a non-profit partnership negatively affects the solution of these global problems on a system basis. In particular, there are currently no uniform requirements that would define specific mechanisms for public-private interaction in this area. As a result, individual countries and construction organizations are trying to develop this direction in the way they believe is correct. These circumstances contribute to the disunity of the parties in achieving the main goal.

Figure 1 International councils for green building

One of the promising areas of development of the construction industry, noted by many researchers, is also the use of various new materials and methods of construction. Therefore, one of the active directions of promoting innovations in the construction industry in developed countries is the use of new building materials with different technological and operational properties (modifying chemical additives, nanocomposites, superplastificates, accelerators, smart materials, various green technologies, etc.), which provide an increase in various properties of the housing being built, as well as reducing the cost of its construction and operation (Mudjanarko et al.,2019).

At the same time, a number of companies, against the background of escalating competitive processes and the lack of a full range of necessary legislative support, are actually independently trying to introduce and implement new forms of process organization, design and technological solutions, including the use of "green technologies" and energy-efficient materials in construction (Fig.2, Innovative developments of the Australian company Green Energy, 2020).

Figure 2 Innovative building materials from Green Energy

In the modern world, the following technologies are used for the construction of residential buildings: frame, panel, prefabricated, monolithic, block, modular, 3D printing, and a number of others presented in table 2 (Kornilov, 2016). In addition, recently, a method of constructing residential buildings from pre-fabricated metal structures with internal insulation and various insulation materials has been actively used, which in the future are sheathed with external panels to give an aesthetic appeal and reduce energy costs for the operation of such a house.

Table 2 Modern building materials

Characteristic	Brick 	Wood 	Claydite-concrete 	Foam concrete 	Aerocrete 	Polystyrene Concrete 	Warm ceramic 
Density, kg\m³	1300-1800	400-550	800-1900	500-900	300-550	250-600	400-800
Thermal conductivity, W\m ° C	0.4-0.6	0.1-0.15	0.35-0.75	0.12-0.25	0.08-0.15	0.1-0.15	0.1-0.18
Strength, kgf\cm²	80-220	380-450	40-80	10-30	25-50	15-40	100-125
Water absorption,% mass	11-19	20-35	7-15	8-15	20-25	1-4	9-20
Frost resistance, cycles	60-100	70-90	50-80	35-60	20-55	70-120	40-60
Recommended thickness, m	>0.6	>;0.3	> 0.8	>0.6	>0.5	>0.5	>0.5

Currently, one of the leading areas of development in a number of countries in Asia (China, Japan), Europe (Germany, France, the Netherlands) and North America (USA, Canada) has become the development of 3D printing of multi-storey residential buildings, which actively began to develop abroad a few years ago. In particular, in 2010, a number of independent companies from the United States, China, and the Netherlands began to develop these innovative technologies. The first significant results in this area were obtained by innovators from the Netherlands, who built a 3D house on one of the canals of Amsterdam using this method (Tay et al., 2017; Niemelä et al., 2019).

In the future, these technologies were also actively developed in other foreign countries. Over the past few years, various Chinese and European construction companies have built residential buildings using this technology. The obvious advantages of this technology are:

- improved performance of printed buildings;
- significant speed and ease of construction;
- Possibility to erect houses of any geometry with different provided channels for in-house communications;
- reduction in construction time and costs for the construction of houses;
- significant reduction in the amount of construction waste and construction waste;
- possibility of using a large number of materials as a basis for 3D printing of houses.

In 2016, the Chinese company Shanghai Xincun Decoration Design Engineering Co managed to develop a 3D printer WinSun whose dimensions are 10 meters high and 50 meters wide. With the use of this construction printer, thirty residential buildings were built in just one day, each of which reached a height of 6 meters. For construction cement was used with fibreglass (Fig.3, Chinese projects of 3d houses, 2015). In the future, it is possible to mount modules of houses on top of each other.

Against the background of significant advantages of this technology, it also has a drawback. Due to a number of technological reasons, namely the difficulty of creating long pipes for feeding construction material to the print heads and restraining the process of solidification of the material, the maximum height of the construction is limited to 15 meters (5 floors). In addition, at the end of 3D printing, houses also need to finish the interior and exterior walls to ensure aesthetic appeal. However, it is already possible to say with a high degree of confidence that these technological problems will be solved in the next 2-3 years,

including the use of modifying nano-additives in the solution and the use of new powerful pumping systems.

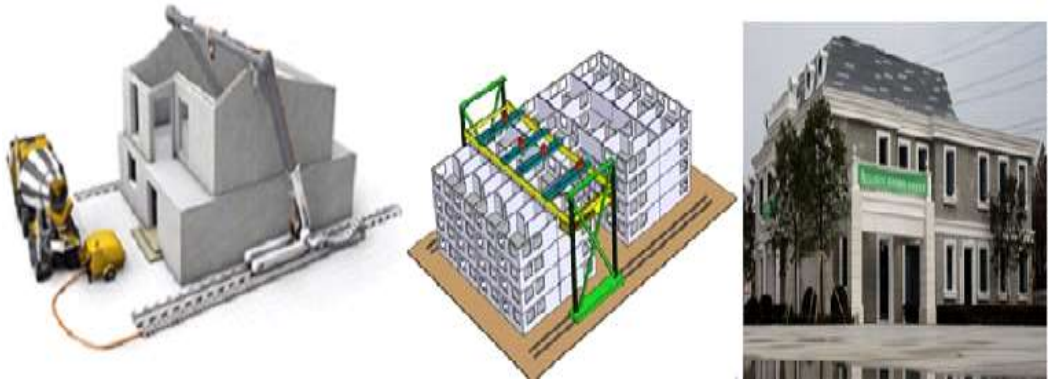

Figure 3 Building a 3D home by Shanghai WinSun Decoration Design Engineering Co

A relatively new innovative vector for the development of housing construction is the rapidly developing technologies of non-volatile, Autonomous buildings and structures in the United States and Europe. These houses include technological equipment that allows you to create the necessary energy and resources for the Autonomous functioning of the house or neighbourhood (Fig.4, Developments by Energy Stock, 2018). At the same time, there are already examples abroad of individuals selling excess energy resources obtained from alternative energy sources to public utilities.

