

ISSN 2073-8412 (PRINT)

ISSN 3034-1485 (ONLINE)

МЕЖДУНАРОДНЫЙ

НАУЧНО-ТЕХНИЧЕСКИЙ

ЖУРНАЛ

НЕДВИЖИМОСТЬ

ЭКОНОМИКА

УПРАВЛЕНИЕ

12+

2/2024

INTERNATIONAL

SCIENTIFIC & ENGINEERING MAGAZINE

REAL ESTATE

ECONOMICS

MANAGEMENT

2/2024

Недвижимость: экономика, управление		Международный научно-технический журнал		# 2 / 2024	
ОТ ГЛАВНОГО РЕДАКТОРА					
1					
ISSN 2073-8412 (Print)		ISSN 3034-1485 (Online)			
НЕДВИЖИМОСТЬ					
ЭКОНОМИКА ■ УПРАВЛЕНИЕ					
Учредители: Федеральное государственное бюджетное образовательное учреждение высшего образования «Национальный исследовательский Московский государственный строительный университет» (НИУ МГСУ); Издательский дом «АСВ»					
Главный редактор: ГРАБОВЫЙ Петр Григорьевич (д-р экон. наук, профессор, НИУ МГСУ) Заместители главного редактора: ГАЛИШНИКОВА Вера Владимировна НИКИТИНА Надежда Сергеевна ХОВАНСКАЯ Галина Петровна Члены редакционного совета Анисимов Сергей Михайлович (Польша) Аспинен Юха (Финляндия) Базен Жак (Нидерланды) Бертран Жозеф (Испания) Бертхаут Том (Нидерланды) Блок Мария (Швеция) Власов Денис Николаевич Гогина Елена Сергеевна Данилов-Данильян Виктор Иванович Завадскас Эдмундас Казимераевич (Литва) Киевский Леонид Владимирович Кулаков Кирилл Юрьевич Ле Вань Тхьонг (Вьетнам) Луговой Владимир (Австралия) Лукманова Инесса Галеевна Михайлович Иван (Сербия) Павлова Анна (Великобритания) Пекка Паяккала (Финляндия) Погребной Игорь Яковлевич (Украина) Синяк Николай Георгиевич (Республика Беларусь) Ченг-Шуан Сан (Китай) Шрестха Мадху Кришна (США) Штерн Глен (Нидерланды) Штеффенберг Артур (Австралия) Якубов Харис Галиуллович Яськова Наталья Юрьевна Международный научно-технический журнал включен в Перечень рецензируемых научных изданий, в которых должны быть опубликованы основные научные результаты диссертаций на соискание ученой степени кандидата наук, на соискание ученой степени доктора наук. Группы научных специальностей, по которым издание входит в Перечень рецензируемых научных изданий: 5.2.3. Региональная и отраслевая экономика (экономические науки) 2.1.7. Технология и организация строительства (технические науки) 2.1.10. Экологическая безопасность строительства и городского хозяйства (технические науки) 2.1.13. Градостроительство, планировка сельских населенных пунктов (технические науки) 2.1.14. Управление жизненным циклом объектов строительства (технические науки)		Дорогие читатели! 22–23 марта 2024 года в г. Хошимин (Вьетнам) прошел XIII Международный научно-практический форум «Экологические аспекты устойчивости строительства и управления объектами городской недвижимости», организованный Национальным исследовательским Московским государственным строительным университетом и Хошиминским архитектурным университетом. Форум имеет богатую многолетнюю историю, являясь ярким примером устойчивого международного сотрудничества, основанного на богатом опыте создания платформы для продуктивного диалога между учеными и практиками из России, Вьетнама и других азиатских стран, направленного на обмен научными разработками и практическим опытом реализации проектов устойчивого развития территорий в контексте экологической безопасности и применения энергоэффективных решений. За годы проведения форума участники из разных стран представили сотни докладов по современным и актуальным вопросам эколого-экономического обоснования эффективных решений в строительстве и недвижимости, экологической безопасности социальной, транспортной, инженерной инфраструктуры и другим фундаментальным и прикладным аспектам устойчивого развития строительной отрасли. В рамках научных секций прошедшего форума обсуждался широкий круг вопросов, имеющих важное значение для социально-экономического развития как в масштабе отдельных территорий, так и на государственном и международном уровне, ключевыми из которых стали: • территориальное градостроительное планирование и механизмы адаптации обновления сложившейся застройки к природным условиям; • инновационно-технические решения экоустойчивого строительства; • управление жизненным циклом объекта строительства: технология, экономика, экспертиза; • развитие городского хозяйства и модернизация жилищно-коммунальной инфраструктуры; • стратегические направления развития городской транспортной инфраструктуры; • инновационно-технические и информационные системы «умного города»; • экологический цикл и рациональное использование ресурсов в строительстве и недвижимости. Тематической основой настоящего номера журнала стали материалы избранных научных докладов участников форума. С уважением, главный редактор, Пётр Грабовый			
© ООО «Издательство АСВ», 2024. © ФГБОУ ВО «НИУ МГСУ», 2024. Подписной индекс в агентстве «Роспечать» 46817. Цена свободная. Основан в 2001 году. Выходит 4 раза в год. Подписан в печать 25.06.2024. Выход в свет 28.06.2024 СВИДЕТЕЛЬСТВО О РЕГИСТРАЦИИ СРЕДСТВА МАССОВОЙ ИНФОРМАЦИИ: ПИ № 77-11025 от 30 октября 2001 г. выдано Министерством Российской Федерации по делам печати, телерадиовещания и средств массовых коммуникаций. Адрес в сети Интернет: http://n-eu.iasv.ru/ Редакция оставляет за собой право редакционной правки публикуемых материалов. Авторы публикуемых материалов несут ответственность за достоверность приведенных сведений, за отсутствие данных, не подлежащих открытой публикации, и точность информации по цитируемой литературе. Редакция может опубликовать статьи в порядке обсуждения, не разделяя точку зрения авторов. Редакция не несет ответственности за содержание рекламы. При перепечатке ссылка на журнал обязательна. Адрес редакции 129337, Москва, Ярославское шоссе, 26 Тел.: +7 (968) 903-00-04; e-mail: info@n-eu.ru На обложке печатаются работы фотохудожника Янковского А.В.		Редакционная коллегия  О.А. Куракова научный редакторС.И. Беляков редакторО.А. Телепнева ответственный секретарь редакции			
Редакция журнала Выпускающий редактор А.А. Дядичева		Редактор Л.Б. Корзухина Корректор О.В. Ермихина Компьютерная верстка Ю.З. Алейникова Перевод на английский язык О.В. Юденкова			

АКЦЕНТЫ НОМЕРА

Грабовый П.Г., Ажимов Т.З.
Важным компонентом улучшения качества жизни людей в современных условиях является строительство нового жилья, в том числе многоквартирных домов наивысших классов энергетической эффективности, и применение технологий «зеленого строительства». При этом важным аспектом совершенствования механизмов организации строительного процесса является целенаправленное сокращение инвестиционно-строительного цикла без ущерба для безопасности объектов

Янковский А.В.
На сегодняшний день решение демографических проблем, а также повышение социальной стабильности являются одними из ключевых задач, стоящих перед правительством России. Невозможно представить повышение качества уровня жизни населения страны без решения жилищного вопроса. Одной из ключевых задач является устойчивое сокращение непригодного для проживания жилого фонда

Власенко В.А.
Проблематизация инновационного развития в инвестиционно-строительной сфере формируется прежде всего общими тенденциями инновационного развития в стране, включая механизмы государственного регулирования и поддержки, спецификой строительной продукции и соответствующей спецификой инвестиционно-строительной сферы, а также глобальными вызовами, которые изменяют внешнюю среду генерируют для инновационно-строительной сферы

1 РАЗДЕЛ — ОФИЦИАЛЬНЫЙ РАЗДЕЛ

6

Грабовый П.Г., Ажимов Т.З.
Стратегические направления и перспективы развития строительного комплекса в России

2 РАЗДЕЛ — ТЕМА НОМЕРА

12

Янковский А.В.
Совершенствование механизмов проектов реновации ветхого и аварийного жилья

3 РАЗДЕЛ — ЭКОНОМИКА И МЕНЕДЖМЕНТ НЕДВИЖИМОСТИ

20

Волгин В.В.
Особенности управления рисками при реализации инвестиционно-строительных проектов

27

Власенко В.А.
Обоснование необходимости и направлений совершенствования стратегического планирования инновационного развития предприятий инвестиционно-строительной сферы

33

Гвоздев Е.В.
Оценка состояния системы комплексной безопасности предприятия с использованием метода расстановки приоритетов

37

Симионов Р.Ю., Ажимов Т.З.
Управление цепями поставок в индустриальном домостроении: специфика, проблемы, методы, показатели эффективности

42

Хрусталева Б.Б., Мещерякова О.К., Мещерякова М.А
Особенности развития интегральной системы риск-менеджмента на предприятиях строительной отрасли

48

Изюмов М.Д.
Практические аспекты решения задачи селекции корпоративных девелоперских проектов

54

Абдалов Р.Е.
Управление предпроектной стадией инвестиционно-строительного проекта: аспекты внедрения нормативного и методического обеспечения деятельности организаций

4 РАЗДЕЛ — ГРАДОРЕГУЛИРОВАНИЕ И УПРАВЛЕНИЕ
ЖИЛИЩНО-КОММУНАЛЬНЫМ КОМПЛЕКСОМ

АКЦЕНТЫ НОМЕРА

Кирпиченков А.А.

61

Применение экономико-математической модели с целью определения эффективности проектов реновации жилой застройки и выбора оптимальной стратегии их реализации

Хрусталеv Б.Б.,
Мещерякова О.К.,
Мещерякова М.А.

Современные строительные компании России внедряют не более трех инструментов управления рисками и не связывают их с финансовой деятельностью компании. Кроме того, управление рисками не интегрировано в основные стратегические направления деятельности компании. Системным управлением рисками в России занимаются только крупные строительные корпорации. Малые и средние предприятия не внедряют эту систему управления

5 РАЗДЕЛ — ТЕХНОЛОГИЯ И ОРГАНИЗАЦИЯ
СТРОИТЕЛЬСТВА

Галишникова В.В., Бочаров М.Е.

65

Информационные модели объектов строительства в течение их жизненного цикла

Звонов И.А., Каширина Н.В.

73

Перспективы применения параметрического метода нормирования в условиях реестрового принципа разработки технических требований

Звонов И.А., Каширина Н.В.

Существующая система нормативных документов в строительстве представляет собой организованную структуру взаимосвязанных документов, применяемых на всех этапах жизненного цикла объектов капитального строительства. В связи с этим в 2024 году планируется разработка свода правил по параметрическому нормированию. Но, несмотря на преимущества параметрического нормирования, переход к нему на практике оказывается затруднен по разным причинам

6 РАЗДЕЛ – ОТЕЧЕСТВЕННЫЙ И ЗАРУБЕЖНЫЙ ОПЫТ

Сезёмин Д.Е.

78

«Зеленый квадрат», инновации и экоустойчивость энергетической инфраструктуры современной городской экосистемы

7 РАЗДЕЛ — ПРАВОВЫЕ И СОЦИАЛЬНЫЕ АСПЕКТЫ

Панин В.В.

84

Правовой аспект влияния коррупции на состояние экологической безопасности государства, экологическую устойчивость и экологические риски в строительной сфере

Панин В.В.

Наряду с реализацией Стратегии экологической безопасности Российской Федерации до 2025 года, Национального плана противодействия коррупции на 2021–2024 годы государству и обществу уже сейчас необходимо принять действенные меры, направленные на решение проблемы снижения влияния коррупции на экологическую безопасность государства, экологическую устойчивость строительства и экологические риски

REAL ESTATE:
ECONOMICS, MANAGEMENT

Scientific and technical journal

Founded in 2001. Published quarterly
Founders: Moscow State University of Civil Engineering (National Research University) (MGSU), ASV Publishing House
The Journal has been included in the list of the leading review journals and editions of the Highest Certification Committee of Ministry of Education and Science of Russian Federation in which the basic results of PhD and Doctoral Thesis are to be published.
The subject matter coverage complies with the approved list of scientific specialties:
5.2.3. Regional and sectoral economics (economic sciences);
2.1.7 Technology and organization of construction (technical sciences);
2.1.10 Environmental safety of construction and urban economy (technical sciences);
2.1.13 Urban planning, planning of rural settlements (technical sciences);
2.1.14 Life cycle management of construction objects (technical sciences).

Editor-in-chief

GRABOVYY Petr Grigor'evich,
Doctor of Economics, Professor,
MGSU, Moscow, Russia

Deputy Chief Editor:

GALISHNIKOVA Vera Vladimirovna
NIKITINA Nadezhda Sergeevna
KHOVANSKAYA Galina Petrovna

Editorial council:

Anisimov Sergey Mikhaylovich (Poland)
Aspinen Yukha (Finland)
Bazen Jacques (Netherlands)
Berkhout Tom (Netherlands)
Bertran Josep (Spain)
Blok Mariya (Sweden)
Cheng-Shuan San (China)
Danilov-Danil'yan Viktor Ivanovich
Gogina Elena Sergeevna
Kievskiy Leonid Vladimirovich
Kulakov Kirill Yur'evich
Le Van' Tkhyong (Vietnam)
Lugovoy Vladimir (Australia)
Lukmanova Inessa Galeevna
Mikhaylovich Ivan (Serbia)
Pavlova Anna (Great Britain)
Pekka Payakkala (Finland)
Pogrebnoy Igor' Yakovlevich (Ukraine)
Shrestkha Madhu Krishna (USA)
Sinyak Nikolay Georgievich (Republic of Belarus)
Stefenberg Arthur (Australia)
Stern Glen (Netherlands)
Yakubov Kharis Galiulovich
Yas'kova Natal'ya Yur'evna
Vlasov Denis Nikolaevich
Zavadskas Edmundas Kazimeraevich (Lithuania)

Editorialboard:

Kurakova O.A., Beliakov S.I., Telepneva O.A.

Editorial team of issues:

Executive editor: **A.A. Dyadicheva**
Editor: **L.B. Korzukhina**
Corrector: **O.V. Ermikhina**
Computer editing: **Y.Z. Aleynikova**
Russian-English translation: **O.V. Yudenkova**

Photographer's work printed on the cover
Valentina Gertsman (New York).

Address: MGSU,
26 Yaroslavskoye shosse, Moscow, 129337
Tel.: +7 (968) 903-00-04; e-mail: info@n-eu.ru
On-line version of journal: <http://n-eu.iasv.ru/>

Signed for printing: 28.06.2024

SECTION 1: OFFICIAL SECTION

- 6
- Grabovyy P.G., Azhimov T.Z.**
Strategic Directions and Development Prospects
of the Construction Industry in Russia

SECTION 2: COVER STORY

- 12
- Yankovsky A.V.**
Improving the mechanisms of renovation
projects for dilapidated and emergency housing

SECTION 3: PROPERTY ECONOMICS AND MANAGEMENT

- 20
- Volgin V.V.**
Risk management in the implementation
of investment and construction projects
- 27
- Vlasenko V.A.**
Justification of necessity and directions for improving strategic planning
of investment and construction enterprises innovative development
- 33
- Gvozdev E.V.**
Assessment of the state of integrated security system
at the enterprise using the priority setting method
- 37
- Simionov R.Yu., Azhimov T.Z.**
Supply chain management in industrial housing construction: specifics,
problems, methods, performance indicators
- 42
- Khrustalev B.B., Meshcheryakova O.K., Meshcheryakova M.A.**
Development of integrated risk management system at construction
industry enterprises
- 48
- Izyumov M.D.**
Practical aspects of solving the problem of selecting
corporate real estate development projects
- 54
- Abdalov R.E.**
Management of the pre-project stage of an investment and construction
project: aspects of the implementation of normative and methodological
support for the activities of organizations

SECTION 4: URBAN REGULATION AND MANAGEMENT OF HOUSING AND PUBLIC UTILITIES

ACCENTS

Kirpichenkov A.A. Application of the economic-mathematical model to determine the efficiency of residential renovation projects and to choose the optimal strategy for their implementation	61
---	-----------

Grabovyy P.G., Azhimov T.Z.
An important component of improving the quality of life of people in modern conditions is the construction of new housing, including apartment buildings of the highest energy efficiency classes, and the use of “green building” technologies. At the same time, an important aspect of improving the mechanisms of organizing the construction process is the purposeful reduction of the investment and construction cycle without compromising the safety of facilities

SECTION 5: TECHNOLOGIES AND ORGANIZATION OF CONSTRUCTION	
Galishnikova V.V., Bocharov M.E. Information models of construction objects during their life cycle	65

Yankovsky A.V.
Today, solving demographic problems, as well as improving social stability, are among the key tasks facing the Russian Government. It is impossible to imagine an improvement in the quality of life of the country's population without solving the housing issue. One of the key tasks is the sustainable reduction of uninhabitable housing stock

Zvonov I.A., Kashirina N.V. Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development	73
--	-----------

SECTION 6: DOMESTIC AND OVERSEAS EXPERIENCE	
Sezemin D.E. “Green Square”, innovation and sustainability of energy infrastructure of the modern urban ecosystem	78

Vlasenko V.A.
The problematization of innovative development in the investment and construction sector is formed, first of all, by the general trends of innovative development in the country, including mechanisms of state regulation and support, the specifics of construction products and the corresponding specifics of the investment and construction sector, as well as global challenges that changes in the external environment generate for the innovation and construction sector

SECTION 7: LEGAL AND SOCIAL ASPECTS	
Panin V.V. Legal aspect of corruption impact on the state of environmental security, environmental sustainability and environmental risks in the construction industry	84

Zvonov I.A., Kashirina N.V.
The existing system of regulatory documents in construction is an organized structure of interrelated documents used at all stages of the life cycle of capital construction projects to protect the rights and interests of their consumers, society and the state. In this regard, it is planned to develop a Set of Rules on parametric normalization in 2024. But despite the advantages of parametric normalization, the transition to it in practice is difficult for various reasons

Grabovyy P.G.
Azhimov T.Z.

Strategic Directions and Development Prospects of the Construction Industry in Russia

The construction sector is an integral core of Russia's economic development, playing a key role in infrastructure development and meeting the housing needs of the population. Analyzing the current state of this sector is of particular importance in the context of the changing economic environment and the country's strategic goals. Despite various challenges and vicissitudes, the Russian construction industry continues to demonstrate resilience and potential for further development. This paper provides an analysis of the current state and prospects of the construction industry in the Russian Federation. The authors assess the key aspects of the sector, its significance for the national economy, market dynamics, investment trends, and technological innovations. The analysis of current statistical data conducted by the authors allows identifying the main challenges and opportunities facing the construction industry, as well as considering possible strategies for achieving sustainable development of the industry in the future. Special attention is paid to the analysis of national projects and programmes for state support of regions, stimulating investment in construction and infrastructure modernization.

Keywords: construction industry, housing and utilities sector, state policy, urban development potential, comprehensive development of territories, development prospects, national economy

Grabovyy
Petr Grigorievich,

Doctor of Economics, Professor, Head of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RSCI: 302471, Scopus: 57164862700, ResearcherID: AAE79422022, ORCID: 0000000286963718; GrabovyyPG@gic.mgsu.ru

Azhimov
Timur Zagidovich,

Candidate of Economic Sciences, Associate Professor, Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 7199-1406, Scopus: 57218826075, ResearcherID: ABD-6000-2021, ORCID: 0000-0002-7648-1950; Timur.Azhimov@gmail.com

The construction industry and the housing and utilities sector are among the most significant sectors of the national economy, largely determining the development dynamics of the Russian Federation. The construction industry provides employment, income for millions of citizens, and directly contributes to creating comfortable living conditions for people.

The implementation of the state policy of the Russian Federation in the fields of housing construction

and housing and utilities sector for the long term is carried out in accordance with the national goals defined by the Decree of the President of the Russian Federation dated July 21, 2020, No. 474 "National Goals of the Development of the Russian Federation for the Period up to 2030".

Based on the analysis of the retrospective development of the construction industry, the following key events, which have determined the strategy for further development, can be identified (Fig. 1).

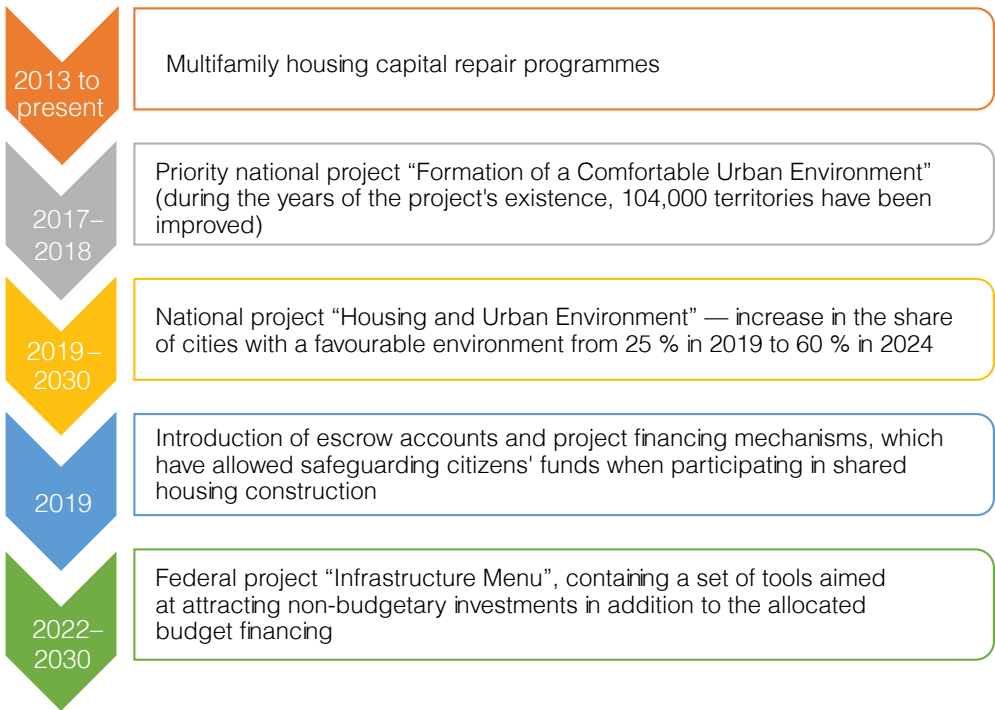


Fig. 1. Key events that determined the strategy for the development of the construction industry in the Russian Federation¹

¹ Official website of the Ministry of Construction and Housing and Communal Services of the Russian Federation. URL: <http://www.minstroyrf.ru/> (accessed: 14.04.2024). (rus.).



Fig. 2. Resettlement of emergency housing stock in various regions of the Russian Federation

During the past period, the Russian construction industry and housing and utilities sector have achieved significant results in their development. Additionally, within the framework of the Russian Government's initiative "Infrastructure Menu", new tools to support infrastructure construction in the regions have been created. This programme aims to strengthen infrastructure and improve the quality of life for citizens [1]. A continuously operating mechanism for resettling emergency housing has also been launched, contributing to the safety and improvement of housing conditions for the population.

In collaboration with deputies, senators, regions, and representatives of the expert community, the development strategy for the construction industry and housing and utilities sector until 2030, with a forecast until 2035, has been prepared by the relevant government agencies. This balanced document takes into account regional specificities in its implementation and is aimed at ensuring the sustainable development of the industry in the long term.

Over the past 10 years, more than 840 million square metres of housing have been put into operation in Russia, including 442.6 million square metres in multifamily buildings and 401.3 million square



Fig. 3. Dynamics of emergency housing stock in the Russian Federation (according to Rosstat) [5]

metres in individual residential buildings. Since 2014, over 22 million Russian families have improved their housing conditions [2].

Another important achievement has been the resettlement of 1,385,000 people from the emergency housing stock (Fig. 2).

Since 2014, capital repairs have been carried out in 283 thousand multi-apartment buildings in Russia, with a total area of 1 billion square metres, housing more than 38.5 million people (Fig. 3, 4) [3].

To maintain the pace of housing construction, it is important to continue to increase the urban development potential and create construction sites in all regions of the country. In 2023, it amounted to 420 million square metres. In order to expand it, at the end of 2020, the mechanism of Comprehensive Territorial Development was launched, aimed at bringing unused or inefficiently used territories, as well as territories of emergency and dilapidated housing stock, into circulation [6, 7].

To improve the quality of life for citizens and create a comfortable environment for public activities, more than 111 thousand public and courtyard areas have been improved over the past period (Fig. 5) [8].

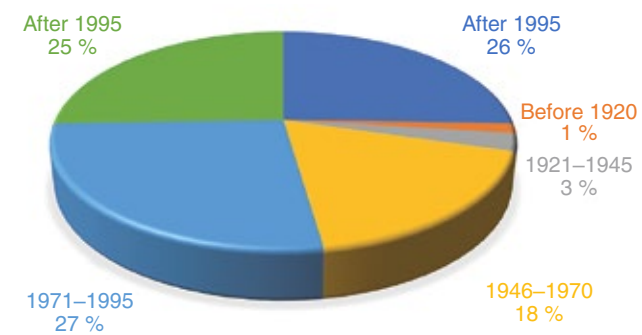


Fig. 4. Distribution of housing stock in the Russian Federation by year of construction, thousand sq. m (according to Rosstat) [5]



Fig. 5. Formation of a comfortable urban environment (improvement of the “Embankment of Lights” area, Verkhny Tagil city, Sverdlovsk region)

An important aspect of improving the mechanisms of organizing the construction process is the targeted reduction of the investment and construction cycle without compromising the safety of objects:

- the list of mandatory requirements of standards and regulations has been reduced from 11,000 to 380;
- the number of information, documents, materials, and approvals required for project implementation has been reduced from 989 to 696.

On average, this allows reducing the time from the idea of construction to commissioning by 336 days (from 1,831 to 1,495 days). By 2030, the exhaustive list is planned to be reduced to 350 items [9].

The industry's priority is a comprehensive approach to the organization and implementation of construction projects aimed at ensuring that housing construction is accompanied by the quantitative and qualitative development of residential quarters with necessary infrastructure. Work continues on the implementation of projects involving the construction and modernization of housing and utilities infrastructure objects [10]. New tools to support infrastructure construction in the regions have been created, which are now part of the government initiative “Infrastructure Menu”, within which the construction and modernization of more than 2,000 utility facilities are planned.

An important component of improving people's quality of life in modern conditions is the construction of new housing, including high-energy-efficiency multifamily buildings, and the use of green building technologies [11].

Issues related to the destruction of the architectural appearance of established development in historical city centers, the increase in the number of dilapidated and emergency buildings, the wear and tear of engineering and social infrastructure objects, the maintenance, repair, and reconstruction of multi-apartment buildings, which are cultural heritage sites, remain relevant.

There is also a need to address issues related to improving the quality of housing and utilities services, energy efficiency, and energy conservation in the housing and utilities sector, timely

renewal of the housing stock, and its provision with necessary infrastructure, as well as improving the management system of multi-apartment buildings.

To preserve and develop positive trends and to address the challenges facing the construction industry and housing and utilities sector, the following directions and specific aspects of industry policy are being implemented [12]:

1. Formation of a national project aimed at achieving the national goal “Comfortable and Safe Living Environment” by 2030, including the following directions:

- accelerated modernization of communal infrastructure systems, including construction and reconstruction of water supply, sewage, and heating systems;
- stimulating the development of housing construction in the Russian regions, including the construction of social, engineering, and transportation infrastructure;
- creating a comfortable urban environment, including identifying additional sources of funding for improvement of courtyard areas of apartment buildings and improvement of rural settlements;
- ensuring sustainable reduction of substandard housing stock, including resettlement of citizens from apartment buildings recognized as emergency after January 1, 2022.

2. Extension of the duration of the mechanisms of the federal project “Infrastructure Menu”.

3. Formation and implementation of preferential mortgage programmes for the construction (purchase) of individual residential houses, including the use of ready-made standardized house kits of factory production.

4. Formation of a database of verified data used to assess the technical condition of communal infrastructure objects.

5. Development of a long-term programme for preserving cultural heritage sites (historical and cultural monuments) of the peoples of the Russian Federation, including residential buildings of historical and architectural value.

6. Establishment of criteria for selecting and evaluating the efficiency of investment projects within the framework of the federal

- project "Infrastructure Menu" in connection with territorial planning documents.
- 7. Development and implementation of unified standards for the management of multi-apartment buildings.
 - 8. Formation of a registry of best regional practices in construction and operation of buildings with minimal environmental impact, including measures to reduce energy and material resource consumption throughout the entire life cycle of a capital construction object.
 - 9. Ensuring, in accordance with urban planning standards, comprehensive development of social infrastructure in the implementation of housing construction projects, financed, in part, through interbudgetary transfers from the federal budget.
 - 10. Improvement of the quality of development and updating of heat supply schemes of municipal entities to make the most effective and justified decisions on the development of heat supply systems.
 - 11. Organizing systematic work on prevention and prompt elimination of the consequences of accidents at housing and utilities sector facilities and in the housing stock operation sphere, ensuring the connection of the necessary data suppliers to the federal monitoring and control system for the elimination of accidents and incidents at housing and utilities sector facilities, and timely provision of required information to this federal system.
 - 12. Ensuring the possibility of using ready-made standardized house kits of factory production based on a wooden frame, solid wood panels, and/or glued structures for the construction of

residential houses within the framework of the implementation of regional targeted programs for resettlement of citizens from emergency housing stock.

13. Development of a mechanism for comprehensive territorial development as a tool for renewing territories with dilapidated and emergency housing stock, creating necessary conditions for the development of transportation, social, and engineering infrastructure.

The development of the construction industry in Russia is aimed at achieving a qualitatively new level of comfort and well-being for citizens [13]. Digitization, strengthening of personnel potential, comprehensive development of infrastructure and housing and utilities sector, as well as ensuring timely commissioning of social facilities and integration of new regions, are key factors determining the success of construction activities in the future (Fig. 6).

Given the dynamic and complex challenges facing the industry, it is necessary to continue actively implementing innovations and modern technologies, as well as constantly improving the personnel potential. Only this way can we ensure sustainable and effective development of the sector, contributing to the improvement of the population's living standards and ensuring the socio-economic growth of the country as a whole [14].

The adoption of comprehensive measures and the implementation of strategic programmes for the development of the construction industry will create favourable conditions for overcoming existing challenges and achieving sustainable development in the long term.

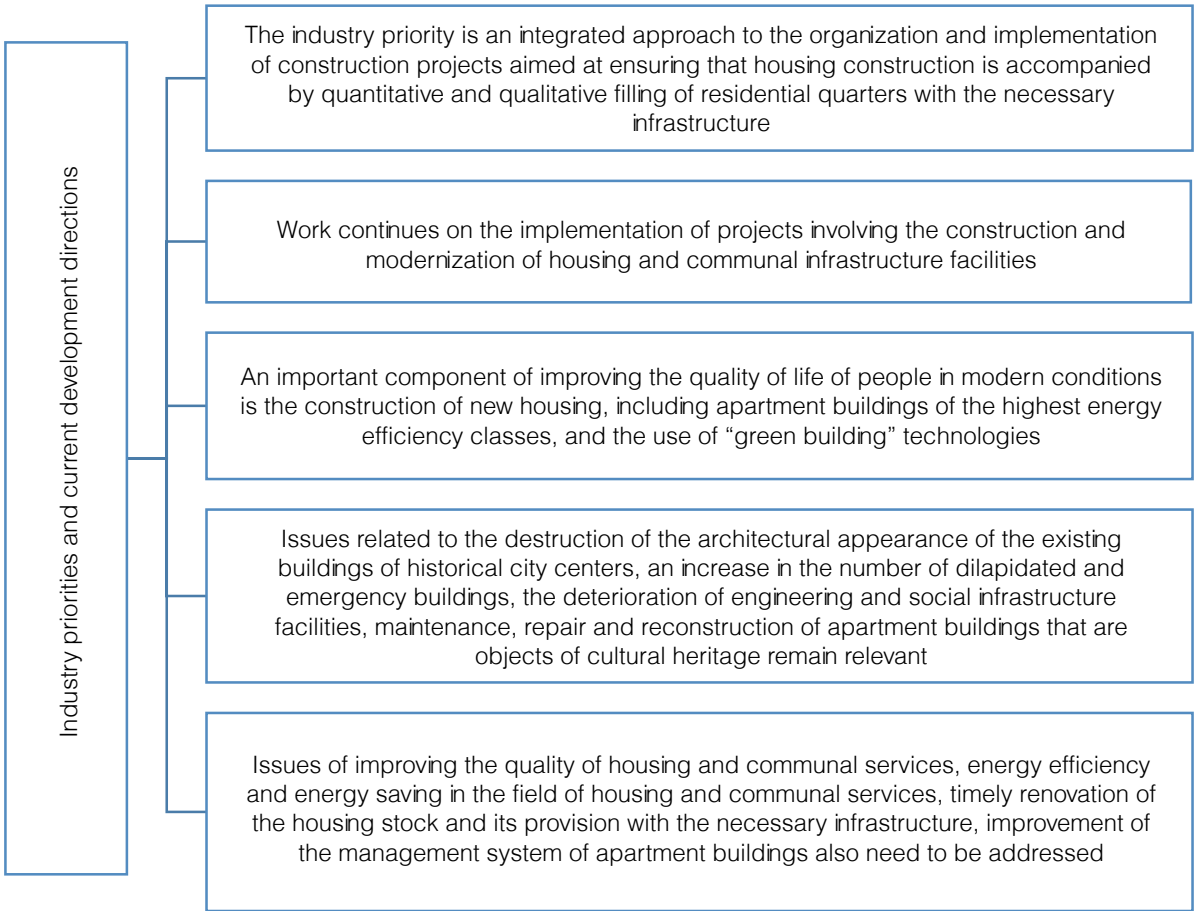


Fig. 6. Industry priorities and current development directions

REFERENCES

1. Federal Project "Infrastructure Menu" Passport. URL: <https://www.minstroyrf.gov.ru/docs/139872/> (accessed: 14.04.2024). (rus.).
2. Unified Information System in Construction. Housing commissioning in 2023. URL: https://наш.дом.рф/аналитика/ввод_жилья (rus.).
3. Housing Sector in Russia. 2022 : statistical digest. Rosstat. Moscow, 2023; 83. URL: [torage/mediabank/Jil_hoz_2022.pdf](https://rosstat.gov.ru/storage/mediabank/Jil_hoz_2022.pdf) (rus.).
4. Ovsyannikova T.Yu. Comprehensive renovation of residential development: development opportunities for Russia. Investments, urban planning, real estate as drivers of socio-economic development of the territory and improving the quality of life of the population : materials of the XIII International Scientific and Practical Conference. Vol. 1. Tomsk, Tomsk State University of Architecture and Construction, 2023; 25-35. (rus.).
5. Social and Economic Indicators. 2023 : statistical collection. Rosstat. Moscow, 2023; 1126. (rus.).
6. Amending the town planning code of the Russian Federation and certain legislative acts of the Russian Federation in order to ensure comprehensive development of territories : Federal Law of December 30, 2020 No. 494-FZ. (rus.).
7. Monitoring the implementation of the mechanism for comprehensive development of territories by the subjects of the Russian Federation, Ministry of Construction of Russia. URL: <https://www.minstroyrf.gov.ru/trades/kompleksnoe-razvitiye-territoriy/1-monitoring-realizatsii-mekhanizma-kompleksnogo-razvitiya-territoriy-subektami-rossiyskoy-federatsii> (rus.).
8. National Projects of the Russian Federation. URL: национальныепроекты.рф/projects/zhile-i-gorodskaya-sreda/blagoustroystvo (accessed: 14.04.2024). (rus.).

9. Faizullin I.E. Investment process in the housing sector at the modern stage of economic relations development, higher and secondary vocational education as the basis for the professional socialization of students : proceedings of the 13th International Scientific and Practical Conference. Kazan, 2019; 3-6. (rus.).
10. Khrustalev B., Grabovyy P., Grabovyy K., Kargin A. Features of the information modeling use of real estate objects in the housing market. E3s web of conferences : XV International Scientific Conference on Precision Agriculture and Agricultural Machinery Industry "State and Prospects for the Development of Agribusiness — INTERAGROMASH 2022", Rostov-on-Don. Vol. 363. EDP Sciences, EDP Sciences, 2022; 02038. DOI: 10.1051/e3sconf/202236302038
11. Manukhina L.A., Yakubov H.G. Analysis of current trends in the greening of urbanized territories. Real Estate: Economics, Management. 2023; 1:11-15. URL: <https://n-eu.iasv.ru/index.php/neu/article/view/110/131>
12. List of assignments following the meeting with government members. URL: <http://www.kremlin.ru/acts/assignments/orders/56012> (accessed: 14.04.2024). (rus.).
13. Belyakov S.I. Main approaches to the assessment of the efficiency of corporate integration of enterprises in investment and construction complex. Real Estate: Economics, Management. 2023; 3:32-36. DOI: 10.22337/2073-8412-2023-3-32-36 URL: <https://n-eu.iasv.ru/index.php/neu/article/view/145/264> (rus.).
14. Kirillova A.N., Balashov E.B. Features of the model of innovation-balanced reproduction of housing and communal services : bulletin of the Russian Academy of Natural Sciences. 2022; 22(2):84-91. DOI: 10.52531/1682-1696-2022-22-2-84-91 (rus.).

Стратегические направления и перспективы развития строительного комплекса в России

Строительный комплекс является неотъемлемым стержнем экономического развития потенциала России, играя ключевую роль в формировании инфраструктуры и обеспечении жилищных потребностей населения. Анализ текущего состояния этого сектора обретает особую важность в контексте изменяющейся экономической среды и стратегических целей страны. Несмотря на разнообразные вызовы и перипетии, российская строительная отрасль продолжает демонстрировать устойчивость и потенциал дальнейшего развития. В статье проведен анализ текущего состояния и перспектив развития строительной отрасли Российской Федерации. Авторы оценивают ключевые аспекты сектора, его значение для национальной экономики страны, динамику рынка, тенденции инвестирования и технологические инновации. Проведенный авторами анализ актуальных статистических данных позволяет выявить основные вызовы и возможности, с которыми сталкивается строительная отрасль, а также рассмотреть возможные стратегии для достижения устойчивого развития отрасли в будущем. Особое внимание уделяется анализу национальных проектов и программ государственной поддержки регионов, стимулирующих инвестиции в строительство и модернизацию инфраструктуры.

Ключевые слова: строительный комплекс, жилищно-коммунальное хозяйство, государственная политика, градостроительный потенциал, комплексное развитие территорий, перспективы развития, национальная экономика

СПИСОК ИСТОЧНИКОВ

1. Паспорт федерального проекта «Инфраструктурное меню». URL: <https://www.minstroyrf.gov.ru/docs/139872/> (дата обращения: 14.04.2024).
2. Единая информационная система в строительстве. Ввод жилья в 2023 г. URL: https://наш.дом.рф/аналитика/ввод_жилья
3. Жилищное хозяйство в России. 2022 : стат. сб. // Росстат. М., 2023. 83 с. URL: https://rosstat.gov.ru/storage/mediabank/Jil_hoz_2022.pdf.
4. Овсянникова Т.Ю. Комплексная реновация жилой застройки: возможности развития российских // Инвестиции, градострои-

тельство, недвижимость как драйверы социально-экономического развития территории и повышения качества жизни населения : мат. XIII Междунар. науч.-практ. конф., Томск, 28 февраля – 02 марта 2023 года. Часть 1. Томск, Томский государственный архитектурно-строительный университет, 2023. С. 25–35.

5. Социально-экономические показатели. 2023 : стат. сб. // Росстат. М., 2023. 1126 с.

6. О внесении изменений в Градостроительный кодекс Российской Федерации и отдельные законодательные акты Российской Федерации в целях обеспечения комплексного развития территорий : Федеральный закон от 30.12.2020 № 494-ФЗ.

7. Мониторинг реализации механизма комплексного развития территорий субъектами Российской Федерации // Минстрой России. URL: <https://www.minstroyrf.gov.ru/trades/kompleksnoe-razvitiye-territoriy/1-monitoring-realizatsii-mekhanizma-kompleksnogo-razvitiya-territoriy-subektami-rossiyskoy-federatsii>

8. Национальные проекты РФ. URL: <https://национальныепроекты.рф/projects/zhile-i-gorodskaya-sreda/blagoustroystvo> (дата обращения: 14.04.2024).