Figure 4 Innovative technologies for autonomous housing

One of the unique innovative approaches to the construction of low-energy Autonomous housing is the joint efforts of the Austrian architectural company Splitterwerk Architects, the German consulting company Strategic Science Consultants, and the international design company Arup (Fig.5, An autonomous house based on bioreactors, 2016). This innovative eco-house (BIQ House) is built in Hamburg and consists entirely of bioreactors, in which special seaweed is placed, which produces energy for home heating, water heating and power supply.

Figure 5 Ecohouse on the basis of bioreactors in Hamburg

Recently, alternative gasification and heating of housing have also been rapidly developing through the production of biogas from organic waste based on biomass fermentation processes. This direction is particularly relevant for rural areas, as it allows for a significant reduction in the cost of laying Central communications for gas supply, as well as provides savings in the absence of monthly payment for the gas supply and heating services themselves (Fig.6,. Innovation of the Austrian company BIOS, 2016).

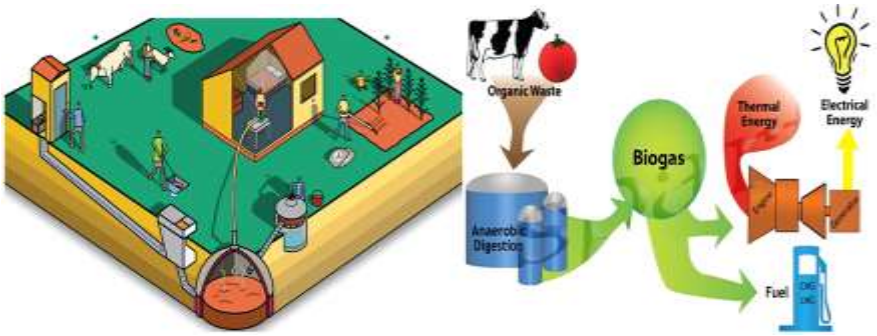

Figure 6 Alternative gasification of the Austrian company BIOS

Innovative design directions have also been actively developed, including design solutions for creating energy-efficient semi-autonomous homes, as well as for reducing harmful emissions into the atmosphere and improving environmental friendliness (Fig.7).

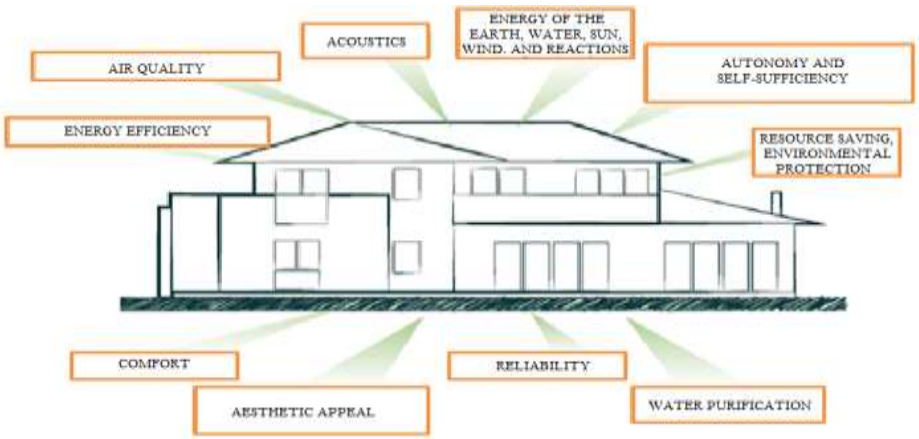

Figure 7 Advanced innovative design

In particular, the international company of Vincent Kallebaut (Belgium) designed an innovative semi-autonomous house in Egypt (the Gate Project), its uniqueness lies in the use of design and technology solutions that contribute to significant energy savings (more than 40%) and reduce emissions into the atmosphere.

The innovative approach is due to the fact that the design takes into account the analysis and calculations of the influence of the atmosphere: the solar cycle, wind direction, and geodetic calculations. In addition, the building was built using the latest achievements in the use of alternative energy sources: wind, solar, earth power generators, gas bioreactors. Various sensors and systems are installed everywhere that control the microclimate and lighting in the premises, taking into account the presence of people in them, as well as performing calculations to optimize energy consumption (Fig. 8, Multi-storey innovative houses in Cairo, 2018).

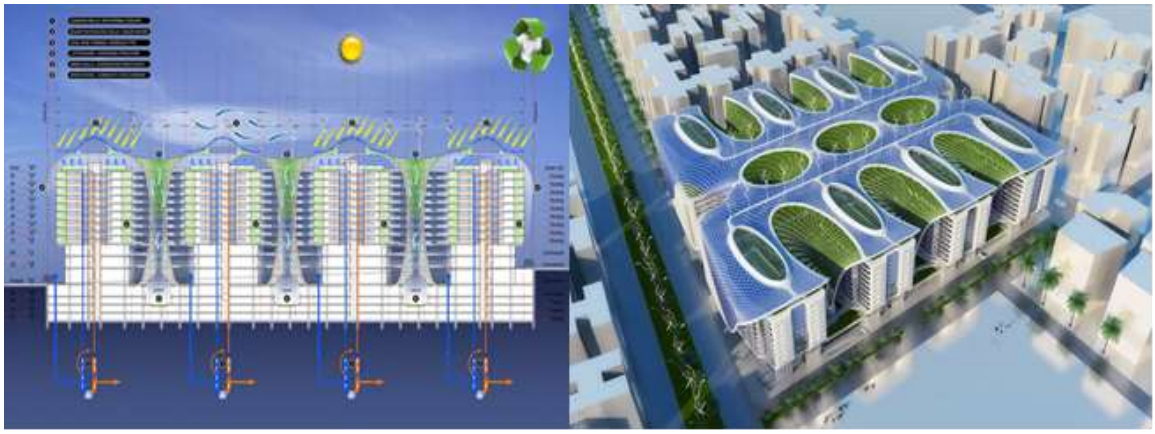

Figure 8 Innovative residential design

In addition, a number of EU, US and Asian countries are implementing advanced automated building design and management systems based on BIM technologies that provide opportunities for all construction entities to model, construct and collectively use the residential building information model throughout the entire life cycle (Fig. 9., Bonenberg & Wei, 2015; Hammad et al., 2019).

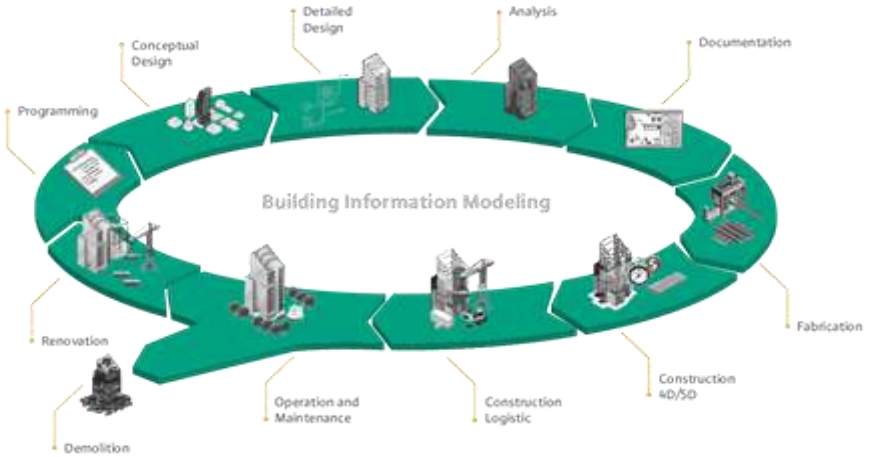

Figure 9 BIM - Technologies for managing the life cycle of residential buildings

It should also be noted about the unique innovative approach to housing construction management used in a number of Asian countries and especially in Japan (Chen et al., 2017; Lacey et al., 2018; Xu, Zayed & Niu, 2020). In this country, they are trying to implement the concept of uniform development of territories, among which special attention is paid to small cities. For these purposes, in the mid-fifties, a state Corporation was created, at the initial stage of formation, managing only the processes of construction and sale of housing. Later, in the early eighties, this state structure launched a new concept, consisting of the construction of apartment buildings. This innovative concept has contributed significantly to the successful turnaround of the invested state funds through the rental housing rent. In addition, with the help of this innovative mechanism, the authorities solve specific regional and socio-economic problems, including those related to the launch of the processes of selective labour migration, providing housing for specialists who are needed in a particular area on preferential terms. Japanese approaches to innovative construction differ significantly from Russian ones. Recently, the main focus in the construction process is not on energy-saving technologies and innovative materials, which are certainly used by Japanese builders, but on precision design and construction, as well as on modular construction (Fig.10, The concept of modular apartment buildings in Japan, 2014).

Figure 10 The technology of modular construction

In accordance with this concept, frame houses are built in Japan, consisting of interchangeable built-in modules of individual rooms. These rooms are made in advance at specialized factories according to the design preferences of a particular buyer. In most cases, Japan does not build houses without finishing. At the initial stage of construction, a showroom is installed in front of the object, which presents a variety of room-modules, the number of design solutions often reaches more than 1000 options, which contributes to creating a unique design for each buyer. The cost of these modules is significantly lower than in traditional construction. This circumstance is due to the fact that production in Japan is extremely unified and technologized.

An additional uniqueness of Japanese innovative construction is that all Central communications are carried out outside in a common space. In particular, there are no common house risers and pipes in the apartments. The undoubted advantage of this approach is the fact that in the case of emergency or repair work the area of apartments of residents of the house is not affected. Taking into account that the modules are mounted as honeycombs, all internal communications are laid in technological niches in the walls, ceiling and floor. If necessary, overhaul the room, it is removed from the cell and replaced with a new one that meets the design needs of the customer.

At the same time, this innovative approach imposes a number of limitations. In particular, module rooms must be designed and manufactured with great precision, which requires the development of hardware and software for the design and manufacture of building structures.

In contrast to foreign countries, the use of innovative approaches in management, design and construction is poorly developed in Russia. These circumstances are caused by a number of reasons, including the insufficient number of regulatory incentives to support innovators, inactive implementation and practical implementation of innovative ideas, technologies and specific management innovations, poorly developed processes of innovative design and construction in housing construction.

These circumstances, along with others, allow us to carry out a comprehensive analysis of the main barriers to the development of the construction industry of the Russian Federation and to outline the main promising directions of its development based on the implementation of the organizational, managerial and technological innovations proposed below.

4. RESULTS AND DISCUSSION

The analysis of the activities of all participants in the construction industry of the Russian Federation suggests that most of the subjects of these economic relations: from local authorities and management to specific developers, developers and developers, as well as other participants in these economic relations take a passive position in promoting and implementing innovative ideas and solutions, often using outdated methods of organization and management, approaches, technologies, and do not seek to invest and implement even small innovations.