9. Файзуллин И.Э. Инвестиционный процесс в жилищной сфере на современном этапе развития экономических отношений. Высшее и среднее профессиональное образование как основа профессиональной социализации обучающихся : мат. 13-й Междунар. научн.-практ. конф., Казань, 28 мая 2019 года / под ред. Р.С. Сафина, Е.А. Корчагина. Казань : ООО «Редакционно-издательский центр «Школа», 2019. С. 3–6.

10. Khrustalev B., Grabovyy P., Grabovyy K., Kargin A. Features of the information modeling use of real estate objects in the housing market // E3s web of conferences : XV International Scientific Conference on Precision Agriculture and Agricultural Machinery Industry "State and Prospects for the Development of Agribusiness — INTERAGROMASH 2022", Rostov-on-Don. Vol. 363. EDP Sciences : EDP Sciences, 2022. P. 02038. DOI: 10.1051/e3sconf/202236302038

11. Манухина Л.А., Якубов Х.Г. Analysis of current trends in the greening of urbanized territories // Недвижимость: экономика, управление. 2023. № 1. С. 11–15. URL: <https://n-eu.iasv.ru/index.php/neu/article/view/110/131>

12. Перечень поручений по итогам совещания с членами Правительства. URL: <http://www.kremlin.ru/acts/assignments/orders/56012> (дата обращения: 14.04.2024).

13. Беляков С.И. Main approaches to the assessment of the efficiency of corporate integration of enterprises in investment and construction complex // Недвижимость: экономика, управление.

2023. № 3. С. 32–36. DOI: 10.22337/2073-8412-2023-3-32-36
URL: <https://n-eu.iasv.ru/index.php/neu/article/view/145/264>

14. Кириллова А.Н., Балашов Е.Б. Особенности модели инновационно-сбалансированного воспроизводства жилищно-коммунального хозяйства // Вестник РАЕН. 2022. Т. 22. № 2. С. 84–91. DOI: 10.52531/1682-1696-2022-22-2-84-91

Об авторах: **Грабовый Петр Григорьевич** — доктор экономических наук, профессор, заведующий кафедрой организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 302471, Scopus: 57164862700; GrabovyyPG@mgsu.ru;

Ажимов Тимур Загидович — кандидат экономических наук, доцент кафедры Организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 7199-1406, Scopus: 57218826075, ResearcherID: ABD-6000-2021, ORCID: 0000-0002-7648-1950; Timur.Azhimov@gmail.com.

For citation: Grabovyy P.G., Azhimov T.Z. Strategic directions and development prospects of the construction industry in Russia. *Real Estate: Economics, Management*. 2024; 2:6-11.

Для цитирования: Грабовый П.Г., Ажимов Т.З. Strategic directions and development prospects of the construction industry in Russia // Недвижимость: экономика, управление. 2024. № 2. С. 6–11.



Л.И. Павлова. Москва. Казанский вокзал. Рисунок, тушь, перо.

Yankovsky A. V.



Yankovsky Alexandr Vladimirovich, leading engineer of the Scientific Research Centre "Integrated development of the territory", applicant for an academic degree of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; Alex.ynk@inbox.ru

Improving the mechanisms of renovation projects for dilapidated and emergency housing

During operation, each building is influenced by two groups of factors: external (natural) and internal, related to the technological or functional process taking place in the building. External or natural factors include: the impact of wind, snow, rain, solar radioactivity and temperature on structures. Internal or technological factors include: damage to structures from mechanical influences, overload of coating structures, corrosion of steel and reinforced concrete structures, damage to wooden structures by fungus as a result of violation of the temperature and humidity conditions of premises, etc. Damage to structures may occur from atmospheric influences as a result of overloading of coatings with snow load, wetting of walls due to small removal of the roof overhang or cornice and penetration of moisture through the roof, due to its unsatisfactory condition, especially in places of height difference, parapets and downspouts. Snow loads, especially in places of elevation differences, quite often create overloads on coatings, leading to deformations of load-bearing and enclosing structures, and in some cases lead to accidents. Wind loads are not dangerous for buildings made according to the project. However, given the insufficient overhang of roof overhangs and the low frost resistance of brick walls, they systematically get wet, freeze, resulting in weathering and destruction of brickwork. Quality control of work in the process of operation and repair of buildings, as well as planning and organizational preparation of building repairs is carried out by the administrative and economic department of the managing organization or the chief engineer.

Keywords: dilapidated and emergency housing, share of emergency housing, the programme of resettlement of emergency housing, problems of dilapidated and emergency housing

ANALYSIS OF DILAPIDATED AND EMERGENCY HOUSING ABROAD

In foreign countries, unlike the CIS countries, where there are state and municipal programmes for the elimination of emergency housing, in developed countries of Western Europe and the United States there is no concept of "emergency housing". Instead, municipal authorities, architectural authorities, social services, insurance companies and law enforcement agencies ensure that residential buildings and areas around them comply with the architectural requirements of the municipality and are in a regulated condition. In case of violation of the requirements, the municipal authorities may impose penalties on the homeowner, which may be significant and do not depend on the social status of the violator. These measures of suppression of violations encourage homeowners to keep their property in the necessary condition and prevent the transition of housing to a state of disrepair. This approach helps to ensure the safety of citizens and keep the housing stock intact. In addition, there are social

support mechanisms in foreign countries that allow people with low incomes to receive subsidies to pay for housing or access cheap housing [1, 2]. Today, we can say that this practice is of little use for Russia due to the low involvement of citizens in solving issues of quality maintenance of the urban environment, but it can be partially applied in the future after the relevant laws and reforms. In other countries, such as Japan, Slovakia, Lithuania and Armenia, the State and municipalities also provide significant support to residential renovation projects, including improving their energy efficiency. In the USA, urban planning policy is used, which includes the participation of local residents and the delegation of architectural authority to the local level, as well as the replacement of outdated buildings with new ones. In general, there is a developed housing services market in Western countries and the United States, where organizations specialize in certain types of work (for example, engineering communications or heat supply systems). To effectively manage all processes, homeowners need a manager who has knowledge of

Table 1. Solving the problem of dilapidated and emergency housing stock in foreign countries

Country	Problem solution
European countries (Germany, Great Britain, France, Sweden, etc.)	The method of reconstruction of the housing stock is used, which is based on innovative solutions in spatial planning design, which is aimed at preserving the historical appearance of the city and improving the quality of housing. Project financing is carried out jointly by the state, local governments and residents (50/50 ratio)
Japan, Slovakia, Lithuania	Plans are being developed to modernize residential buildings, taking into account the introduction of measures aimed at improving the energy efficiency of housing. Homeowners are stimulated by subsidizing and obtaining preferential loans from state funds for the development of the housing sector
Western countries, USA	Involvement of the population and local governments in urban planning policy, priority development of new territories and reconstruction of existing buildings

the secondary construction market, prices, financing tools and acts as a consultant [3].

Summarizing the above, the problem of dilapidated and emergency housing abroad is solved by reconstructing existing buildings, and not by demolition and new construction, except in the most extreme cases (Table 1).

ANALYSIS OF THE PROBLEM OF DILAPIDATED AND EMERGENCY HOUSING IN RUSSIA

In Russia, the housing stock has a low level of improvement, there are problems with major repairs, and a significant part of the population lives in cramped and unsettled housing. Living in dilapidated and emergency housing becomes life-threatening [4].

Over the past 20 years, the size of the emergency housing stock has increased significantly due to low rates of demolition or decommissioning, as well as insufficient capital repairs.

Today, solving demographic problems, as well as improving social stability, are among the key tasks facing the Russian government. An extensive number of different measures are used for this, but it is impossible to imagine improving the quality of life of the country's population without solving the housing issue.

According to VTSIOM surveys, more than two thirds of Russians expressed a desire to live in houses built after 2000. However, at the moment about 46 % of the total living area consists of dilapidated houses built between 1971 and 1995, which are gradually losing their original appearance [5–7].

In mid-2018, Decree of the President¹ was signed, which stipulated the improvement of housing conditions for five million families annually.

Within the framework of this national project, one of its goals is to sustainably reduce the uninhabitable housing stock, which means that at least 50 % of emergency housing will be settled in the reporting period.

But in the process of studying statistical data on this issue (dynamics of changes in the volume of emergency and dilapidated stock by country and region, distribution of emergency buildings by number of storeys and years of construction of buildings, etc.), we have to observe some trends that may negatively affect the results of solving this issue (Fig. 1).

Based on Fig. 1, we can note a clear negative trend towards an increase in the volume of dilapidated and emergency housing stock in recent years.

At the same time, the total cost of the dilapidated and emergency fund has already exceeded 93 billion rubles.

Taking into account the steady increase in the worn-out housing stock, capital repairs of 4 % of the total housing volume (about 100 million square metres) per year are required.

According to preliminary estimates, the cost of a comprehensive overhaul of all facilities in need is about 4.6 trillion rubles.

Statistics on the share of dilapidated and emergency funds in the Russian regions are shown in Fig. 2.

The regions were ranked according to the level of deterioration of the housing stock, including both dilapidated and emergency housing in the general housing stock. If the indicators were equal, then the regions with a smaller share of the emergency fund occupied higher places in the rating. If the share of dilapidated and emergency housing was the same, then the regions with the best dynamics of the share of dilapidated and emergency housing

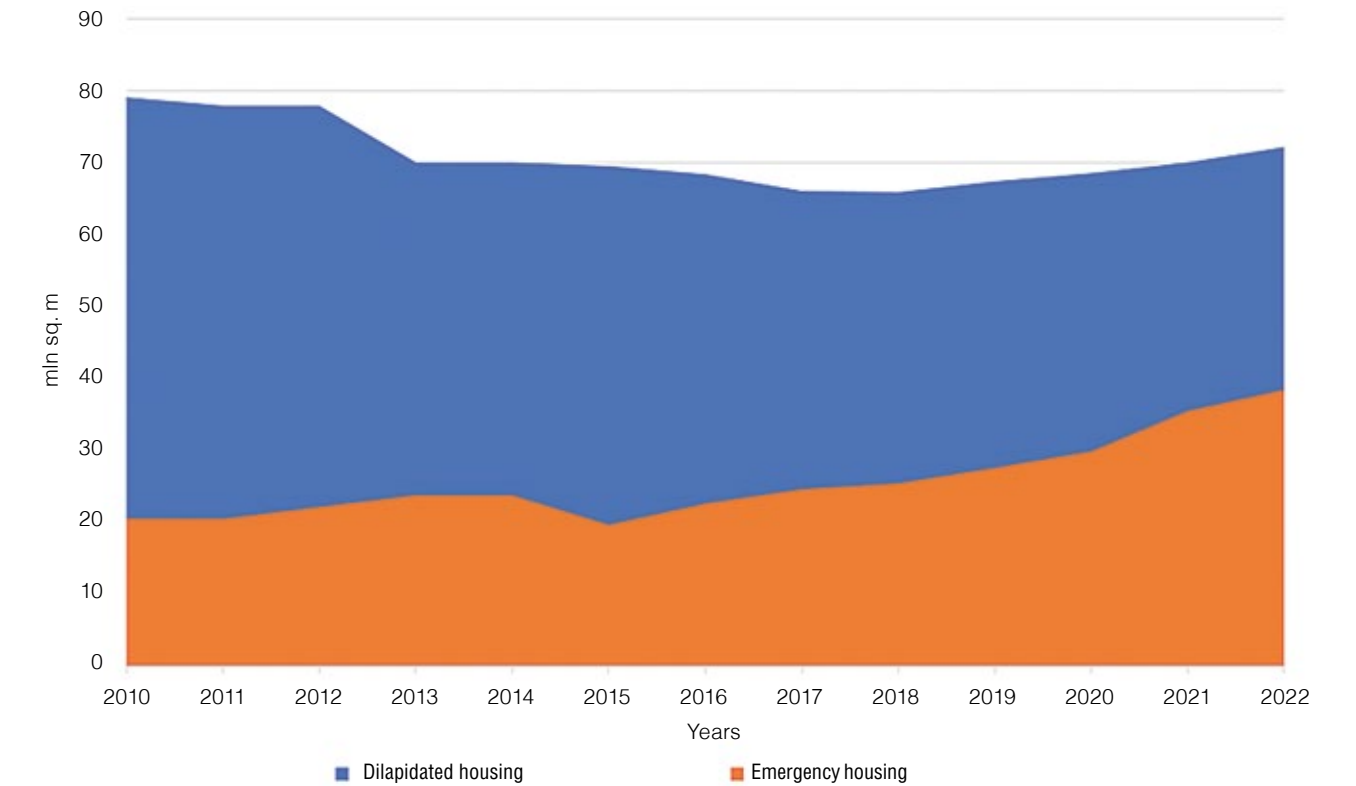


Fig. 1. Structure and dynamics of dilapidated and emergency housing stock in the Russian Federation, million square metres

¹ National Goals and Strategic Objectives for the Development of the Russian Federation for the period up to 2024 : Decree of the President of the Russian Federation No. 204; dated 05.07.2018.

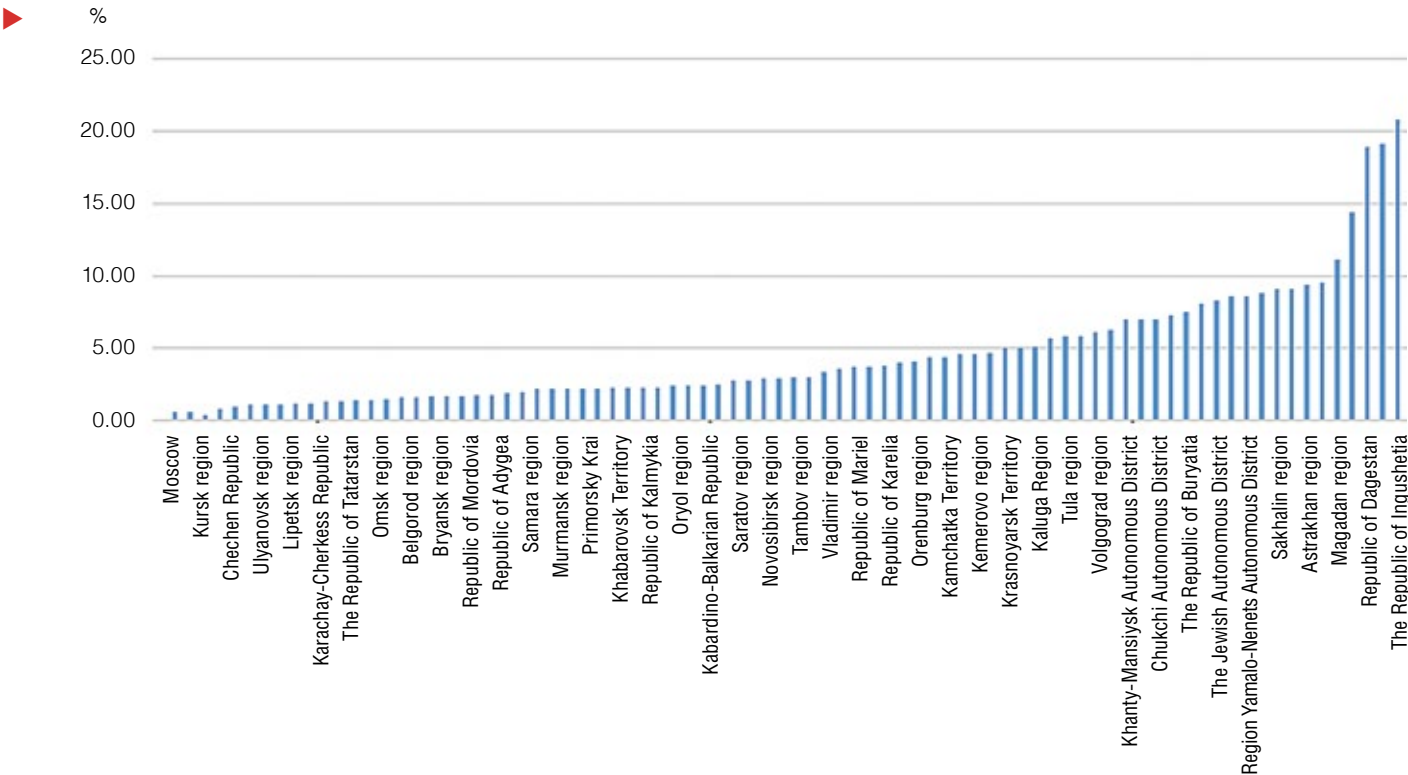


Fig. 2. Statistical information on the share of dilapidated and emergency housing stock in Russian regions

occupied higher places in the rating. At the end of the rating are the Republic of Ingushetia (20.8 % of the housing stock), the Republic of Tyva (19.1 %), the Republic of Dagestan (18.9 %), the Republic of Sakha (Yakutia) (14.4 %) and the Magadan Region (11.1 %), as well as other regions that, as a rule, are characterized by a low level of socio-economic development. They are located in the northern regions, where high deterioration of the housing stock is caused by climatic conditions and the peculiarities of the construction of settlements during the Soviet period [8–10].

Based on these statistics, we can say that there are a number of regions for which solving the problem of dilapidated and emergency housing is vital.

It can also be noted that the housing stock of Russia began to age noticeably in the late 20th – early 21st century due to the low

pace of housing construction, and today continues to age due to the deteriorating apartment buildings built from 1950 to 1970, which were a standard solution in housing construction during the reign of N.S. Khrushchev (Fig. 3, 4).

Today, Khrushchevki accounts for 46 % of the living area of all apartment buildings classified as emergency, which suggests that in the near future the problem of dilapidated and emergency housing may affect even more Russian families [11].

To solve the problem of dilapidated and emergency housing at the present stage, resettlement programmes are being implemented, which have been developed in all regions and municipalities of the Russian Federation. The state programme for the resettlement of citizens from emergency housing is based on the Decree of

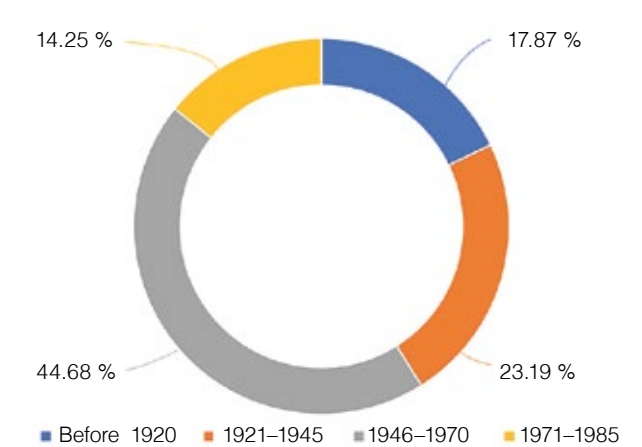


Fig. 3. The structure of the emergency housing stock in Russia (by year of construction of buildings) for 2023

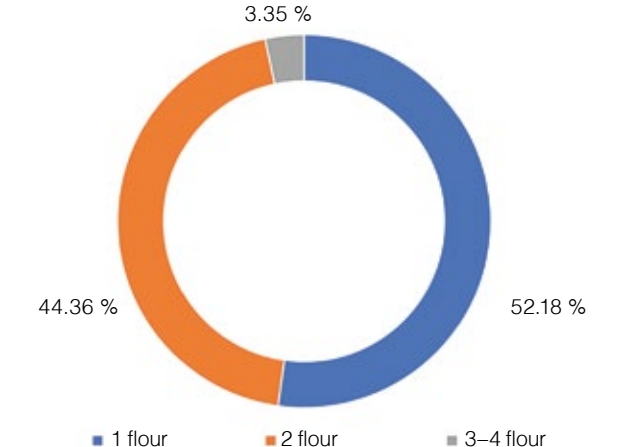


Fig. 4. The structure of the emergency housing stock of Russia (by number of storeys of buildings) for 2023

Financing of a new resettlement programme of emergency housing, billions of rubles

Source: Housing and Communal Services Reform Assistance Fund



Fig. 5. Schedule of financing of the state programme for the resettlement of emergency housing

the President of the Russian Federation¹ and is included in the national project “Housing and Urban Environment” [12].

According to this project, it is planned to relocate 530.9 thousand people from 9.54 million square metres of emergency housing in the period from 2019 to 2024, as well as another 133.3 thousand people from 2.4 million square metres in 2025 using funds allocated in 2024.

As a result, 664.2 thousand people from almost 12 million square metres of emergency housing will be settled within the framework of the project. The total budget for the implementation of this federal project “Ensuring sustainable reduction of uninhabitable housing stock” is 507.17 billion rubles, including 431.94 billion rubles from the federal budget, 67.84 billion rubles from the consolidated budgets of the subjects of the Russian Federation and 7.39 billion rubles from extra-budgetary sources (Fig. 5).

More than 86 % of the total financial support for the fulfillment of this task is made up of federal budget funds [13].

A study of the dilapidated and emergency housing stock, resettlement programmes and major repairs revealed the following problems in this industry (Table 2).

EXISTING APPROACHES TO PROBLEM SOLVING

In Fig. 6 is presented a conceptual five-process model of the life cycle of accelerated and effective implementation of investment and construction projects for the resettlement of dilapidated and emergency housing. In addition to the proposed measures outlined in Fig. 1, the authors believe that some of the following ways to improve the work of these programmes may be possible, namely:

the introduction of additive technologies into construction, which can help speed up the repair and reconstruction process, as well as reduce labor costs and the cost of work [14, 15].

Additive technologies in construction are technologies that are used to create three-dimensional objects using layered application of material, for example, using a 3D printer.

Let’s take a closer look at the most common and promising additive technologies in construction:

- core production: this method is used to produce metal structures by heating the rod and stirring it with a laser;
- fusible casting: this method allows you to create three-dimensional objects from plastic by applying layers of material using a laser or a melting head;
- selective laser welding: this method is used to create three-dimensional metal objects using a laser that welds metal layers together;
- photopolymerization: this method is used to create three-dimensional plastic objects using light;
- photopolymerization with suppression of surface shadows (SLA): this method is used to create three-dimensional objects from epoxy polymers using light. At the same time, special equipment is used that suppresses shadows, which allows you to create thinner layers of material;
- metal 3D printing: this method is used to create three-dimensional objects made of metal using special equipment that applies layers of metal to the surface.

Table 2. Identified problems in the field of dilapidated and emergency housing

Problem category	Problem	Significance	How is it being solved now	Result	Offers
Regulatory documents	1. At the legislative level, there is no concept of dilapidated housing	Average	Related regulatory documents have been adopted	The concept of dilapidated housing is not legalized	To amend the legislation to clearly separate controversial issues and interpretations
Financing	1. Insufficient funding	High	Implementation of federal programmes, attracting investors	Execution of programmes at the expense of budgetary funds, the difficulty of attracting investors	Modernize the programme financing scheme
	2. Funds cannot be mastered	Average	Withdrawal of surpluses, bringing to justice	Strict control over the disbursement of funds within the framework of the programme	–
The condition of the housing stock	1. Increase in emergency housing stock	High	Development of federal resettlement programmes, maintenance of dilapidated housing stock	The level of unsuitable housing is not increasing, but the housing stock continues to become obsolete	The offer of accelerated settlement at a low interest rate within the framework of the proposed financing scheme
	2. Increase in dilapidated housing stock	High	Development of major repair programmes	Due to the lack of an effective financing model, it is not possible to include in the programme the entire housing stock in need of repair	To increase the volume of work carried out through the introduction of modern additive technologies
The quality of the housing being introduced	1. Low quality of building materials, low qualification of contractors	High	Increased control over the involvement of third-party organizations, as well as over the progress of construction	Improving the quality of newly commissioned homes	Introduction of additive technologies
Official information	1. Insufficient degree of openness of information, underestimation of indicators	Average	Control over the provision of reliable information, bringing to justice	Expert assessment and statistics provided in official sources may differ	Creation of an open and complete database in the field of dilapidated and emergency funds of the Russian Federation
	2. Misrepresentation of data for illegal activities	High	The control bodies carry out checks on the legality of certain actions on the part of local governments	There may be cases of misrepresentation of information in order to obtain additional funding	Creation of an open and complete database in the field of dilapidated and emergency funds of the Russian Federation, bringing those responsible to justice

EXPECTED RESULTS FROM THE INTRODUCTION OF MECHANISMS FOR THE RESETTLEMENT OF DILAPIDATED, EMERGENCY HOUSING

The expected results from the implementation of the proposed mechanisms for the resettlement of dilapidated and emergency housing for the state and citizens:

1. Improving living conditions for people living in dilapidated or emergency housing: the repair and reconstruction of existing housing and the construction of new residential premises will improve the quality of life of people living in such conditions.
2. Reducing the risk of accidents and accidents. Dilapidated and emergency housing is often associated with a high risk of accidents and accidents, such as fires, electrical incidents, etc. Repair and reconstruction of existing housing using additive technologies and the construction of new residential premises will reduce the risk of such accidents.

3. Improving social integration and living standards. People living in dilapidated or emergency housing often experience social isolation and a low standard of living. The proposed measures will help to improve the social integration and standard of living of such people.
4. Reducing the cost of housing: the use of additive technologies will make it possible to reduce the cost of repairs, increase the energy efficiency of buildings and reduce the costs of the population and the municipality for the operation of premises.
5. Improvement of the environmental situation. Dilapidated and emergency housing is often associated with low energy efficiency. The use of new materials in combination with the use of energy-efficient technologies will improve the environmental situation in the area.
6. Improvement of the economic situation. The renovation and reconstruction of existing housing and the construction of new residential premises will create jobs and improve the economic

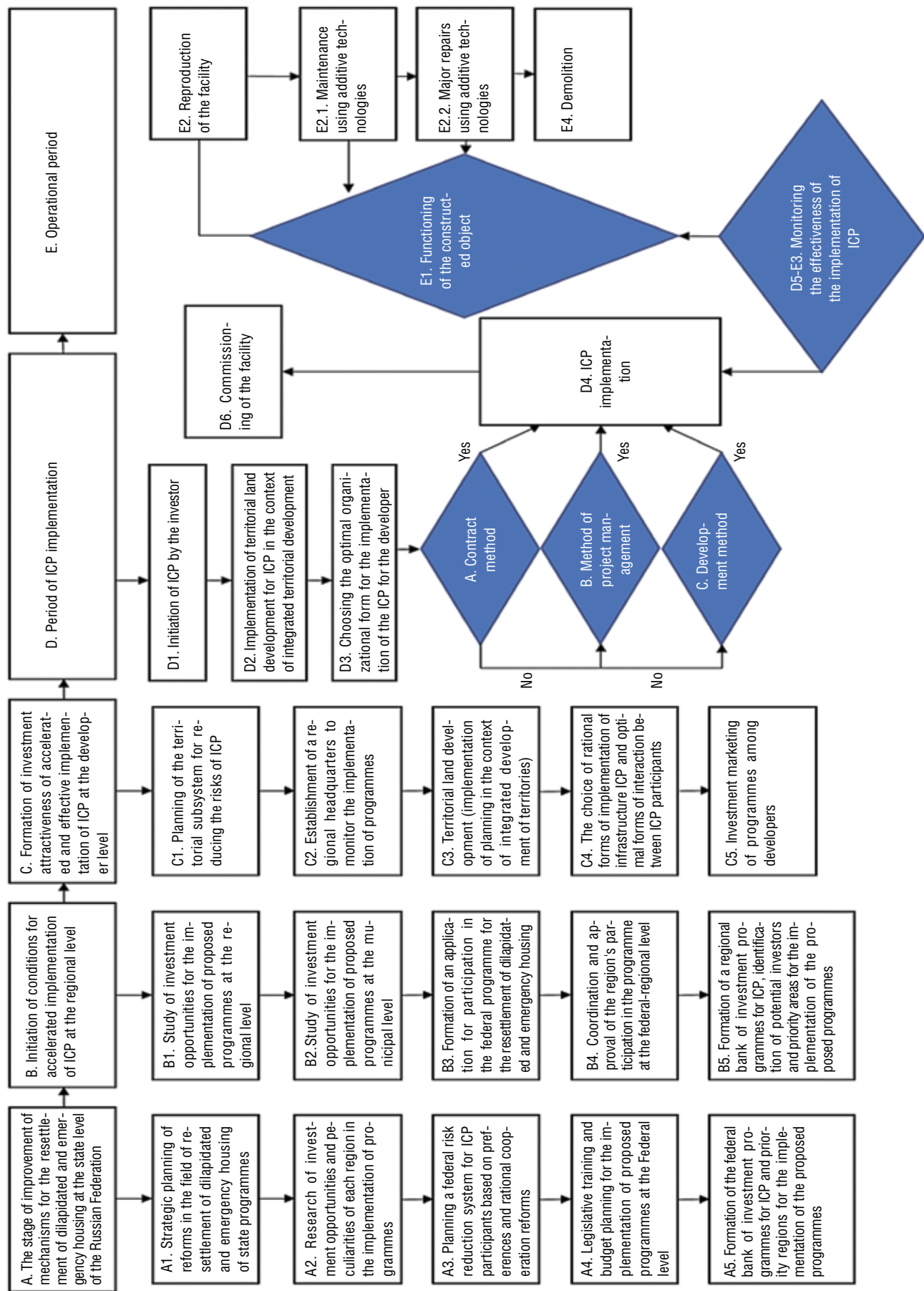


Fig. 6. A conceptual five-process life cycle model for accelerated and effective implementation of investment and construction projects for the resettlement of dilapidated and emergency housing

► situation in the city/district. This can be especially important in areas with high unemployment and low living standards.

7. Risk reduction: the resettlement of dilapidated and emergency housing reduces the risks associated with illegal buildings and illegal use of land.

It is important to note that mechanisms for the resettlement of dilapidated and emergency housing should be developed and implemented taking into account local conditions and needs, as well as taking into account the social, economic and environmental situation.

CONCLUSIONS

The expected results from the implementation of the proposed mechanisms for the resettlement of dilapidated and emergency funds for developers allows for:

1. Income increase: the resettlement of dilapidated and emergency housing can become a new source of income for developers who will be able to profit from the reconstruction and repair of such facilities.

2. Improving reputation: the introduction of mechanisms for the resettlement of dilapidated and emergency housing can help improve the reputation of the developer in the eyes of society and authorities.

3. Increasing competitiveness: a new scheme for financing the resettlement of dilapidated and emergency housing can improve the position of the developer in the market, as he will be able to compete more effectively with other companies.

4. Attracting additional investments for business expansion for the implementation of projects for the repair and reconstruction of dilapidated housing and the resettlement of the emergency fund.

However, it should taken into account that the resettlement of dilapidated and emergency housing also brings a number of difficulties for developers. For example, the reconstruction and repair of such facilities can be complex and time-consuming, requiring large financial and time costs. In addition, there may be problems with attracting investments and reducing profits for a while.

That is why it is important to select companies carefully for the implementation of these projects.

REFERENCES

1. Ivanova E.S. Liquidation of dilapidated and emergency housing is an important tool for solving a housing problem. *Housing and Communal Infrastructure*. 2020; 2(13):99-104. (rus.).

2. Krutskikh E.N. Problems of dilapidated and emergency housing and ways to solve them. *The Diary of Science*. 2020; 6(42):39. (rus.).

3. Gabitdinov R.F. Resettlement from dilapidated and emergency housing as a problem of housing stock management. *Proceedings of the Orenburg Institute (branch) Moscow State Law Academy*. 2022; 1(51):58-66. (rus.).

4. Bannikova I.D. Problems of dilapidated and emergency housing in Russia. *Scientific Leader*. 2022; 22(67):211-212. (rus.).

5. Smirnov A.S., Pakhaleev V.M., Ushakov V.N. Dilapidated and emergency housing : situational analysis. *Bulletin of scientific thought*. 2022; 6:324-329. DOI: 10.34983/DTIPB.2022.51.24.001 (rus.).

6. Luzyanina A.I. Features in the field of implementation of resettlement of citizens from dilapidated and emergency housing. *My Professional Career*. 2022; 1(42):164-171. (rus.).

7. Kondrashova M.A., Pyataev D.A. Dilapidated and emergency housing as a legal category under Russian housing legislation. *The Legal Position*. 2023; 6(42):33-38. (rus.).

8. Lepekhin I.A., Kostina L.V. The implementation of housing policy in Russia and prospects for solving the problem of dilapidated and emergency housing. *Bulletin of the Tver State Technical University. Series: Social Sciences and Humanities*. 2023; 4(35):84-88. DOI: 10.46573/2409-1391-2023-4-84-88 (rus.).

9. Rumyantsev F.P. From renovation to integrated development of territories. *Modern Society and Law*. 2022; 1(56):65-74. (rus.).

10. Ovsyannikova T.Y. State policy in the field of housing renovation: a regional aspect. *Real Estate: Economics, Management*. 2020; 2:6-11. DOI: 10.22227/2073-8412.2020.2.6-11 (rus.).

11. Zakharchenko D.A., Vologzhanina Yu.A. Russian experience of renovation of obsolete and dilapidated housing. *Economics of Construction and Urban Economy*. 2020; 16(1):5-11. (rus.).

12. Petukhova A.S., Zhidkov D.E., Potapov M.A., Kolobova P.A., Khromin R.A. Problems of dilapidated and emergency housing in Russia. *Financial Economics*. 2021; 11:153-155. (rus.).

13. Afanasyevskaya A.V. Correlation of concepts of dilapidated and emergency housing: problems of law enforcement practice. *Society and Civilization*. 2022; 4(1):37-40. (rus.).

14. Yatsenko Yu.A., Smirnova E.N. Modern ways of solving problems in the field of dilapidated and emergency housing. *Construction and Real Estate*. 2022; 2(11):155-159. (rus.).

15. Nikitina E.V. Demolition of dilapidated housing: current problems and ways to solve them. *The best research paper of 2023 : Collection of articles of the VII International Scientific Research Competition. Petrozavodsk, 2024*; 33-42. (rus.).

Совершенствование механизмов проектов реновации ветхого и аварийного жилья

В процессе эксплуатации каждое здание находится под воздействием двух групп факторов: внешних (природных) и внутренних, связанных с происходящим в здании технологическим или функциональным процессом. К внешним или природным факторам относятся: воздействие на конструкции ветра, снега, дождя, солнечной радиоактивности и температуры. К внутренним или технологическим факторам относятся: повреждения конструкций от механических воздействий, перегрузка конструкций покрытия, коррозия стальных и железобетонных конструкций, поражение деревянных конструкций грибом в результате нарушения температурно-влажностного режима помещений и т.д.

От атмосферных воздействий могут возникнуть повреждения в конструкциях в результате перегрузки покрытий снеговой нагрузкой, намокания стен из-за малого выноса кровельного свеса или карниза и проникновения влаги через кровлю в связи с неудовлетворительным ее состоянием, особенно в местах перепада высот, парапетов и водосточных воронок. Сне-

говые нагрузки, особенно в местах перепада высот, довольно часто создают перегрузки на покрытия, приводящие к деформациям несущих и ограждающих конструкций, а в некоторых случаях приводят к авариям. Ветровые нагрузки не являются опасными для зданий, выполненных по проекту. Однако, учитывая недостаточный вылет кровельных свесов и низкую морозостойкость кирпичных стен, они систематически намокают, промерзают, в результате чего происходит выветривание и разрушение кирпичной кладки.

Контроль качества выполнения работ по эксплуатации и ремонту зданий, а также планирование и организационная подготовка ремонта зданий осуществляется административно-хозяйственным отделом управляющей организации или главным инженером.

Ключевые слова: ветхое и аварийное жилье, доля аварийного жилья, программа расселения аварийного жилья, проблемы ветхого и аварийного жилья

СПИСОК ИСТОЧНИКОВ

1. Иванова Е.С. Ликвидация ветхого и аварийного жилья — важный инструмент решения жилищной проблемы // *Жилищное*

хозяйство и коммунальная инфраструктура. 2020. № 2 (13). С. 99–104.

2. Крутских Е.Н. Проблемы ветхого и аварийного жилья и пути их решения // *Дневник науки*. 2020. № 6 (42). С. 39.

3. Габитдинов Р.Ф. Переселение из ветхого и аварийного жилья как проблема управления жилищным фондом // *Труды Оренбургского института (филиала) Московской государственной юридической академии*. 2022. № 1 (51). С. 58–66.

4. Банникова И.Д. Проблемы ветхого и аварийного жилья в России // *Научный лидер*. 2022. № 22 (67). С. 211–212.

5. Смирнов А.С., Пахалеев В.М., Ушаков В.Н. Ветхое и аварийное жилье: ситуационный анализ // *Вестник научной мысли*. 2022. № 6. С. 324–329. DOI: 10.34983/DTPB.2022.51.24.001

6. Лузянина А.И. Особенности в сфере реализации переселения граждан из аварийного и ветхого жилья // *Моя профессиональная карьера*. 2022. Т. 1. № 42. С. 164–171.

7. Кондрашова М.А., Пятаев Д.А. Аварийное и ветхое жилье как правовая категория по российскому жилищному законодательству // *Правовая позиция*. 2023. № 6 (42). С. 33–38.

8. Лепехин И.А., Костина Л.В. К вопросу о реализации в России жилищной политики и перспективах решения проблемы ветхого и аварийного жилья // *Вестник Тверского государственного технического университета. Серия: Науки об обществе и гуманитарные науки*. 2023. № 4 (35). С. 84–88. DOI: 10.46573/2409-1391-2023-4-84-88

9. Румянцев Ф.П. От реновации к комплексному развитию территорий // *Современное общество и право*. 2022. № 1 (56). С. 65–74.

10. Овсянникова Т.Ю. Государственная политика в сфере реновации жилищного фонда: региональный аспект // *Недвижимость: экономика, управление*. 2020. № 2. С. 6–11. DOI: 10.22227/2073-8412.2020.2.6-11

11. Захарченко Д.А., Вологжанина Ю.А. Российский опыт реновации морально устаревшего и ветхого жилья // *Экономика строительства и городского хозяйства*. 2020. Т. 16. № 1. С. 5–11.

12. Петухова А.С., Жидков Д.Е., Потапов М.А., Колобова П.А., Хромин Р.А. Проблемы ветхого и аварийного жилья в России // *Финансовая экономика*. 2021. № 11. С. 153–155.

13. Афанасьевская А.В. Соотношение понятий ветхого и аварийного жилья: проблемы правоприменительной практики // *Общество и цивилизация*. 2022. Т. 4. № 1. С. 37–40.

14. Яценко Ю.А., Смирнова Е.Н. Современные пути решения проблем в сфере ветхого и аварийного жилья // *Строительство и недвижимость*. 2022. № 2 (11). С. 155–159.

15. Никитина Е.В. Снос ветхого жилья: актуальные проблемы и пути их решения // *Лучшая исследовательская статья 2023 : сб. ст. VII Междунар. науч.-исслед конкурса. Петрозаводск, 2024. С. 33–42.*

Об авторе: **Янковский Александр Владимирович** — ведущий инженер Научно-исследовательского центра «Комплексное развитие территории» (НОЦ КРТ), соискатель кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; Alex.ynk@inbox.ru.

For citation: Yankovsky A.V. Improving the mechanisms of renovation projects for dilapidated and emergency housing. *Real Estate: Economics, Management*. 2024; 2:12-19.

Для цитирования: Янковский А.В. Improving the mechanisms of renovation projects for dilapidated and emergency housing // *Недвижимость: экономика, управление*. 2024. № 2. С. 12–19.



Л.И. Павлова. Москва. Ул.Моховая. Рисунок, тушь, перо.

Volgin V.V.



Volgin Valentin Valentinovich,
Candidate of Technical Sciences,
Associate Professor of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RSCI: 1212902, ResearcherID: AAE-8862-2022, ORCID: 0000-0001-7130-3410; VolginVV@mgsu.ru

Risk management in the implementation of investment and construction projects

The developer is a professional figure in the real estate market, combining managerial and entrepreneurial functions in his activities. At the same time, there are features and tasks associated with the creation and implementation of development projects. Thus, in the process of selecting and implementing investment and construction projects, their responsibility, in addition to providing liquidity, includes taking into account social, aesthetic and environmental aspects.