Administrative barriers and bureaucracy at all stages of design and construction negatively affect the development of innovations; weak relationships between the consumer, developer and manufacturer; poor quality of construction materials that are produced according to outdated standards using outdated technological lines and technical solutions.

At the same time, it is not correct to say that there is no use of innovations in housing construction in the Russian Federation, because the movement in this direction is carried out, but not fast enough and only in a narrow direction, namely in the field of new materials. The development of the processes of innovative organization and management of housing construction is not carried out sufficiently.

The conditions and factors that influence the formation of the innovation vector in the field of housing construction include the political and economic situation, the level of development of the necessary production, availability of financial loans, infrastructure, resources and raw materials, staffing, social and consumer needs, compliance with environmental requirements, accounting risks associated with, among other things, innovation in the implementation of the project. These factors, consisting of a large number of indicators, in fact, form the investment attractiveness of the innovative project.

The features of these factors allow them to be grouped into direct and indirect. The latter are not directly related to housing construction, but at the same time have an impact on the construction market. Direct factors include the physical components that affect the implementation of the project (Table 3).

Table 3 Factors affecting innovative housing

Degree of influence	Group of factors	Factors
Indirect	social	dynamics of change population, educational and cultural level, employment, well-being and soon
	economic	the current situation in the economy, credit and financial sphere, risks, solvency, taxation, dynamics of income, prosperity, employment, population demand, availability of borrowed funds, cost of housing, availability of subsidizing programs for the purchase of housing, R&D; investment climate
	political	state policy, availability of the necessary Federal and regional regulatory framework for the development of innovations in the construction and related industries
Direct	physical	geographical conditions: topography, geodesy, topography and natural environment, ecological situation, the degree of infrastructure development and the availability of necessary natural resources; remoteness from the main logistics routes, large transhipment bases and cities, the size of the land plot and its architectural and planning components
	financial and cost	the cost of land, cost of communication, the cost of new materials, resources, construction work

The conducted research has shown that the main problems of development of the construction industry of the Russian Federation on the basis of organizational, managerial and technological innovations are:

- imperfection of the state policy, regulatory framework and management system of the industry to motivate and create a new order for the implementation of organizational and managerial and technological improvements, development of innovative management of industrial processes;
- lack of development of functional management methods in the unification and receipt of state and municipal services in the preparation of initial permits and obtaining approvals for construction against the background of a large number of bureaucratic barriers;
- inconsistency of management functions of planning, control, analysis of economic attractiveness of introduction of innovations in the field of housing construction;
- lack of management structures at the Federal and regional levels that form a portfolio of orders for investors to develop territories for innovative housing construction in the medium and long term;
- uncoordinated management structures that determine inter-industry prospects for the development of energy capacity, physical deterioration of engineering infrastructure, and high connection costs;
- the imperfection of the regulatory and technical regulation during design and construction work, the use of outdated GOSTs, HS&R, methods and rules;
- the bureaucratization of management structures for certification of new products and R&D results, as well as their implementation in the management of organizational and technological processes.

- imperfect interaction in investment management to attract third-party investors from other regions and countries using new forms and methods of housing construction;
- underestimation by all participants in economic relations of the effect of applying the latest achievements of science and technology in the planning and organization of activities in the field of housing construction.

Taking into account the presented specifics and the conducted research, it is proposed to group the main restrictions that hinder the strategic development of innovative housing construction into institutional, organizational and informational, regulatory and political ones (Table 4).

Table 4 Restrictions on housing development

Management factors		
Institutional	**Regulatory and policy issues**	**Organizational and information**
Imperfect interaction in investment management to attract third-party investors from other regions and countries using new forms and methods of housing construction	The imperfection of legal acts regulating the minimum levels of management and technological innovations	Underestimation by all participants of economic relations of the effect of applying the latest achievements of science and technology in the planning and organization of activities in the field of housing construction
Lack of coordination of management structures that define a cross-sectoral perspective on the development of energy capacities	The bureaucratization of management structures in the certification of new products and R&D results, as well as their implementation in the industry	The imperfection of promotion mechanisms new organizational, managerial and technological solutions at various stages of construction
The imperfection of management structures that form a portfolio of orders for investors to develop territories for innovative housing construction in the long term	A large number of technical and legal regional specifics against the background of a significant number of regulations and Federal construction standards	Low public awareness of the benefits of implementing new technologies and solutions in construction and as a result conservatism in the choice of housing
Insufficient investment in research by construction industry enterprises against the background of low activity of participants in search, processing and implementation of new ideas and practical solutions from related industries	The imperfection of functional management methods in the unification and receipt of public services when preparing the necessary documentation and obtaining the required approvals	Unsatisfactory interrelations between scientific and business communities, disunity in the field of goal-setting in the implementation of specific innovative projects, low quality of their study for the investor
Poor training of construction industry management in innovative process management, lack of motivation for R& D	Ineffective mechanisms of administration of innovative activities in the construction industry	Insufficient scientific justification for the correlation between the use of organizational and managerial innovations and the income received
Insufficient number of construction companies interested in investing in the development of innovations	The complexity of procedures for approving the introduction of innovations by financial and insurance structures	Lack of a single integrator to support new ideas and organizational and management solutions for implementation in construction

Thus, summarizing the analysis of the development of innovative housing construction abroad and in Russia, as well as existing barriers, allows us to determine the following promising areas of innovation in construction (Table 5).