Today, individuals engaged in investment and construction activities, including developers, cannot always spend their time in order to solve certain problems related to the transfer of land directly between different established categories. In this case, land transfer refers to the process associated with the transfer of lands with agricultural purposes to their combined development. To do this, an investment product is being created, i.e. a plot of land with which the necessary actions were carried out for the subsequent construction of necessary structures for various purposes on it [1].

Today, many developers indicate that the implementation of IDT projects (integrated development of territories) needs to be reimbursed from the local budget for a share of the costs associated with the implementation of the development of the relevant territories.

Different land plots have different investment potential, which creates the need for an assessment by its owner. With the participation of local authorities in the development of territories, they have the right to receive compensation.

Keywords: *land rent, land categories, land transfer from one category to another, land development risk management, economic efficiency of projects*

FORMATION OF RISK FACTOR SPACE FOR ESTIMATING THE VALUE OF LAND RESOURCES

Often, local authorities, when selling land, do not assess its actual value, as well as the future income that can be obtained with their participation.

Fig. 1 shows the factors that are used to determine the amount of land rent, these are:

- available natural features;
- standard of living;
- infrastructure development;
- results of the development of the site.

The municipality, acting as the owner of a piece of land, can lease it out, while receiving compensation for the above factors if they have a positive impact on this piece of land [2].

As the analysis of some European countries has shown, when compared with the situation on the Russian market (Fig. 2), it becomes obvious that today

Land rent		
Natural features	Standard of living: development of social, engineering, and transport infrastructure	The results of entrepreneurial activity in the development of residential and non-residential facilities

Fig. 1. Factors for determining land rent

the municipal authorities of our state do not pay due attention to the land resources available on its territory, from the point of view of studying the cost structure when implementing projects.

At the same time, there is the highest profitability of housing construction projects in the Russian Federation than is observed in statistics for European countries.

Economic theory is accompanied by a process of redistributing public rent to the developer directly from the value that certain plots of land possess [3].

Taking into account the existing schemes for paying for rights to purchase a plot of land, Russian developers have the lowest level of profitability than the accepted average indicators that can be obtained when implementing similar projects in European countries.

Thus, based on the information provided above, it can be argued that today there is a need to develop a nationwide methodology for an adequate assessment of the value of land resources [4].

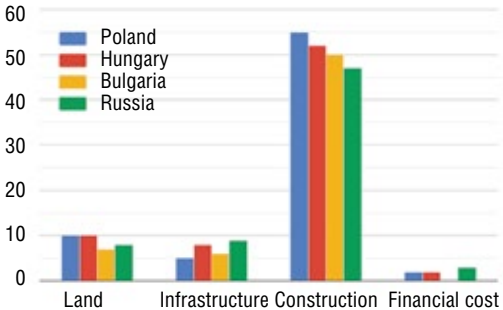


Fig. 2. Cost structure of mass housing construction by key expenditure items in Russia, Europe

ANALYSIS OF EXISTING LAND CATEGORIES

The inefficient use of various land resources on the territory of our state is caused by the presence of problems that are associated with the imperfection of the implemented land policy, and, of course, the accounting of land plots, which leads to a problem of national scale. We will analyze these circumstances in further research, but for now we need to understand what lands exist.

In accordance with Article 7 of the RF Land Code, Russian lands are divided into 7 categories for their intended purpose (Fig. 3):

- 1. Agricultural lands.
- 2. Settlements.
- 3. Industry.
- 4. Specially protected areas, facilities.
- 5. Forest fund.
- 6. Water fund.
- 7. Stocks.

These categories are used to identify opportunities associated with the use of land plots, i.e. they act as an important factor for investing in them.

The objectives of the agro-industrial complex of the Russian Federation:

- increase in the gross harvest of the entire crop;
- increase in acreage.

Our state has substantial land resources. According to the data provided by Rosreestr, on 01.01.2023, their area size is 1,712.5 million hectares, where agricultural land is 383.2 million hectares, which is 22.4 %.

According to the data provided by the Federal Register, in 2021 the size of the area of all farmland is 197.8 million hectares, where 58.8 % (116.3 million hectares) are arable land.

81.7 % of agricultural land in the Russian Federation is located in the following areas:

- 25.9 % — Volga;
- 25.0 % — Siberian;
- 15.9 % — Southern;
- 14.9 % — Central.

In 2017–2023, there was a reduction in farmland by 1.6 million hectares, which was observed in 2013–2016.

During the analyzed period, the reduction of agricultural land amounted to 3.64 million hectares due to the fact that the land was transferred to other categories. Whereas the reverse transfer from the reserve lands increased the indicator by 0.59 million hectares. While the increase in their area amounted to 1.45 million due to the fact that the administrative borders were changed due to the annexation of the Republic of Crimea [2].

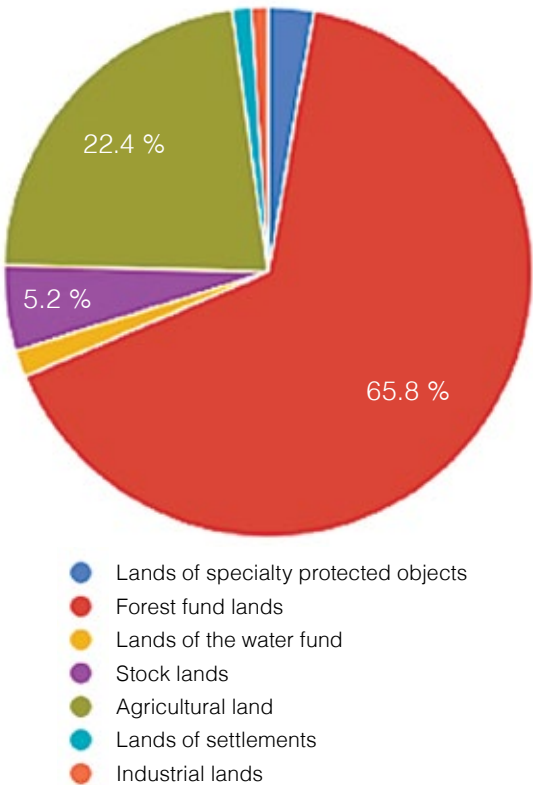


Fig. 3. The structure of the land fund of the Russian Federation in accordance with the categories of land on 01.01.2021

In the Russian Federation, according to Federal Law No. 172 dated 21.12.2004 “The transfer of lands or land plots from one category to another”, this process is bilateral in nature and is carried out on an annual basis.

Let’s display the dynamics of the translation in Table 1.

By 2021, the fall in farmland due to their transfer to other categories amounted to 599.7 thousand hectares, while their growth amounted to 215.4 thousand hectares as a result of the reverse transfer, including:

- reserve lands, where the Republic of Crimea has 72 thousand hectares (Rostov 34.2 thousand hectares Jewish Autonomous — 35 thousand hectares) — 208.1 thousand hectare;
- lands of settlements, mainly due to the Lipetsk region with an indicator of 1.6 thousand hectares — 4.1 thousand hectare;
- lands belonging to the water fund at the expense of the Republic of Tatarstan with an indicator of 2.2 thousand hectares — 0.2 thousand hectare;

Table 1. Change in agricultural land conversion

Transfer from agricultural lands to lands of	01.01.2017	01.01.2018	01.01.2019	01.01.2020	01.01.2021
Forest fund	554	261	3,307	163	197
Settlements	70.9	64.1	52.7	45.7	72.6
Territories under special protection	29.8	1.18	37.5	5.5	290
Industry, communications, transport, etc.	37.8	54.4	37.1	56	37
Stock	5.8	850	2.9	4.4	2.7
Water fund	–	–	0.9	–	0.3

Note: the presented figures do not include new territories (DPR, LPR, Zaporizhia and Kherson regions).

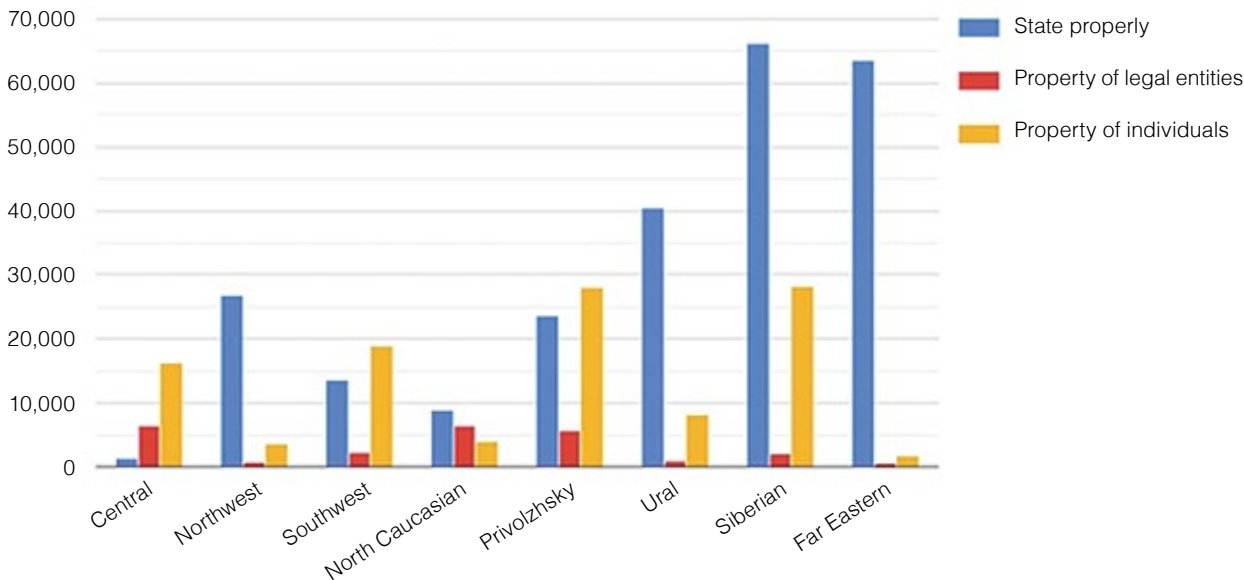


Fig. 4. Distribution of agricultural land in accordance with forms of ownership, which is observed in the federal districts of the Russian Federation on 01.01.2021, thousand hectares

- industrial lands at the expense of the Yamalo-Nenets Autonomous District with an indicator of 1.8 thousand hectares — 2.6 thousand hectare;
- lands belonging to the forest fund at the expense of the Yaroslavl region with an indicator of 0.3 thousand hectares — 0.4 thousand hectares.

Change from 2017–2021:

- lands of the forest fund: $(19,700:554) - 100 = -64.4\%$;
- lands of settlements: $(7,090:72.6) - 100 = 2.3\%$;
- territories under special protection: $(29,000:29.8) - 100 = 873.1\%$;
- Industrial lands: $(3,700:37.8) - 100 = -2.1\%$;
- reserve land: $(270:5.8) - 100 = -53.45\%$;
- lands of the water fund: 100 %.

The federal districts where the largest number of decisions related to land transfer were made:

- 2,944 decisions — Volga;
- 1,777 — Ural;
- 1,376 — Central.

There was a decrease in the area of agricultural land owned by the population by 4.5 million hectares, while their increase by 4.1 million hectares owned by legal entities.

In Fig. 4, we will display the distribution of agricultural land in accordance with the forms of ownership according to the FD.

It turns out that many agricultural lands are owned by the state. Whereas some of them have no borders, which is a problem of inefficient management, which has a negative impact on the formation and development of the land market, the involvement of land in circulation as a means of production.

The share of land in private ownership is small. There are no significant changes in it recently.

Today, in the Russian Federation, many land users have lands that they do not use. In their total volume, they own a significant area of agricultural land in the Russian Federation.

For this reason, today it is necessary to identify and involve abandoned, unused agricultural land in agricultural turnover [3].

CONCEPTUAL FEATURES OF RISK MANAGEMENT AT THE MAIN STAGES OF LAND DEVELOPMENT

Development projects are investments with a long-term nature, generating income for a long period of time.

It should be noted that the beginning of the development cycle is the emergence of an idea. Whereas it ends with the sale, the completion of the project. The duration of the cycle is 3–5 years or more in accordance with the nature of the project [5].

The payback period in the Russian Federation is 3–4 years, whereas in some cases it can reach 10 years.

The goals of spending funds are determined at the beginning of the activity, which is not accompanied by final results.

The developer makes a decision, according to available information, that is, performs activities under conditions of uncertainty. Uncertainty is the lack of accuracy of data, which is accompanied by risks. The nature of development in the form of the formation of an object is based on the causes of uncertainty, which indicates a change in its connections. The nature of the changes, the results are not subject to accurate calculation, because there are factors affecting the environment, the object, and the inability to obtain data for decision-making.

In order to implement the concept of land development, the involvement of lawyers is required. This necessity is due to the fact that different issues that relate to the CC RF can be interpreted in different ways.

In addition, the services of a lawyer are necessary for the reason that there is a restriction in relation to the plot of land. For this reason, specialists will need to offer the most rational and easiest way to overcome them [6].

Uncertainty entails the occurrence of risk. For this reason, it is imperative to minimize it by increasing the reliability of the data.

It is possible to minimize uncertainty by obtaining more high-quality information.

One of the features of risk is the likelihood of conditions that can have negative consequences for someone. It can arise due to the probability of an occurrence of consequences, which is subject to one or another measurement. For this reason, risk acts as an uncertainty that cannot be calculated or foreseen [7].

To date, there is an alternative definition of risk, which consists in the presence of the probability of deviations in indicators.

Possible risk outcomes:

- 1) positive (availability of profit, income, etc.);
- 2) negative (presence of damage, loss, etc.);
- 3) zero (no changes).

Today, the effectiveness of investment and construction projects depends on changes in equipment, technology, productivity, cost, which entails the implementation of the project in the presence of different types of risks.

ALGORITHMS FOR MANAGING EXISTING RISKS

Initially, risk identification is performed in order to carry out its analysis, which will allow an adequate response to it (Table 2).

To date, ongoing projects have features that actualize the problem of risks:

- 1. Each project is an innovative, investment process, where a unique, new product enters the market, which indicates that it is not possible to predict the risk response to it.
- 2. Each project is a complex social, technical and economic system, where there are different participants, whose final result depends on the quality of their activities.
- 3. Each participant is a potential risk carrier. It turns out that when organizing the interaction of project participants, it is necessary to anticipate risks for a particular market participant in order to minimize them later.
- 4. The main source of financing is investor funds, which entails responsibility for reducing risks.

The basis for managing risks is identification, analysis, and identification [8].

The implementation of development projects is accompanied by the following risks:

- 1. Systematic — the risks that arise for each participant who carries out the implementation of economic activities. In the analyzed area, they are risks that cannot be excluded in project management. The following types of risks can be attributed to such risks:
 - changes in the economic situation during the implementation of the project;
 - low liquidity of real estate in the form of an asset, etc.

This list is updated with regional risks when considering the real estate market.

Regional risks include the following risks:

- decrease in business activity in the region;
- migration.

- 2. Non-systematic — the risks of the project, its features. It is possible to minimize them through management [9, 10].

Table 2. Possible combinations of probabilities and consequences of risks

Probability/ consequence level	High	Medium	Low
Minor	B	D	D
Medium	A	B	C
Catastrophic	A	A	B

Note: A — inability to transfer the risk to be excluded; B — presence of difficulties in transferring, subject to immediate disposal; C — a transferable risk to be eliminated if necessary; D — an acceptable level of risk.

This problem can be solved through the creation of a scheme for the execution of works on land development of a territory where effective interaction is required by development participants to achieve the desired result in the execution of works related to land development [11].

Example 1. “1st Nagatinsky” is a residential complex surrounded by existing buildings. This is a project for the integrated development of an area of 13 hectares. A new reading of the location with an emphasis on all its strengths: opens the entrance to the Nagatino-Sadovniki area. Nagatinskaya metro station is just a 3-minute walk away, Nagatinskaya MCC (Verkhnie kotly) is 4 minutes away, TTC — at 5 min. Nagatinskaya Embankment is a few minutes' walk away. A 10-minute drive by public transport is the “Island of Dreams”, where little Moscow residents like to spend time.

Variety of leisure activities:

- libraries;
- cinemas;
- Marc Chagall Embankment;
- Novodanilovskaya, Nagatinskaya embankments;
- urban landscape parks.

It should be noted that the internal territory of this complex is fenced. For this reason, outsiders cannot be on it. In addition, there are plans to implement a program called “yard without cars”.

An important element of the landscaping of this inner territory is the promenade, which connects various functional areas with a unique Japanese garden. Within the framework of the project, there are plans to build their own kindergarten, as well as a school.

In the process of executing commercial projects, land development consists in extracting income, making a profit from the sale of assets that have increased in value.

It turns out that the success of the land development project depends on such factors as:

- 1. Correct determination of the optimal use case for a plot of land.
- 2. Well-developed project concepts, a reasonable financial model.
- 3. Effective project execution [12].

Example 2. The methodology of the residential complex called “1st Nagatinsky” is based on such a concept as “effective profitability”. Its main difference directly from the general level of profitability lies in taking into account the current value of the land when calculating the project, that is, there is a deduction from the total profitability of the delta, which was formed when the market value of the land plot increased during the period of construction. This is essential in order to assess the effectiveness of the project being carried out for the reason that the increase in the cost of land plots during the pre-crisis period established errors, as well as miscalculations that were made by developers.

Dynamic assessment methods include the following models:

- 1. Net discounted income.
- 2. Investment return index.
- 3. Internal rate of return.
- 4. Discounted payback period of the investment.

Profit from sales and savings are calculated from total revenue and savings minus costs.

The simple rate of return (SRR) is calculated from the ratio of the profit of the investment project over a certain period to the cost of the investment project. The interpretative meaning of the simple norm established for profit is the assessment of the recoverable part of investment costs as profit during one planning interval.

Table 3. Outcome of the enterprise

Name of fixed assets	Price per unit, thousand rubles	Number of units	Total cost	Life period, years	Amortization per year, thousand rubles	Amortization per month, thousand rubles
Building	15,000,000	4	60,000,000	100	600,000	50,000
Security costs of the facility	750,000	1	750,000	35	21,429	1,786
Construction of playgrounds	225,000	2	450,000	15	30,000	2,500
Construction of a recreational area	2,250,000	1	2,250,000	50	45,000	3,750
Construction of leisure facilities	6,000,000	5	30,000,000	75	400,000	33,333
Total	24,225,000	13	93,450,000	–	1,096,429	91,369

In the process of performing a comparative analysis of the calculated SRR value with an average or minimum level of profitability, a potential investor is able to form a preliminary conclusion on the expediency of deepening and continuing the analysis of an investment project. According to this indicator, it becomes possible to estimate the approximate payback period of investments [13].

Example 3. Table 3 takes into account the necessary fixed assets for the construction of the residential complex “1st Nagatinsky”.

A recreational area is an area that is specially allocated in a city or in a suburban area in order to organize recreation areas, consisting of parks, gardens, urban forests, beaches and other facilities. Their main purpose is to restore the moral and physical strength of a person. They may include natural objects and territories under special protection [12].

Playgrounds are essential for the physical, social, emotional and cognitive development of children.

It is also necessary to build leisure facilities.

In accordance with established practice, in large cities of the Russian Federation, the problem associated with meeting the need for healthy leisure for young people is solved, which cannot be said about small urban formations due to various social, economic, and other reasons. Therefore, the formation of a network of different leisure facilities is subject to development in a small city.

This Table 4 takes into account the main income of the developer of the residential complex “1st Nagatinsky”.

This indicator is calculated using the following formula:

$$IRR = r_1 + \frac{NPV(r_1)}{NPV(r_1) - NPV(r_2)} (r_2 - r_1),$$

(1)

where r — percentage rate;
 NPV — net present value.

Table 5. Net present value, NPV

Period	Income, C	Outcome, f	Cashflow	Discount rate, r	Net present value, NPV
1st half of 2023	0	6,056,250	–6,056,250	0.075	–454,219
2nd half of 2023	0	6,056,250	–12,112,500	0.075	–908,438
1st half of 2024	4,136,718.75	6,056,250	–14,032,031.3	0.05	–701,602
2nd half of 2024	4,136,718.75	6,056,250	–15,951,562.5	0.05	–797,578
1st half of 2025	12,410,156.25	0	–3,541,406.25	0.045	–159,363
2nd half of 2025	12,410,156.25	0	8,868,750	0.045	399,093.8

Table 4. Income of the enterprise

Source of income	Average unit cost	Number of units	The total amount
Apartment sales	14,063	1,900	26,718,750
Leasing of space for the construction of leisure facilities	669,642.8571	7	4,687,500
State subsidy for the construction of a recreational area	8,437,500	1	1,687,500
Total	9,121,205	1,908	33,093,750

NPV is calculated using the following formula:

$$NPV = \sum_{t=6}^n \frac{CF_t}{(1 + R)^t},$$

(2)

where n, t — number of time periods;
 CF — Cash Flow;
 R — cost of capital (i.e. discount rate).

The results are presented in Table 5.

The internal rate of return (IRR) is a rate that ensures that there are no losses on different deposits, and that all income received from investing costs for a given project is identical. It turns out that this is the maximum percentage value, where the difference between the inflow and outflow of funds, i.e. the net present value (NPV) is 0 [14, 15].

CONCLUSIONS

As a result of the above calculations in Table 5, we see that in the first year of the enterprise there are no revenues, in the second

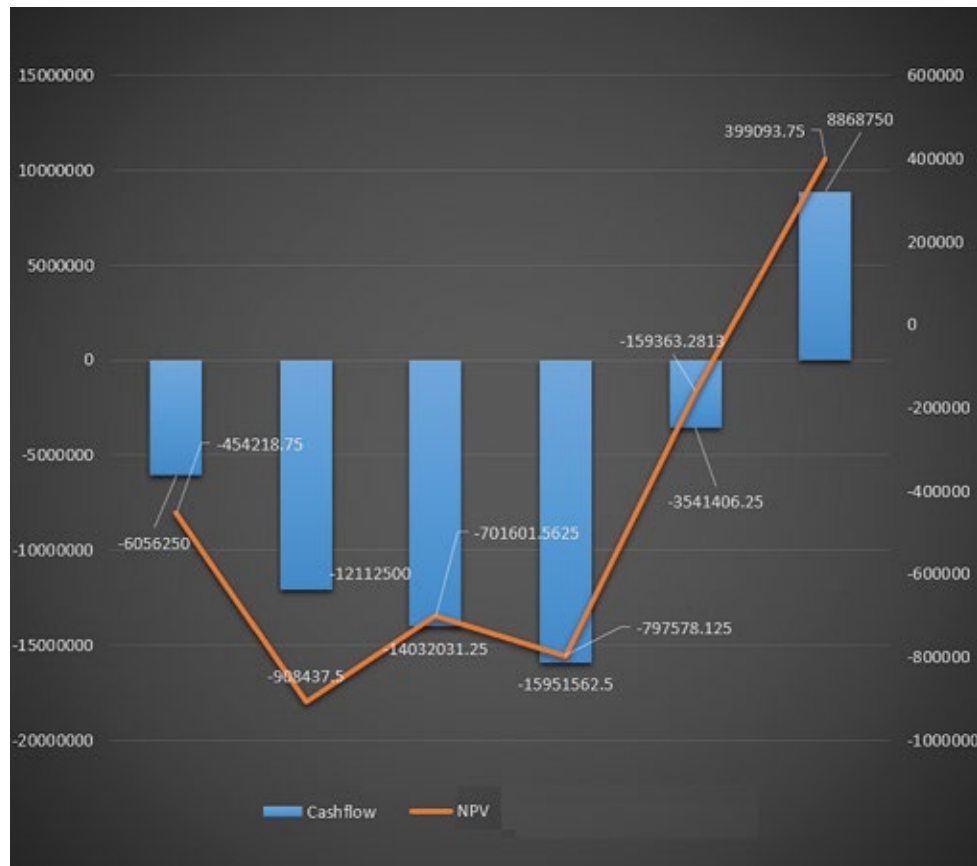


Fig. 5. Calculation of the profitability of a land development project using the NPV methodology (for half-years from 1st 2023 to 2nd 2025)

years sales partially begin in the residential complex under construction "1st Nagatinsky" in a mortgage with a discount for buyers. Sales peak is in the third year.

REFERENCES

1. Kononova P.P., Kulagin M.Yu. Land development as a modern technology of land management. *The Successes of Modern Science and Education*. 2017; 6(4):42-44. (rus.).
2. Chesnokova E.A., Karlina D.A. Analysis of the current state of land development in the construction sector. *Theoretical and Applied Research: Achievements, Problems and Prospects of Development*: collection of scientific papers based on the materials of the International Scientific and Practical Conference. Saint Petersburg, 2021; 72-78. (rus.).
3. Stefantsova T.V., Dokukin A.D. Improvement of land development in the management of real estate objects in urban settlements. *Fundamental Research*. 2022; 7:101-105. DOI: 10.17513/fr.43291 (rus.).
4. Zaitseva L.I., Budanov I.V. Contract structures for environmentally sustainable development of enterprises in the investment and construction sector. *Real Estate: Economics, Management*. 2023; 2: 16-20. DOI: 10.22337/2073-8412-2023-2-16-20 URL: <https://neue.iasv.ru/index.php/neu/article/view/128/250>
5. Nikulina O.V., Novoselova I.V., Kotomchenkova V.Yu., Seredina V.V. Risk management for the effective implementation of investment and construction projects. *Actual Problems of Socio-Economic Development of Russia*. 2020; 2:39-42. (rus.).
6. Grishin M.O., Kuznetsov K.Yu. Fundamentals of integrated risk management in investment and construction projects. *Actual Problems of Military Scientific Research*. 2020; S10(11):119-123. (rus.).
7. Mammedov I.N., Mustafin T.A. Evaluation of investment projects: goals, interests, effectiveness. *Economics and Entrepreneurship*. 2023; 7(156):806-809. DOI: 10.34925/EIP.2023.156.7.140 (rus.).

Fig. 5 shows the ratio of Cashflow and net present income. As we can see, the payback period begins after the 1st half of 2025.

8. Tikhonov V.A., Shalina D.S. Risk management in an investment and construction project under conditions of uncertainty. *Bulletin of the Altai Academy of Economics and Law*. 2023; 3:115-120. (rus.).
9. Dukhanina E.V., Khametova A.T. Implementation of a risk-oriented approach in the management of the investment and construction process. *Bulletin of Eurasian Science*. 2023; 15(2). URL: <https://esj.to-day/PDF/10SAVN223.pdf> (rus.).
10. Karpov P.A., Klykov M.S. The issue of risk management in the implementation of an investment and construction project. *Designing the Development of the Regional Railway Network*. 2020; 8:39-44. (rus.).
11. Seryakov G.N. Management of investment and construction activities in the modern economy. *Fundamental Research*. 2022; 10(2):233-237. DOI: 10.17513/fr.43372 (rus.).
12. Organization of construction and real estate development: textbook in two hours. P.G. Grabovoy (Ed). Moscow, Publishing House of the DIA, Prosvetitel' Publ., 2018. (rus.).
13. Pobegailov O.A., Al-Tai Samer Visam Saadun, Mohammed Hassan Ali Mohammed. Cost management in investment and construction activities. *Actual Problems and Prospects of Economic Development: Russian and foreign experience*. 2021; 2(34):24-27. (rus.).
14. Bryantseva I.V., Voronina N.V., Korostelev A.G. The concept of management of investment and construction activities of the company based on investment and construction potential. *Bulletin of the Pacific State University*. 2021; 4(63):101-108. (rus.).
15. Mokhnachev S.A., Grakhov V.P., Sharitdinov Yu.A. Analysis of the main factors of achieving sustainable success in managing investment and construction activities. *Financial Management*. 2023; 3-2:21-27. DOI: 10.25806/fm3-2202321-27

Особенности управления рисками при реализации инвестиционно-строительных проектов

Девелопер — профессиональная фигура на рынке недвижимости, сочетающая в своей деятельности управленческие и предпринимательские функции. При этом имеются особенности и задачи, связанные с созданием и выполнением девелоперских проектов. Так, в процессе выбора и осуществления инвестиционно-строительных проектов в их обязанность, помимо обеспечения ликвидности, входит учет социальных, эстетических и экологических аспектов.

На сегодняшний день физические лица, осуществляющие инвестиционно-строительную деятельность, в том числе девелоперы, не всегда могут тратить свое время на то, чтобы решать те или иные проблемы, связанные с переводом земель непосредственно между разными установленными категориями. В данном случае под переводом земель подразумевается процесс, связанный с переводом земель, обладающих сельскохозяйственным назначением, к совокупному их развитию. Для этого происходит создание инвестиционного продукта, т.е. участка земли, с которым проводились необходимые действия для последующего строительства на нем необходимых сооружений различного назначения.

Сегодня многие девелоперы указывают, что осуществление проектов по КОТ (комплексное освоение территорий) нуждается в возмещении из местного бюджета доли расходов, связанных с выполнением развития соответствующих территорий.

Разные земельные участки обладают разным инвестиционным потенциалом, что формирует необходимость оценки его собственником. При участии местных властей в развитии территорий у них появляется право на получение компенсации.

Ключевые слова: земельная рента, категории земель, перевод земель из одной категории в другую, управление рисками ленд-девелопмента, экономическая эффективность проектов

СПИСОК ИСТОЧНИКОВ

1. Коннова П.П., Кулягин М.Ю. Ленд-девелопмент как современная технология управления земельными ресурсами // *Успехи современной науки и образования*. 2017. Т. 6. № 4. С. 42–44.
2. Чеснокова Е.А., Карлина Д.А. Анализ современного состояния ленд-девелопмента в строительной сфере // *Теоретические и прикладные исследования: достижения, проблемы и перспективы развития* : сб. науч. тр. по мат. Междунар. науч.-практ. конф. СПб., 2021. С. 72–78.
3. Стефанцова Т.В., Докукин А.Д. Совершенствование ленд-девелопмента при управлении объектами недвижимости на территории городских поселений // *Фундаментальные исследования*. 2022. № 7. С. 101–105. DOI: 10.17513/fr.43291
4. Zaitseva L.I., Budanov I.V. Contract structures for environmentally sustainable development of enterprises in the investment and construction sector // *Real Estate: Economics, Management*. 2023. № 2. С. 16–20. DOI: 10.22337/2073-8412-2023-2-16-20 URL: <https://n-eu.iasv.ru/index.php/neu/article/view/128/250>

5. Никулина О.В., Новоселова И.В., Котоменкова В.Ю., Середина В.В. Управление рисками для эффективной реализации инвестиционно-строительных проектов // *Актуальные проблемы социально-экономического развития России*. 2020. № 2. С. 39–42.
6. Гришин М.О., Кузнецов К.Ю. Основы интегрированного управления рисками в инвестиционно-строительных проектах // *Актуальные проблемы военно-научных исследований*. 2020. № S10 (11). С. 119–123.
7. Мамедов И.Н., Мустафин Т.А. Оценка инвестиционных проектов: цели, интересы, эффективность // *Экономика и предпринимательство*. 2023. № 7 (156). С. 806–809. DOI: 10.34925/EIP.2023.156.7.140
8. Тихонов В.А., Шалина Д.С. Управление рисками в инвестиционно-строительном проекте в условиях неопределенности // *Вестник Алтайской академии экономики и права*. 2023. № 3. С. 115–120.
9. Духанина Е.В., Хаметова А.Т. Реализация риск-ориентированного подхода в управлении инвестиционно-строительным процессом // *Вестник евразийской науки*. 2023. Т. 15. № 2. URL: <https://esj.today/PDF/10SAVN223.pdf>
10. Карпов П.А., Клыков М.С. К вопросу управления рисками при реализации инвестиционно-строительного проекта // *Проектирование развития региональной сети железных дорог*. 2020. № 8. С. 39–44.
11. Серяков Г.Н. Управление инвестиционно-строительной деятельностью в современной экономике // *Фундаментальные исследования*. 2022. № 10–2. С. 233–237. DOI: 10.17513/fr.43372
12. Организация строительства и девелопмент недвижимости : уч. в двух ч. / под общ. ред. П.Г. Грабового. М. : Изд-во АСВ, Просветитель, 2018.
13. Побегайлов О.А., Аль-Таи Самер Висам Саадун, Мохаммед Хасан Али Мохаммед. Управление затратами при инвестиционно-строительной деятельности // *Актуальные проблемы и перспективы развития экономики: российский и зарубежный опыт*. 2021. № 2 (34). С. 24–27.
14. Брянцева И.В., Воронина Н.В., Коростелев А.Г. Концепция управления инвестиционно-строительной деятельностью компании на основе инвестиционно-строительного потенциала // *Вестник Тихоокеанского государственного университета*. 2021. № 4 (63). С. 101–108.
15. Мохначев С.А., Грахов В.П., Шаритдинов Ю.А. Анализ основных факторов достижения устойчивого успеха в управлении инвестиционно-строительной деятельностью // *Финансовый менеджмент*. 2023. № 3–2. С. 21–27. DOI: 10.25806/fm3-2202321-27

Об авторе: **Волгин Валентин Валентинович** — кандидат технических наук, доцент кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; ПИНЦ ID: 1212902, ResearcherID: AAE-8862-2022, ORCID: 0000-0001-7130-3410; VolginVV@mgsu.ru.

For citation: Volgin V.V. Risk management in the implementation of investment and construction projects. *Real Estate: Economics, Management*. 2024; 2:20-26.

Для цитирования: Волгин В.В. Risk management in the implementation of investment and construction projects // *Недвижимость: экономика, управление*. 2024. № 2. С. 20–26.

UDC 330.322

Justification of necessity and directions for improving strategic planning of investment and construction enterprises innovative development

In modern conditions of the investment and construction sector development, characterized by the need to implement a policy of technological sovereignty, import substitution and the creation of their own competitive industries by enterprises, there is a need to improve the conceptual and methodological foundations for activating the innovative development of construction enterprises. The paper identifies the features of innovative activity of enterprises in the investment and construction sector, systematizes scientific approaches to the construction of a methodology for strategic planning of innovative development, and proposes a methodology for analyzing the dynamics of characteristics and identifying trends in innovative development in construction. Based on the analysis, the main problems and trends in the development of the innovation space in the industry are identified, methods for solving problems and appropriate tools and directions for their scientific justification are proposed. When determining strategic guidelines for the development of construction organizations, as well as when determining meso-level development strategies, respectively, a value-oriented approach in the projection of value innovation as a sustainable competitive advantage of enterprises, industries and regions, as well as a stakeholder approach in the projection of the formation of an innovation network, should be taken into account. A new approach to planning and implementing the strategy of innovative development of a construction enterprise is proposed, including a change in the innovation paradigm based on value innovation and foresight forecast of the construction industry. The application of the author's approach will increase the level of innovative activity in construction and ensure a steady growth of innovative competitive advantages of the enterprise in accordance with the targets of scientific, technical and sectoral development. The expediency of improving the methodology for forming the strategy of innovative development of enterprises in the investment and construction sector on the basis of a new paradigm of value innovation is shown, a logical scheme for improving the methodology is developed, which allows to provide advanced development of domestic construction enterprises on an innovative basis.

Keywords: innovative development, investment and construction sector, strategy, enterprise, methodology

The modern investment and construction sector is a network of regional construction clusters. Construction is distinguished from other types of economic activity by the specifics of final and intermediate construction products, the peculiarities of the construction market and the institutional environment, the specifics of network interactions [1–6].

The specific features of the investment and construction sector form both the need for its innovative development and the corresponding strategic orientation of the development and implementation of innovations, as well as the difficulties in their implementation, that is, innovative inertia [3, 7–11]. Overcoming innovative inertia and activation of innovative development of an enterprise in the investment and construction sector determine the need and expediency of a deeper study of the specifics of innovative development of construction in order to develop a methodology for forming a strategy for innovative development of enterprises in the investment and construction sector.

The analysis of scientific approaches to the construction of a methodology for the formation of a strategy for the innovative development of construction enterprises allowed us to present the prospects for their application, taking into account the peculiarities of innovation in the investment and construction sector and the identified economic and managerial focuses in the form of Fig. 1.

The problematization of innovative development in the investment and construction sector is formed, first of all, by the general trends of innovative development in the country, including mechanisms of state regulation and support, the specifics of construction products and the corresponding specifics of the investment and construction sector, as well as global challenges that changes in the external environment generate for the innovation and construction sector.

To identify the problems and prospects of innovative development in construction, it is necessary to analyze the characteristics of the space of innovative activity of construction enterprises. The space of innovation activity, based on the analysis of scientific literature [3, 12–14] and the analysis of the specifics of innovative development of the investment and construction sector, we propose to structure as follows (Fig. 2).

As can be seen from the above diagram, the characteristics of the innovation activity space are structured on the basis of the environment of the construction enterprise into sectoral and intersectoral. In order to build a strategy for the activity of a construction enterprise and determine strategic goals and guidelines, it is necessary to analyze the dynamics of the characteristics of the space of innovative activity of construction enterprises and identify trends and limitations of development [15–19].

Vlasenko V. A.