Table 5 Directions for the development of innovative housing

Prospects for innovative construction	Russian experience	Overseas experience	Distinctive features
Construction materials	Using traditional types of concrete and building materials. Most additives are not produced by Russian industry. Energy-efficient materials deficit	The use of construction materials with various chemical modifying additives, nanocomposites, superplasticity, accelerators, smart materials, etc. Using green technology	The use of modifiers reduces the mass of materials produced, reduces the cost and labour intensity of construction, reduces transport costs, improves performance and environmental friendliness of the building. Mass of one cubic meter of the building volume abroad about 160kg, in the Russian Federation about 430kg.
Building Technologies	Construction of houses on reinforced concrete panel technology based on obsolete technological solutions	Using of modular assembly technology based on common samples in the workshops of manufacturing organizations based on modern technological solutions	Increase in construction volumes due to the transition to an industrial, mass-scale type of housing construction. Modules for houses are produced in factories in a serial way using common samples, which also speeds up the installation process and reduces costs
Design & modelling	Traditional approaches and computer-aided design systems based on old building standards, norms and rules are used	Modern CAE systems and BIM systems for building information modelling, processing and management of building data throughout the construction and operational period is used	The implementation of SAE and BIM technologies based on high-precision architectural and construction design tools contribute to the creation of a unified building information model that all participants in the construction process can work with at all stages of the building's life cycle
R&D	A low percentage of the cost of real estate development companies in the scientific component, difficulties with certification	Investing in R&D 3-4% of sales in residential construction, simplified certification procedures	The decrease in the practical implementation of innovative ideas and solutions from the development stage till mass production, generating substantial revenue for innovators from development results
Utility systems and infrastructure	The traditional centralized system of heat, gas, electricity, water and sewage	The use of autonomous systems for providing houses and generating energy from alternative sources and biomass processing	Decline in national expenses for summing up and overhauling communications, reducing harmful emissions, improving energy efficiency and coefficient of efficiency
Profitable Housing	This Institute practically not developed in the Russian Federation	Widely applied in developed countries, rental periods reach 50 years	The interest of operators of profitable housing in reducing operating costs through the use of innovative solutions, an opportunity for the state to form labour migration flows
Housing Innovation management	There is no single coordinating structure-institute in the field of housing innovations	Housing innovation institutions organized in almost every developed country	The presence of a single integrator responsible for the implementation of new ideas and technologies in housing construction promotes innovation and reduces costs
Regulatory incentives	are underdeveloped	Availability of accessible and understandable conditions for obtaining subsidies and of innovations	Stimulating and supporting the development of innovations and developers, research teams and companies that implement innovative ideas and solutions

To increase the effectiveness of strategic management of innovative housing construction and its support with appropriate investments, it is necessary to implement a systematic approach to removing existing restrictions, which allows identifying the following promising vectors (Fig. 11) of industry management:

- creation and improvement of the state policy and regulatory framework in the field of construction, providing support to developers-innovators, stimulating the market for the development of new technologies and investment attractiveness, and the transition to training specialists in innovative management of construction processes and reducing the time frame for practical implementation of innovative organizational and management ideas and solutions;
- improving the system of strategic housing management in order to optimize the work and increase the efficiency of all elements of the system, improve institutional ties within the industry, the operational integration of new elements and management processes based on the latest achievements in this field;
- expanding the practice of legislative motivation for the introduction of new architectural and planning solutions, improved forms of organization of construction works and the widespread introduction of innovative elements in the modern conditions of development of the construction industry;
- implementation of mechanisms for program and target support for the market of promising energy-efficient and low-energy technologies, unified for the production of materials with improved properties in the field of environmental friendliness and operation;
- reducing the time for implementing the results of scientific and technological progress with the use of advanced forms and methods, as well as applied hardware and software systems for designing, constructing, modelling and constructing residential buildings and structures, creating new construction equipment that is more economical and productive, reducing the construction time;
- development of legislative acts, economic, organizational and managerial mechanisms to motivate the transition to mass construction of Autonomous and profitable housing using renewable energy sources and "green technologies".

The concentration of all subjects of economic relations in the construction industry on the effective implementation of these directions will allow betraying the innovative vector of development of the entire construction industry and related sectors of the national economy. At the same time, the transition to the full-scale implementation of new ideas and solutions at various stages of the organization and strategic management of processes will make it possible to overcome existing barriers.

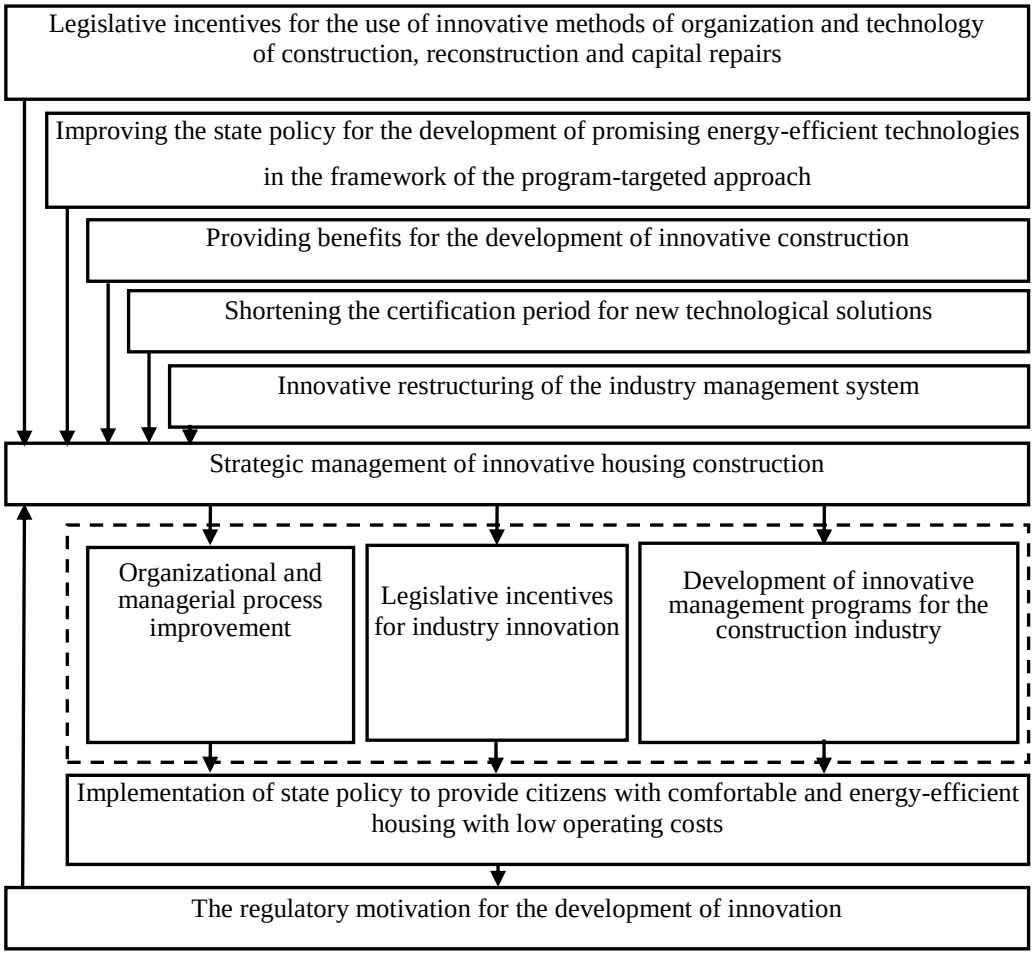

Figure 11 Perspective vectors of strategic management of innovative housing

Summarizing the research of foreign and Russian experts who studied approaches to improving the management of innovative housing construction, it should be noted that specific methods and mechanisms for managing innovations in the context of housing construction are proposed to be formed as follows (Table 6).

Table 6 Methods and mechanisms for managing innovative housing processes

Management methods	Control mechanisms
Administrative	Improvement of legislation to stimulate the development and implementation of innovations, modernization of state Standards, BCRs, housing policy, improving the efficiency of management of state and municipal structures
Organizational and planned	Creating new or improving old organizational forms, rules and regulations, strategies for forecasting, planning, implementation and development of innovations in the construction industry
Financial and economic	Targeted investment programs, grants, subsidies, incentives, and other payments to support the development of innovations in construction and related industries
Socio-psychological	Creating an optimal climate for the development and support of investors, innovators, research teams and R&D, forming a subculture of innovation acceptance among the population

In turn, taking into account the above, the management structure of innovative housing construction, in order to increase its attractiveness, should look like this (Fig. 12).