Vlasenko Vyacheslav Aleksandrovich,
Candidate of Technical Sciences, doctoral student, Moscow State University of Civil Engineering (National Research University) (MGSU), 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; RISC ID: 8541-4739, Scopus AuthorID: 56437610100, WoS ResearcherID: W-1655-2018, ORCID: 0000-0002-0771-5661; vlslava@mail.ru

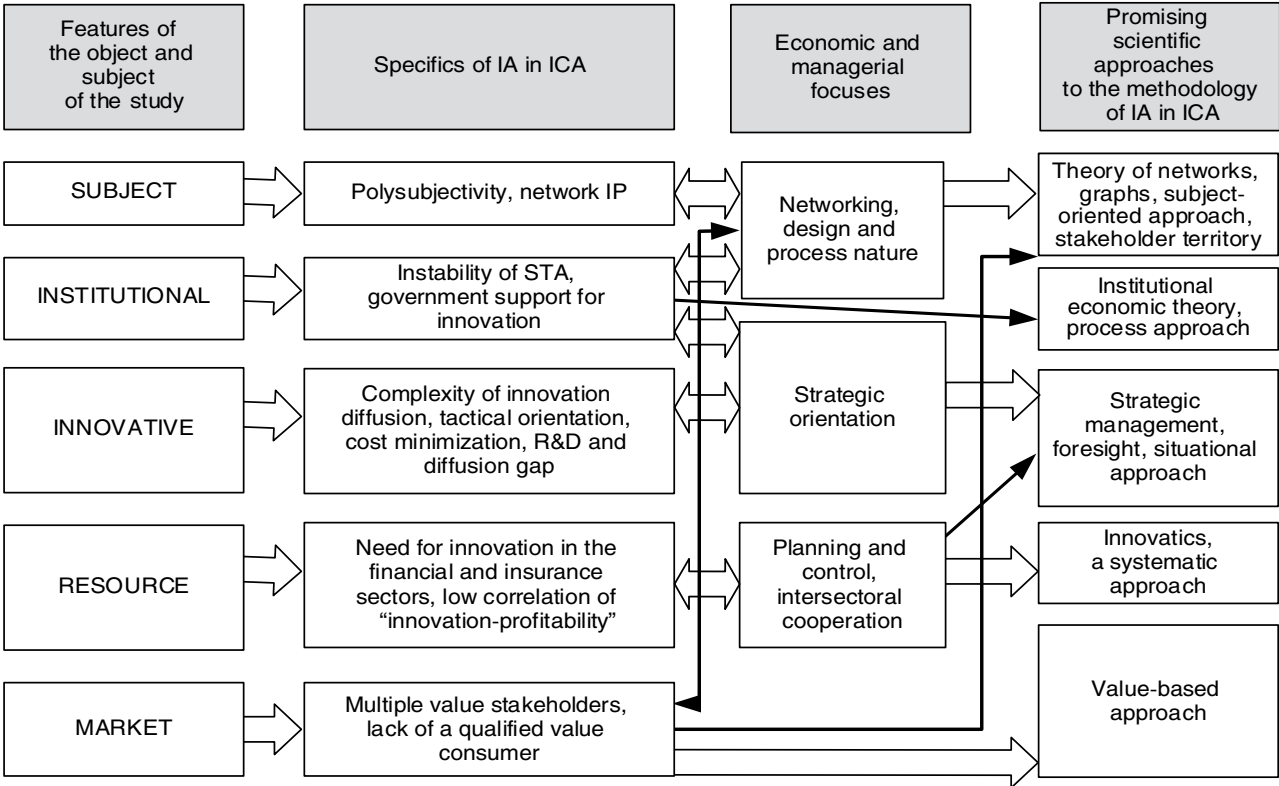


Fig. 1. The specifics of innovation activity in the investment and construction sector and promising scientific approaches to the construction of a methodology for the formation of an innovative development strategy

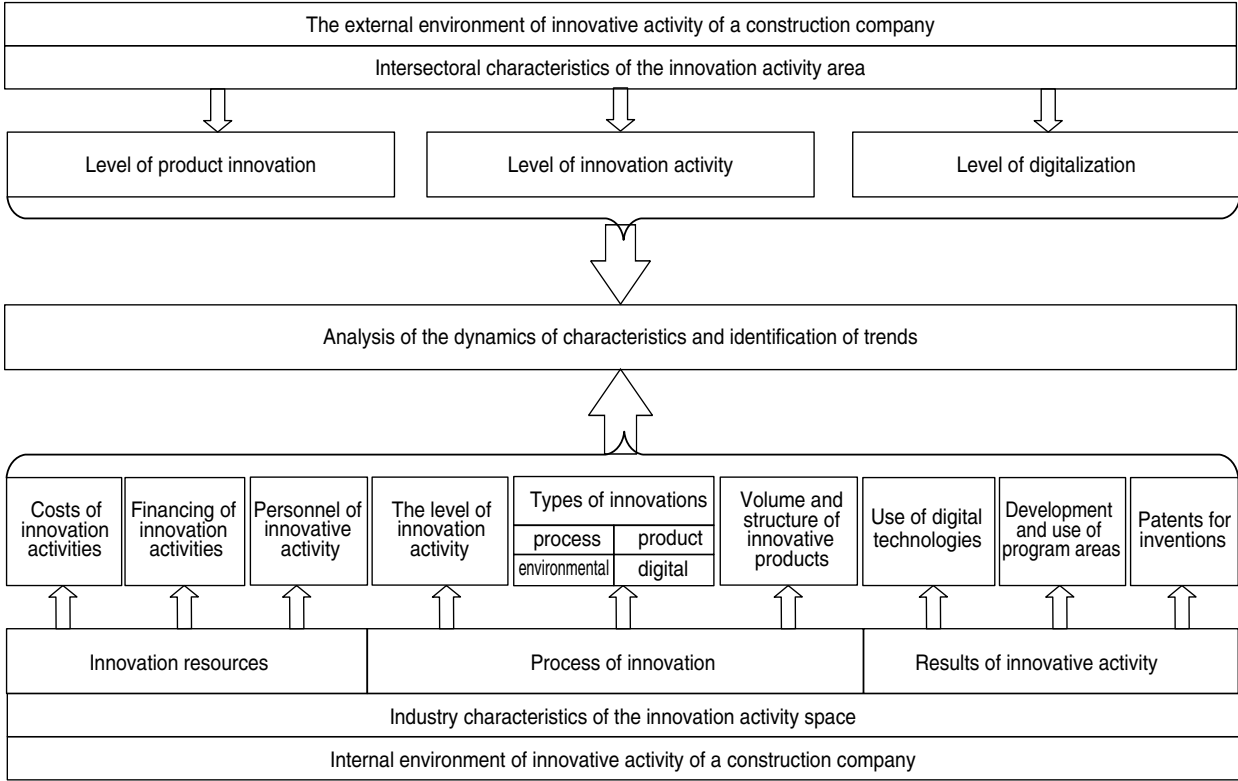


Fig. 2. Structure of the characteristics of the space of innovative activity of construction enterprises

Trends and problems of characteristics of the space of innovative activity of construction enterprises and proposed research directions

The problem / trend of the development of the innovation activity space	Methods of solving the problem	Research directions
Insufficient financing, financing from own funds / –	Improving the return on investment in innovation, state innovation policy	• foresight technologies for choosing innovations; • creation and development of “points of innovative growth”
High level of costs for innovation activities with low efficiency	Creating effective long-term unique Sustainable Competitive Advantage (SCA)	Value innovation
Low and uneven innovative activity of enterprises in the investment and construction sector / –	• activation of scientific and technical developments; • accelerating the diffusion of innovation; • organization of innovation promotion centers; • training and stimulation of personnel	Creation of “points of innovative growth”
Uneven innovative potential of organizations, under-development of cooperative relations / –	• acceleration of the diffusion of innovations; • organization of innovation promotion centers; • increasing information openness	• network methods of organizing innovative interactions; • foresight technologies
High level of competition in ICS / –	Creating long-term unique SCA	Value innovation
– / Sustainable development	• creating effective SCA; • state innovation policy	• foresight technologies for choosing innovations; • creating “points of innovative growth”
– / Digitalization of products and processes	• creating digital SCA; • development and application of modern software	Value innovation
– / Consumer requirements	Creating effective SCA	Creating “points of innovative growth”
Insufficient intersectoral and sectoral diffusion / –	• acceleration of the diffusion of innovations; • organization of innovation promotion centers; • state innovation policy	• creation of “points of innovative growth”; • network methods of organizing innovative interactions

The results of structuring and analyzing the characteristics of the innovation space of construction enterprises are summarized in a table (Table), which also suggests the directions (tools), proposed to solve the identified problems and prolong the deterministic trends in the development of the innovation space in the investment and construction sector.

Based on the analysis of the characteristics of the innovation activity space, the expediency of applying four main focuses or directions in further research is revealed, namely: foresight technologies, value innovations, the creation of “points of innovative growth” and appropriate network methods for organizing innovative interactions in the process of implementing ICP.

The results of the analysis of the characteristics of the space of innovative activity of construction enterprises indicate the presence of a number of problems of innovative development of a strategic nature, which led to the preservation and further increase of the innovative inertia of construction. There is an objective need to improve the methodology for forming an innovative development strategy for the investment and construction sector, especially at

the level of the basic link (enterprises), with the elaboration of issues of activation and improvement of the effectiveness of innovation activities, as well as the diffusion of innovations, mainly with the need for state incentives based on innovation policy. Consequently, the necessity of developing a concept and methodology for the formation of an innovative development strategy for ICS enterprises is identified, taking into account the specifics we have substantiated, as well as the identified problems and trends in the dynamics of the characteristics of the innovation activity space in order to prolong positive trends in innovative development and minimize its uncertainty [20].

Based on the comprehensive analysis and the set goals and objectives of the dissertation, the author has developed a logical scheme of the dissertation research (Fig. 3).

Following the proposed logical scheme, we believe, will allow us to create a unified methodological support for the processes of formation and implementation of an innovative development strategy at all levels of management of the investment and construction sector.

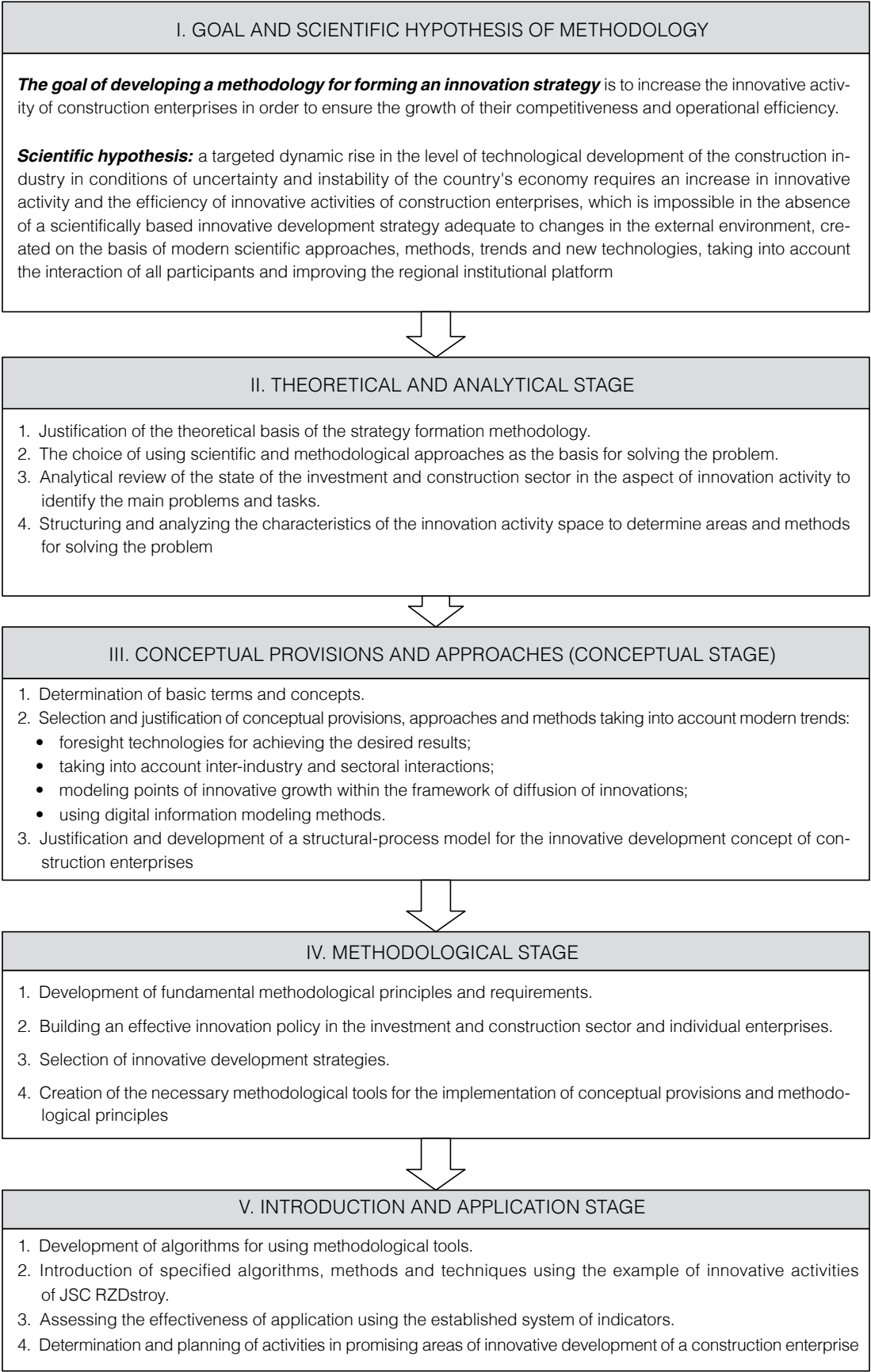


Fig. 3. A systematic framework for developing a methodology to shape an innovative development strategy for large construction companies

REFERENCES

- Grabovyy P.G., Manukhina L.A., Budanov I.V. Features of project financing of investment and construction projects of residential real estate: problems, risks, forecast. *Real estate: economics, management*. 2019; 4:6-12. (rus.).
- Grabovyy P.G., Grebenshchikov V.S., Belyakov S.I. Risks in the investment and construction sector : monograph. Moscow, 2017, 160. (rus.).
- Kankhva V.S., Uvarova S.S., Belyaeva S.V. Rapid assessment of the current price level of basic building materials and analysis of their dynamics. *Real Estate: Economics, Management*. 2023; 2: 27-32. DOI: 10.22337/2073-8412-2023-2-27-32
- Lukmanova I., Panenkov A., Kuzovleva I., Bredikhin V. Methodology of the theory of change management in the implementation of digital transformation of construction: problems and prospects. *E3S Web of Conferences*. 22. "22nd International Scientific Conference on Energy Management of Municipal Facilities and Sustainable Energy Technologies, EMMFT 2020". 2021; 05005. DOI: 10.1051/e3sconf/202124405005
- Uvarova S., Voronov D., Erypalov S. Assessment and management of developer company competitiveness in the conditions of business changes. *MATEC Web of Conferences*. 2017; 08036. DOI: 10.1051/mateconf/201710608036
- Tipili P.O., Ilyasu M.S. Evaluating the effects of communication in construction project delivery in Nigeria. *J. Environ. Sci. Technol.* 2014; 2:48-54.
- Vlasenko V., Bukreev A., Sizova E., Vasilyeva O. Specifics of the strategic management of innovative activity of big development and construction companies. *MATEC Web of Conferences*. 2017; 08034. DOI: 10.1051/mateconf/201710608034
- Uvarova S., Andryunina Ya., Smorodina E., Ovsyannikov A., Chugunov A. Increasing the attractiveness of green construction objects from the perspective of a value-based approach. *AIP Conference Proceedings*. VIII international scientific and technical conference "Solving environmental problems in the construction industry" ESCI 2022. AIP PUBLISHING. 2023; 040025. DOI: 10.1063/5.0129529
- Wang N., Gong Z., Xu Z., Liu Z., Han Y. A quantitative investigation of the technological innovation in large construction companies. *Technol. Soc.* 2021; 65:101533. DOI: 10.1016/j.techsoc.2021.101533
- Yaskova N., Kolosova T. The investment and construction activities transformation at the modern development stage of Russia. In the collection : *IOP Conference Series: Materials Science and Engineering*. 23, Construction — The Formation of Living Environment. "XXIII International Scientific Conference on Advance in Civil Engineering: «Construction — The Formation of Living Environment», FORM 2020 — Management in Construction" 2020; 062050. DOI: 10.1088/1757-899X/869/6/062050
- Zhang X., Le Y., Liu Y., Liu M. Fostering ambidextrous innovation in infrastructure projects: Differentiation and integration tactics of cross-functional teams, *J. Constr. Eng. Manag.* 2021; 147:04021046. DOI: 10.1061/(ASCE)CO.1943-7862.0002060
- Lekan A., Clinton A., Owolabi J. The Disruptive Adaptations of Construction 4.0 and Industry 4.0 as a Pathway to a Sustainable Innovation and Inclusive Industrial Technological Development, *Buildings*. 2021; 11:79. DOI: 10.3390/buildings11030079
- Gumba K., Belyantseva O., Kochetova L. Justification of the Sources of Forming Competitive Advantages of Underground Construction Companies under the Production Concentration Conditions, *Procedia Engineering*. 2016; 165:1323-1327. DOI: 10.1016/j.proeng.2016.11.858
- Chen W., Yu M., Hou J. Synergistic Relationship, Agent Interaction, and Knowledge Coupling: Driving Innovation in Intelligent Construction Technology, *Buildings*. 2024; 14: 542. DOI: 10.3390/buildings14020542
- Uvarova S.S., Belyaeva S.V., Kankhva V., Vlasenko V. Implementation of innovative strategy in underground construction as a basis for sustainable economic development of a construction enterprise. In the collection : 15th International scientific conference "Underground Urbanization as a Prerequisite for Sustainable Development" 12-15 September 2016, St. Petersburg, Russia. "Procedia Engineering". 2016; 1317-1322. DOI: 10.1016/j.proeng.2016.11.857
- Gumba K., Belyaeva S. Specific character of sustainable innovative development of transport construction in self-regulation conditions. *IOP Conference Series : Earth and Environmental Science*. 2017; 012163. DOI: 10.1088/1755-1315/90/1/012163
- Kuzyk B.N., Yakovets Yu.V. Global forecast "The future of civilizations" for the period up to 2050. Part 5. Moscow, Publishing house of the Moscow Institute of Socio-Cultural Programs , 2009. (rus.).
- Lukmanova I.G., Yaskova N.Y. New tasks of investment and construction activities in the context of trends in spatial development of Russia. *Bulletin of MGSU*. 2019; 14:6 (129):774-784. DOI: 10.22227/1997-0935.2019.6.774-784 (rus.).
- Yaskova N.Yu., Zaitseva L.I. Construction: overcoming growth limits, *Real Estate: Economics, Management*. 2022; 4:12-17.
- Vlasenko V.A. Formation of sustainable competitive advantages in the development of a construction company strategy based on value innovation. *Real Estate: Economics, Management*. 2023; 3:37-41.

Обоснование необходимости и направлений совершенствования стратегического планирования инновационного развития предприятий инвестиционно-строительной сферы

В современных условиях развития инвестиционно-строительной сферы, характеризующихся необходимостью реализации политики технологического суверенитета, импортозамещения и создания собственных конкурентоспособных производств предприятиями, возникает необходимость совершенствования концептуальных и методологических основ активизации инновационного развития строительных предприятий. В статье выявлены особенности инновационной деятельности предприятий инвестиционно-строительной сферы, систематизированы научные подходы к построению методологии стратегического планирования инновационного развития, предложена методика анализа динамики характеристик и выявления трендов инновационного развития в строительстве. На основе проведенного анализа определены основные проблемы и тренды развития пространства инновационной деятельности в отрасли, предложены методы решения проблем и соответствующий инструментарий и направления их научного обоснования.

При определении стратегических ориентиров развития строительных организаций, равно как и при определении стратегий развития мезоуровня, соответственно, должен учитываться прежде всего ценностно-ориентированный подход в проекции инновации ценности как устойчивого конкурентного преимущества предприятий, отраслей и регионов, а также стейкхолдерский подход в проекции формирования инновационной сети. Предложен новый подход к планированию и реализации стратегии инновационного развития строительного предприятия, включающий изменение инновационной парадигмы на основе инновации ценности и форсайт-прогноза строительной отрасли. Применение авторского подхода позволит повысить уровень инновационной активности в строительстве и обеспечить устойчивый рост инновационных конкурентных преимуществ предприятия в соответствии с целевыми ориентирами научно-технического и отраслевого развития. Показана целесообразность совершенствования методологии формирования стратегии инновационного развития предприятий инвестиционно-строительной сферы на основании новой парадигмы инновации ценности, разработана логическая схема совершенствования методологии, позволяющая обеспечить опережающее развитие отечественных строительных предприятий на инновационной основе.

Ключевые слова: инновационное развитие, инвестиционно-строительная сфера, стратегия, предприятие, методология

СПИСОК ИСТОЧНИКОВ

1. Грабовый П.Г., Манухина Л.А., Буданов И.В. Особенности проектного финансирования инвестиционно-строительных проектов жилищной недвижимости: проблемы, риски, прогноз // *Недвижимость: экономика, управление*. 2019. № 4. С. 6–12.
2. Грабовый П.Г., Гребенщиков В.С., Беляков С.И. Риски в инвестиционно-строительной сфере : монография. М., 2017. 160 с.
3. Kankhva V.S., Uvarova S.S., Belyaeva S.V. Rapid assessment of the current price level of basic building materials and analysis of their dynamics // *Real Estate: Economics, Management*. 2023. No. 2. Pp. 27–32. DOI: 10.22337/2073-8412-2023-2-27-32
4. Lukmanova I., Panenkov A., Kuzovleva I., Bredikhin V. Methodology of the theory of change management in the implementation of digital transformation of construction: problems and prospects // *E3S Web of Conferences*. 22. Сер. “22nd International Scientific Conference on Energy Management of Municipal Facilities and Sustainable Energy Technologies, EMMFT 2020”. 2021. P. 05005. DOI: 10.1051/e3sconf/202124405005
5. Uvarova S., Voronov D., Erypalov S. Assessment and management of developer company competitiveness in the conditions of business changes // *MATEC Web of Conferences*. 2017. P. 08036. DOI: 10.1051/mateconf/201710608036
6. Tipili P.O., Ilyasu M.S. Evaluating the effects of communication in construction project delivery in Nigeria // *J. Environ. Sci. Technol*. 2014. Vol. 2. Pp. 48–54.
7. Vlasenko V., Bukreev A., Sizova E., Vasilyeva O. Specifics of the strategic management of innovative activity of big development and construction companies // *MATEC Web of Conferences*. 2017. P. 08034. DOI: 10.1051/mateconf/201710608034
8. Uvarova S., Andryunina Ya., Smorodina E., Ovsyannikov A., Chugunov A. Increasing the attractiveness of green construction objects from the perspective of a value-based approach // *AIP Conference Proceedings*. VIII international scientific and technical conference “Solving environmental problems in the construction industry” *ESCI 2022*. AIP PUBLISHING. 2023. P. 040025. DOI: 10.1063/5.0129529
9. Wang N., Gong Z., Xu Z., Liu Z., Han Y. A quantitative investigation of the technological innovation in large construction companies // *Technol. Soc.* 2021. Vol. 65. P. 101533. DOI: 10.1016/j.tech-soc.2021.101533
10. Yaskova N., Kolosova T. The investment and construction activities transformation at the modern development stage of Russia // *B сб. : IOP Conference Series : Materials Science and Engineering*. 23, *Construction — The Formation of Living Environment*. Сер. XXIII International Scientific Conference on Advance in Civil Engineering: “Construction — The Formation of Living Environment”, *FORM 2020 — Management in Construction 2020*. P. 062050. DOI: 10.1088/1757-899X/869/6/062050
11. Zhang X., Le Y., Liu Y., Liu M. Fostering ambidextrous innovation in infrastructure projects: Differentiation and integration tactics of cross-functional teams // *J. Constr. Eng. Manag.* 2021. Vol. 147. P. 04021046. DOI: 10.1061/(ASCE)CO.1943-7862.0002060
12. Lekan A., Clinton A., Owolabi J. The Disruptive Adaptations of Construction 4.0 and Industry 4.0 as a Pathway to a Sustainable

- Innovation and Inclusive Industrial Technological Development // Buildings*. 2021. Vol. 11. P. 79. DOI: 10.3390/buildings11030079
13. Gumba K., Belyantseva O., Kochetova L. Justification of the Sources of Forming Competitive Advantages of Underground Construction Companies under the Production Concentration Conditions // *Procedia Engineering*. 2016. Vol. 165. Pp. 1323–1327. DOI: 10.1016/j.proeng.2016.11.858
 14. Chen W., Yu M., Hou J. Synergistic Relationship, Agent Interaction, and Knowledge Coupling: Driving Innovation in Intelligent Construction Technology // *Buildings*. 2024. Vol. 14. P. 542. DOI: 10.3390/buildings14020542
 15. Uvarova S.S., Belyaeva S.V., Kankhva V., Vlasenko V. Implementation of innovative strategy in underground construction as a basis for sustainable economic development of a construction enterprise // *В сб. : 15th International scientific conference “Underground Urbanisation as a Prerequisite for Sustainable Development” 12-15 September 2016, St. Petersburg, Russia*. Сер. “Procedia Engineering”. 2016. Pp. 1317–1322. DOI: 10.1016/j.proeng.2016.11.857
 16. Gumba K., Belyaeva S. Specific character of sustainable innovative development of transport construction in self-regulation conditions // *IOP Conference Series: Earth and Environmental Science*. 2017. P. 012163. DOI: 10.1088/1755-1315/90/1/012163
 17. Кузык Б.Н., Яковец Ю.В. Глобальный прогноз «Будущее цивилизаций» на период до 2050 года. Часть 5. М. : изд-во Московский институт социально-культурных программ, 2009.
 18. Лукманова И.Г., Яськова Н.Ю. О новых задачах инвестиционно-строительной деятельности в контексте трендов пространственного развития России // *Вестник МГСУ*. 2019. Т. 14. № 6 (129). С. 774–784. DOI: 10.22227/1997-0935.2019.6.774-784
 19. Yaskova N.Yu., Zaitseva L.I. Construction: overcoming growth limits // *Real Estate: Economics, Management*. 2022. No. 4. Pp. 12–17.
 20. Vlasenko V.A. Formation of sustainable competitive advantages in the development of a construction company strategy based on value innovation // *Real Estate: Economics, Management*. 2023. No. 3. Pp. 37–41.

Об авторе: **Власенко Вячеслав Александрович** — кандидат технических наук, докторант; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; ПИНЦ ID: 8541-4739, Scopus AuthorID: 56437610100, WoS ResearcherID: W-1655-2018, ORCID: 0000-0002-0771-5661; vslava@mail.ru.

For citation: Vlasenko V.A. Justification of necessity and directions for improving strategic planning of investment and construction enterprises innovative development. *Real Estate: Economics, Management*. 2024; 2:27-32.

Для цитирования: **Власенко В.А.** Justification of necessity and directions for improving strategic planning of investment and construction enterprises innovative development // *Недвижимость: экономика, управление*. 2024. № 2. С. 27–32.

UDC 614.842.8

Gvozdev E. V.

Assessment of the state of integrated security system at the enterprise using the priority setting method

The paper presents justification for using the priority setting method together with the Gaussian normal distribution functional to assess the state of the integrated security system of production enterprises. The justified method has a certain advantage over other methods of expert assessment due to the fact that it has no limit to expanding the boundaries in order to obtain adequate results in the form of quantitative values. The statistics of the occurrence of accidents and fires at enterprises of the oil and gas complex of Russia is analyzed, information is presented on the procedure for determining the primary factors initiating the occurrence of joint events (accidents and fires). An example is shown with the results of processing information received from experts. The developments presented in the paper will make it possible to solve in practice the problem of reducing damage from accidents and fires, i.e. solve a problem that has important socio-economic significance for Russia.

Keywords: Integrated security system, priority setting method, Gaussian normal distribution, influence coefficient, expert decision



**Gvozdev
Evgeny Vladimirovich,**
Candidate of Technical Sciences,
Associate Professor, Associate
Professor of the Department of Gen-
eral and Applied Physics; Moscow
State University of Civil Engineering
(National Research
University); 26 Yaroslavskoe
shosse, Moscow, 129337,
Russian Federation; ID RSCI:
296055, Scopus: 57213143299,
ResearcherID: AAD-7686-2022,
ORCID: 0000-0002-3679-1065;
evgvozdev@mail.ru

INTRODUCTION

The results of the analysis of statistics on the occurrence of joint dangerous events (accidents and fires) from which various damages are caused (economic, material, damage to life or health of enterprise personnel and third parties) at explosion and fire hazardous (hereinafter referred to as EFH) enterprises, which occur in the form of the following sequence of implementation: (accident → fire or fire → accident), are characterized by focusing on the primary event that occurred initially, it became the cause of the secondary event. However, the Department (industry structure), for example, (in the Ministry of Emergency Situations of Russia, or in Rostekhnadzor) collects information with statistics on the occurrence of dangerous events (accidents, fires), and in the case under consideration, when a dangerous event began to cause damage as a secondary factor, it is recorded in the information statistics of the Department (industry structure) as a defect. A similar situation occurs at manufacturing enterprises, when the specialized services of Industrial Safety (hereinafter referred to as IS), Fire Safety (hereinafter referred to as FS), and labour protection (LP) perform their labour functions and collect data on the occurrence of hazardous events (accidents, fires), they are recorded in the enterprise statistics as an accident — in the IS service, as a fire — in the FS service, and the LP service in the event of damage to the life and health of the enterprise personnel or third parties, has to take upon itself such damage as a defect [1–5].

The information presented above confirms the need for further research taking into account the influence of subsystems (IS and FS, LP) on each other.

METHODS

The purpose of the presented paper is to substantiate the method for conducting a qualitative assessment of the state of the integrated security systems (hereinafter referred to as ISS) at the enterprise.

To obtain the quantitative value of the studied factors considered under conditions of uncertainty, when the control system is described from the point of view of its qualitative state, there is a need to resort to the use of expert assessment in the form of experts expressing their justifications in quantitative terms of the degree of preference, which allows us to talk about conducting a quantitative expert assessment.

The procedure for carrying out activities to assess the state of ISS at EFH enterprises is designed to present a logical conclusion based on the existing knowledge and personal experience of the expert. Whenever a problem is formulated by an expert, the following mandatory set of measures is carried out:

- modelling the measurement object from its decomposition into its component elements;
- identify factors that play a key role in determining quantitative assessment;
- taking into account the degree of influence of factors on determining the final quantitative assessment.

In subsystems (IS, FS, LP) various methods are used in practice to assess risks. To confirm the elements of novelty in the ongoing study, it was necessary to present information using different features proposed by the authors of the paper:

1) in Rostekhnadzor, with using in practice order No. 387 of November 3, 2022¹, calculation methods are used: *analysis of the “Failure Tree”*; *analysis of the “Event Tree”*; *“What if?” “What — If”*;

¹ On approval of the safety manual “Methodological basis for hazard analysis and accident risk assessment at hazardous production facilities” : Order of Rostekhnadzor dated 11.03.2022 No. 387. URL: <https://kubancentr.ru/images/docs/Prikaz-Rostekhnadzora-ot-03.11.2022-N-387.pdf?ysclid=lr2dcccj55628540024> (accessed: 06.01.2024) (rus.).

► analysis of “Hazards and Performance” (AOP); checklist (“Check-List”); “Hazard Identification”; HAZID (Hazard Identification); analysis of “Security Measures”; analysis of the “Mode and Consequences of Failures” (AVFO); quantitative assessment of accident risk;

2) in the Ministry of Emergency Situations of Russia, with using in practice order No. 404 of July 10, 2009², calculation methods are used — logical event trees; determining the estimated evacuation time; determining the specific frequency of various types of pipeline depressurization; determining the time of blocking of evacuation routes as a result of the spread of dangerous fire factors to them;

3) in the Ministry of Labour, with using Order No. 929 of December 28, 2021³ in practice, calculation methods are used — analysis of the “Decision Tree”; analysis of “Scenarios”; “What if?” (Swift); Bow-tie analysis; checklists; HAZOP (Hazard and Operability Study); “matrix” based on points; analysis of “Cause and Effect Relationships”; “Maintenance” aimed at ensuring reliability; analysis of “Levels of protection” (LOPA layers of protection analysis); analysis of the “Influence of the human factor” (HRA-Hyman Reliability assessment); assessment of the “Risk of getting an occupational disease”; cost-effectiveness analysis (cost-benefit analysis);

4) the new method proposed by the author of the paper is the method of prioritization, which, together with the use of the Gaussian normal distribution functionality, becomes a powerful tool that has replenished the group of methods used for calculating individual weighting coefficients. Using the proposed method in practice will allow:

- by a group of experts, selecting a specific subsystem (IS, FS, LP) as well as the subsystem production structural units (hereinafter referred to as PSU) operating at the enterprise, deficiencies in which led to a joint dangerous event (accident and fire), which had an impact (direct; indirect; circumstantial);
- obtain a specific numerical value located in the interval (from 0.001 to 0.999) as an indicator of the level of influence of the subsystem (IS, FS, LP, PSU).

The information presented above clearly confirms the presence of elements of novelty in the paper, when compared with existing solutions used in practice.

RESULTS

Mathematically, the solution of expert problems can be described as the effectiveness of the assessed object in relation to another in the form of a directed graph (Fig. 1).

Each of the n — objects ($X_1, X_2, \dots, X_n$) corresponds to a vertex of the graph, which expresses the result of the preference of one evaluated object over another.

Solving such a problem of determining the preference of one object over a group consisting of n objects using a drawing presents certain difficulties; in this case, it is necessary to build matrix $A = \|a_{ij}\|$;

$$A = \begin{pmatrix} a_{11} & a_{12} \dots & a_{1j} \dots & a_{1n} \\ a_{21} & a_{23} \dots & a_{2j} \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{i1} & a_{i2} \dots & a_{ij} \dots & a_{in} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} \dots & a_{nj} \dots & a_{nn} \end{pmatrix}.$$

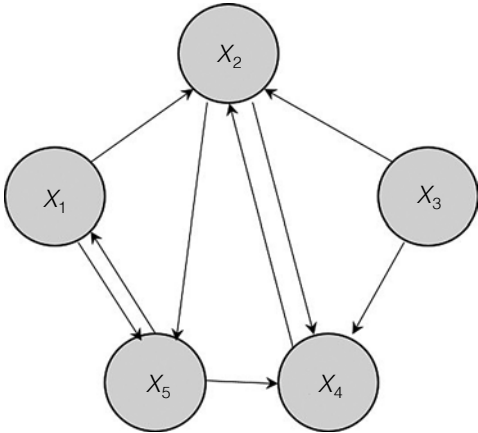


Fig. 1. Graph of the evaluation result of n -objects

And in this case:

$$a_{ij} = \begin{cases} 1, & \text{if } X_i > X_j; \\ 0.5, & \text{if } X_i = X_j; \\ 0, & \text{if } X_i < X_j, \end{cases}$$

where $i = j \rightarrow \{1, 2, \dots, n\}; a_{ij} = 0.5$;

$X_i > X_j$ means the priority of one assessed object over another;
 $X_i = X_j$ means equal importance of the objects being evaluated.

The justification presented above largely corresponds to the method of prioritization [6–10], which has a certain advantage over other methods of expert assessment due to the fact that it allows:

- establish relationships for the elements that make up the structure;
- present quantitative assessments where possible (subjective, expert);
- formulate and transform the problem into a logical-structured one;
- expand the capabilities of this method by using together with it the functionality of mathematical modelling and selecting optimal solutions.

Considering that the experts will give a non-numerical and qualitative characteristic, here, when determining the quantitative value for each qualitative value presented above, then using the Gaussian normal distribution functional (three sigma rule for a Gaussian random variable) [11–13], a specific the maximum value from the specimen for each of the presented qualitative characteristics (Fig. 2).

Using the graph it becomes possible to assign quantitative values for the following qualitative characteristics:

- directly related to the emergence and growth of conditions for causing damage from accidents and fires in volumetric terms, the value is $\approx 68.2\%$, or ≈ 0.682 , this indicator is assigned to a specific subsystem (IS, FS, LP, PSU);
- having an indirect relationship of $\approx 27.2\%$, or ≈ 0.272 , this indicator is assigned to a specific subsystem (IS, FS, LP, PSU), even that subsystem, which, during the assessment, was previously assigned a characteristic as having a direct relationship;

2 Approval of the methodology for determining the estimated values of fire risk at production facilities : Order of the Ministry of Emergency Situations of Russia dated 07.10.2009 No. 404. URL: torage/acts/173.pdf (accessed: 01.06.2024) (rus.).

3 Approval of recommendations for the selection of methods for assessing the levels of professional risks and for reducing the levels of such risks : Order of the Ministry of Labour of Russia dated 12.28.2021 No. 929. URL: <https://normativ.kontur.ru/document?moduleId=1&documentId=411523&ysclid=lr2de60y5x667189787> (accessed: 01.06.2024) (rus.).

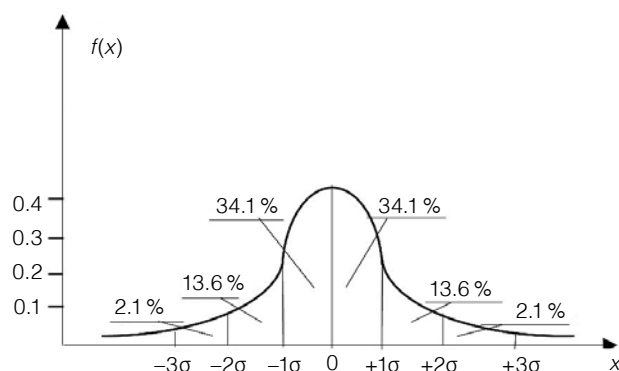


Fig. 2. The density distribution graph of a normalized value showing the volume ratio

- having a circumstantial relation of $\approx 4.6\%$, ≈ 0.046 , this indicator can be assigned to 1–2 specific subsystems (IS, FS, LP, PSU).

Then, in general mathematical form, the calculated value for determining the impact coefficient — k_i (IS, FS, LP, PSU), can be written by the equation:

$$k_i \{IS, FS, LP, PSU\} = 1 - \sum_{i=1}^3 k_d \{IS, FS, LP, PSU\}, \quad (1)$$

where k_d is a value representing the coefficient of deficiencies in the subsystem (IS, FS, LP, PSU) that is (directly, indirectly or circumstantially) related to the emergence and increase of conditions for causing damage from accidents and fires.

The overall resulting indicator of the operation of the subsystem (IS, FS, LP, PSU) for the period — t is calculated with reference to the functioning of the types of technological production process (P — production; T — transportation; Ps — processing; S — storage; O — other).

The final resulting indicator, which is the influence coefficient — k_{inf} of the subsystem (IS, FS, LP, PSU) for the period — t (year, quarter, month, etc.) with reference to the functioning of the production technological process, can be represented by the equation:

$$K_{inf} \{P; T; Ps; S; O\} \{IS, FS, LP, PSU\} t = \sum_{i=1}^n k_i / n, \quad (2)$$

where n — numbered extreme value belonging to the specimen.

CONCLUSIONS

1. The rationale for the use of the *prioritization method*, with the help of which specific quantitative values are obtained, displayed in the form of a level coefficient, which indicates certain deviations and will allow adjusting the personnel management model (IS, FS, LP, PSU) is presented based on an analysis of methods used in practice.

2. The method of prioritization, together with the use of the Gaussian normal distribution functionality, becomes a powerful tool that has replenished the group of methods used for calculating individual weight coefficients.

REFERENCES

1. Gvozdev E.V. A rational-targeted model for the development of an integrated safety and security system at oil and gas enterprises in Russia. *Real Estate: Economics, Management*. 2023; 1:33-38. DOI: 10.22337/2073-8412-2023-1-33-38
2. Gvozdev E.V. Risk assessment methodology within the framework of integrated safety of industrial enterprises. *E3S Web of Conferences*. 2023; 457:02004. DOI: 10.1051/e3sconf/202345702004
3. Makhutov N.A., Gadenin M.M. Scientific information and analytical base of industrial safety. *Labour Safety in Industry*. 2023; 10:20-26. DOI: 10.24000/0409-2961-2023-10-20-26 (rus.)
4. Gvozdev E.V. On a rational-target model for the development of integrated security system at the enterprises of the Russia's oil and gas sector. *2023 International Conference on Decision Aid Sciences and Applications (DASA), Annaba, Algeria, 2023*; 406-409. DOI: 10.1109/DASA59624.2023.10286572
5. Grazhdankin A.I., Pecherkin A.S., Sidorov V.I. On the possibility of uniform and counterproductiveness of identical criteria for assessing the risk of an industrial accident. *Labour Safety in Industry*. 2023; 10:36-44. DOI: 10.24000/0409-2961-2023-10-36-44 (rus.)
6. Gvozdev E.V. Development of risk management methodology at explosion- and fire-hazardous enterprise facilities. *Labour Safety in Industry*. 2023; 8:61-69. DOI: 10.24000/0409-2961-2023-8-61-69 (rus.)
7. Bochkov A. Reflections on Dual nature of risk. Toward a formalism. *Reliability: Theory & Applications*. 2023; 18(S5):44-74. DOI: 10.24412/1932-2321-2023-575-44-74
8. Arefyeva E. Managing the risk of emergencies caused by groundwater flooding of the historical built-up areas. *Reliability: Theory & Applications*. 2023; 18(S5):125-135. DOI: 10.24412/1932-2321-2023-575-125-135
9. Blumberg V.A., Glushchenko V.F. Which solution is better? Prioritization method. Leningrad, Lenizdat Publ., 1982; 160. (rus.)
10. Gvozdev E.V. Statement and solution of the problem of developing an integrated safety system at explosion- and fire-hazardous production facilities of enterprises. *Labour Safety in Industry*. 2023; 10:45-53. DOI: 10.24000/0409-2961-2023-10-45-53 (rus.)
11. Belikov A.B. Mathematical processing of geodetic measurement results : textbook. Ministry of Education and Science of the Russian Federation. 2nd ed. rev. Moscow, MGSU, 2016; 432. (rus.)
12. Alamdari A.M., Jabbarzadeh Y., Adams B., Samson D., Khanmohammadi S. An analytical network process model to prioritize supply chain risks in green residential megaprojects. *Operations Management Research*. 2023; 16(1). DOI: 10.1007/s12063-022-00288-2
13. Dvulit P., Savchuk S., Sosonka I. Accuracy estimation of site coordinates derived from GNSS-observations by non-classical error theory of measurements. *Geodesy and Geodynamics*. 2021; 12(5). DOI: 10.1016/j.geog.2021.07.005

Оценка состояния системы комплексной безопасности предприятия с использованием метода расстановки приоритетов

Представлено обоснование по использованию метода расстановки приоритетов совместно с функционалом нормального распределения Гаусса для оценки состояния системы комплексной безопасности производственных предприятий. Обоснованный метод обладает определенным преимущест-

вом по отношению к другим методам экспертных оценок в связи с тем, что он не имеет предела для расширения границ с целью получения адекватных результатов в виде количественных значений. Проанализирована статистика возникновения аварий и пожаров на предприятиях нефтегазового комплекса России, представлена информация о порядке определения первичных факторов, инициирующих возникновение совместных событий (аварий и пожаров). Показан пример с результатами обработки информации, полученной от экспертов. Представленные в статье разработки позволят на практике решать проблему по снижению ущерба от аварий и пожаров, т.е. решать

проблему, имеющую важное социально-экономическое для России значение.