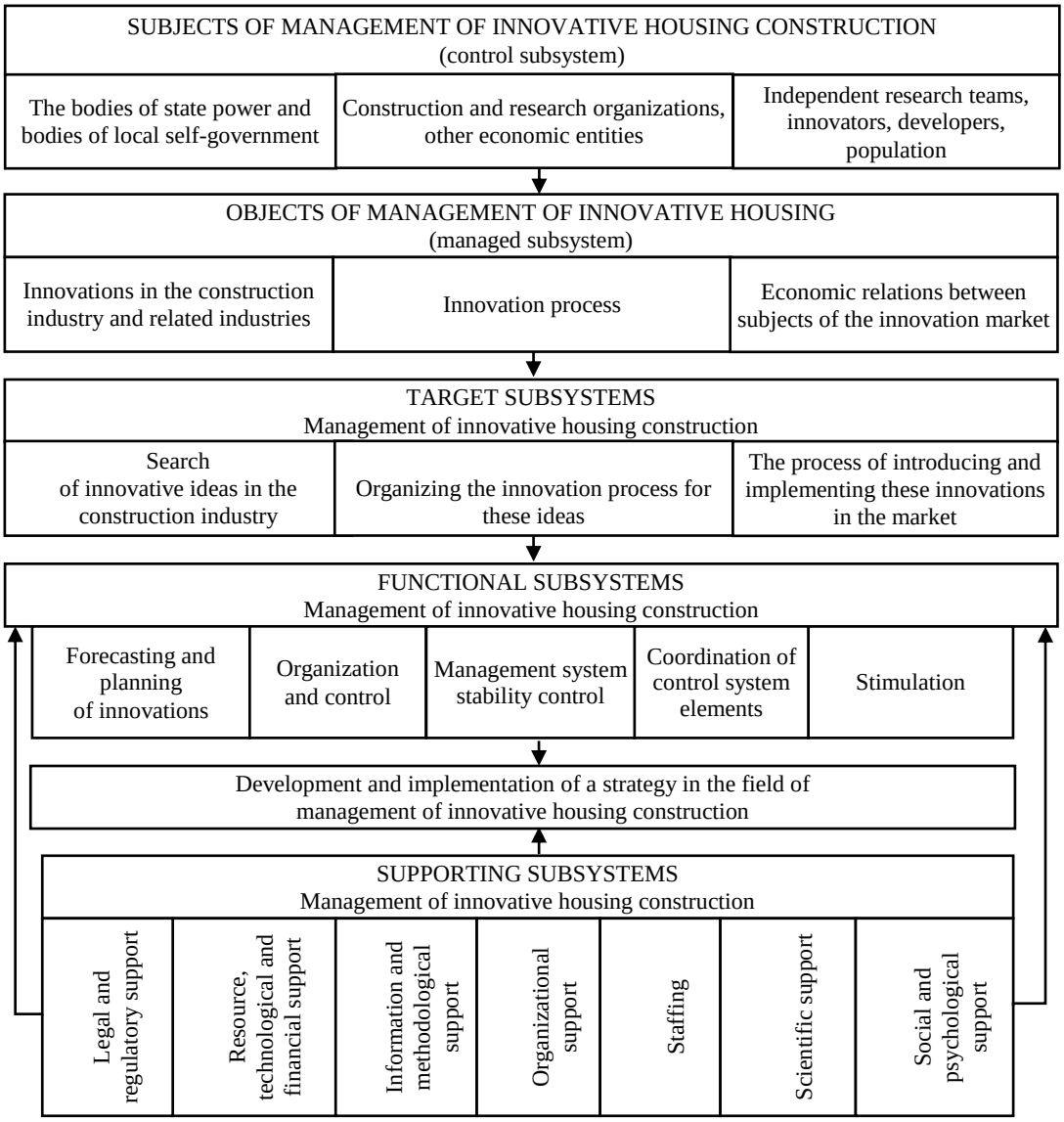

Figure 12 Control block diagram of innovative housing

Thus, the successful implementation of this industry development strategy requires the introduction of new organizational and management mechanisms and regulatory incentives (tax incentives, grants, subsidies) for the widespread use of advanced approaches that stimulate the development of production and technological processes with reduced energy costs when creating a unit of the final product, using energy-efficient materials and technologies. In order to introduce innovations widely and support them with appropriate investments, it is also necessary to implement a systematic approach to removing existing restrictions. A purposeful policy of the state in this direction would facilitate the rapid transition to full-scale implementation of innovative solutions at various stages: from the organization and management of processes to the design and construction of facilities, as well as the corresponding infrastructure. Based on the general outline, the implementation stages of the innovative housing management strategy will look like this (Fig.13).

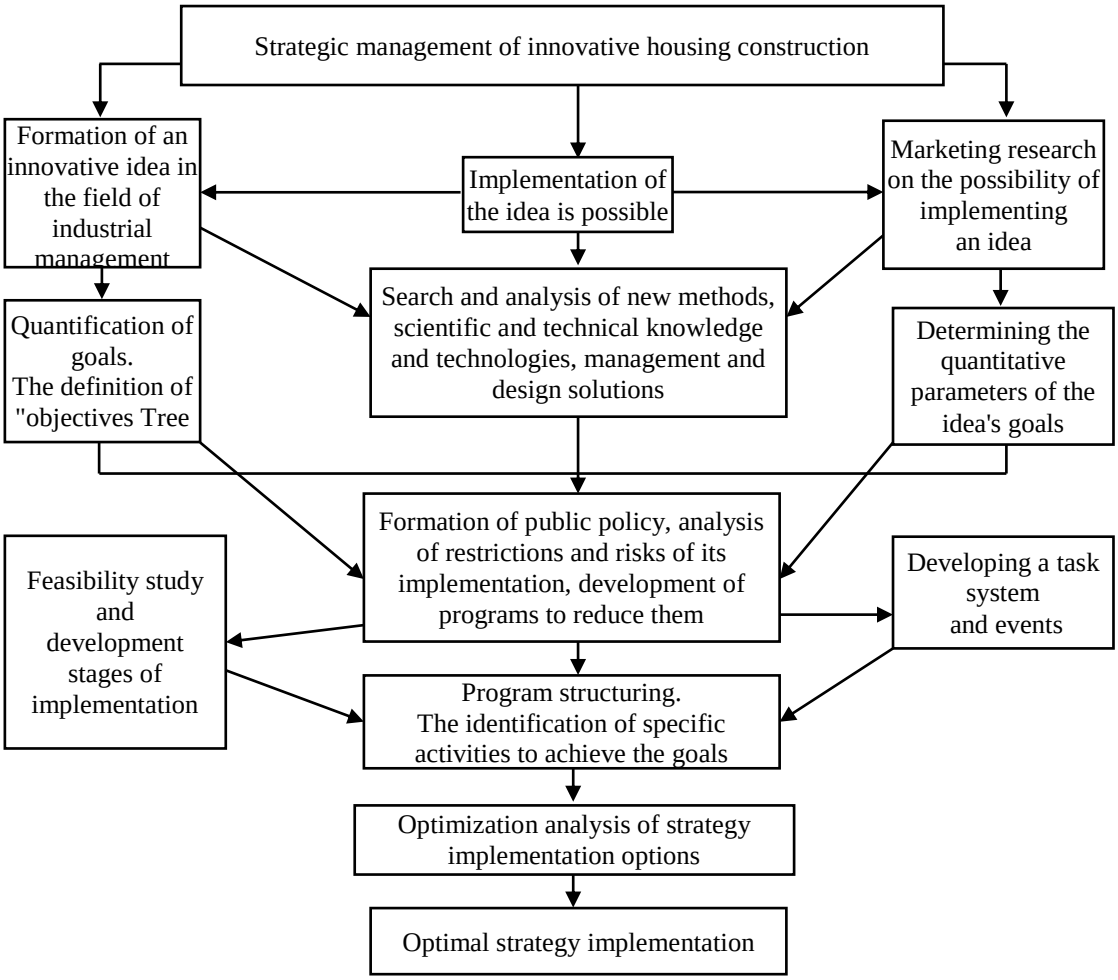

Figure 13 A methodological approach to developing strategic management of innovative housing construction based on organizational and managerial innovations

In order to achieve the goals and overcome the barriers outlined in the article, it is necessary to improve the national policy in the field of innovative housing construction by providing motivating conditions (tax and other benefits, subsidies, methodological, information and organizational support) for the restructuring of the system of relations of industry entities to the innovative vector of development. In addition, one of the important aspects in this area is the improvement of legislation and the launch of appropriate targeted programs to create incentives and form the basis for all industry participants to actively transition to the development and commercialization of promising ideas and technological solutions. In our opinion, the successful solution of the set strategic tasks is possible through a program-oriented approach.