Ключевые слова: система комплексной безопасности, метод расстановки приоритетов, нормальное распределение Гаусса, коэффициент влияния, экспертное решение

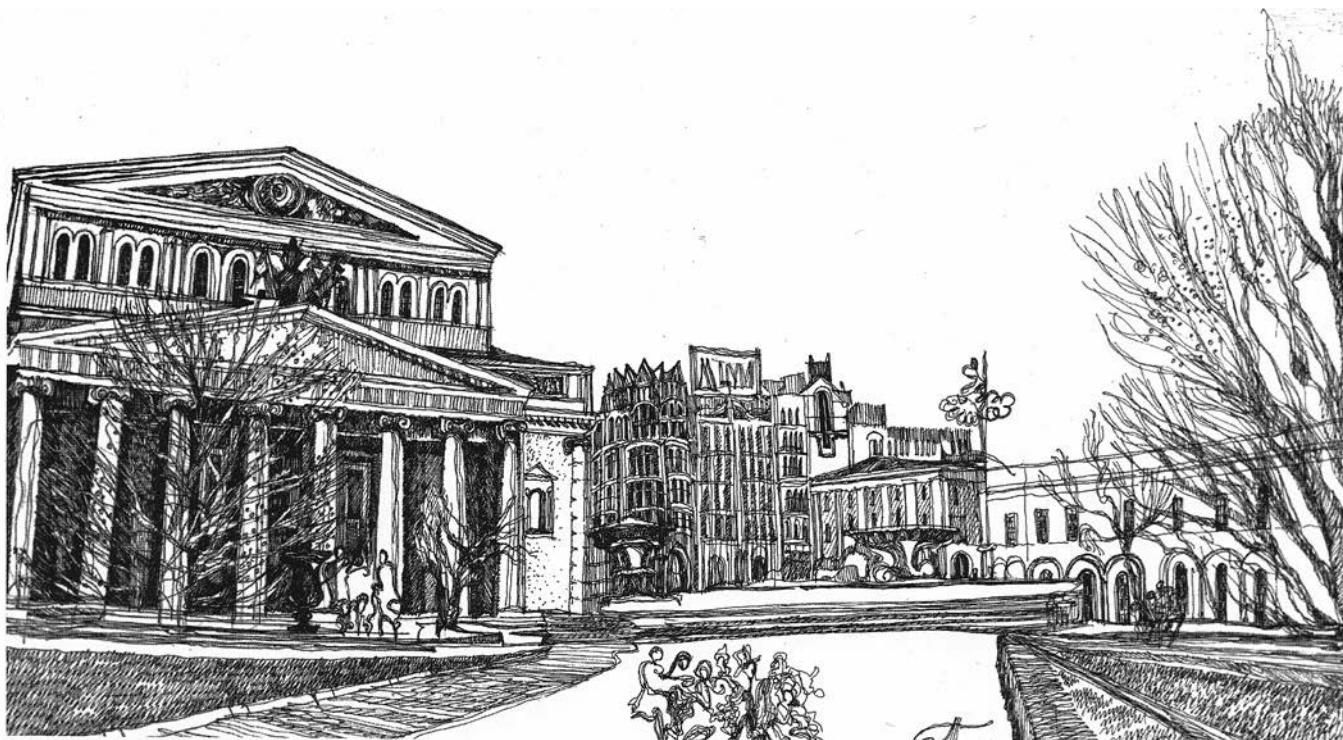
СПИСОК ИСТОЧНИКОВ

1. Гвоздев Е.В. A rational-targeted model for the development of an integrated safety and security system at oil and gas enterprises in Russia // *Недвижимость: экономика, управление*. 2023. № 1. С. 33–38. DOI: 10.22337/2073-8412-2023-1-33-38 URL: <https://n-eu.iiasv.ru/index.php/neu/article/view/114/136>
2. Gvozdev E.V. Risk assessment methodology within the framework of integrated safety of industrial enterprises // *E3S Web of Conferences*. 2023. Vol. 457. P. 02004. DOI: 10.1051/e3s-conf/202345702004.
3. Махутов Н.А., Гаденин М.М. Научная информационно-аналитическая база промышленной безопасности // *Безопасность труда в промышленности*. 2023. № 10. С. 20–26. DOI: 10.24000/0409-2961-2023-10-20-26
4. Gvozdev E.V. On a rational-target model for the development of integrated security system at the enterprises of the Russia's oil and gas sector // *2023 International Conference on Decision Aid Sciences and Applications (DASA)*, Annaba, Algeria, 2023. Pp. 406–409. DOI: 10.1109/DASA59624.2023.10286572
5. Гражданкин А.И., Печеркин А.С., Сидоров В.И. О возможности единых и контрпродуктивности одинаковых критериев оценки риска промышленной аварии // *Безопасность труда в промышленности*. 2023. № 10. С. 36–44. DOI: 10.24000/0409-2961-2023-10-36-44
6. Гвоздев Е.В. Развитие методологии управления риском на взрывопожароопасных объектах предприятий // *Безопасность труда в промышленности*. 2023. № 8. С. 61–69. DOI: 10.24000/0409-2961-2023-8-61-69
7. Bochkov A. Reflections on Dual nature of risk. Toward a formalism // *Reliability: Theory & Applications*. 2023. Vol. 18. Issue 5 (75). Pp. 44–74. DOI: 10.24412/1932-2321-2023-575-44-74
8. Arefyeva E. Managing the risk of emergencies caused by groundwater flooding of the historical built-up areas // *Reliability: Theory & Applications*. 2023. Vol. 18. Issue S5 (75). Pp. 125–135. DOI: 10.24412/1932-2321-2023-575-125-135
9. Блюмберг В.А., Глущенко В.Ф. Какое решение лучше? Метод расстановки приоритетов. Л.: Лениздат, 1982. 160 с.
10. Гвоздев Е.В. Постановка и решение задачи по развитию системы комплексной безопасности на взрывопожароопасных производственных объектах предприятий // *Безопасность труда в промышленности*. 2023. № 10. С. 45–53. DOI: 10.24000/0409-2961-2023-10-45-53
11. Беликов А.Б. Математическая обработка результатов геодезических измерений: учеб. пос. // Министерство образования и науки РФ. НИУ МГСУ, 2-е изд. перераб. М.: НИУ МГСУ, 2016. 432 с.
12. Alamdari A.M., Jabbarzadeh Y., Adams B., Samson D., Khanmohammadi S. An analytic network process model to prioritize supply chain risks in green residential megaprojects // *Operations Management Research*. 2023. Vol. 16. Issue 1. DOI: 10.1007/s12063-022-00288-2
13. Dvulit P., Savchuk S., Sosonka I. Accuracy estimation of site coordinates derived from GNSS-observations by non-classical error theory of measurements // *Geodesy and Geodynamics*. 2021. Vol. 12. Issue 5. DOI: 10.1016/j.geog.2021.07.005

Об авторе: **Гвоздев Евгений Владимирович** — кандидат технических наук, доцент кафедры общей и прикладной физики; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID : 296055, Scopus: 57213143299, ResearcherID: AAD-7686-2022, ORCID: 0000-0002-3679-1065; evgvozdev@mail.ru.

For citation: Gvozdev E.V. Assessment of the state of integrated security system at the enterprise using the priority setting method. *Real Estate: Economics, Management*. 2024; 2:33-36.

Для цитирования: Гвоздев Е.В. Assessment of the state of integrated security system at the enterprise using the priority setting method // *Недвижимость: экономика, управление*. 2024. № 2. С. 33–36.



Л.И. Павлова. Москва. Театральная площадь. Рисунок, тушь, перо.

UDC 69.05:574

Supply chain management in industrial housing construction: specifics, problems, methods, performance indicators

Construction belongs to one of the resource-intensive sectors of the economy, which makes the problem of organizing the resource supply of construction production urgent. An analysis of foreign and domestic supply chain management practices has shown that logistics costs have a high share in the costs of organizations, regardless of their industry affiliation. The share of transportation costs is significant. Taking into account the dynamics of business environment, it is necessary to continuously improve the supply chain management mechanism, including taking into account regional and sectoral aspects of enterprises' activities. Considering the specifics of construction from the standpoint of resource provision, it can be concluded that logistical problems are increasing due to the lack of integration of construction participants, uneven consumption of certain types of resources, as well as the high impact on both supply processes and construction production, natural and climatic conditions. Each participant in the supply chain has risks and they affect the activities of all subjects of the chain, complicating management processes. The SCOR model, focused on the key business processes of the organization, has found wide application in supply chain management. The metrics proposed in the model have a hierarchical system and are focused on individual subsystems of the supply chain, management levels of control, and create an information basis for making effective management decisions. The authors propose a system of indicators reflecting the specifics of construction in relation to the subsystems of the SCOR model: supply reliability, resource efficiency, logistics cost management and efficiency of logistics asset management. The system can be effectively used in the organization of management accounting for cost centers, which reliably reflects the logistical costs of construction projects, processes, types of work, consumed resources, and resource suppliers. **Keywords:** industrial housing construction, supply chain management, construction specifics, management problems, features of logistics processes, supply chain management models, performance assessment indicators

The organization of the resource supply chain management system for construction projects makes it possible to significantly reduce construction production costs, reduce production losses and defects, avoid unnecessary labour costs and means of production, loss of working time, violation of construction deadlines. This will strengthen the market position of the construction company and ensure financial stability. The specifics of construction as an industry with a variety of relationships and factors determining them, a large number of participants in the construction process, form the main properties of the supply chain [1]:

- instability of sales for suppliers due to uneven consumption of a particular type of resources;
- difference between design solutions and the real situation on the construction site;
- insufficient integration of logistics processes, which can be enhanced if subcontractors and suppliers are involved in the early stages of the planning process for the construction of an object or a development complex.

These features reflect the specifics of construction as a type of activity. Additionally, the following construction features are highlighted, which determine the importance of logistics process management, in particular¹ [2]:

- territorial dispersion of construction facilities

included in the contractor's work programme, which increases transportation costs, which have a high share in the structure of logistics costs;

- long production period that does not have the cyclical nature inherent in other industries;
- limited building area, which determines the specifics of warehouse logistics;
- increase in the degree of individualization of the production process in housing construction significantly increases the range of resources consumed;
- subcontractors are involved who perform certain types of specialized work, which requires clear coordination of their activities;
- rental relations with suppliers of construction equipment for facilities are widely practiced and their maximum load is important;
- constantly increasing requirements for construction production, due to the need to shorten the construction period, increase the life cycle of the real estate object, reduce resource conservation both during the construction phase and operation of the object;
- high material consumption of construction determines the need to search for reserves to reduce material costs through procurement, warehouse and production logistics;

Simionov R. Yu.
Azhimov T. Z.



Simionov Radomir Yurievich,
Doctor of Economics, Assistant Professor, Dean of the Faculty of Economics; Russian Customs Academy, Rostov Branch; 20 Budennovsky prospect, Rostov-on-Don, 344002, Russian Federation; SPIN-code: 1377-6230; radomir@rambler.ru



Azhimov Timur Zagidovich,
Candidate of Economic Sciences, Associate Professor, Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 7199-1406, Scopus: 57218826075, ResearcherID: ABD-6000-2021, ORCID: 0000-0002-7648-1950; Timur.Azhimov@gmail.com

1 Borisova L.A. The use of logistics in construction in a crisis. URL: <https://cyberleninka.ru/article/n/ispolzovanie-logistiki-v-stroitelstve-v-usloviyah-krizisa> (rus.).

- material flows are characterized by high risks, since discrete flows prevail in construction.

A properly organized supply chain management system allows for increased transparency and consistency of logistics processes, including material and financial flows, regardless of functional and corporate boundaries, and to create a single configuration. Each participant in the supply chain has business risks and they are projected onto the activities of all subjects of the chain, complicating management processes. The problems of a construction company also consist in the fact that, being a focal company in the supply chain, in fact, it is not the owner of logistics processes, but only a consumer. What problems are created in the way of improving management in the supply chain [1, 3]:

- high logistical costs, including through the transportation of construction materials, since manufacturers are usually geographically removed from construction sites;
- insufficient capacities of manufacturers of building materials, which cannot be rapidly increased due to increasing demand; as an example, the identified risks of implementing federal projects, when risks of providing construction materials arose during planned large-scale construction²;
- low quality of building materials, which leads to the need not only to increase the warranty reserves, but also to solve the problem of recycling the waste that has arisen;
- lack of balance in the composition and dynamics of the formation of various types of inventories;
- reduced labour productivity at the construction site, which leads to disruption of resource consumption schedules;
- problems of coordination of subcontractors' work schedules.

According to the strategy for the development of the construction industry, the volume of housing commissioning by 2030 will amount to 120 million sq. m per year, including by increasing the share of industrial housing construction, which should amount to 75 % of the total construction volume (according to the baseline scenario) and at least 60 %, taking into account the impact of possible risks³. This requires solutions to improve the construction resource support system and improve the supply chain management system. In particular, the issues of the formation of a technological "chain" as a set of organizations involved in the production of components for the technological cycle of the final product, ordered in the performance of operations for processing raw materials, are considered.

The lean construction concept is focused on reducing all types of costs in the construction and operation of a finished facility by optimizing the interaction of all parts of the production process and optimizing their work. This will contribute to ensuring the planned increase in labour productivity in construction in 2035 by 117 % compared to 2021. However, there is also a feedback here: if for some reason, including the natural and climatic conditions of the construction of facilities, insufficiently developed road infrastructure, measures to increase labour productivity and reduce logistical costs cannot be implemented.

In construction practice, on highly organized and mechanized construction sites, when constructing large-panel buildings, labour

costs per 1 sq. m of the total area are reduced by almost 2 times compared with traditional construction methods, and up to 60 % of labour costs are transferred to factory conditions. The experience of construction in China shows how to solve the problems of industrialization of construction by improving the supply chain management system. In particular, modelling the organization of construction on the site, including the delivery of structures to the site and their installation [4, 5].

In industrial housing construction, a combined organizational form of production is used, which contributes to the development of concentration and specialization processes by equipping with modern equipment and using advanced technologies, more complete use of material resources. Combining several technologically interconnected industries with the construction stage at one house-building plant allows for continuity of production and financial processes. These organizations are characterized by efficient logistics, but there is a need for further development of resource and innovation potential in order to solve the problems of integration with sales logistics [6].

The introduction of information modelling technologies in the Russian construction industry is considered to be an innovative process, characterized by intersectoral interaction of participants in the investment and construction process to create a real construction object and its digital twin. At the same time, the model describes the entire life cycle of the object. In 2019, a concept was developed for the implementation of a life cycle management system for capital construction facilities using BIM technologies in building an information model of an object under construction⁴. The implementation of these measures makes it possible to create an integrated supply chain management system, which will make it possible in 2024 to increase construction efficiency, reduce the cost of projects, reduce construction time and the number of violations of deadlines.

In almost all countries, transport costs account for a significant share of logistics costs (up to 60 %). According to experts, due to logistical measures, it is possible to reduce the stock level by 30–50 %, reduce repeated warehouse transportation by 1.5–2 times, the cost of road transportation by 7–20 %, and rail transportation by 12 % [7].

At the current stage of development of the supply chain management system, the following measures can give results [8]:

- systematic planning of measures for the timely identification, prevention or reduction of risks;
- as part of the process approach, set standards for the basic indicators of each logistics process;
- structuring the system of basic indicators according to the management vertical;
- to set the maximum possible deviations of the actual values of the indicators from the planned value;
- to evaluate the effectiveness of each process in the supply chain.

An integrated logistics system assumes the maximum integration of such functions as transportation, warehousing, and inventory management at the level of their optimal size, including taking into

2 Results of monitoring of individual national projects (summarized). URL: <http://council.gov.ru/media/files/S9VoCEQB37XXxBQWGgP9LXecQFaJgdfy.pdf> (rus.).

3 Strategy for the development of the construction industry and housing and communal services of the Russian Federation for the period up to 2030 with a forecast up to 2035. Approved by the Decree of the Government of the Russian Federation 3268-r dated October 31, 2022. (rus.).

4 The concept of implementing a life cycle management system for capital construction facilities using BIM technologies. URL: <https://gge.ru/upload/iblock/93c/0/%20концепции%20внедрения%20системы%20управления%20жизненным%20циклом%20объектов%20капитального%20строительства%20с%20использованием%20BIM-технологий.pdf> (rus.).

account shortages, possible seasonal restrictions at the level of a specific facility and the organization as a whole. It also envisages logistical integration of supply and production, the possible orientation of the benchmarking of the logistics of a construction enterprise to the logistics systems of enterprises with assembly technologies.

In modern conditions, the tightening of requirements for the fulfillment of construction deadlines is an objective process, since it affects the economic sustainability of construction companies. At the same time, the fulfillment of contractual construction deadlines is hampered by the high-rise buildings, the high degree of equipment of facilities with engineering communications, and an extended group of construction participants [9].

In countries with advanced technologies of industrial housing construction, the method of organizing construction "installation from wheels" is used, when prefabricated structures are delivered to the construction site according to hourly or minute schedules, taking into account the technological sequence. On-site warehouses are created only for small components. Such a system has a positive effect on many indicators of the contractor organization: construction time is reduced, construction equipment is used more efficiently, and the safety of structures increases due to a decrease in the number of loading/unloading [9].

Logistics processes can be well organized in the context of the use of modular housing technology for the construction of certain types of facilities in conditions where mobility, speed of construction and relatively low cost are important. The key features are: ease of installation and dismantling of buildings, cost-effective transportation. In addition, finishing works can also be carried out at the plant, which reduces construction time and increases the speed of financial flows due to logistics [10].

There are proposals within the problematic field of logistics of the housing and construction complex to improve the system [11]:

- use of modular housing construction, which will ensure the rhythm of construction processes;
- improvement of technological production and supply processes based on digitalization;
- adaptation of the logistics system of the housing and construction complex to the conditions of the urban environment.

The SCOR model, developed for the purpose of more effective analysis, design and planning of supply chains, has found wide application in market practice. The supply chain operations model has been developed and is being developed as an inter-industry management standard. The model has developed more than 200 metrics that can be used in supply chain management^{5, 6}. In each of the company's areas of activity, key business processes are selected that must be performed at a high level, which will determine the effectiveness of the system as a whole. The model creates benchmarks, but the need to take into account industry specifics should be taken into account.

The assessment of the effectiveness of indicators of logistics business processes in supply chains is based on the use of indicators of the functioning of the first level of the model, i.e. on high-rank meters that can generalize a number of logistics processes. With regard to the specifics of the activities of construction contractors, we propose the following system of indicators that maximally cover supply chain management (Table).

The applied logistic indicators should correspond to the managerial level of control, create an information basis for making

Indicators for assessing the logistics processes of a construction organization

Subsystem of indicators of the SCOR model	Subsystem indicators
Reliability of delivery in the supply chain	1. The number of orders completed in violation of the delivery schedule (for each resource and supplier) for the period. 2. The share of orders completed in violation of the delivery schedule (for each resource and supplier) for the period, %. 3. The percentage of defective supplies (for each resource and supplier), for the period, %. 4. Downtime of crews at the construction site due to lack of resources, people/hour, for the period. 5. Downtime of construction equipment at the construction site due to lack of resources, machines/shifts, during the period
Resource efficiency of the logistics infrastructure	1. Productivity of warehouse lifting and transport equipment, volume of resources/hour. 2. The average percentage of loading of on-site warehouses, for the period, %. 3. The cost of storing a unit of resource (by type of resource), rub.
Costs associated with supply chain logistics operations	1. Total logistics costs per 1 sq. m of the total area of the construction site, rub/sq. m. 2. Total logistics costs to revenue from sales of construction products, rub. 3. Inventory turnover ratio (by type of resources). 4. Costs for the organization and execution of the order (by type of resources), rub. 5. The cost of managing returns/waste, rub. 6. Transportation costs per unit of resource (by type of resources). 7. Costs associated with a shortage of resources, per unit of resource (by type of resources), rub.
Efficiency of logistics asset management in the supply chain	1. Resource efficiency as the cost-effectiveness of the material resources of construction production. 2. Inventory turnover ratio (by type of resources). 3. Revenue from sales of construction products per 1 rub. material resources. 4. Cost-effectiveness of material resources, %

effective management decisions. At the same time, it is necessary to organize management accounting for cost centers, which allows you to reliably determine the logistical costs of construction projects, processes, types of work, and resources consumed.

In construction, a properly organized supply chain gives a significant economic effect, since even minor supply disruptions lead to downtime, violation of the work schedule, increase in

5 SCOR — supply chain model. URL: [http://Downloads/L10+SCOR model+supply chain+%20\(4\).pdf](http://Downloads/L10+SCOR model+supply chain+%20(4).pdf)

6 The Apics Scor model and its main processes. URL: [cor-model.pdf](#)



► construction time, increase in the cost of construction and violation of contractual obligations.

The planning of logistics activities should be comprehensive and systematic, reflecting the dynamics of the market of resources for construction. The correct organization of the supply chain management system of material resources allows you to significantly reduce the costs of construction production, reduce production losses and defects, avoid unnecessary labour costs and means of production, loss of working time, and violation of construction deadlines. This will strengthen the competitive position of the construction company and ensure financial stability.

REFERENCES

1. Lapidus A.A., Safaryan G.B. The role of supply chain management in construction. *Technology and Organization of Construction Production*. 2018; 1:28-31.
2. Pasyada I.N. Features of construction logistics in projects of integrated development and development of territories. *Vestnik of Rostov State Economic University*. 2017; 3(59):63-69. (rus.).
3. Berezhnaya G.G. The essence and types of risks in the supply chains of organizations of the construction complex. *Bulletin of BSTU named after V.G. Shukhov*. 2019; 3:5-11. (rus.).

4. Gurinovich V.Yu., Leonovich S.N., Pozdnyakov D.A. Trends and directions of development of industrial housing construction in the world and domestic practice of housing construction. *Vestnik of Polotsk State University. Part F. Constructions. Applied Sciences*. 2023; 1:10-18. DOI: 10.52928/2070-1683-2023-33-1-10-18 (rus.).
5. Gurinovich V.Yu. A comprehensive study of the development of industrial housing construction. *Science and Technology*. 2022; 5:397-409. DOI: 10.21122/2227-1031-2022-21-5-397-409 (rus.).
6. Azhimov T.Z. Management of the resource and innovative potential of industrial housing construction enterprises : dissertation of the Candidate of Technical Sciences. Moscow, MGSU, 2022; 180. (rus.).
7. Pletneva N.G. Features of organizational logistics in construction. *Theory and Practice of Management*. 2019; 7:75-79.
8. Golovin S.V., Lutsenko M.S., Fadina A.S. Modern aspects of supply chain management at an industrial enterprise. *Modern Economy: Problems and Solutions*. 2020; 12(132):58-73. DOI: 10.17308/meps.2020.12/2491 (rus.).
9. Davletov I.H. Prospects for the development of industrial housing construction. *Bulletin of Science and Practice*. 2021; 7(6):324-328. DOI: 10.33619/2414-2948/67/35 (rus.).
10. Pakhomova L.A., Oleinik P.P. Comfortable housing of the new industrial generation. *Construction Production*. 2020; 2:23-29. DOI: 10.54950/26585340_2020_2_23 (rus.).
11. Bashidze R.R. The problematic field of logistics of the construction and housing complex. *Economics and Management: Scientific and Practical Journal*. 2022; 1(163):82-86. DOI: 10.34773/EU.2022.1.15 (rus.).

Управление цепями поставок в индустриальном домостроении: специфика, проблемы, методы, показатели эффективности

Строительство относится к одной из ресурсоемких отраслей экономики, что делает актуальной проблему организации ресурсообеспечения строительного производства. Анализ зарубежной и отечественной практики управления цепями поставок показал, что логистические издержки имеют высокую долю в затратах организаций независимо от их отраслевой принадлежности. Существенна доля транспортных расходов. С учетом динамики бизнес-среды необходимо постоянное совершенствование механизма управления цепями поставок, в том числе с учетом региональных и отраслевых аспектов деятельности предприятий.

Рассматривая специфику строительства с позиций ресурсного обеспечения, можно сделать вывод, что логистические проблемы возрастают из-за недостаточной интегрированности участников строительства, неравномерности потребления отдельных видов ресурсов, а также высокого влияния и на процессы поставок, и на строительное производство природно-климатических условий. Каждый участник цепи поставок имеет риски, и они влияют на деятельность всех субъектов цепи, усложняя процессы управления.

В управлении цепями поставок нашла широкое применение SCOR-модель, ориентированная на ключевые бизнес-процессы организации. Предлагаемые в модели метрики имеют иерархическую систему и ориентированы на отдельные подсистемы цепи поставок, управленческие уровни контроля, создают информационную основу для принятия эффективных управленческих решений. Авторами предлагается система показателей, отражающих специфику строительства, применительно к подсистемам SCOR-модели: надежность поставок, ресурсоотдача, управление логистическими затратами и эффективность управления логистическими активами. Система может эффективно применяться при организации управленческого учета по центрам затрат, достоверно отражающего логистические затраты по объектам строительства, процессам, видам работ, потребляемым ресурсам, поставщикам ресурсов.

Ключевые слова: индустриальное домостроение, управление цепями поставок, учет специфики строительства, проблемы управления, особенности логистических процессов, модели управления цепями поставок, показатели оценки эффективности

СПИСОК ИСТОЧНИКОВ

1. Лапидус А.А., Сафарян Г.Б. Роль управления цепями поставок в строительстве // *Технология и организация строительного производства*. 2018. № 1. С. 28–31.
2. Пасяда И.Н. Особенности строительной логистики в проектах комплексного освоения и развития территорий // *Вестник Ростовского государственного экономического университета*. 2017. № 3 (59). С. 63–69.
3. Бережная Г.Г. Сущность и виды рисков в цепях поставок организаций строительного комплекса // *Вестник БГТУ им. В.Г. Шухова*. 2019. № 3. С. 5–11.
4. Гуринович В.Ю., Леонович С.Н., Поздняков Д.А. Тенденции и направления развития индустриального домостроения в мировой и отечественной практике жилищного строительства // *Вестник Полоцкого государственного университета. Серия F. Строительство. Прикладные науки*. 2023. № 1. С. 10–18. DOI: 10.52928/2070-1683-2023-33-1-10-18
5. Гуринович В.Ю. Комплексное исследование развития индустриального домостроения // *Наука и техника*. 2022. № 5. С. 397–409. DOI: 10.21122/2227-1031-2022-21-5-397-409
6. Ажимов Т.З. Управление ресурсно-инновационным потенциалом предприятий индустриального домостроения : дис. ... канд. экон. наук. М. : МГСУ. 2022. 180 с.
7. Плетнева Н.Г. Особенности организационного обеспечения логистики в строительстве // *Теория и практика управления*. 2019. Вып. 7. С. 75–79.
8. Головин С.В., Луценко М.С., Факина А.С. Современные аспекты управления цепями поставок на промышленном предприятии // *Современная экономика: проблемы и решения*. 2020. № 12 (132). С. 58–73. DOI: 10.17308/meps.2020.12/2491
9. Давлетов И.Х. Перспективы развития индустриального строительства жилья // *Бюллетень науки и практики*. 2021. Т. 7. № 6. С. 324–328. DOI: 10.33619/2414-2948/67/35
10. Пахомова Л.А., Олейник П.П. Комфортное жилье нового индустриального поколения // *Строительное производство*. 2020. № 2. С. 23–29. DOI: 10.54950/26585340_2020_2_23
11. Башидзе Р.Р. Проблемное поле логистики строительного жилищного комплекса // *Экономика и управление: научно-практический журнал*. 2022. № 1 (163). С. 82–86. DOI: 10.34773/EU.2022.1.15

Об авторах: **Симионов Радомир Юрьевич** — доктор экономических наук, доцент, декан экономического факультета; **Российская таможенная академия, Ростовский филиал;**

344002, г. Ростов-на-Дону, Буденновский пр-т, д. 20; SPIN-код: 1377-6230; radomir@rambler.ru;

Ажимов Тимур Загидович — кандидат экономических наук, доцент кафедры Организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 7199-1406, Scopus: 57218826075, ResearcherID: ABD-6000-2021, ORCID: 0000-0002-7648-1950; Timur.Azhimov@gmail.com.

For citation: Simionov R.Yu., Azhimov T.Z. Supply chain management in industrial housing construction: specifics, problems, methods, performance indicators. *Real Estate: Economics, Management*. 2024; 2:37-41.

Для цитирования: *Симионов Р.Ю., Ажимов Т.З.* Supply chain management in industrial housing construction: specifics, problems, methods, performance indicators // Недвижимость: экономика, управление. 2024. № 2. С. 37–41.



Л.И. Павлова. Москва. Улица Петровка. Рисунок, тушь, перо.

■ Khrustalev B.B.
Meshcheryakova O.K.
Meshcheryakova M.A.



Khrustalev Boris Borisovich,

Doctor of Economics, Professor, Head of the Department of the Economics, Organization and Production Management; Penza State University of Architecture and Construction; 28 German Titov St., Penza, 440028, Russian Federation; ID RSCI: 468261, Scopus: 56682739600, ResearcherID: AAR-2319-2021, ORCID: 0000-0002-9172-3487; khrustalev_bb@mail.ru



Meshcheryakova Olga Konstantinovna,

Doctor of Economics, Associate Professor, Professor, Department of Technology, Construction Organization, Expertise and Real Estate Management; Voronezh State Technical University; 84 st. 20th anniversary of the October Revolution, Voronezh, 394006, Russian Federation; Onora@list.ru



Meshcheryakova Maria Alexandrovna,

Doctor of Economics, Associate Professor, Professor, Department of Technology, Construction Organization, Expertise and Real Estate Management; Voronezh State Technical University; 84 st. 20th anniversary of the October Revolution, Voronezh, 394006, Russian Federation; Masha0207@mail.ru

Development of integrated risk management system at construction industry enterprises

The paper is devoted to the problem of identifying and taking into account the main features in the development of the risk management system in the construction industry. Such concepts as risk, risk classification, informatization, basic principles of developing a risk management system in the activities of enterprises, investment project and investment process are considered. The purpose of the paper is to study the features and methods of improving the efficiency of construction companies based on the development of a risk management system. The object of this paper is the construction industry and business in Russia. The subject of the study is the specifics of developing a risk management system for this area. The research methods are theoretical analysis and empirical research, in particular, the analysis of statistical data, as well as description and grouping of data. The information base for the study of this problem was literature sources on the activities of construction holdings under the influence of external and internal environmental factors on the process of developing their strategy of functioning and development, scientific papers, monographs, electronic resources, legal sources. Such scientific methods as description, comparison, classification served as the methodological basis for the paper.

Keywords: *management, construction business, enterprise, risk management, risk management strategies, implementation, big data*

INTRODUCTION

Nowadays, the construction industry is one of the leading sectors of the economy and it provides us not only with a sense of stability and confidence among the citizens of the state, but also creates the foundation for economic growth of a country. It is the construction sector that creates the conditions for the functioning of the whole market mechanism, which is the economic basis of the capitalist state and it also lays the groundwork for solving complex social problems. However, in modern Russia under conditions of macroeconomic crisis and geo-political turbulence associated with the fall in demand for property, by reducing solvency of the population, market volatility and the intensification of internal problems of organization financial management, previously profitable investment and construction projects can become increasingly loss-making that leads to the growth of the number of bankrupt construction companies and the transition of the construction industry to recession.

LITERATURE REVIEW

A great deal of studies have been devoted to the effective functioning of construction enterprises, problems of economic regulation of their development and identification of ways to improve their efficiency under risk conditions, namely: P.G. Grabovyy, G.M. Zagidullina, M.I. Kamenetsky, I.G. Lukmanova, B.B. Khurstalev, N.Yu. Yaskova and others. Many scientists tend to point out the risks caused by the action of objective (external to the company and unmanageable) and subjective factors.

MATERIALS AND METHODS

The methods (Fig.) of the study are theoretical analysis and empirical research in particular statistical data, immutability of the first two principles of risk

management can be considered a debatable issue due to the existence of objective risks that accompany the enterprise, regardless of the governing body decisions [1–3]. Analysis, as well as grouping of data.

The information base for the study of this problem was the literature (textbooks, study guides) on investment and innovation activities of enterprises under the influence of external and internal environment risk on the process of developing a risk management system, scientific papers, monographs, electronic resources, reference legal system “Consultant Plus”, legal sources.

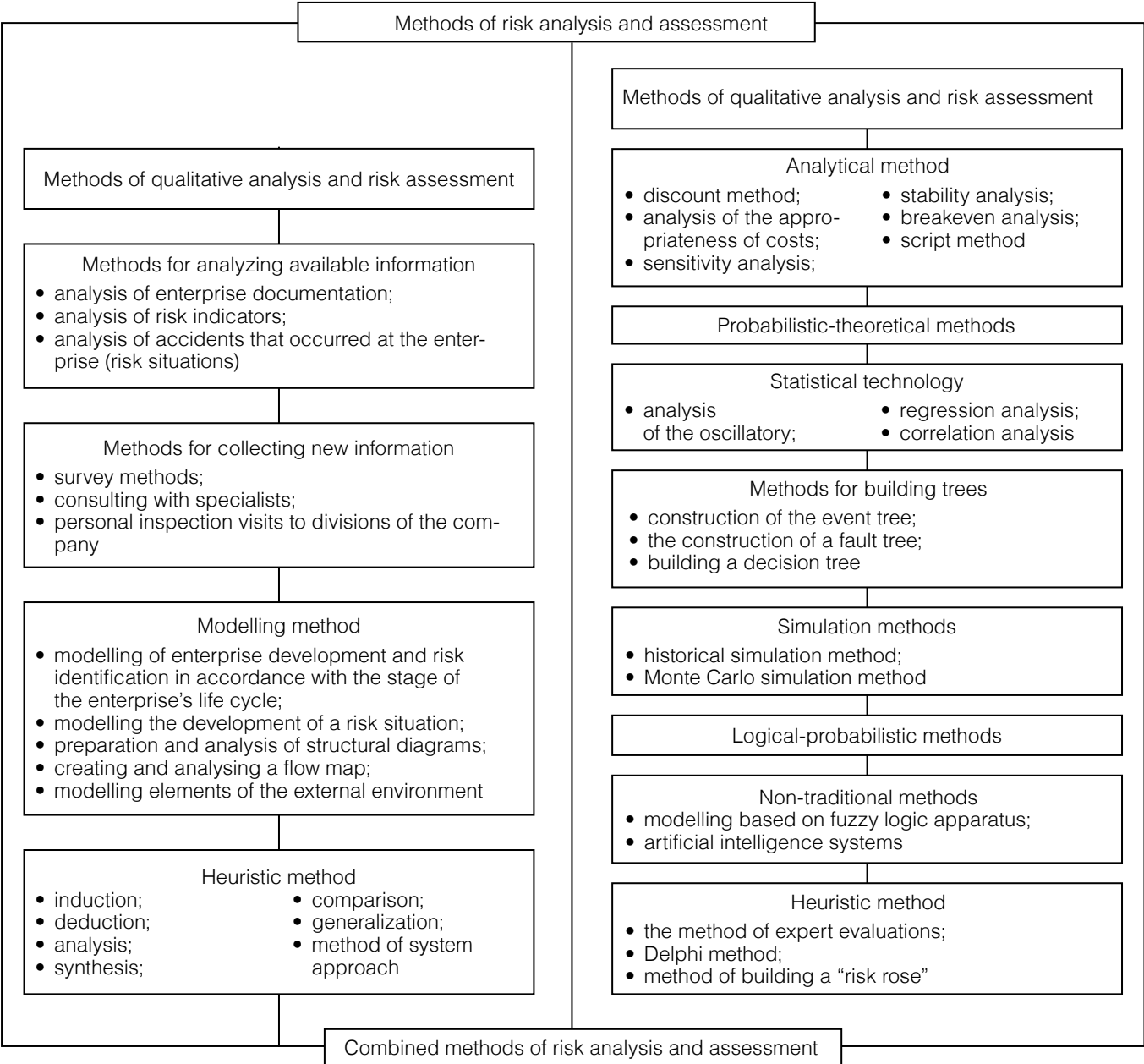
Scientific methods such as description, comparison and classification served as the methodological basis for the paper.

A comparative study of the economic literature of Russian and foreign authors allows us to classify existing methods of risk analysis and assessment into three mutually complementary groups: methods of qualitative, quantitative and combined analysis (Fig.).

Qualitative methods are mainly directed to carrying out a logical analysis of establishing the existence of various types of risks, their determining factors, reasons and possible consequences. There are four subgroups of methods for qualitative risk analysis:

- 1) methods for analyzing existing information;
- 2) methods for collecting new information;
- 3) modelling methods;
- 4) heuristic methods.

Methods for the available information analysis include, first of all, document analysis of financial, managerial, statistical, technical, etc. reports of the enterprise, as well as the analysis of the relative financial indicators of the enterprise and the analysis of the accidents that occurred at the enterprise (risk events). For example, by analyzing financial



Methods of risk analysis and assessment

reporting documents (the balance sheet, the reports of financial results (profit and loss), and other forms of accounting statement), one can identify all the existing property of the organization, its liabilities and debts and its exposure to risks. Based on the analysis of the relative financial indicators of the company (solvency, liquidity, stability, bankruptcy), it is possible to reliably predict possible risks, the degree of probability of their manifestation and possible losses from each risk. The analysis of the accidents (risk events) that occurred at the enterprise will contribute to the formation of standard procedure reserve for behavior in such situations and decision-making for their rapid elimination of adverse consequences of accidents (risk events).

Among the methods of collecting new information about potential risks in the company's activities there are mainly survey methods,

consulting with specialists, as well as personal inspection visits to the company divisions [4–6].

A survey is a collection of written information using standardized or specialized questionnaires that include a detailed list of questions that reflect the various fields of activity of the enterprise. The difference between these questionnaires is that standardized questionnaires contain a universal set of general questions and they can be used for most types of manufacturing, while specialized questionnaires are developed for specific activities taking into account their characteristics and the necessary detailing of particular provisions.

Consulting allows us to identify risks in a direct conversation with specialists working in the company, as well as with external ones who know and have an idea of the difficulties that arise in their work. This method allows us to assess the risks in the dynamics including the forecast for the future.

► In order to collect additional information and to verify its accuracy and completeness on places, personal inspection visits to the company divisions are conducted which allow not only to identify and clarify certain aspects of the risk management system but also to assess the possible costs of risk management in the given division, as well as to make recommendations on risk level regulation. Meanwhile, the inspection visit may be unexpected so that it is possible to note specially hidden facts or it may be with advance notification for the employees. In any case, when planning a visit, the list of tasks and problems that can be solved or clarified during a direct inspection visit is initially determined. Then the division visiting plan is formed based on a preliminary assessment of the tasks and taking into account various special factors and containing a logical scheme for identifying risks and allowing us not to miss anything significant.

Methods of modelling involve creating and researching of business process models and phenomena in order to predict the occurrence of possible risks. First of all, these methods include modelling of enterprise development and risk identification in accordance with the stage of the enterprise life cycle, modelling of risk situations, making and analyzing structural diagrams, analyzing flow maps and modelling the elements of the external environment.

Modelling the enterprise development and determining risks in accordance with the stage of the enterprise life cycle make it possible to predict and assess the risks inherent to enterprise development in a certain stage with a sufficiently high degree of probability. The given method also allows to develop a set of measures to influence risks taking into account the organizational and economic characteristics of the life cycle stage.

Modelling the development of a risk situation is based on the identification and the study of objective and subjective risk factors, individual groups or types of risk, as well as the consequences of each real or predicted risk. At the same time, risk factors can be identified in various ways: from complex probabilistic analysis in operation research models to purely intuitive suppositions.

The method of structural diagrams clearly demonstrates the various aspects of activity and the interrelation between structural and technological divisions of the enterprise and it is intended to identify, first of all, internal risks associated with the quality of management, marketing, organization of work, etc.

The analysis of the flow map, which is a useful addition to the method of structural diagrams, is aimed at identifying the main risk factors of the production process and an approximate assessment of the reliability and stability of the key elements of the manufacturing and technological processing chain.

Modelling elements of the external environment is necessary to identify risks emanating from the external environment, as well as to determine the degree of their homogeneity and stability.

Heuristic methods of qualitative risk analysis are based on logical rules and techniques generated by thinking and implemented on the basis of existing information, including the methods such as induction, deduction, analysis, synthesis, as well as the methods of comparison, generalization and system approach.

The induction method is a process of identifying the most likely patterns arising from the comparison of the initial individual statements and facts, providing the opportunity to make generalizing conclusions and formulate general provisions. In other words, induction is characterized by the knowledge of reality by moving from the particular to the general.

The method of deduction involves the study of reality by investigation from a general conclusion or proposition to single specific cases, statements and facts.

Analysis is a method of research that involves dividing the object, process, or phenomenon under consideration into separate parts and determining the characteristics, properties and qualities of an individual element.

Parts, attributes, properties and qualities that have been divided by analysis are combined by means of synthesis in order to identify common features, properties and qualities that link these parts into a single whole [7, 8].

The essence of the comparison method is identifying the qualitative and quantitative characteristics of an object, process or phenomenon and implementing on the basis of certain criteria for classification, ordering and assessment.

The generalization method is a procedure for establishment and fixation common properties, attributes and qualities of objects, processes or phenomena.

The method of the system approach provides for the study of a single object, process or phenomenon as a system consisting of a certain number of interrelated elements that interact with each other and affect the efficiency of the entire system as a whole.

RESULTS

Modern construction companies of Russia implement no more than three risk management tools and do not link them to the financial activities of the company. There is also no integration of risk management into the fundamental strategic orientation of the company. Only large construction corporations in Russia are engaged in systematic risk management. Small and medium-sized enterprises do not implement this system in management as they consider it economically unprofitable and unsound.

Implementation of risk management in the construction sector requires the commitment of the governing body and availability of certain conditions for the realization of the risk management programme. The "big data" system allows us to process large amounts of relevant information. It also contributes to the accuracy of risk assessment and thereby making the development of risk management is one of the most actual tasks using this system.

DISCUSSION

Construction is traditionally one of the leading economic sectors that play a fundamental role in the social and economic development of any country and set the prerequisites for ensuring social wellbeing and strategic economic stability.

Taking into account the given destructive prerequisites and features, we can state that the situation in Russia remains tense and the business prospects of the construction industry are uncertain. Under the pressure of destabilizing factors that weaken the "immunity" of national construction enterprises to the turbulence of the external environment, companies are turning to the search for the new methods and means of management. Risk management is one of these methods, the task of which can be recognized as the conservation of assets and profitability of the enterprises with the possible risk of significant losses.

The ultimate goal of risk management corresponds to obtaining the highest profit at the optimal ratio of profit and risk for the company's governing body. We can distinguish the main goals that can be set for the risk management system: revealing zones (areas) of high risk; risk assessment; eligibility analysis of the given risk level for the organization; development of measures to prevent or reduce risks; if the risk event occurs, measures should be taken to minimize or compensate for the damage.

The main element in the risk management process is the risk classification, which determines the place of risk and its factors in the overall risk system. The main group risks that are specific to the construction business are presented in Table.

Risk management is based on a range of principles. Thus, when making management decisions in this area of management, it is necessary to follow the given principles: awareness of risk taking, comparability of risks and prospective profitability level, comparability of the probability of threats and the size of associated losses for the enterprise, accounting of the time factor and the overall strategy of the enterprise development.

The principle of awareness implies that the manager taking such decisions must have sufficient substantiation for the implementation of an action involving risk. However, one should take into account the fact that although the evasion/avoidance of risk is an acceptable risk management method, it is impossible to eliminate the risk situations entirely out of the functional activities of

the organization because financial risk is an objective phenomenon affecting many economic operations of the enterprise.

The essence of the principle of comparability of risks and prospective profitability level is directly related to the principle of awareness since the search for the optimal ratio of profit and risk is fundamental in financial management. Therefore, the company can only assume those risks that are compensated by bonuses received as a result of the operation– in another case, the risk is unjustified [9]. However, the process of implementing and using the risk management system is associated with certain difficulties. The main barriers that prevent the most effective use of risk management tools in enterprise management include: insufficient development and effectiveness of the methods used to identify risks, incorrect assessments of threats and uncertainty factors; insufficient information support for risk management; poor quality of the information about risks; low level of communication policy in the company, not adequate enough, actual and complete exchange of information on risks between departments; underdevelopment of the corporate culture of risk

Classification of risk factors in construction industry [9]

Factors		Description
Exogenous	General economic	Changes in currency exchange rate, ruble devaluation, growth of tariffs and prices, increase or decrease of tax rates, investing in the economy, etc.
	Sectoral	Competition in the industry, monopoly in the market, barriers to “entry” to the market, alternative of transition to other industries, cooperation with related industries, low purchasing capacity of contractors, etc.
	Legislative	Changes in the legal framework, arbitration practice, customs policy, logistics policy, licensing policy, protection of the internal market, changes in tax legislation, etc.
	Political	Political instability, military actions, sanctions, etc.
	Social	Strikes, absenteeism of workers, decrease in the general level of education of the population (qualification of employees), decrease in the rhythm of construction operations, etc.
	Ecological	Increase of radiation level, atmospheric pollution, soil pollution, technogenic disasters, accidents, etc.
	Geological	Occurrence of landslides, reservoir overflow (leading to flooding of the surrounding areas), revealing potential sources of deformations that are specific for the given area, etc.
	Climatic	Storm, snowfall, hail, downpour, icy conditions, tornado, etc.
Endogenous	Technological	Admission of failures in the production technology, obsolescence of technologies, incompatibility of technologies, occurrence of unexpected work activities, poor-quality materials, etc.
	Mmanufacturing	Malfunction of equipment, vehicles, mechanisms, poor-quality raw materials, failures of power supply and sanitation systems, failure or production processes stoppage for other reasons, etc.
	Operational	Depreciation of fixed assets, increasing of the number of holders of right to use infrastructure facilities, failure of the contractor to fulfill post-launch warranty obligations, etc.
	Marketing	Weak competitor analysis, failed strategy in the market, variability of demand, problems of the sales network, etc.
	Organizational	Planning and designing errors, shortcomings or coordination failures of work, shortcomings (including breach of obligations) in the design and estimate documentation, design and survey work, problems in the supply of materials (logistics system), etc.
	Innovative	Difficulties in implementing a cheaper method of production, introduction of new computer programmes, usage of new technologies, materials, etc.
	Financial	The choice of an investment object, changes in interest rates, insolvency risk, the possibility of deposit return failure, etc.
	Economic	Sales guarantee, competitiveness, incomplete construction, material and technical supply, reduction of production volumes, decrease in the rhythm of construction operations, distribution of financial resources between construction participants, etc.
	Social and labour	Labor conflicts, staff turnover, quality of working conditions, shortage and difficulties in recruitment of qualified personnel, and complexity of recruitment of qualified labor, untimely improving the skills of employees, etc.
	Specific	Unique features of construction projects, the duration of implementation period of the project, the complexity of technical means, and others

management, low staff and the governing body motivation to the real, but not declarative usage of a risk-based approach.

The implementation of the risk management system requires conditions and readiness the governing body and the staff to apply the programme, which is more contributed by the development of corporate culture in the field of risk management. In order to understand the concepts, we will distinguish the "risk culture" as the main part in the formation of the internal environment of the enterprise, the state of which risk management depends on. At a company, enterprise, or department level, personnel must be prepared to respond to risks and choose the optimal balance of risks and opportunities. In the process of forming the positions and levels of the integrated risk management system, an assessment of the conditions should be carried out taking into account the interests of each group of employees and departments.

When evaluating, it is important to have experienced groups of qualified personnel who support the ideas of risk management, while the management is carried out vertically and horizontally in order to implement the corporate risk management system and reveal the company's potential. A detailed system of incentives and encouragements is important for the staff which determines the motivation of specialists to improve their competencies for risk management. The system includes material support and financial compensation, non-material reward, socially oriented encouragement and career growth promotion.

The creation of a system has a basis in the form of qualitative and complete information support that increases the effectiveness of risk management in the enterprise. As experts point out, the achievement of minimizing, neutralizing and eliminating financial risks in the enterprise depends on the information base of risk management, which provides an indissoluble, purposeful process of selecting appropriate informative indicators for evaluation, identification and preparation of management decisions [10–12]. The initial requirements for the information base of risk management should include consistency, synchronization with the coordination structure of the risk management system; rapidity of obtaining information; completeness and uniqueness of the received data; increase of the information flow from verified sources.

According to the accuracy and regularity of the information received, the specification is based on indicators from external and internal sources of information. In the era of digitalization, the formation of an information system of financial risk management depends on the implementation of automated information technologies for financial management at the enterprise. The detailing and quality of a great amount of relevant information contributes to the accuracy of risk assessment, for which it is important to actively use "big data", which helps to process an unlimited amount of structured and unstructured data of various specifications [13]. The development of risk management based on "big data" is becoming an urgent task for the enterprise. However, despite the noted advantages, a high degree of automation, information technologies in the financial system also increase risks, reducing safety, increasing openness and insecurity in the IT sphere regarding the destructive actions of competitors.

CONCLUSIONS

Thus, we can draw the following conclusions based on our research: the activity of each construction organization is associated with risks: production, organizational, investment, marketing, technology, innovation, sectoral, social and others. In order to react in time and cope with changes in external and internal environment, construction companies must organize a flexible and efficient risk

management system. Important factors of underdevelopment of risk management in Russia are the use of global risk management technologies without taking into account the specifics of the activities of national enterprises, the general low level of risk management culture, the lack of trained personnel in this area, declarative nature of risk management, associated with the lack of real interest in the integration of risk management tools. It seems that the national trends of increasing business risk in the construction industry will act as an incentive to overcome the existing problems of the national risk management and its wide implementation not only in large, but also in medium and small organizations. Nowadays there is a tendency in Russia for increasing business risks in the construction sector and this fact is an incentive to overcome the problems of enterprise risk management in our country and its further development. A huge breakout in this field will be the introduction of risk management in the sphere of small and medium-sized construction business [14–16].

The main directions of risk management development can be "big data" technologies and reporting technologies as obligatory requirements for intrafirm accounting and risk analysis.

REFERENCES

1. Badalova A.G., Panteleyev A.V. *Enterprise Risk Management : Study Guide*. Moscow, University book, 2015. (rus.).
2. Borkovskaya V.G. *Quality management system and risks in construction enterprises*. CITIS. 2018; 2(15):2. (rus.).
3. Burmistrova A.A. *Risk management in construction*. Investment and Innovation Management. 2017; 2:38-43. DOI: 10.14529/iimj170206 (rus.).
4. Vyatskova N.A. *Algorithm for improving the efficiency of an enterprise based on the functioning of a risk management system*. Innovative economics : proceedings of the IV International Scientific Conference (Kazan, October 2017). Kazan, Buk Publ., 2017; 59-66. URL: <https://moluch.ru/conf/econ/archive/262/12983/> (rus.).
5. Grebenshchikov V.S., Grabovyy P.G., Belyakov S.I. *Risks in the investment and construction sector : monograph*. Ministry of Education and Science of the Russian Federation. Federations, National research. Moscow state is building. Univ. m., Publishing House of Moscow State University. builds. unita, 2017; 160. (rus.).
6. Uchayeva T.V., Ivanova D.S., Dukhanina E.V. *Formation of the risk management system at the enterprises of the investment and construction complex*. Regional architecture and construction. 2018; 1(36):190-193. (rus.).
7. Dorokhina E.Yu. *Risk management at small and medium-sized construction enterprises*. Transport Business of Russia. 2018; 1: 88-89. (rus.).
8. Efimenko A.Z., Antonets P.Yu. *Issues of risk management in the construction industry*. Building materials, equipment, technologies of the XXI century. 2016; 1-2(204-205):51-54. (rus.).
9. Zonova O. *Risk management in business activities*. Moscow, LAP Lambert Academic Publishing, 2017. (rus.).
10. Kagan P.B. *Analytical studies of large data arrays in construction*. Industrial and civil construction. 2018; 3:80-84. (rus.).
11. Kiryushkin V.E. *Basics of risk management*. Moscow, Ankil Publ., 2017. (rus.).
12. Krui M., Galai D., Mark R. *Fundamentals of risk management*. Lyubertsy, Yurait Publ., 2017. (rus.).
13. Kudryavtsev A.A. *Integrated Risk Management*. Moscow, Economy Publ., 2018. (rus.).
14. Mamaeva L.N. *Risk Management : Study Guide*. Moscow, Dashkov and K Publ., 2013. (rus.).
15. Sokol I.A. *Risk management in the implementation of investment and construction projects*. University Bulletin (State University of Management). 2017; 11:141-145. DOI: 10.26425/1816-4277-2017-11-141-145 (rus.).
16. Tsvetkova E.A. *Management of economic risks of construction organizations*. Economic Journal. 2017; 2(46):6-19. (rus.).

Особенности развития интегральной системы риск-менеджмента на предприятиях строительной отрасли

Статья посвящена проблеме определения и учета главных свойств в развитии системы риск-менеджмента строительной отрасли. Рассматриваются такие концепции, как риск, классификация рисков, информатизация рисков, основные принципы развития системы риск-менеджмента в работе предприятий, инвестиционных проектов и процессов. Целью статьи является исследование свойств и методов улучшения эффективности деятельности строительных предприятий, основанное на развитии системы риск-менеджмента. Объектом исследования в статье является строительная отрасль и предприятия в России. Предметом исследования является специфика развития системы риск-менеджмента в данной сфере. Методами исследования являются теоретический анализ и эмпирическое исследование, в частности анализ статистических данных, а также описание и группировка данных. Информационной базой для изучения данной проблемы явились литературные источники по вопросам деятельности строительных холдингов в условиях влияния факторов внешней и внутренней среды на процесс разработки их стратегии функционирования и развития, научные статьи, монографии, электронные ресурсы, источники правового характера. Методологической основой при выполнении статьи послужили такие научные методы, как описание, сравнение, классификация.

Ключевые слова: управление, строительный бизнес, предприятие, риск, менеджмент, стратегии риск-менеджмента, внедрение, большие данные

СПИСОК ИСТОЧНИКОВ

1. Бадалова А.Г., Пантелеев А.В. Управление рисками предприятия : уч. пос. М. : Университетская книга, 2015.
2. Борковская В.Г. Система менеджмента качества и риски на строительных предприятиях // ЦИТИСЭ. 2018. № 2 (15). С. 2.
3. Бурмистрова А.А. Управление рисками в строительстве // Инвестиционный и инновационный менеджмент. 2017. № 2. С. 38–43. DOI: 10.14529/iimj170206
4. Вяцкова Н.А. Алгоритм повышения эффективности деятельности предприятия на основе функционирования системы управления рисками // Инновационная экономика : мат. IV Междунар. науч. конф. (г. Казань, октябрь 2017 г.). Казань : Бук, 2017. С. 59–66. URL: <https://moluch.ru/conf/econ/archive/262/12983/>
5. Гребенчиков В.С., Грабовый П.Г., Беляков С.И. Риски в инвестиционно-строительной сфере : монография. М. : Изд-во Моск. гос. строит. ун-та, 2017. 160 с.
6. Учаева Т.В., Иванова Д.С., Духанина Е.В. Формирование системы управления рисками на предприятиях инвестиционно-строительного комплекса // Региональная архитектура и строительство. 2018. № 1 (36). С. 190–193.
7. Дорохина Е.Ю. Управление рисками на малых и средних строительных предприятиях // Транспортное дело России. 2018. № 1. С. 88–89.
8. Ефименко А.З., Антонец П.Ю. Вопросы управления рисками в строительной отрасли // Строительные материалы, оборудование, технологии XXI века. 2016. № 1–2 (204–205). С. 51–54.
9. Зонина О. Управление рисками в предпринимательской деятельности. М. : Академическое издательство LAP Lambert, 2017.
10. Каган П.Б. Аналитические исследования больших массивов данных в строительстве // Промышленное и гражданское строительство. 2018. № 3. С. 80–84.
11. Кирюшкин В.Е. Основы управления рисками. М. : Анкил, 2017.
12. Круи М., Галай Д., Марк Р. Основы управления рисками. Люберцы : Юрайт, 2017.
13. Кудрявцев А.А. Интегрированное управление рисками. М. : Экономика, 2018.
14. Мамаева Л.Н. Управление рисками : уч. пос. М. : Дашков и К, 2013.
15. Сокол И.А. Управление рисками в процессе реализации инвестиционно-строительных проектов // Университетский вестник (Государственный университет управления). 2017. № 11. С. 141–145. DOI: 10.26425/1816-4277-2017-11-141-145
16. Цветкова Е.А. Управление экономическими рисками строительных организаций // Экономический журнал. 2017. № 2 (46). С. 6–19.

Об авторах: **Хрусталеv Борис Борисович** — доктор экономических наук, профессор, заведующий кафедрой экономики, организации и управления производством; **Пензенский государственный университет архитектуры и строительства (ПГУАС)**; 440028, г. Пенза, ул. Германа Титова, д. 28; RINID ID: 468261, Scopus: 56682739600, ResearcherID: AAR-2319-2021, ORCID: 0000-0002-9172-3487; Hrutalev_bb@mail.ru;

Мещерякова Ольга Константиновна — доктор экономических наук, доцент, профессор кафедры технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; Onora@list.ru;

Мещерякова Мария Александровна — доктор экономических наук, доцент, профессор кафедры технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84, Masha0207@mail.ru.

For citation: Khrustalev B.B., Meshcheryakova O.K., Meshcheryakova M.A. Development of integrated risk management system at construction industry enterprises. *Real Estate: Economics, Management*. 2024; 2:42–47.

Для цитирования: Хрусталеv Б.Б., Мещерякова О.К., Мещерякова М.А. Development of integrated risk management system at construction industry enterprises // Недвижимость: экономика, управление. 2024. № 2. С. 42–47.

Izyumov M. D.

Practical aspects of solving the problem of selecting corporate real estate development projects



Izyumov
Maxim Dmitriyevich,

Postgraduate student of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 6927-2156, ORCID: 0000-0003-4741-9821; mizumov@gmail.com

In the modern world, corporate real estate development projects play an important role in business development. The success of the company largely depends on the efficiency of the implementation of these projects. In this paper, the author considers the practical aspects of solving the problem of selecting corporate real estate development projects, with an emphasis on the need for a comprehensive approach to making a decision on project implementation. Various strategies that are used in the process of corporate real estate portfolio management are considered. The diversity of strategies necessitates the formation of a multicomponent list of criteria for solving the problem of selecting development projects implemented in the framework of corporate real estate portfolio management. The author developed a list of criteria that includes three groups of project parameters: financial and economic, environmental and managerial. It is proposed to use social return on investment as a criterion of overall efficiency, which is included in the group of financial and economic criteria, together with capital intensity, scale and total cost of ownership. Environmental criteria take into account such parameters of the real estate object as availability of various certificates, energy efficiency class, as well as implementation of automated building management systems. Management criteria allow assessing the compliance of the project with the general strategy of the corporation, so this group includes such parameters as: commissioning date, project implementation format, as well as provision of space for employees. To make the final decision, the author proposes to use the method of hierarchy analysis, which is widely used in various industries in solving similar problems. The paper presents the methodological basis, as well as a practical example of the application of this method.

Keywords: *project management, corporate real estate development, project selection, portfolio management*

Uninterrupted functioning of enterprises of any type and orientation is impossible without providing the business with resources of various types, one of which is real estate [1].

One of the most important indicators that can be used to assess the effectiveness of a corporate real estate development project is the social return on investment (SROI) [2, 3]. Taking into account the peculiarities of corporate real estate development, strategic aspects of corporate real estate portfolio management, as well as the methodology of SROI assessment, we can distinguish the following groups of criteria that should be taken into account when making a decision on project implementation: financial and economic, environmental, managerial.

The first group of criteria includes primarily such indicators as SROI and TCO, however, in some cases it is possible to apply generally accepted metrics such as NPV, IRR, PI [4, 5]. Application of these metrics is possible in case of realization of a real estate development project aimed at realization of the main activity of the corporation: for a corporation of the banking sector — opening of a new bank branch, for logistics companies — construction of a new warehouse complex, for retailers — construction of new retail premises, etc. Financial and economic criteria can also include the scale of the project and the capital intensity of the project [6]. The scale of the project is determined based on the impact of the project on the regional real estate portfolio and is defined as a share of the total area of the regional project. Accordingly, capital intensity is determined based on the amount of investment required in the project.

The second group of criteria is environmental. In this case, the following parameters are taken into account [7]:

- energy efficiency class of the real estate object;
- availability of certifications and compliance with green building standards;
- availability of energy-saving engineering systems (heating, ventilation);
- availability of automated building management systems;
- use of renewable energy sources in the power supply scheme of the real estate object;
- implementation of systems for separate collection of solid waste in the project;
- availability of systems for water collection and reuse.

Consideration of environmental parameters of a real estate object is important from various aspects. In addition to the obvious positive effect on the environment, the introduction of green technologies allows to reduce operating and utility costs, and positively affects the image of the corporation.

The next group of criteria is managerial. This group first of all includes parameters that allow assessing the compliance of all project characteristics with the current strategy of corporate real estate portfolio management and development. The modern concept of real estate portfolio management is primarily aimed at increasing its value. However, the increase in value can be achieved through various tools and with a focus on certain aspects of the real estate portfolio. In foreign practice,

the following corporate real estate management strategies can be found [8–10]:

- productivity improvement (production process support);
- cost control (production process support);
- reducing environmental impact (sustainability);
- ensuring social and economic sustainability (sustainability support);
- development of the company's brand (support of the company's brand);
- interaction support (support of the production process, support of sustainable development, support of the company's brand);
- improving employee safety (supporting the production process, supporting sustainable development, supporting the company's brand);
- increasing employee satisfaction (supporting the production process, supporting sustainable development, supporting the company's brand);
- risk control (production process support, sustainable development, company brand support);
- increasing flexibility and liquidity (increasing the share of lease agreements, entering into short-term lease agreements);
- promoting innovation (adapting design to realize an innovative workflow).

This diversity of strategies necessitates a careful selection of criteria to determine whether the project under consideration is consistent with the strategy. The minimum required set of management criteria should include the following project parameters:

- class of the real estate object to be created — this parameter

will influence the degree of employee satisfaction and the brand image of the corporation [11];

- staff space availability also affects employee satisfaction [12];
- possible commissioning period — this criterion reflects the relationship with the overall strategy of the corporation;
- impact on the total area of the portfolio — the need for this criterion is due to the fact that the total area of the portfolio is an important indicator of its efficiency, projects should be aimed at achieving the target set by the strategy;
- project implementation format — with a strategy aimed at increasing flexibility, it is preferable to implement projects in build-to-suit format or on leased sites.

In the case of solving the problem of project selection, it is necessary to take into account all the above criteria. For convenience, Table 1 provides a complete list of all criteria and target values of indicators.

With the help of these criteria it is possible to solve one of the most important practical tasks of project portfolio management, namely project selection. The most common way of solving this problem is to use the method of forming a comprehensive assessment based on the construction of a hierarchical structure of the criteria tree or Analytic Hierarchy Process (AHP) [13].

To apply the AHP method, each group of criteria and subsequently each criterion must be given a certain weight. To determine the weight of each group of criteria and criteria within the groups, the method of pairwise comparison and ranking of criteria is applied [14]. The standard scale of criteria evaluation is presented in Table 2.

Table 1. Project selection criteria for the corporate real estate portfolio

Criteria group	Criterion	Target value of the indicator
Financial and economic	SROI	> 1, →max
	TCO, mln rub.	→min
	Capital intensity, mln rub.	→min
	Scale of the project, %	→max
Environmental	Energy efficiency class	A+
	Availability of certifications and compliance with green building standards	Certification of international standards BREEAM, LEED is possible
	Availability of energy-saving engineering systems (heating, ventilation)	The project provides for energy-saving engineering systems
	Availability of automated building management systems	The project includes the installation of a telemetry and remote control system (RTMS)
	Use of renewable energy sources in the power supply scheme of the real estate object, %	→max
	Implementation of systems for separate collection of solid waste in the project	The project envisages and possible realization of
	Availability of systems to reduce water consumption	The project envisages and possible realization of
Managerial	Class of the object to be created	A+
	Provision of staff with space	For offices — 10 sq. m/person
	Possible commissioning date	→min
	Impact on total portfolio area, sq. m	→max
	Project implementation format	Consistent with the strategy

Source: compiled by the author.

Table 2. Fundamental scale for pairwise comparisons of criteria

Degree of significance	Determination
1	Equal weighting of criteria
3	One criterion is slightly more important than the other
5	One criterion is significantly more important than the other
7	One criterion is indisputably more important than the other, confirmed not only by expert judgment but also in practice
9	One criterion is absolutely more important than the other

Source: compiled by the author on materials [15].

Table 3. Ranking of criteria groups

Criteria group	Financial and economic	Managerial	Environmental
Financial and economic	1	1	7
Managerial	1	1	5
Environmental	0.14	0.2	1

Source: compiled by the author.

Accordingly, it is initially necessary to determine the weights of each of the groups of criteria to form a comprehensive assessment. The ranking of the groups of criteria is presented in Table 3. According to the AHP method, the total sum of values of all criteria corresponds to one, the weight of each group is determined based on the ranking.

Next, the quotient of each value in the table from the sum of numbers in the column is determined. After that, the arithmetic mean of each row is determined. The final results of determining the weights of each group of criteria are presented in Table 4.

Similarly, within each group of criteria, the weights of the criteria themselves are determined. The results of determining the weights for all criteria are presented in Table 5.

Further, for each criterion it is necessary to provide a scale on which projects will be evaluated. The scale developed by the author is presented in Table 6.

According to the analytical hierarchical process method, the project that has the maximum score for all criteria will have the highest overall rating. Let us apply this scale to compare the previously considered project for the creation of a technology hub in Yekaterinburg, which will be labeled as project A, and

Table 4. Total weight of each group of criteria

Criteria group	Financial and economic	Managerial	Environmental	Weight
Financial and economic	$1/(1 + 1 + 0.14) = 0.47$	$1/(1 + 1 + 0.2) = 0.45$	$7/(7 + 5 + 1) = 0.54$	0.487
Managerial	$1/(1 + 1 + 0.14) = 0.47$	$1/(1 + 1 + 0.2) = 0.45$	$5/(7 + 5 + 1) = 0.38$	0.435
Environmental	$0.14/(1 + 1 + 0.14) = 0.07$	$0.2/(1 + 1 + 0.2) = 0.09$	$1/(7 + 5 + 1) = 0.08$	0.078

Source: compiled by the author.

Table 5. Final weights of each of the criteria groups

Criteria group	Weight of the criteria group	Criteria	Weight of criteria, within the group
Financial and economic	0.487	SROI	0.56
		TCO, mln rub.	0.23
		Capital intensity, mln rub.	0.15
		Scale of the project, %	0.06
Managerial	0.435	Class of the object to be created	0.07
		Provision of staff with space	0.46
		Possible commissioning date	0.24
		Impact on the total portfolio area	0.10
		Project implementation format	0.13
Environmental	0.078	Energy efficiency class	0.21
		Availability of certifications and compliance with green building standards	0.05
		Availability of energy-saving engineering systems (heating, ventilation)	0.17
		Availability of automated building management systems	0.24
		Use of renewable energy sources in the power supply scheme of the real estate, %	0.22
		Implementation of systems for separate collection of solid waste in the project	0.06
		Availability of systems to reduce water consumption	0.06

Source: compiled by the author.

the project for the creation of a technology hub in St. Petersburg, which will be labeled as project B. The evaluations of the projects under consideration are presented in Table 7.

The final rating of each project is obtained after summing up the product of each of the scores by the respective weights of the criteria and criterion groups. The results of the rating calculation are summarized in Table 8.

Thus, the results of the assessment indicate that, according to the totality of all criteria, Project A is the most attractive for implementation.

Table 6. Scale for assessing corporate real estate development projects

Criterion	Score				
	1	3	5	7	9
SROI	Less than 0.8	0.9	1	1.2	More than 1.5
TCO, mln rub.	The difference is more than 30 %	The difference is less than 30 %	The difference is less than 20 %	The difference is less than 10 %	The lowest among all projects
Capital intensity, mln rub.	The difference is more than 30 %	The difference is less than 30 %	The difference is less than 20 %	The difference is less than 10 %	The lowest among all projects
Scale of the project, %	Less than 1 %	3 %	5 %	7 %	10 % or more
Energy efficiency class	E and below	D	C	B	A and above
Availability of certifications and compliance with green building standards	Certification is not possible	Certification according to Russian standards is possible when changes are made to the object	Certification according to Russian standards is possible without changes to the object	Certification according to international standards is possible when modifications are made to the facility	It is possible to certify to international standards without modifying the facility
Availability of energy-saving engineering systems	The project does not provide for energy-saving engineering systems	The project includes one of the energy efficient engineering systems: • heating; • ventilation; • power supply; • conditioning	The project includes two energy-efficient utility systems: • heating; • ventilation; • power supply; • conditioning	The project includes three energy-efficient utility systems: • heating; • ventilation; • power supply; • conditioning	The project provides for all types of energy-saving engineering systems: • heating; • ventilation; • power supply; • conditioning
Availability of automated building management systems	Not foreseen by the project	–	A dispatching system is provided	–	Provision is made for the installation of a comprehensive STDU
Use of renewable energy sources in the power supply scheme of the real estate object, %	0 %	Less than 1 %	1 to 3 %	3 to 5 %	More than 5 %
Implementation of systems for separate collection of solid waste in the project	Separate collection of TCO is not envisaged	Provision for a two-stream system for the collection of solid waste	A three-stream system for the collection of solid waste is envisaged	A four-stream system for the collection of MSW is envisaged	A five-stream system for the collection of solid waste is envisaged
Availability of systems to reduce water consumption	Not foreseen	–	Use of metered water supply systems and water saving devices (aerators, batch faucets, infrared sensors, automatic faucets)	–	Provision is made for water collection and reuse systems
Class of the object to be created	C	B	B+	A	A+
Provision of staff with space	Less than 8 sq. m/person	9 sq. m/person	10 sq. m/person	11 sq. m/person	Over 11 sq. m/person
Possible commissioning date	More than 3 years	3 years	2 years	1 year	Less than 1 year
Impact on total portfolio area, sq. m	Up to 1,000 m ²	1,000 m ²	10,000 m ²	50,000 m ²	More than 50,000 m ²
Project implementation format	Not in line with the strategy	–	Not taken into account by the strategy	–	Consistent with the strategy

Source: compiled by the author.

Table 7. Estimates of projects A and B under consideration

Criterion	Project A		Project B	
	Value	Score	Value	Score
SROI	1.221	5	1.1	5
TCO, mln rub.	5,303	9	7,386	1
Capital intensity, mln rub.	1,100	9	1,300	5
Scale of the project, %	5 %	3	6 %	5
Energy efficiency class	A	9	A	9
Availability of certifications and compliance with green building standards	GREEN ZOOM certificate	5	No	1
Availability of energy-saving engineering systems (heating, ventilation, power supply, air conditioning)	All types of systems	9	All types of systems	9
Availability of automated building management systems	STDU installation	9	STDU installation	9
Use of renewable energy sources in the power supply scheme of the real estate object, %	Not foreseen	1	Not foreseen	1
Implementation of systems for separate collection of solid waste in the project	Three-stream collection system	5	Three-stream collection system	5
Availability of systems to reduce water consumption	Use of metered water supply systems and water saving devices	5	Use of metered water supply systems and water saving devices	5
Class of the object to be created	A	7	B+	5
Provision of staff with space	10.3 sq. m/person	5	11.8 sq. m/person	9
Possible commissioning date	1 year	7	1.5 years	5
Impact on total portfolio area, sq. m	27,800	5	26,000	5
Project implementation format	Build-to-suit is in line with the strategy	9	Build-to-suit is in line with the strategy	9

Source: compiled by the author.

Table 8. Results of calculating the final rating of projects

Project	Project A	Project B
Final score	6.31	5.70

Source: compiled by the author.

REFERENCES

1. Izyumov M.D. The role of development activity in the structure of corporation management. *First Economic Journal*. 2023; 12(342):18-24. DOI: 10.58551/20728115_2023_12_18 (rus.).

2. Kuznetsova S.V. Problems of evaluation of social results and effects of activity of social preparations. *Moscow Economic Journal*. 2021; 3. URL: <https://cyberleninka.ru/article/n/problemy-otsenki-sotsialnyh-rezultatov-i-effektov-deyatelnosti-sotsialnyh-predpriyatiy> (date of address: 21.04.2024). DOI: 10.24412/2413-046X-2021-10185 (rus.).

3. Izyumov M.D. Evaluation of the economic efficiency of corporate real estate ownership taking into account the development stage. *Russian Economic Internet Journal*. 2023; 4. (rus.).

4. Akhmedova T.M. Kizi. Investment projects in the neftegas-effecting industry and their characterical features. *Criteria for Evaluating*. 2021; 15(5):2201-2226. URL: <https://cyberleninka.ru/article/n/kriterii-otsenki-investitsionnyh-proektov-v-neftegazodobyvayuschey-promyshlennosti-i-ih-harakternye-osobennosti> (date of access: 21.04.2024). DOI: 10.18334/ce.15.5.112089 (rus.).

5. Orlov A.I. In what cases can the economic evaluation of efficiency of investment project? *Scientific Journal of KubGAU*. 2022; 180.

URL: <https://cyberleninka.ru/article/n/v-kakih-sluchayah-mozhno-dat-ekonomicheskuyu-otsenku-effektivnosti-investitsionnogo-proekta> (date of address: 21.04.2024). (rus.).

6. Dolgov M.A., Kruglyakova V.M. Development in construction as a form of investment activity in the real estate market. *Vestnik VSU. Series: Economics and Management*. 2020; 4. URL: <https://cyberleninka.ru/article/n/development-v-stroitelstve-kak-forma-investitsionnoy-deyatelnosti-na-rynke-nedvizhimosti> (date of address: 25.04.2024). DOI: 10.17308/econ.2020.4/3193 (rus.).

7. Dobrovolskienė N., Pozniak A., Tvaronavičienė M. Assessment of the sustainability of a real estate project using multi-criteria decision making. *Sustainability*. 2021; 13(7). DOI: 10.3390/su13084352

8. Ristaniemi E., Lindholm A. Added value of corporate real estate management in industrial premises. *ERES eres2011_134*, European Real Estate Society (ERES). 2011. URL: <https://eres.architexturez.net/doc/oai-eres-id-eres2011-134> (access date: 26.02.2024).

9. Lindholm A.-L., Gibler K., Levänen K. Modeling the value-adding attributes of real estate to the wealth maximization of the firm. *Journal of Real Estate Research*. 2006; 23(4):445-476. DOI: 10.1080/10835547.2006.12091187

10. Appel-Meulenbroek R., Haynes V.R. An overview of steps and tools for the corporate real estate strategy alignment process. *Corporate Real Estate Journal*. 2014; 4(1):44-61.

11. Feshchenko A.A. Development of strategy of management of corporate real estate portfolio of a bank as a profit centre (example of Sberbank PJSC). *Property relations in the Russian Federation*. 2021; 8(239). URL: <https://cyberleninka.ru/article/n/razvitie-strategii-upravleniya-portfelem-korporativnoy-nedvizhimosti-banka-kak-profit-tsentrom-na-primere-pao-sberbank> (date of reference: 25.04.2024). DOI: 10.24412/2072-40-98-2021-8-66-74 (rus.).

12. Volk S.A., Gorshkov D.A. Actual problems in the sphere of state office real estate management. Property relations in the Russian Federation. 2010; 3(102):29-44. (rus.).
13. Zubova T.N., Melnikov B.F., Soldatov A.A. Mathematical modeling of organization management by value orientations: algorithms of hierarchy analysis based on the quantitative significance of criteria. International Journal of Open Information Technologies. 2019; 7(8):1-8. URL: [https://](https://cyberleninka.ru/article/n/matematiceskoe-modelirovanie-upravleniya-organizatsiy-po-tsennostnym-orientiram-algoritmy-analiza-ierarhiy-na-osnove)

- cyberleninka.ru/article/n/matematiceskoe-modelirovanie-upravleniya-organizatsiy-po-tsennostnym-orientiram-algoritmy-analiza-ierarhiy-na-osnove (date of access: 10.02.2024). (rus.).
14. Saaty T. Decision making with the Analytic Hierarchy Process. International Journal of Services Sciences. 2008; 1(1):83-98.
15. Saaty T. The analytic hierarchy process: planning, priority setting, resource allocation. McGraw-Hill International Book Company, 1980; 287.

Практические аспекты решения задачи селекции корпоративных девелоперских проектов

В современном мире корпоративные девелоперские проекты играют важную роль в развитии бизнеса. От эффективности реализации этих проектов во многом зависит успех компании. Автором рассмотрены практические аспекты решения задачи селекции корпоративных девелоперских проектов с акцентом на необходимость комплексного подхода к принятию решения о реализации проекта.

Рассмотрены различные стратегии, которые применяются в процессе управления портфелем корпоративной недвижимости. Многообразие стратегий обуславливает необходимость формирования многосоставного перечня критериев для решения задачи селекции проектов девелопмента, реализуемых в рамках управления портфелем корпоративной недвижимости. Разработан перечень критериев, включающий в себя три группы параметров проектов: финансово-экономические, экологические и управленческие. В качестве критерия общей эффективности предлагается использовать социальный возврат на инвестиции, который входит в группу финансово-экономических критериев, совместно с капиталоемкостью, масштабностью и совокупной стоимостью владения. Экологические критерии учитывают такие параметры объекта недвижимости, как наличие различных сертификатов, класс энергоэффективности, а также внедрение автоматизированных систем управления зданием. Управленческие критерии позволяют оценить соответствие проекта общей стратегии корпорации, поэтому в данную группу входят такие параметры, как: срок ввода в эксплуатацию, формат реализации проекта, а также обеспеченность сотрудников площадью.

Для принятия итогового решения автором предлагается использовать метод анализа иерархий, широко применяемый в различных отраслях при решении подобных задач. Представлены методические основы, а также практический пример применения данного метода.

Ключевые слова: управление проектами, девелопмент корпоративной недвижимости, селекция проектов, управление портфелем

СПИСОК ИСТОЧНИКОВ

1. Изюмов М.Д. Роль девелоперской деятельности в структуре управления корпорацией // Первый экономический журнал. 2023. № 12 (342). С. 18–24. DOI: 10.58551/20728115_2023_12_18
2. Кузнецова С.В. Проблемы оценки социальных результатов и эффектов деятельности социальных предприятий // Московский экономический журнал. 2021. № 3. URL: <https://cyberleninka.ru/article/n/problemy-otsenki-sotsialnyh-rezultatov-i-effektov-deyatelnosti-sotsialnyh-predpriyatii> (дата обращения: 21.04.2024). DOI: 10.24412/2413-046X-2021-10185
3. Изюмов М.Д. Оценка экономической эффективности владения корпоративной недвижимостью с учетом этапа девелопмента // Российский экономический интернет-журнал. 2023. № 4.
4. Ахмедова Т.М. Кызы. Критерии оценки инвестиционных проектов в нефтегазодобывающей промышленности и их характерные особенности // Креативная экономика. 2021. Т. 15. № 5. С. 2201–2226. URL: <https://cyberleninka.ru/article/n/kriterii-otsenki-investitsionnyh-proektov-v-neftegazodobyvayushey-promyshlennosti-i-ih-harakternye-osobennosti> (дата обращения: 21.04.2024). DOI: 10.18334/ce.15.5.112089
5. Орлов А.И. В каких случаях можно дать экономическую оценку эффективности инвестиционного проекта? // Научный журнал

КубГАУ. 2022. № 180. URL: <https://cyberleninka.ru/article/n/v-kakih-sluchayah-mozhno-dat-ekonomicheskuyu-otsenku-effektivnosti-investitsionnogo-proekta> (дата обращения: 21.04.2024).