Of course, support and promotion of the development of these and other promising areas of innovative construction should be carried out within the framework of the development of appropriate Federal programs and the implementation of effective mechanisms for interaction between all participants in economic relations: from the authorities and management to the direct developer and developer. In this regard, a successful example of such development would be the legislative stimulation of public-private partnership processes in the form of concession agreements and agreements on integrated development of territories for innovative housing development. The development and launch of relevant Federal target programs would be a driver for the transition to an innovative vector of development and commercialization, both of promising technological ideas and solutions, and of the implementation of proposed

organizational and managerial innovations, including innovative process administration at all stages of the construction life cycle.

5. CONCLUSION

Taking into account the conducted research, it is proposed to focus the state's strategic efforts on improving the management of innovations in the housing industry in the following areas:

1. Regulatory and legal incentives for the development of material production industries that specialize in creating new energy-saving and energy-processing construction materials and technologies by providing various benefits within the framework of a program-oriented approach and state subsidies.

2. Creating a favourable investment climate for financing innovative housing construction projects. It is proposed to Supplement the relevant legal acts with rules that provide tax, property, land benefits and deductions, as well as preferential loans and the application of accelerated depreciation rules for investors, developers, and manufacturers who ensure the development and implementation of innovative products at levels not lower than those approved by the authorities. At the same time, the direct size of the implementation of the relevant innovations is proposed to be divided into several levels: basic, medium, and high, based on which to set the size of the corresponding benefits for the construction industry entities. This circumstance will ensure the desire of market participants to constantly improve their products and services, thereby forming a transition to an innovative vector of development of both the construction industry and related industries.

3. In order to improve the quality of process administration by the authorities, it is proposed to create a unified all-Russian information system based on BIM technologies, which should provide remote provision of the entire set of public services and accumulation of the information model of a residential building, starting from the initial stage to the stages of its operation and dismantling.

4. Stimulation of the transition to new technologies for housing construction, including through 3-D printing and the use of interchangeable modular structures with internal openings for communication without affecting the structure of the building during its maintenance, to increase the speed of construction, as well as the possibility of replacing a separate module/apartment.

5. Regulatory and legal incentives for construction companies to increase funding for innovative research and development in the interests of the construction industry for their subsequent commercialization and implementation in the framework of construction, management and organizational processes.

6. Creation of an innovation Institute on the basis of the housing and utilities reform Fund or other Federal structures to coordinate and consolidate interaction between market participants, including to minimize barriers to commercialization of innovations, simplify and accelerate certification procedures and launch new products on the market, and support innovators. The newly formed structure is proposed to be responsible for improving legislation and bylaws, taking into account the latest achievements in science and technology, as well as developing mechanisms to encourage their implementation in the construction and related industries. In addition, this structure should be responsible for creating a long-term register of innovative projects in the regions of the Russian Federation for interested investors and developers. Within the framework of the structure, it is also necessary to organize a Bank of construction innovations, where the most effective solutions in the field of innovative construction and related technologies will be presented online. In addition, it is necessary to organize the selection of the most successful of them, who received the largest number of votes of citizens,

for further investment support in the framework of the relevant Federal and regional programs.

7. Creation of a unified state information system for remote submission, processing, approval and issuance of all necessary initial permits without visiting various energy supply organizations and structures of the housing and communal complex.

8. Development of a Federal target program to support and develop Autonomous housing construction in the regions of the Russian Federation based on the latest achievements in the field of alternative energy. In particular, the application of the latest achievements in the field of renewable energy (use of solar, wind, earth energy, gasification by processing biomass, etc.) will improve the efficiency of energy supply, as well as improve the environmental situation. These circumstances will also give an additional impetus to the development and development of remote areas that were previously considered unpromising due to the lack of necessary communications, reduce government costs for laying Central communications and minimize losses from their operation, as well as reduce environmental damage from the life of society. At the initial stage, this innovation is more effective to implement in the construction of micro-districts of industrial low-rise building type (up to 4 floors). In the future, after testing technical ideas and solutions, it is possible to switch to multi-storey Autonomous construction.

9. Development and implementation of a program to provide preferential conditions for credit and financial organizations that issue appropriate targeted loans for the development of innovative construction and production of necessary innovative materials. It is also proposed to divide the levels of benefits provided by the state according to the degree of innovation of the project. For the allocation of loans for projects with a high level of effective innovations, provide more favourable credit conditions from the state.

10. Implementation of Federal and regional programs to provide preferential conditions under concession agreements for investors and developers engaged in the complex development of territories for innovative residential development.

11. Improving support for innovators and research structures, as well as their interaction with direct manufacturers by providing targeted grants for the development and implementation of innovative ideas, techniques, and specific organizational and technological solutions, ensuring copyright protection for intellectual property, and encouraging the training of innovative-minded employees who can reduce the cost and energy intensity for each unit of product\service\operation. In particular, the analysis of the foreign experience of innovative housing construction allows us to confirm the emerging trend in the transition to the design and construction of residential buildings, taking into the account energy consumption of not more than 20 kWh/year per square meter.

12. Development of the Institute of rental/profitable housing within the framework of concession agreements with investors. This direction will help improve the living conditions of citizens, as well as provide an opportunity for local authorities to form interregional labour migration flows. At the same time, concessionaires will be interested in using innovative technologies in its construction and operation in order to reduce the cost of maintaining such housing, thus providing support to the market for the development of construction innovations.

13. Creating a subculture among the population and the need to constantly search for ways to improve life and adopt innovations by informing them about receiving appropriate benefits and reducing costs when implementing an innovative construction product or service.

Of course, targeted support for the development of public-private partnerships based on the proposed innovations will create a basis for the development of a multiplier effect

in both construction and related industries, which will ultimately provide a solution to the strategic socio-economic problems of the state.

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