6. Долгов М.А., Круглякова В.М. Девелопмент в строительстве как форма инвестиционной деятельности на рынке недвижимости // Вестник ВГУ. Серия: Экономика и управление. 2020. № 4. URL: <https://cyberleninka.ru/article/n/development-v-stroitelstve-kak-forma-investitsionnoy-deyatelnosti-na-rynke-nedvizhimosti> (дата обращения: 25.04.2024). DOI: 10.17308/econ.2020.4/3193
7. Dobrovolskienė N., Pozniak A., Tvaronavičienė M. Assessment of the sustainability of a real estate project using multi-criteria decision making // Sustainability. 2021. Vol. 13. Issue 8. DOI: 10.3390/su13084352
8. Ristaniemi E., Lindholm A. Added value of corporate real estate management in industrial premises. ERES eres2011_134, European Real Estate Society (ERES). 2011. URL: <https://eres.architecture.net/doc/oai-eres-id-eres2011-134> (дата обращения: 26.02.2024).
9. Lindholm A.-L., Gibler K., Levainen K. Modeling the value-adding attributes of real estate to the wealth maximization of the firm // Journal of Real Estate Research. 2006. Vol. 28. No. 4. Pp. 445–476. DOI: 10.1080/10835547.2006.12091187
10. Appel-Meulenbroek R., Haynes B.P. An overview of steps and tools for the Corporate Real Estate strategy alignment process // Corporate Real Estate Journal. 2014. Vol. 4 (1). Pp. 44–61.
11. Фещенко А.А. Развитие стратегии управления портфелем корпоративной недвижимости банка как профит-центром (на примере ПАО «Сбербанк») // Имущественные отношения в РФ. 2021. № 8 (239). URL: <https://cyberleninka.ru/article/n/razvitiye-strategii-upravleniya-portfelem-korporativnoy-nedvizhimosti-banka-kak-profit-tsentrom-na-primere-pao-sberbank> (дата обращения: 25.04.2024). DOI: 10.24412/2072-40-98-2021-8-66-74
12. Волк С.А., Горшков Д.А. Актуальные проблемы в сфере управления государственной офисной недвижимостью // Имущественные отношения в Российской Федерации. 2010. № 3 (102). С. 29–44.
13. Zubova T.N., Melnikov B.F., Soldatov A.A. Математическое моделирование управления организацией по ценностным ориентирам: алгоритмы анализа иерархий на основе количественной значимости критериев // International Journal of Open Information Technologies. 2019. Т. 7. № 8. С. 1–8. URL: <https://cyberleninka.ru/article/n/matematiceskoe-modelirovanie-upravleniya-organizatsiy-po-tsennostnym-orientiram-algoritmy-analiza-ierarhiy-na-osnove> (дата обращения: 10.02.2024).
14. Saaty T. Decision making with the analytic hierarchy process // International Journal of Services Sciences. 2008. Vol. 1. No 1. Pp. 83–98.
15. Saaty T. The analytic hierarchy process: planning, priority setting, resource allocation. McGraw-Hill International Book Company, 1980. 287 p.

Об авторе: **Изюмов Максим Дмитриевич** — аспирант кафедры организации строительства и управление недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 6927-2156, ORCID: 0000-0003-4741-9821; mizumov@gmail.com.

For citation: Izumov M.D. Practical aspects of solving the problem of selecting corporate real estate development projects. Real Estate: Economics, Management. 2024; 2:48-53.

Для цитирования: Изюмов М.Д. Practical aspects of solving the problem of selecting corporate real estate development projects // Недвижимость: экономика, управление. 2024. № 2. С. 48–53.

Abdalov R.E.



Abdalov Roman Evgenyevich,
Postgraduate student of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RSCI: 1226983, ORCID: 0009-0006-2366-6392; abdalov.roman@yandex.ru

Management of the pre-project stage of an investment and construction project: aspects of the implementation of normative and methodological support for the activities of organizations

The scientific paper highlights the issue of the current level of development of technical regulation in construction, in particular, regulation of the pre-project stage of an investment and construction project (ICP). In recent years, the concept of managing the life cycle of a real estate object has become firmly entrenched in investment and construction activities, implying a focus on managing each state of the system — from the idea to the liquidation of the object. However, in practice, construction projects participants manage the pre-project stage of ICP without due attention and responsibility. The author emphasizes that the neglect of the work of the pre-project phase is caused by a number of reasons, one of which is the lack of understanding of the structure and content of the pre-project phase and awareness of the possible benefits of its results. It is assumed that regulatory support could act as a theoretical basis and assist ICP entities in real conditions. To assess the assumption, an analysis of the system of the domestic regulatory framework was carried out and content elements were identified that will be useful in the implementation of the pre-project stage of ICP. According to the results of the analysis, it turned out that the regulatory support of the pre-project phase of ICP is imperfect in the lens of the current stage of the evolution of the construction industry. Today, the development of a universal mechanism for regulating the pre-project stage of ICP is difficult to implement, since we are surrounded by a huge variety of diverse and completely dissimilar buildings and structures. The author proposes the introduction of normative and methodological support (NMS) at the organizational level, based on already established norms and rules, available methods and practical recommendations and developed corporate mechanisms. To form the organizations of the construction industry their own model for conducting the pre-project stage of ICP, the author has developed a pyramid of NMS properties, which clearly reflects the basic principles that documents and information used by ICP participants in practice should have. Taking into account the vectors of development of the construction sector and the Russian national economy, the proposed author's initiative is able to have a comprehensive positive effect.

Keywords: *pre-project stage of an investment and construction project, management of the pre-project stage, normative and methodological support, technical regulation, competitiveness of organizations*

In the context of the decomposition of the life cycle, the initial phase of an investment and construction project (ICP) is the pre-project stage, which is a systematic set of measures and procedures, the main purpose of which is to assess the viability of the project and form a reliable basis for it [1, 2]. In order to achieve this goal, a large amount of labour and resource-intensive research, analytical, evaluation, and often creative work is carried out [3, 4]. Taking into account the main features of construction products (stationarity and continuity with the earth, long duration of the production cycle, large-scale level of material consumption and high cost of finished products) and the internal and external circumstances affecting it, important tasks are to determine the optimal composition of pre-project works, strict control of the timeliness and quality of their implementation, awareness of the expediency and importance of each individual the pre-project process, a judicious assessment of the results of the pre-project stage and planning of their application in the next steps.

To date, great attention and interest are paid to the processes of design and survey work, construction and operation groups, promising horizons for their improvement are constantly being explored and progressive reforms are regularly introduced to achieve national, regional and sectoral goals and objectives. The pre-project stage often suffers from a lack of attention from players in the investment

and construction industry, especially in the focus of commercial projects where investments are the own funds of a private investor (individual or legal entity). As a rule, the pre-project stage for participants in commercial construction projects is limited to a block of not always interconnected operations devoid of logical sequence and extremely limited in time and resources — chaotic market analysis, superficial assessment of the land plot, approximate calculation of technical and economic indicators, formation of an architectural sketch of the future object, disorganized collection of title and initial permits. The key problem points causing the disorder of the pre-project phase system are:

- the desire of stakeholders to minimize the loss of financial, labour and time resources;
- the lack of understanding among the project participants of the structure and content of the work of the pre-project stage and the possible profit from its final results;
- the absence or inconsistency of the company's project management mechanisms and tools with the modern challenges of the national economy (low level of business process development, low professional qualifications of full-time employees).

Ultimately, each of these factors characterizes a low level of managerial, economic, financial and

production-technical approaches at the pre-project stage, which entails a qualitative degradation of the results of subsequent stages and the project as a whole in the long term, and subsequently a decrease in competitiveness in the market. Otherwise, with competent management of pre-project operations, budget savings at each subsequent stage after the pre-project stage can amount to about 20 % [5]. In order to avoid obtaining the results of the low-quality pre-project stage, a meaningful and rational use by ICP participants of effective tools for the implementation of the pre-project stage of the ICP life cycle is required.

Regulatory support, which is one of the most important means of achieving planned results in construction, can act as a reliable mechanism for creating a solid theoretical arsenal and a true guideline for the implementation of pre-project works [6]. In the organizational activity of ICP management, normative regulation occupies an integral part and, mainly, determines the features of management decisions, regulates the provisions on certain types of work and processes within the life cycle of a real estate object, requirements for used building materials, structures, buildings and structures [7–9]. The great importance of normative regulation for the construction complex of the Russian Federation is confirmed by the multifaceted administration and constant monitoring by state regulators, as well as the systematic development of special measures for the qualitative transformation of the regulatory block. The Strategy for the development of the construction industry and housing and communal services of the Russian Federation for the period until 2030 with a forecast until 2035, adopted at the end of 2022, presents a package of initiatives for the transformation of technical regulation, aimed at comprehensive improvement of the construction sector and the country's economy as a whole [10, 11]. The list reflects the following target vectors: reduction of administrative and bureaucratic burden and elimination of contradictions between separate documents; elimination of redundant regulatory documents and updating of existing requirements and provisions; formation of an advanced system of regulatory documentation for innovative and energy-efficient solutions in construction.

To assess the situation with regulatory support in the context of the ICP pre-project stage, a systematic review of legal acts, technical standards and methodological documentation in force in Russia was carried out. After analyzing the domestic regulatory system, a selection of documents was made, that reflect the provisions on individual procedures and processes [12–18], affecting the pre-project stage of ICP and potentially being, in the author's opinion, the supporting elements for the formation of algorithms, approaches and methods of pre-project study by project participants in modern practice:

1. Urban Planning Code of the Russian Federation (Federal Law No. 190-FZ of 12/29/2004).
2. Land Code of the Russian Federation (Federal Law No. 136-FZ of 10/25/2001).
3. GOST R 57363–2023. Project management in construction. Activity of the project manager (technical customer).
4. GOST R 71177–2023. Managing large construction projects using integrated contracts.
5. GOST R 58917–2021. Technological engineering and design. Feasibility study of the investment project of an industrial facility. General requirements.
6. CP 11-101–95. The procedure for the development, coordination, approval and composition of justifications for investments in the construction of enterprises, buildings and structures.
7. MRR 2.2.16–00. Recommendations on the organization and conduct of marketing research before the development of pre-project

and project documentation in order to determine the commercial effectiveness of the territory.

After a detailed analysis, the received information was aggregated and a summary table was formed, the main purpose of which is to assess the significance of documents and their individual provisions for applied use in investment and construction activities (Table).

The study of this issue has shown that at the moment there is a number of imperfections in the regulatory support of the pre-project stage of ICP that require updating and rationalization, among which:

- the concept of “pre-project stage” is absent in regulatory documents, and the definition of the term “pre-project preparation of construction” as close as possible to it in meaning (according to clause 3.3 of GOST R 57363–2023 this is a set of works carried out in order to substantiate urban planning activities in the territory, and obtaining the right to carry it out) does not reveal the actual essence of ICP pre-project works in full;
- there is no common understanding of the structure and content of the pre-project stage in regulatory resources, which causes disagreements and misunderstandings among the parties in practical terms among members of the scientific community, experts and participants in the investment and construction sector;
- there is no single document containing the main, most complete and standard requirements and provisions for the implementation of the pre-project stage of the ICP (for example, as Decree of the Government of the Russian Federation No. 87 of 02/16/2008 “The composition of sections of project documentation and requirements for their content” for design work);
- a series of current regulations and methodological recommendations are outdated and no longer meet the modern challenges of socio-economic, scientific and technological development of the Russian Federation, in particular the current realities of the digital economy, the evolutionary level of the construction industry and the relevant criteria for the competitiveness of companies in the investment and construction sector.

Adherence to strategic planning documents and the implementation of national projects and state programmes of the Russian Federation contributes to the systematic recovery of the national economy from recession and the achievement of target indicators in the next 5–7 years. Experts consider the urgent need to develop an ICP life cycle management system to be an important issue in the construction segment of the economy. As one of the solutions to this issue, motivated proposals are put forward to create uniform rules for the implementation of ICP, taking into account the digital transformation of construction, effective project management tools and the introduction of process and product innovations [19]. In the future, this consideration can be successfully integrated into the reform being developed to improve the regulatory block, especially from the perspective of the two initiatives most actively discussed by the industry regulator and the professional community — optimization of technical regulation and the transition from a prescriptive method of rationing to a parametric one [9, 10]. The fulfillment of both tasks entails the creation of the latest principles of “seamless” management of the ICP life cycle and each stage separately.

As it turned out earlier in this study, the regulation of the pre-project stage of ICP has a number of specific problems. On the other hand, it is not possible to develop a universal mechanism that will

► *Analysis of the significance of regulatory documents for the pre-project stage*

Name of the document	The relevance of the action (as of March 1, 2024)	Useful components for the ICP pre-project stage	Scope of application in the pre-project stage of ICP
Urban Planning Code of the Russian Federation (Federal Law No. 190-FZ of 12/29/2004)	Valid (last updated in February 2024)	+ regulations on the preparation and approval of territorial planning documents; + regulations on the preparation and approval of standards for urban planning design; + regulations on the preparation and coordination of land use and development rules; + regulations on territorial zones, urban planning regulations, types of permitted use of land plots and capital construction buildings; + requirements for documentation on territory planning (territory planning project, territory surveying project)	1. Primary audit of the land plot. 2. "Best Use" analysis for a land plot. 3. Assessment of the urban development potential of the territory. 4. Feasibility study. 5. Creating a concept / draft design
Land Code of the Russian Federation (Federal Law No. 136-FZ of 10/25/2001)	Valid (last updated in February 2024)	+ regulations on land registration; + provisions on comprehensive aspects of land use; + provisions on property and legal relations regarding land plots; + regulations on supervision and land protection	1. Primary audit of the land plot. 2. "Best Use" analysis for a land plot. 3. Assessment of the urban development potential of the territory
GOST R 57363–2023. Project management in construction. Activity of the project manager (technical customer)	Valid (last updated in September 2023)	+ definition of the term "pre-project preparation of construction"; + presentation of the pre-project stage by the stages of initiation and planning; + theoretical provisions on the composition and content of the stages of project initiation and planning	1. Project analysis. 2. Project management and its individual elements
GOST R 71177–2023. Managing large construction projects using integrated contracts	Valid (last updated in January 2024)	+ presentation of the pre-project stage by stages of initiation, evaluation, selection and definition; + provisions on the composition and content of the stages of initiation, evaluation, selection and determination for large construction projects with integrated EPC-contracts; + presentation of tasks, key results, decisions taken and areas of responsibility of project participants within the stages of initiation, evaluation, selection and definition for large construction projects with integrated EPC-contracts	1. Project analysis. 2. Project management and its individual elements
GOST R 58917–2021. Technological engineering and design. Feasibility study of the investment project of an industrial facility. General requirements	Valid (last updated in January 2022)	+ provisions on the procedure for the preparation, composition, content and functional purpose of project documents developed for the purpose of feasibility studies of industrial facilities	1. Feasibility study. 2. The investment plan. 3. Preparation of a business plan. 4. Justification of investments
CP 11-101–95. The procedure for the development, coordination, approval and composition of justifications for investments in the construction of enterprises, buildings and structures	Not valid	+ the procedure for preparation and approval, as well as the composition and content of documentation on the justification of investments; + templates for calculation and analytical tables to justify investments	1. Feasibility study. 2. The investment plan. 3. Preparation of a business plan. 4. Justification of investments
MRR 2.2.16–00. Recommendations on the organization and conduct of marketing research before the development of pre-project and project documentation in order to determine the commercial effectiveness of the territory	Valid (last updated in November 1999)	+ conditions and procedure for the preparation and conduct of pre-project marketing research; + background information and templates for conducting marketing research	1. Pre-project marketing research. 2. Creating a marketing strategy. 3. Preparation of a business plan

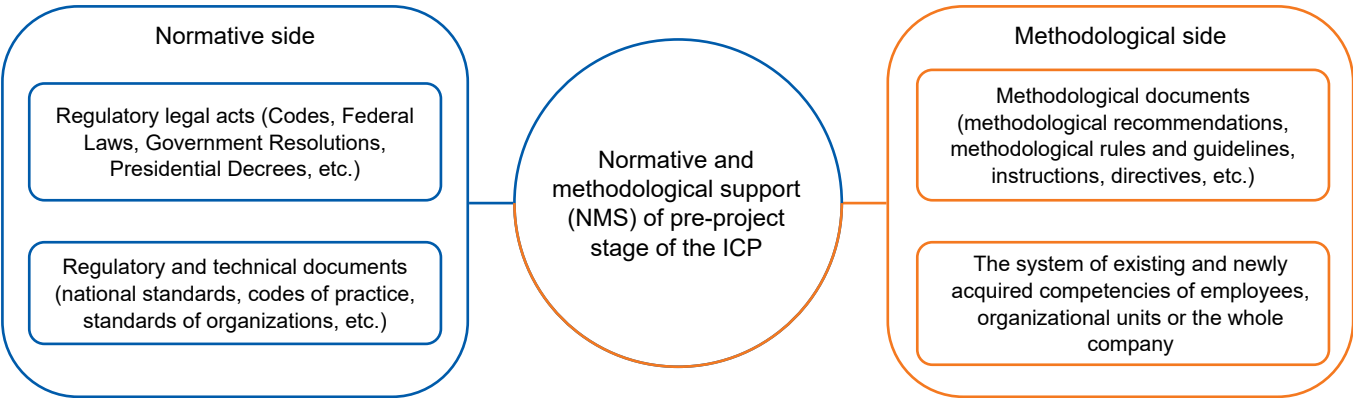


Fig. 1. The content of normative and methodological support for the pre-project stage of the ICP (developed by the author)

standardize the requirements for the links of the ICP pre-project stage due to the rich variety of real estate objects, their individual attributes and the specifics of each individual project. Based on the above, it is proposed to implement the most appropriate means of technical regulation for the pre–project stage and to assist participants in the successful implementation of the ICP, maintaining a balance between fixed directives and practical recommendations based on real experience — normative and methodological support (NMS). The concept of “normative and methodological support” is interpreted by the author as an interconnected set of regulatory requirements and methodological guidelines that regulate and describe the specifics of the execution of work processes and aimed at achieving design, tactical and strategic goals as desired end results (Fig. 1).

In fact, the normative and methodological support in the pre-project stage of ICP is a structured resource synthesizing a large set of requirements, instructions and useful reference and recommendation information and aimed at the effectiveness of processes within the pre-project stage of ICP [20, 21]. Each organization in the construction industry, which has a direct or indirect connection with pre-project work, independently forms its own NMS platform in accordance with established short-term business goals and long-term corporate mission. As a fundamental model reflecting

the inherent content of the NMS system and recommended for use as a basis for building a policy for conducting the pre-project stage, a pyramid of properties of normative and methodological support for the pre-project ICP stage is presented (Fig. 2).

The pyramid, which is a template for managing the pre–project stage of ICP by its functional purpose, is based on two principles — theoretical and ideological maturity (theoretical beginning) and adaptability to project conditions (practical beginning).

1. Theoretical and ideological maturity is characterized by the fact that various kinds of documentation or information used by ICP participants during operations within the framework of the ICP pre-project stage should have its own established theoretical basis. This principle consists of three properties that normative and methodological support should have — thoroughness, relevance and innovation.

The thoroughness is determined by the presence of mandatory fundamental justifications for the applied standards and methods, formed on the basis of scientific and practical achievements and experiences of previous years. Such documents that have been developed by government agencies, associations, expert groups or individual scientists and industry specialists, as well as scientific papers, author’s manuals and notes approved by authorized at-testation commissions, have thoroughness.

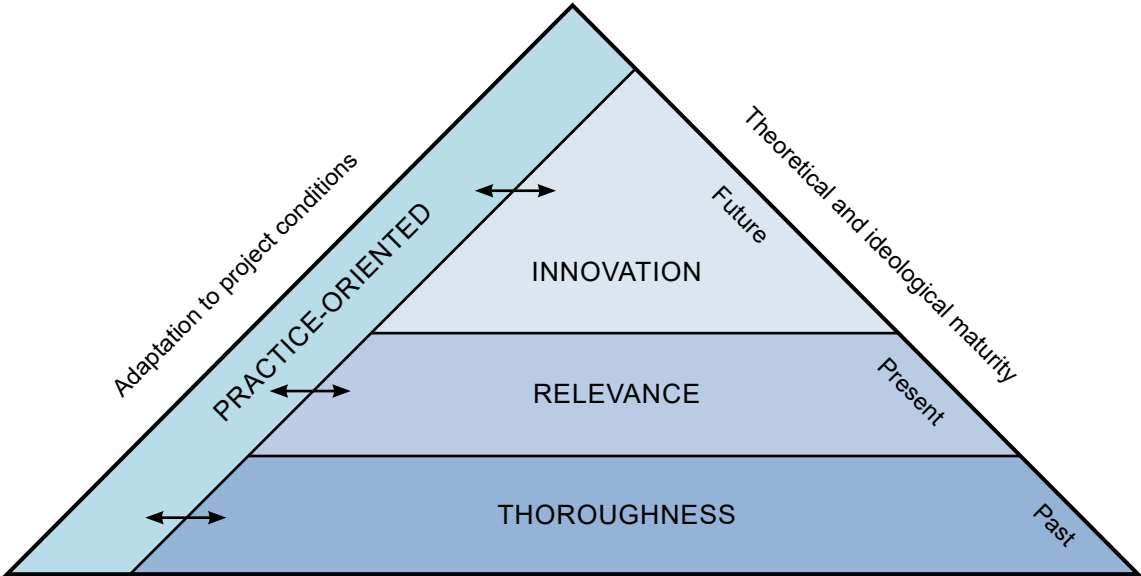


Fig. 2. Pyramid of properties of normative and methodological support for the pre-project stage of the ICP (developed by the author)

The relevance translates the condition according to which the information that is accessed during the implementation of the pre-project phase must be substantive, meeting both the current officially established rules and the all-encompassing needs of the present time.

The innovation in the presented model is expressed as a property in which the information materials used contain the potential for the development of innovative solutions based on them in the near future in the interests of investment and construction activities and its surrounding areas.

2. The principle of adaptability to project conditions is embedded in the NMS property model, since the issue of compliance of the provisions of regulatory acts with the actual construction picture with all its features seems significant. The property responsible for adaptability to design conditions in the focus of pre-project work is practice-oriented. Practice-oriented approach can be defined as functional flexibility, conflict-free perception of ongoing changes and transformation under them. In practice, this implies that, under the control of ICP subjects, the sources of the NMS system should be maneuverable, able to seamlessly assimilate to a specific project environment, taking into account all possible changes. Due to the existing features, the activities of the pre-project phases for the implementation of real estate objects of different functional purposes differ in their composition and content, therefore it is advisable to provide for the possibility of flexible use of the information fund not only for one type of project, but also for others without cardinal transformations of the meaning of the resources used. For example, the NMS feasibility study of a multi-storey residential complex in the city center, according to the practical beginning of the presented model, implies its application for conducting a feasibility study of a logistics center in the production area, but taking into account the comprehensive features between the two projects.

An important subtlety of the developed pyramid is the inextricable relationship between practical and theoretical principles. In fact, this means that theoretical information should be correlated with the applied approaches and tools in real processes, and practical experience should be successfully integrated into new documents and scientific papers.

Accordingly, the proposed idea of implementing normative and methodological support for the pre-project stage of ICP, including the developed pyramid model of properties, can be widely used in investment and construction activities and will allow to establish internal organizational processes and solve a number of global strategic tasks in the construction industry, namely:

- for organizations in the investment and construction sector: development of their own methods and algorithms for conducting the ICP pre-project stage, reduction of budget, time and labour costs of ICP due to high-quality project initiation and planning processes, improvement of the quality of product solutions for real estate objects;
- for the construction industry: increasing the level of competitiveness of organizations in the construction sector, improving the system of technical regulation in construction, reducing waste construction costs, stimulating a decrease in the number of objects under construction, large-scale development and innovation;
- for the national economy: increasing the profitability of construction organizations, sustainable development of territories, increasing investment rates in the construction of buildings and structures.

REFERENCES

1. *Construction management. Part one. Organizational management models and contract designs of the capital construction : textbook in two parts and a workshop.* Grabovyy P.G., Lapidus A.A. (ed.). 4th ed., rew. and add. Moscow, Publishing House ASV, Prosvetitel' Publ., 2022; 484. (rus.).
2. *Construction management. Part two. Complex development and development of the territory of the building : textbook in 2 parts and a Workshop (Part 3).* P.G. Grabovyy, A.A. Lapidus (ed.). 4th ed., rew. and add. Moscow, Publishing House ASV, Prosvetitel' Publ., 2022; 620. (rus.).
3. Mazur I.I. et al. *Project management : a textbook for students studying in the specialty "Organization Management"* I.I. Mazur, V.D. Shapiro (ed.). 7th ed., erased. Moscow, Omega-L Publishing House, 2011; 959. (rus.).
4. Abdalov R.E., Kulakov K.Yu. *Conceptual model of pre-project marketing research and its impact on the quality of investment and construction project.* Real Estate: Economics, Management. 2023; 4:31-35. DOI: 10.22337/2073-8412-2023-4-31-35
5. Platonov A.M. Koroleva M.A., Blednykh E.I., Bazhenov S.I., Buzayev V.V., Vlasova M.F. et al. *Production management in construction : textbook.* Ekaterinburg, UFU, 2016; 700. (rus.).
6. Ananchenko A.Yu. *Legal and regulatory and technical support of urban planning activities : a textbook.* Saint Petersburg, 2020; 170. (rus.).
7. Doloi H., Week D., Bora A. *Role of regulatory framework for supporting construction industry in India.* AUBEA 2017 (EPIC Series in Education Science). 2017; 1:351-360. DOI: 10.29007/RRRR
8. Lapidus A., Topchiy D. *Regulatory support for the redevelopment design system.* E3S Web of Conferences Vol. 274 (2021) : 2nd International Scientific Conference on Socio-Technical Construction and Civil Engineering (STCCE-2021), Kazan. Vol. 274. France, EDP Sciences, 2021; 6003. DOI: 10.1051/e3sconf/202127406003
9. Sborshchikov S.B., Lazareva N.V., Markova I.M. *Reengineering of construction organizations and reengineering of the construction industry.* E3S Web of Conferences. 2023; 410:03035. DOI: 10.1051/e3sconf/202341003035
10. *Approval of the Strategy for the development of the construction industry and housing and communal services of the Russian Federation for the period up to 2030 with a forecast up to 2035 : Decree of the Government of the Russian Federation dated October 31, 2022 No. 3268-R.* URL: <http://static.government.ru/media/files/AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf> (accessed: 03.05.2024). (rus.).
11. *The Concept of improving the system of technical regulation and regulation in the construction industry : a project of the Ministry of Construction and Housing and Communal Policy of the Russian Federation, 2021.* URL: http://www.rgr.ru/data/discussion/2021/26.03.21_Концепция.pdf (accessed: 03/05/2024). (rus.).
12. *Urban Planning Code of the Russian Federation : Federal Law No. 190-FZ of 12/29/2004: adopted by the State Duma on 12/22/2004.* (rus.).
13. *Land Code of the Russian Federation : Federal Law No. 136-FZ of 10/25/2001: adopted by the State Duma on 09/28/2001.* (rus.).
14. GOST R 57363–2023. *Project management in construction. Activity of the project manager (technical customer) : National standard of the Russian Federation: date of introduction 01.09.2023,* Federal Agency for Technical Regulation and Metrology. Official publication. Moscow, Russian Institute of Standardization, 2023; 20. (rus.).
15. GOST R 71177–2023. *Managing large construction projects using integrated contracts : National Standard of the Russian Federation: date of introduction 01.01.2024,* Federal Agency for Technical Regulation and Metrology. Official edition. Moscow, Russian Institute of Standardization, 2024; 62. (rus.).
16. GOST R 58917–2021. *Technological engineering and design. Feasibility study of the investment project of an industrial facility. General requirements : National Standard of the Russian Federation: date of introduction 01.01.2022,* Federal Agency for Technical Regulation and Metrology. Official edition. Moscow, Russian Institute of Standardization, 2021; 16. (rus.).
17. CP 11-101–95. *The procedure for the development, coordination, approval and composition of justifications for investments in the construction of enterprises, buildings and structures : Code of practice: date of introduction 01.07.1995,* Ministry of Construction of the Russian Federation. Moscow, 1995; 12. (rus.).

18. MRR 2.2.16–00. *Recommendations on the organization and conduct of marketing research before the development of pre-project and project documentation in order to determine the commercial effectiveness of the territory* : date of introduction 11.11.1999, Committee on Architecture and Urban Planning of Moscow. Moscow, 2000; 50. (rus.).
19. Vladimirova I.L. *Digital methods of innovative management of investment and construction projects* : monograph. Moscow, Plekhanov Russian University of Economics, 2020; 448. (rus.).

20. Grabovyy P.G., Lunyakov M.A. *Performance management in the investment-building complex: planning, monitoring and awareness*. Real Estate: Economics, Management. 2015; 2:11–13. URL: <https://elibrary.ru/uiouhp> (rus.).
21. Kulakov K.Yu., Korolev M.A. *Development of a system for managing the performance of organizations in the field of construction*. Real Estate: Economics, Management. 2020; 3:40–44. DOI: 10.22227/2073-8412.2020.3.40–44 URL: <https://elibrary.ru/item.asp?id=44813052> (rus.).

Управление предпроектной стадией инвестиционно-строительного проекта: аспекты внедрения нормативного и методического обеспечения деятельности организаций

В научной работе освещается вопрос нынешнего уровня развития технического регулирования в строительстве, в частности регулирования предпроектной стадии инвестиционно-строительного проекта (ICP). За последние годы в инвестиционно-строительной деятельности прочно укоренилась концепция управления жизненным циклом объекта недвижимости, подразумевающая сфокусированность на менеджменте каждого состояния системы — от идеи до ликвидации объекта. Тем не менее на практике участники строительных проектов осуществляют управление предпроектной стадией ICP без должного внимания и ответственности. Автором подчеркивается, что пренебрежительное отношение к работам предпроектной группы вызвано рядом причин, одна из которых — отсутствие понимания структуры и содержания предпроектной фазы и осознания возможной пользы ее результатов. Предполагается, что выступить в качестве теоретической базы и оказать содействие субъектам ICP в реальных условиях могло бы нормативное обеспечение. Для оценки предложения был проведен анализ системы отечественной нормативной базы и выделены элементы содержимого, которые будут полезны в применении при реализации предпроектной стадии ICP. По результатам проведенного анализа выяснилось, что нормативное обеспечение предпроектной фазы ICP несовершенно в объективе актуальной ступени эволюции строительной отрасли. Сегодня разработка универсального механизма для регламентирования предпроектной стадии ICP трудноосуществима, так как нас окружает колоссальное множество разнообразных и абсолютно не похожих друг на друга зданий и сооружений. Автором предлагается внедрение на организационном уровне нормативного и методического обеспечения (NMS), основанного на уже закрепленных нормах и правилах, имеющих методиках и практических рекомендациях и выработанных корпоративных механизмах. Для формирования организациями строительной отрасли собственной модели ведения предпроектной стадии ICP автором разработана пирамида свойств NMS, доступно отражающая основные принципы, которыми должны обладать документы и информация, применяемая участниками ICP в практической деятельности. Учитывая векторы развития строительного сектора и национальной экономики России, предложенная авторская инициатива способна оказать всесторонний положительный эффект.

Ключевые слова: предпроектная стадия инвестиционно-строительного проекта, управление предпроектной стадией, нормативное и методическое обеспечение, техническое регулирование, конкурентоспособность организаций

СПИСОК ИСТОЧНИКОВ

1. *Управление строительством. Часть первая. Организационные модели управления и контрактные конструкции объекта капитального строительства* : учебник в 2 частях и практикум. 4-е изд., перераб. и доп. / под общ. науч. ред. П.Г. Грабового, А.А. Лapidуса. М. : Изд-во АСВ, Просветитель, 2022. 484 с.

2. *Управление строительством. Часть вторая. Комплексное освоение и развитие территории застройки* : учебник в 2 частях и практикум / под общ. науч. ред. П.Г. Грабового, А.А. Лapidуса. 4-е изд., перераб. и доп. М. : Изд-во АСВ, Просветитель, 2022. 620 с.
3. Мазур И.И. и др. *Управление проектами* : учебное пособие для студентов, обучающихся по специальности «Менеджмент организации» / под общ. ред. И.И. Мазура, В.Д. Шапиро. 7-е изд., стер. М. : Изд-во Омега-Л, 2011. 959 с.
4. Абдалов Р.Е., Кулаков К.Ю. *Conceptual model of pre-project marketing research and its impact on the quality of investment and construction project* // Недвижимость: экономика, управление. 2023. № 4. С. 31–35. DOI: 10.22337/2073-8412-2023-4-31-35
5. Платонов А.М., Королева М.А., Бледных Е.И., Баженов С.И., Бузырев В.В., Власова М.Ф. и др. *Производственный менеджмент в строительстве* : учебник. Екатеринбург : УрФУ, 2016. 700 с.
6. Ананченко А.Ю. *Правовое и нормативно-техническое обеспечение градостроительной деятельности* : уч. пос. СПб., 2020. 170 с.
7. Doloi H., Week D., Bora A. *Role of regulatory framework for supporting construction industry in India* // AUBEA 2017 (EpiC Series in Education Science). 2017. Vol. 1. Pp. 351–360. DOI: 10.29007/RRRR
8. Lapidus A., Topchiy D. *Regulatory support for the redevelopment design system*. E3S Web of Conferences Volume 274 (2021) // 2nd International Scientific Conference on Socio-Technical Construction and Civil Engineering (STCCE-2021), Kazan. Vol. 274. France : EDP Sciences, 2021. P. 6003. DOI: 10.1051/e3sconf/202127406003
9. Sborshchikov S.B., Lazareva N.V., Markova I.M. *Reengineering of construction organizations and reengineering of the construction industry* // E3S Web of Conferences. 2023. Vol. 410. P. 03035. DOI: 10.1051/e3sconf/202341003035
10. Об утверждении Стратегии развития строительной отрасли и жилищно-коммунального хозяйства РФ на период до 2030 г. с прогнозом до 2035 г. : Распоряжение Правительства РФ от 31 октября 2022 г. № 3268-п. URL: <http://static.government.ru/media/files/AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf> (дата обращения: 05.03.2024).
11. Концепция совершенствования системы технического нормирования и регулирования в строительной отрасли : проект Министерства строительства и жилищно-коммунальной политики Российской Федерации, 2021 год. URL: http://www.rgtr.ru/data/discussion/2021/26.03.21_Концепция.pdf (дата обращения: 05.03.2024).
12. Градостроительный кодекс Российской Федерации : Федеральный закон № 190-ФЗ от 29.12.2004; принят Государственной Думой 22.12.2004.
13. Земельный кодекс Российской Федерации : Федеральный закон № 136-ФЗ от 25.10.2001; принят Государственной Думой 28.09.2001.
14. ГОСТ Р 57363–2023. *Управление проектом в строительстве. Деятельность управляющего проектом (технического заказчика)* : национальный стандарт Российской Федерации: дата введения 01.09.2023. Федеральное агентство по техническому регулированию и метрологии. Изд. Официальное. Москва, Российский институт стандартизации, 2023. 20 с.
15. ГОСТ Р 71177–2023. *Управление крупными строительными проектами с использованием интегрированных контрактов* : национальный стандарт Российской Федерации: дата введения 01.01.2024. Федеральное агентство по техническому регулированию и метрологии. Изд. Официальное. Москва, Российский институт стандартизации, 2024. 62 с.

16. ГОСТ Р 58917–2021. Технологический инжиниринг и проектирование. Техничко-экономическое обоснование инвестиционного проекта промышленного объекта. Общие требования : национальный стандарт Российской Федерации: дата введения 01.01.2022. Федеральное агентство по техническому регулированию и метрологии. Изд. официальное. Москва, Российский институт стандартизации, 2021. 16 с.

17. СП 11-101–95. Порядок разработки согласования, утверждения и состав обоснований инвестиций в строительство предприятий, зданий и сооружений : свод правил: дата введения 01.07.1995. Министерство строительства Российской Федерации. Москва, 1995. 12 с.

18. МРР 2.2.16–00. Рекомендации по организации и проведению маркетинговых исследований до разработки предпроектной и проектной документации с целью определения коммерческой эффективности территории: дата введения 11.11.1999. Комитет по архитектуре и градостроительству г. Москвы. Москва, 2000. 50 с.

19. Владимирова И.Л. Цифровые методы в инновационном управлении инвестиционно-строительными проектами : монография. М. : ФГБОУ ВО «РЭУ им. Г.В. Плеханова», 2020. 448 с.

20. Грабовый П.Г., Луняков М.А. Управление результативностью в инвестиционно-строительном комплексе: планирование, мониторинг и повышение уровня // Недвижимость: экономика, управление. 2015. № 2. С. 11–13. URL: <https://elibrary.ru/uiouhp>

21. Кулаков К.Ю., Королев М.А. Развитие системы управления результативностью деятельности организаций в области строительства // Недвижимость: экономика, управление. 2020. № 3. С. 40–44. DOI: 10.22227/2073-8412.2020.3.40-44 URL: <https://elibrary.ru/item.asp?id=44813052>

Об авторе: **Абдалов Роман Евгеньевич** — аспирант кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 1226983, ORCID: 0009-0006-2366-6392; abdalov.romain@yandex.ru.

For citation: Abdalov R.E. Management of the pre-project stage of an investment and construction project: aspects of the implementation of normative and methodological support for the activities of organizations. *Real Estate: Economics, Management*. 2024; 2:54-60.

Для цитирования: Абдалов Р.Е. Управление предпроектной стадией инвестиционного и строительного проекта: аспекты реализации нормативной и методологической поддержки для деятельности организаций // Недвижимость: экономика, управление. 2024. № 2. С. 54–60.



Л.И. Павлова. Вена. Площадь Фрайянг. Рисунок, тушь, перо.

UDC 69.003

Application of the economic–mathematical model to determine the efficiency of residential renovation projects and to choose the optimal strategy for their implementation

Implementation of the residential renovation programme is one of the most important programmes aimed at improving the socio-economic well-being of the Russian regions. The implementation of this programme involves the restoration and renovation of existing residential buildings in order to provide citizens with comfortable and safe housing conditions. In order to reduce the number of emergency and dilapidated dwellings, a set of measures is envisaged to restore the technical condition, reduce physical deterioration or, if restoration is not feasible, to carry out works on liquidation of existing dwellings and implementation of new construction projects. The experience of the residential renovation programme in the Moscow region, where the programme has been in effect since 2017, shows that the choice of project implementation strategy does not always fully take into account all the initial parameters of the land plot or object included in the targeted renovation programme. This peculiarity may lead to a decrease in the efficiency of project implementation and increase the risk of project cost increase, increase in construction time and other negative consequences.

Due to the fact that the residential renovation programme is implemented at the expense of the federal budget, and the programme assumes timely planned wave resettlement of citizens, the reduction of the probability of occurrence of a delay in the implementation time and exceeding the initial budget are among the most significant negative aspects in the implementation of the residential renovation programme. In order to assess the initial parameters of the objects, as well as to determine the resulting efficiency of the project, the application of the economic-mathematical model will allow to sufficiently form a number of estimated parameters that are of the greatest importance for the renovation projects being implemented, to analyze them and on their basis to calculate the resulting indicator of the project efficiency, which will subsequently form the basis for determining the most optimal strategy of the project implementation, taking into account its characteristics.

Keywords: *residential development renovation programme, integrated territorial development, economic and mathematical modelling, Moscow City Renovation Programme*

The development and application of economic and mathematical models is directly related to efficiency assessment. When considering the construction industry, the assessment of project efficiency can be carried out when considering organizations, management methods, implementation of construction projects. The development of an economic-mathematical model implies, among other things, the assessment of parameters and factors that determine a particular object (organization, construction project and so on). The main task of applying an economic-mathematical model is to consider the processes, as well as interrelated with them initial parameters and factors that affect the efficiency of the processes, which can be determined on the basis of the calculated resulting indicator.

The development of economic and mathematical model is carried out by applying the method of system analysis¹. The analysis allows determining the processes to be evaluated, as well as the factors that have the greatest influence on them. Application of the method of system analysis allows to evaluate processes that involve a large number of initial parameters. This method allows to evaluate factors when considering from general to particular, which

differs from the inductive approach. Application of the system approach within the framework of building an economic-mathematical model makes it possible to evaluate and analyze all the factors affecting the subject under consideration at all stages of system research and building its model. The system approach means that each system is an integrated whole even when it consists of heterogeneous subsystems².

The use of the system approach in building an economic and mathematical model under a large number of initial conditions also requires determining the necessary amount of control information in the real system, estimation of the considered indicators. This method will subsequently allow us to determine the most effective variant of construction and the optimal mode of functioning of the model^{1, 3}.

The content of the modelling method is the construction of the model on the basis of preliminary study of the object and selection of its essential characteristics, experimental or theoretical analysis of the model, comparison of the results with the data on the object, adjustment of the model resulting — efficiency. In this regard, economic and mathematical models describing the impact of

Kirpichenkov A.A.



Kirpichenkov Andrey Andreevich,
Postgraduate student of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 2155-3825, ORCID: 0000-0003-0291-6015; andrey.kirpichenkov@mail.ru

1

Programme for Renovation of Housing in the City of Moscow : Decree of the Government No. 497-PP.

2

Consideration of Public Opinion on Housing Renovation Project in Moscow : Decree of the Government No. 245-PP.

3

Approving the Addressed List of Neighbourhoods (Territories) : Government Decree No. 708-PP.

► individual factors (parameters) on the final results of enterprises (objects) are used⁴.
Additive computational model has linear constraints:

$$q = \sum_{i=1}^n a_i, \tag{1}$$

where n — number of analyzed parameters; a_i — weight of i — parameter.

The adaptive model under consideration is expressed as an algebraic sum of deterministic summands, which are the estimated factors affecting the performance of the assessed entity. In this regard, the adaptive model can be used only if the considered factors (summands in the algebraic sum) are represented and belong to a single economic nature⁵.

Multiplicative models of economic and mathematical modelling are written as follows:

$$q = \sum_{i=1}^n a_i = a_1 + a_2 + \dots + a_i, \tag{2}$$

where q is the resultant indicator; a_1, a_2 and so on — factors affecting the resultant indicator.

Thus, in multiple models, the resulting indicator is a relative value reflecting the ratio of factorial indicators. Most often multiple models are used to develop various ratios. When working with multiple models, it is necessary to take into account that although they allow calculating the ratio of factorial indicators that have different nature and dimensionality.

The basis for the construction of an economic-mathematical model that allows the evaluation and choice of strategy for the implementation of a particular project of renovation of residential buildings is the construction of the factor space, which can determine the basic initial parameters of the considered object in order to select the most appropriate strategy and will allow a more accurate calculation using the developed economic-mathematical model^{4, 5} [1].

In order to carry out further calculations to determine the efficiency of the land plot considered for construction and within the framework of building an economic and mathematical model, it is necessary to determine the limit values for each of the parameters under consideration, which should subsequently serve as a basis for calculating the resulting indicator for the assessment of the land plot under consideration and the subsequent choice of the project implementation strategy based on the calculation. For this purpose, it is proposed to determine the limit values of the parameters under consideration on the basis of the minimum and maximum values of each of them [2].

Thus, after determining the factors, it is possible to assess the land plot under consideration for the construction of a residential building within the framework of the residential renovation programme and to determine the efficiency of the land plot use. Also, the proposed assessment of the land plot according to the factors described above will allow further analysis in order to choose the most optimal strategy for the implementation of the residential renovation project [2, 3]. Based on the obtained values of the resulting indicators of project efficiency, the efficiency of the planned for implementation project of residential development renovation will be determined.

The construction of economic-mathematical model is a universal mechanism that allows to make a calculated assessment of the initial data of the project. The result of building an economic-mathematical model should be a calculated index of project efficiency, varying in the range of certain and individual values [2, 4]. As part of the application of the economic-mathematical model, each evaluated project should receive a calculated efficiency index, which will subsequently serve as a basis for choosing a project implementation strategy.

Thus, it is logical to assign additional indices and symbols to the factors and parameters, namely: the initial parameters of the object are determined by the parameter a_n , the project performance indicators are determined by the value f_n , where f is the calculated value based on the assessment of the initial parameters.

In order to more accurately calculate the final indicators of project efficiency, it is proposed to introduce the following formula for calculating the forecast indicator of the evaluated factor:

$$\Delta f_{1max} \cdot (100 \% - a_1), \tag{3}$$

where f_1 is the value of the evaluated performance indicator; a_1 is the value of the initial parameter of the project.

$$k_{calc} = \left(1 + \frac{(a_{nmax} - a_{nfact}) (k_{max} - k_{min})}{(a_{nmax} - a_{nmin})} \right). \tag{4}$$

In order to add the values of the initial parameters of the evaluated project, it is suggested to use the method of interpolation, thanks to which it is possible to evaluate all kinds of parameters in different values on a single evaluation scale. Then, the parameter will be rationally defined by the following calculation formula:

where k_{calc} — estimated estimator of the estimated parameter; a_{nmax} — maximum estimated value of the parameter (determined empirically); a_{nfact} — actual values of the estimated parameters; k_{max} — maximum estimated value of the parameter; k_{min} — minimum estimated value of the parameter; a_{nmin} — estimated value of the parameter (determined empirically).

It is proposed to use the above formula when calculating each actual a_n parameter as part of the evaluation of the project under consideration [5]. Evaluation of the forecast indicator will show the calculated percentage deviation of the maximum (best project indicators) indicators of project efficiency and will allow to determine the forecast value of the efficiency indicator, which, in turn, will help in the construction of economic and mathematical model to calculate the resulting indicator of project efficiency [4, 5].

To assess each parameter, it is proposed to use a scale from 1 to 100. To obtain the value for each of the parameters, an interpolation method is used depending on the value in the range of values for each parameter being evaluated.

The formula for assessing the effectiveness of each separately taken parameter is defined can be presented in the following general form:

$$K = \sum_{i=1}^n P_i K_i, \tag{5}$$

where K — evaluation coefficient of parametric efficiency of the project; P_i — evaluation weighting coefficient of the evaluated parameter; K_i — efficiency coefficient of the evaluated parameter.

4 Approval of the Basic Requirements to Improvement of the Residential Development Territory during the Implementation of the Programme for Renovation of the Residential Stock in the City of Moscow : Government Decree No. 515-PP.
5 Approval of the Requirements for Improved Finishing of Equivalent Residential Premises Provided in Replacement of Residential Premises in Multifamily Buildings : Government Resolution No. 516-PP.

In order to calculate the estimated indicator of project efficiency, which is dependent on a certain initial factor with the reduction of this indicator to a single evaluation scale, it is proposed: based on the efficiency coefficient of the renovation project obtained by the calculation method, it is possible to determine the possible and most effective strategy adopted for the implementation of the project [6, 7]. The choice of the project implementation strategy is made taking into account the calculated project indicator K and on the basis of the project baseline data, which are individual for each of them. Determination of the exact estimation of each parameter takes place using the interpolation method within the specified range [8]. This value is proposed to be determined as follows using the estimated formula:

$$y = \left(1 + \frac{(a_{n\text{fact}} - a_{n\text{min}})(k_{\text{max}} - k_{\text{min}})}{(a_{n\text{max}} - a_{n\text{min}})} \right), \quad (6)$$

where y — calculated estimated indicator of the estimated parameter; $a_{n\text{fact}}$ — actual values of the estimated parameters; $a_{n\text{min}}$ — minimum estimated value of the parameter (determined empirically); $a_{n\text{max}}$ — maximum estimated value of the parameter (determined empirically); k_{max} — maximum estimated value of the parameter; k_{min} — minimum estimated value of the parameter (from 1 to 100).

In turn, the estimated value of the estimated parameter of project

efficiency is proposed to be determined by the following formula:

$$\Delta f_{n\text{max}} = (f_{\text{max}} - f_{\text{min}})t, \quad (7)$$

where $\Delta f_{n\text{max}}$ — absolute maximum deviation by indicator; f_{max} — maximum estimated value of the evaluated indicator; f_{min} — minimum estimated value of the estimated indicator; t — coefficient of influence of the considered factor on the estimated indicator.

Then, the estimated projected project performance indicator will be presented in the form of:

$$\Delta f_{n\text{calc}} = \Delta f_{n\text{max}}(100\% - y), \quad (8)$$

where $\Delta f_{n\text{calc}}$ — estimated value of the assessed indicator in absolute values.

Based on the above developed formulas for calculating actual and forecast indicators of project efficiency, it seems possible to form a formula for calculating the resulting coefficient of project efficiency, which will be able to show a universal value, showing the effectiveness of the project based on the values obtained:

$$K_{\text{calc}} = \sum_{i=1}^n \left(1 + \frac{(f_{1\text{calc}} - f_{1\text{min}})(k_{\text{max}} - k_{\text{min}})}{(f_{1\text{max}} - f_{1\text{min}})} \right) k_i, \quad (9)$$

Consequently, combining the above, the general calculation formula can be summarised as follows:

$$K_{\text{calc}} = \sum_{i=1}^n \left(1 + \frac{\left((f_{\text{max}} - f_{\text{min}})t \right) \cdot \left(100\% - \left(1 + \frac{(a_{n\text{fact}} - a_{n\text{min}})(k_{\text{max}} - k_{\text{min}})}{(a_{n\text{max}} - a_{n\text{min}})} \right) - f_{n\text{min}} \right) (k_{\text{max}} - k_{\text{min}})}{(f_{1\text{max}} - f_{1\text{min}})} \right) k_i, \quad (10)$$

After parameter estimation is determined, the project indicator is calculated according to the specified formula in order to find the exact value corresponding to one of the specified ranges for the choice of strategy for the implementation of the residential renovation object, which, in turn, determines the set of methods and means necessary to improve the overall efficiency of the project [9, 10].

In order to build an economic-mathematical model for projects implemented within the framework of the renovation programme, it is necessary to develop a mechanism for parameter estimation. The initial parameters will help to assess the potential of the project and the degree of risks in its possible implementation [9, 11, 12].

The main objective is to reduce the level of risks in order to increase the efficiency of implementation of residential renovation projects. According to the author's conclusion, the application of the economic-mathematical model of choosing the most optimal strategy for the implementation of the residential renovation project contributes to the reduction of the risk level, which can increase the predictability of the object, as well as reduce the probability of exceeding the established terms of the project implementation and exceeding the established budget, and thus increase the overall efficiency of the implementation of residential renovation projects.

REFERENCES

1. Ovsianikova T.Yu. Renovation of residential buildings in the regions: organizational and financial mechanisms and constraints. *Real Estate*:

Economics, Management. 2023; 1:44-48. DOI: 10.22337/2073-8412-2023-1-44-48 (rus.).

2. Khokhlov O.B. Evaluation of efficiency of housing renovation projects and programmes : dissertation of the Candidate of Technical Sciences. Tomsk, 2006; 188. (rus.).

3. Zharkov I.S. Development of tools for investment design of real estate objects during renovation : dissertation of the Candidate of Technical Sciences. Voronezh, 2020; 175. (rus.).

4. Shahraki A.A. Renovation programmes in old and inefficient neighborhoods of cities with case studies. *City Territory and Architecture*. 2022; 9(1):28. DOI: 10.1186/s40410-022-00174-1

5. Nezhnikova E.V. Formation of strategic priorities for the development of the housing industry based on the creation of competitive housing construction facilities : dissertation of the Doctor of Technical Sciences. Moscow, 2017; 334. (rus.).

6. Mangold M., Österbring M., Wallbaum H., Thuvander L., Femerías P. Socio-economic impact of Renovation and Energy Retrofitting of the Gothenburg building stock. *Energy and Buildings*. 2016; 123(1):41-49. DOI: 10.1016/j.enbuild.2016.04.033

7. Rusakova Ya.D. Formation of strategic priorities of housing industry development on the basis of creation of competitive housing construction objects : dissertation of the Candidate of Technical Sciences. St. Petersburg, 2012. (rus.).

8. Pope C., Marks E., Back Ed., Leopard T., Love T. Renovation versus new construction and building decision tool for educational facilities. *Journal of Construction Engineering*. 2016; 1:1-10. URL: <https://www.hindawi.com/journals/jcen/2016/5737160/> DOI: 10.1155/2016/5737160 (rus.).

9. Visscher H., Femerías P., Thuvander L., Jensen P.A. Sustainable building renovation — strategies and processes. *Construction Management and Economics*. 2022; 40(3):157-160. DOI: 10.1080/01446193.2022.2045717

- 10. Prokhorova Y.S. *Organizational and economic mechanism for managing the cost of object construction in conditions of public investment : dissertation of the Candidate of Technical Sciences. Moscow, 2020; 231. (rus.).*
11. Pastukhov V. *Rational use of urban land in projects of renovation of residential development building renovation business: the effects*

of specialization on profitability territory : dissertation of the Candidate of Technical Sciences. Moscow, 2022; 274. (rus.).

12. Rajala P., Ylä-Kujala A., Sinkkonen T., Kärri T. *Building renovation business: the effects of specialization on profitability. Construction Management and Economics. 2023; 41(8):687-702. DOI: 10.1080/01446193.2023.2192040*

Применение экономико-математической модели с целью определения эффективности проектов реновации жилой застройки и выбора оптимальной стратегии их реализации

Реализация программы реновации жилой застройки является одной из важнейших программ, ориентированных на улучшение социально-экономического благосостояния регионов Российской Федерации. Реализация данной программы предполагает восстановление и обновление сложившейся жилой застройки с целью обеспечения граждан комфортными и безопасными жилищными условиями. С целью сокращения количества аварийных и ветхих жилых домов предусмотрен комплекс мер по восстановлению технического состояния, сокращению физического износа или в случае, если восстановление не является целесообразным, то проведение работ по ликвидации существующих жилых домов и реализации проектов нового строительства. Опыт реализации программы реновации жилой застройки на территории московского региона, где данная программа действует с 2017 г., показывает, что выбор стратегии реализации проекта не всегда в полной мере учитывает все исходные параметры, которыми обладает земельный участок или объект, попадающий в адресную программу реновации. Данная особенность может приводить к снижению эффективности реализации проекта и повышению рисков увеличения стоимости проекта, увеличению сроков строительства и иным негативным последствиям.

В связи с тем, что программа реновации жилой застройки реализуется за счет федерального бюджета, а также программа предполагает своевременное планомерное волновое переселение граждан, то сокращение вероятности возникновения отставания в сроках реализации и превышение первоначального бюджета являются одними из самых существенных негативных аспектов при реализации программы реновации жилой застройки. С целью оценки исходных параметров объектов, а также определения результирующей эффективности проекта применение экономико-математической модели позволит в достаточной мере сформировать ряд оцениваемых параметров, которые представляют наибольшую значимость для реализуемых проектов реновации, провести их анализ и на их основе сформировать расчетным образом результирующий показатель эффективности проекта, который впоследствии ляжет в основе определения наиболее оптимальной стратегии реализации проекта с учетом его особенностей.

Ключевые слова: программа реновации жилой застройки, комплексное развитие территорий, экономико-математическое моделирование, программа реновации города Москвы

СПИСОК ИСТОЧНИКОВ

1. Овсянникова Т.Ю. *Реновация жилой застройки в регионах: организационно-финансовые механизмы и ограничения // Недвижимость: экономика, управление. 2023. № 1. С. 44–48. DOI: 10.22337/2073-8412-2023-1-44-48*

2. Хохлов О.Б. *Оценка эффективности проектов и программ реновации жилищного фонда : дис. ... канд. техн. наук. Томск, 2006. 188 с.*
3. Жарков И.С. *Развитие инструментария инвестиционного проектирования объектов недвижимости при реновации : дис. ... канд. техн. наук. Воронеж, 2020. 175 с.*
4. Abdol Aziz Shahraki. *Renovation programmes in old and inefficient neighborhoods of cities with case studies // City Territory and Architecture. 2022. Vol. 9 (1). P. 28. DOI: 10.1186/s40410-022-00174-1*
5. Нежникова Е.В. *Формирование стратегических приоритетов развития жилищной отрасли на основе создания конкурентоспособных объектов жилищного строительства : дис. ... д-ра техн. наук. М., 2017. 334 с.*
6. Mangold M., Österbring M., Wallbaum H., Thuvander L., Femenias P. *Socio-economic impact of renovation and energy retrofitting of the Gothenburg building stock // Energy and Buildings. 2016. Vol. 123. No. 1. Pp. 41–49. DOI: 10.1016/j.enbuild.2016.04.033*
7. Русакова Я.Д. *Формирование стратегических приоритетов развития жилищной отрасли на основе создания конкурентоспособных объектов жилищного строительства : дис. ... канд. техн. наук. СПб., 2012.*
8. Pope C., Marks E., Back Ed., Leopard T., Love T. *Renovation versus new construction and building decision tool for educational facilities // Journal of Construction Engineering. 2016. No. 1. Pp. 1–10. URL: <https://www.hindawi.com/journals/jcen/2016/5737160/> DOI: 10.1155/2016/5737160*
9. Visscher H., Femenias P., Thuvander L., Jensen P.A. *Sustainable building renovation — strategies and processes // Construction management and economics. 2022. Vol. 40. No. 3. Pp. 157–160. DOI: 10.1080/01446193.2022.2045717*
10. Прохорова Ю.С. *Организационно-экономический механизм управления стоимостью строительства объекта в условиях государственного инвестирования : дис. ... канд. техн. наук. М., 2020. 231 с.*
11. Пастухов В.Э. *Рациональное использование городских земель в проектах реновации территории жилой застройки : дис. ... канд. техн. наук. М., 2022. 274 с.*
12. Pekka Rajala, Antti Ylä-Kujala, Tiina Sinkkonen, Timo Kärri. *Building renovation business: the effects of specialization on profitability // Construction Management and Economics. 2023. Vol. 41. No. 8. Pp. 687–702. DOI: 10.1080/01446193.2023.2192040*

Об авторе: **Кирпичников Андрей Андреевич** — аспирант кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 2155-3825, ORCID: 0000-0003-0291-6015; andrey.kirpichenkov@mail.ru.

For citation: Kirpichenkov A.A. Application of the economic-mathematical model to determine the efficiency of residential renovation projects and to choose the optimal strategy for their implementation. *Real Estate: Economics, Management. 2024; 2:61-64.*

Для цитирования: Кирпичников А.А. Application of the economic-mathematical model to determine the efficiency of residential renovation projects and to choose the optimal strategy for their implementation // Недвижимость: экономика, управление. 2024. № 2. С. 61–64.

UDC 004.9:69.003

Information models of construction objects during their life cycle

Information modeling has been playing a pivotal role during the last decade in bringing in revolutionary and systematic changes in Civil Engineering. The current paper describes the development of models used by architects and engineers from scale models of the Renaissance to the operative models supporting constructed object throughout their life cycle. The development of Information Modeling concept is described, and the focal role of the engineering data and data management in the information modeling process is introduced. The analysis of the existing OpenBIM concept used by Western vendors shows that although it works well at the design stage, but at the construction site and in operation the data management seriously lacks efficiency. The important property of the interoperability also has not been achieved by the means of Industry Foundation classes that are currently used in most Western software products. Under the existing conditions, Russia has a chance to take a leading position in the development of information models. The second part of the paper describes the digital ecosystem of software products developed by the Russian Group of Companies CSoft for consistent digitalization of design, construction, and operation of buildings. An extensive description of the functionality of the products, forming the seamless system for the life cycle of construction objects is provided.

Keywords: information modeling, objects of capital construction, life cycle, data management, interoperability

INTRODUCTION

Scientists and engineers have traditionally described systems with models. A model of a system consists of a set of objects and the set of processes which change these objects with time. Both the objects and the processes of the model of a system are images of objects and processes of the original of the system. Scientific methods are used to select the objects and processes of the original in the world, to map objects and processes between the original and the model, and to simulate the original and its behavior with the model.

The use of models in Civil Engineering has a long history. In the Renaissance, architectural scale models played an important role [1]. At that time, models were used by the designers of significant buildings and bridges to gain the approval of their clients for their plans. In addition, the models were used to study architectural effects of the bulk of the buildings and of the use of various materials in the elevations and floors of the buildings.

An outstanding example of an architectural model is the model of St. Peter's Basilica in Rome, which was designed and constructed from 1506 to 1626. Each of the four master builders who were entrusted with the project (Bramante, Michelangelo, Maderno and Bernini) modified the design of his predecessors significantly. Michelangelo created a wooden model of the dome at a scale of 1:15. The model is more than 5 meters high and can still be seen in the Vatican today (Fig. 1). It was used by Michelangelo and by his successors to study the original design of the dome and its modifications.

In the 18th century, Switzerland was famous for large span wooden bridges like the bridge crossing the river Rhine at Schaffhausen. An initial design had a single span of 119 meters. Although a model

was built and even stood on it to demonstrate the stability of the design, the clients were not convinced. They may have been familiar with scale effects, or found the design too expensive. The redesigned bridge in figure 2 was built from 1755 to 1758 with spans of 56 and 63 meters. The original models of the initial and of the final design can be seen even today in museums in Switzerland.

The nature of engineering changed fundamentally when the scientific method was introduced to augment the traditional empirical approach. The concept of the design engineer was now presented in



Fig. 1. Wooden Model Dome St. Peters Basilica, Rome

Galishnikova V.V.
Bocharov M.E.



Galishnikova Vera Vladimirovna,
Doctor of Technical Sciences, Docent, PhD. Vice-rector; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 294267, Scopus: 55303553900, ResearcherID: AAA-7515-2022; GalishnikovaVV@mgsu.ru



Bocharov Mikhail Evgenievich,
PhD in Technical Sciences; CSoft Development (CSoft); 18 1 Nagatinskaya Embankment, Moscow, 115533, Russian Federation; SPIN-code: 2974-4449; Bocharov.mihail@csoft.ru

▶ the form of a static model consisting of mathematical calculations, texts and technical drawings on paper. This approach is still well known in engineering practice. The data of static models can only be used and passed on through human intervention.

The computer has completely changed the engineering profession. If we can derive a suitable theory for an engineering project, we can today nearly always apply this theory to realistic models of a system and predict the engineering behavior, even for highly complex systems, by using computers and computer-oriented methods. This trend was already revealed in the earliest efforts to use computers beneficially, for example in the development and application of the finite element method FEM and of computer-aided design CAD. The character of models has changed from static to operative in the digital environment [2]. The digital modelling concept includes both the objects of the system and the processes which occur as the system changes. The models themselves can operate on input data to generate information which is required to design, construct and operate originals and to transfer this information in networks [3]. Models with such properties are called operative models. The change from static to operative models is a measure for the changes in our professions due to the novel digital technologies.

The most representative example of the development of operative modeling in Civil Engineering is Building Information Modeling, which involves the generation and management of digital representations of the physical and functional characteristics of buildings. The concept of BIM has been developing from 1970s, and since that time has experienced important transformations^{1, 2, 3} [4, 5]. The Urban Development Code of the Russian Federation provides the following definition: "Information model of a capital construction object is a set of interrelated information, documents and materials about a capital construction object, generated in electronic form at the stages of engineering surveys, design, construction, reconstruction, major repairs, operation and demolition of the capital construction object". It is obvious from this definition that the key component of the information model is the engineering data. This data must be generated, processed, stored, transferred and operated on, and therefore it should be read and understood by the computer.

Despite some consonance in the names BIM (Building Information Model / Modeling) and IM (Information Model or Modeling), it has to be noted that IM is a logical continuation of BIM, as it moves to the next stage — not "modeling", but data management. This allows us to divide the areas of IM into two large components, which in Russian legislation are designated by the verbs "formation" and "maintenance" of the Information Model. This separation process is still only at the beginning of its organization, and many people habitually use either the term "BIM", or "DIM" (Digital Information Model), or "TIM" (Information Modeling Technologies) using the word "technology" in the singular, considering this term, introduced by the President of Russia in 2018, to be a certain knowledge. Moreover, this knowledge is still used as an analogue of BIM, but only in the context of the third version of the letter "M" (Methodology). A typical method of global technological expansion is the creation of a "new science" from the way of designing, constructing and managing structures using

specialized software, resulting in the creation of a building information model [6–8].

Before moving on to maintaining the information model, it should be pointed out that the division of the "general methodology or knowledge" designated in some non-legislative sources as "TIM" into separate technologies allows us to make a qualitative leap in the regulation of each of the technologies for forming the information model, which will lead to the so-called competitive turnover. As a result, the consumer will benefit, and the progress of information modeling development will not be constrained by the modern platform approach which is designated in the OpenBIM concept as a shared data environment⁴. Information modeling assumes a broader approach in the form of the information space of the information model. This is indirectly called for by the definition of the information model given in the Urban Planning Code of Russia, and which supporters of the archaic OpenBIM concept do not like.

There is a general opinion in Russia that domestic developments are not at the same level as the developments of Western vendors. This raises a smile and understanding that they are often comparing completely the wrong things and do not take into account the goals of vertical (state) digitalization. The lack of fashionable and convenient buttons on the interface or avoidable difficulties with some functions is elevated to the rank of technological backwardness. This is not true. The work of a designer and an architect is very important and a beautiful information model will also please the eye, but these are passing values. The main thing is the efficiency of data management, and this is not enough in OpenBIM. Although it should be noted that the OpenBIM concept works great, but only at the design stage, but at the construction site and in operation it is either a deterrent in data management or low-efficiency. Moreover, this is a global trend and in the West, there are many publications with reflections on "what to do next" and attempts to find a way out to the effectiveness of data management in the current conditions. But the finances of major global vendors invested in products created under the OpenBIM concept are holding back such development.

Another critical issue that should be addressed while developing information models for the life cycle of construction objects is interoperability. Current standardization of technological objects, such as the Industry Foundation Classes IFC which have been incorporated into many Western commercial software applications for building information modelling (BIM), employs as one option the index table concept. The huge volume of standardization required for the many types of objects in practical applications is a serious drawback. In addition, relations between solids must be modelled by additional objects and are not integral part of the geometry. While interoperability has been reached within the product chains of individual software houses, the original goal of the IFC development, to reach full interoperability [9] between models constructed independently on various software platforms, has not been reached completely.

Therefore, under the conditions of sanctions, Russia has a chance to take a leading position, and sets of software, data architecture formats and necessary regulations will ensure a technological and competitive advantage in the markets of other countries.

What does the so-called and not yet explicitly expressed next step, called maintaining an information model, give us in data man-

1 ERDC SR-12-2. The US Army Corps of Engineers Roadmap for Life-Cycle Building Information Modelling (BIM). Washington 2012. 45 p.

2 Bundesamt für Bauwesen und Raumwirtschaft. BIM Leitfadens für Deutschland. Final report. 2013. 109 p.

3 EU BIM Taskgroup. Handbook for the Introduction of Building Information Modelling by the European Public Sector. 2017. URL: http://www.eubim.eu/wp-content/uploads/2017/07/EUBIM_Handbook_Web_Optimized-1.pdf

4 BuildingSMART. IFC Overview. Retrieved from buildingSMART. URL: <http://www.buildingsmart-tech.org/specifications/ifc-overview> (accessed on January 27, 2018).

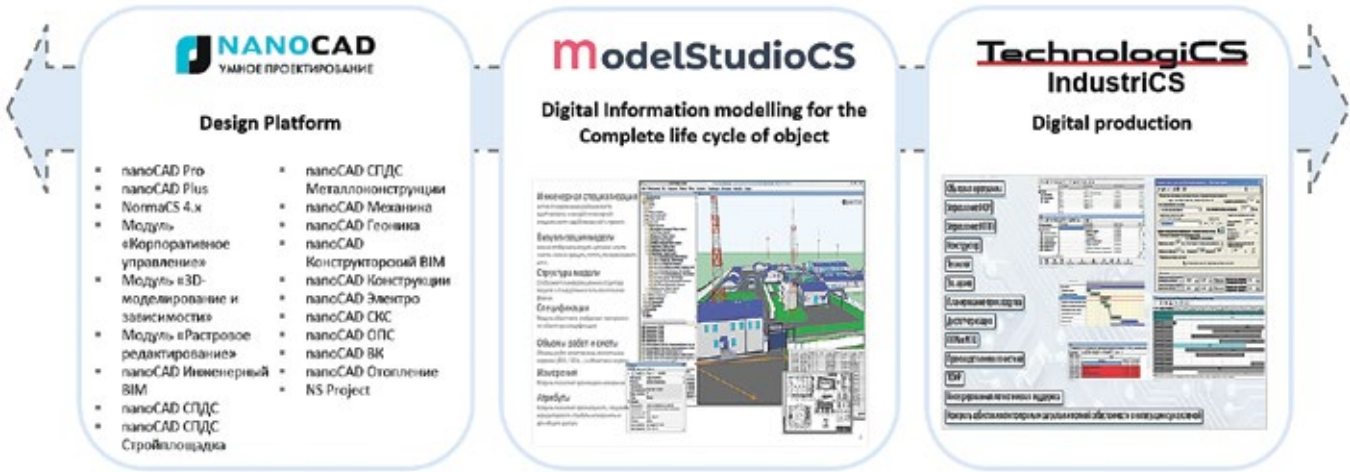


Fig. 2. Digital ecosystem of CSoft software products

agement? Under this term, Russian legislation provides for “...updating of information, documents, materials included in the archival storage...”. It clearly follows from this that “someone” or “something” during the life of the information model manages the data of the information model in the way necessary for itself, while the information model itself turns into a “smart database”. If by the phrase “something” we mean various software products (technologies) that manage information model data in an automated or automatic mode, then we will get the very division of functions into separate technologies (TIM) and the next step (maintenance) in information model data management. Where the formed information model of the “as built” level itself contains data about the object of information modeling in a convenient structured (machine-readable) form, and the information space of the information model itself adds the functionality of “interconnectedness” to the “structuring”, which already refers to the function of machine-readable data or a “smart database”⁵. It is this word (interconnectedness) in the definition of the Urban Planning Code of Russia also does not agree with the archaic concept of OpenBIM. You can learn more about the terminology and concept of the information model life cycle in the standards of the CSoft company.

It is necessary to move from general reasoning to the plane of practical embodiments of information modeling technologies that ensure the maintenance of an information model. At the same time, it is necessary to note an important circumstance — under the term “exploitation” we will understand at least two meanings — the exploitation of the object itself in the form of maintaining its operative condition, for example, to the level of “as built” and the second type of exploitation — for the intended purpose of the constructed object. Let’s call this type of exploitation — design or production-technological or socially useful exploitation. Then information modeling technologies, in the context of “management”, include such classes of software products as EDA/CAE/CFD/CAPP/CAM/MDM/PDM/MES and others. Or more broadly, the engineering data management system (EDMS) and other management systems — design, financial, sociological, personnel, environmental, etc. [10–15] At the same time, there is absolutely no need to revise the listed and non-listed systems themselves, it is enough to regulate their principles of managing their own input/output data with the principles of data management of the information space of the information model. At the same time, the information model itself plays the role of a “smart database”

due to the preliminary preparation of data in its own information space.

In a short article, it is not possible to explain in more detail the principles of building an information space and data management of an information model, but one can only say that the API principle (application programming interface) will not be able to solve all problems. For example, with an avalanche-like accumulation of data and gradation in their management. The logical way out of the impasse of data management is a seamless horizontal, which means the formation and maintenance of an information model throughout its life cycle from a business plan to an archive. At the same time, the technologies for forming and maintaining the information model itself, as a rule, use a common editable format and data architecture [7, 8]. This significantly speeds up data management and eliminates errors and the risk of data loss inherent in following the principles of the OpenBIM concept.

CSoft’s solutions for digitalization in the field of design, construction and operation are moving along this path. Moreover, exploitation in two senses is the exploitation of the object itself in the form of maintaining its operative sound condition and for the intended purpose of the constructed object. The basis of the digital ecosystem of the seamless horizontal CSoft are three software products. This is the “nanoCAD” platform, these are complex products “ModelStudioCS” and “CadLib”, as well as 14 software products for managing the construction and subsequent operation of the facility — “TechnologiCS” or, in a special case, “NS Project” as a comprehensive “3-in-1” solution for project management, processes, and document management (Fig. 2).

Let’s consider typical work organization processes, the life cycle of an information modeling object (capital structures, building or structure), in particular, more for design and construction stages (Fig. 3). At these stages, the main goal of digitalization is to eliminate design errors, optimize the timing of all construction organization processes, and make effective use of material and human resources leading to increased economic efficiency. At the same time, it is necessary to create a significant amount of documentation, usually of a standardized type, and exchange data with government, industry and other information systems.

At the same time, the information model with the help of “CadLib” provides the necessary technologies for organizing a temporary and estimated scenario for organizing construction work and if CadLib

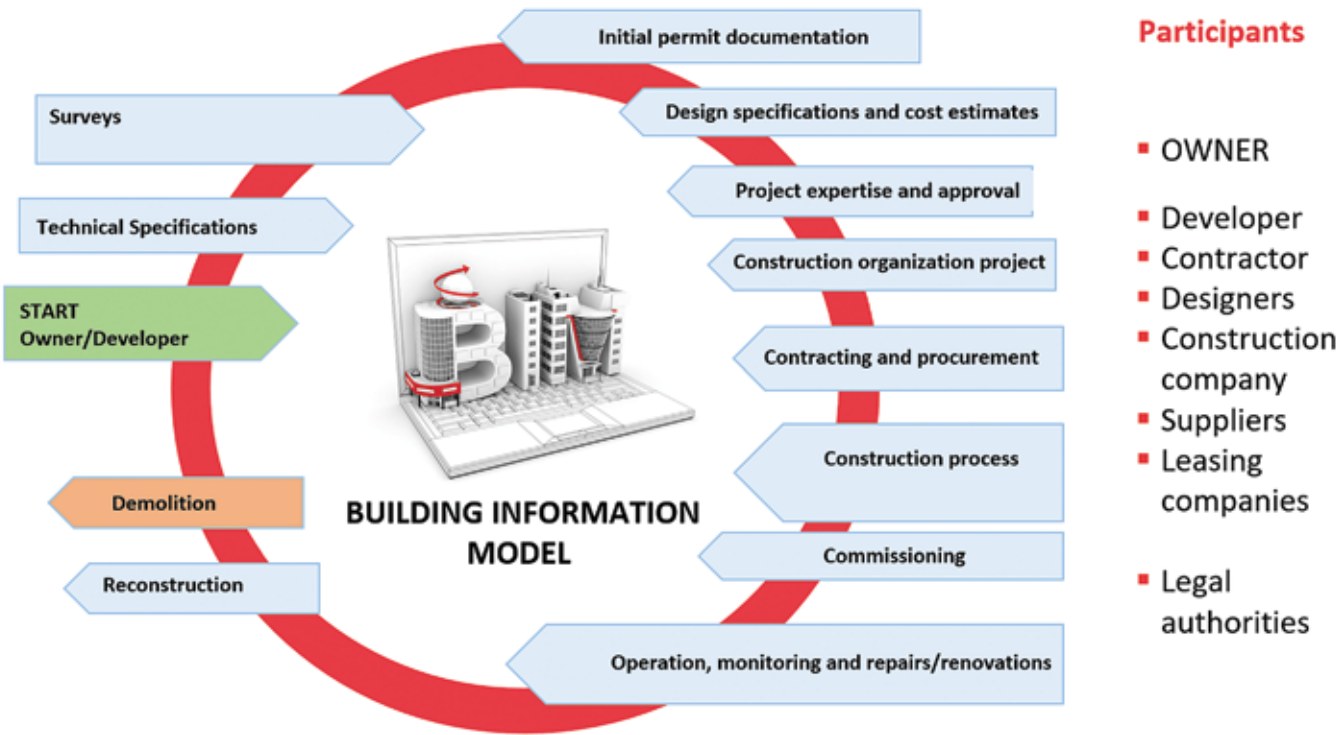


Fig. 3. Organization of information document flow in the ecosystem of CSoft products

performs calendar and network planning on its own. Then specialized software is used to perform the estimated calculations. There are several such software products in Russia and there is automated integration with several main ones³. The data required for the estimate calculation is taken from the information model itself and returned after the estimate calculation is completed.

If we return to project management, then from the point of view of automating routine processes, using specialized software products for project preparation and management, it is possible to significantly reduce errors when creating all kinds of documents, for example, at the design and/or construction stages. It is best to do this with the help of specialized technologies, which, as a rule, are

combined into specialized platform solutions, for example, “NS Project” — a comprehensive “3-in-1” solution containing modules: Electronic archive and document management, Project and Process management, Construction Management (Fig. 4).

Such technologies simplify the work of leading specialists in many ways, because it allows to avoid large labor costs for correcting errors or, if necessary, reworking ready-made packages of documents. At the same time, there are other possibilities for organizing work. Many people really like the various functions for organizing teamwork, working in various groups and internal chat between employees, regulated and customizable chains of approvals for various documents, electronic signature capabilities, services



Fig. 4. Project Management in NS Project (3-in-1 complex for project management)

for monitoring construction and installation work and much more. And all this is already in a ready-made boxed solution, but customization is not excluded both from the vendor and when using the capabilities of integrators. All these functions work in close data exchange with the information model itself. Features that allow one to implement a construction organization project, determine preliminary construction solutions, model the nuances of production, sequence and alternation of work, taking into account technology, schedules, productivity and resources of contractors and suppliers may serve as an additional tool of such project management platforms, in particular for the construction field.

Digitalization of construction sites, together with the introduction of information modeling technologies, is often a complex process, which primarily encounters the low qualifications of most employees of construction and contracting organizations. Therefore, the main task of digitalization is lower the threshold for digitalization to enter a construction site. One of the best understood mechanisms of digitalization is the technology of visualization of construction works, their organization, sequence, arrangement of construction equipment and emerging collisions. The CSofT software package allows one to make visualizations in various areas of construction work and with customizable visualization parameters, including opportunities for mobile viewing on electronic devices (gadgets) of employees. Full interoperability between technologies is one important factor, which can be difficult to implement for the principles of the IFC transport format. An example of setting visualization parameters is shown in Fig. 5.

Beautiful and colorful visualization of construction is the external aspect of the project management process. The process, which the attribute data undergoes, is much more important. They, as well as the "picture" on the screen, experience changes, ensuring clear document flow at all construction stages and phases. Labor costs are considered, the results of work, performed by executor and contractors, are issued, and recorded, work schedules are rearranged in case of delays or changes, for example, in supplies or other resources, precise and mostly automated work is carried out, which will then allow to restore the construction picture.

Special attention is paid to the increased functionality of the construction schedule, considering the availability of resources. In addition to the standard functions known from certain Western products, several important features are added that, for example, allow to estimate the necessary labor costs to perform a particular job. At the same time, the subjectivity of the assessment of the work performed is excluded and comparison is made with the planned deadlines and standards in the construction organization project. This is in fact the first or even the second step towards a "smart" graph based on machine-readable data. The next step will be using machine-readable data.

The safety and efficiency of the use of construction equipment can be significantly improved with a fairly simple feature such as tracking people and equipment on the construction site. There are many solutions which allow to track the presence of people and technical mechanisms in three-dimensional space, as well as to compare their relative location and even to assess possible future movements, especially when using bulky loads, mechanisms taking into account turning radius, U-turns, dangerous zones, etc. In this regard, people, builders and those temporarily on the construction site, receive sensors for monitoring the location, for example, of a chest mount or inside the so-called "smart" helmets; vehicles and mechanisms are equipped with sensors that allow to control not only their trajectory of movement, but also the trajectory of movement of individual parts, for example, a boom of the crane, a trailer, or a tank of a vehicle Fig. 6. The status of the sensors is transmitted to a special workplace in real time and recorded in separate files, if necessary. Feedback from the object of control is also possible, when a "smart" helmet informs a person about being in a dangerous zone.

The CSofT TechnologiCS product is used to implement the functionality of operation according to the principle of production and technological support of the production cycle. It allows one to provide continuous information support for the main business processes of the enterprise, production planning and management,



Fig. 5. Visualization of the construction process

▶ Connecting equipment components and mechanisms

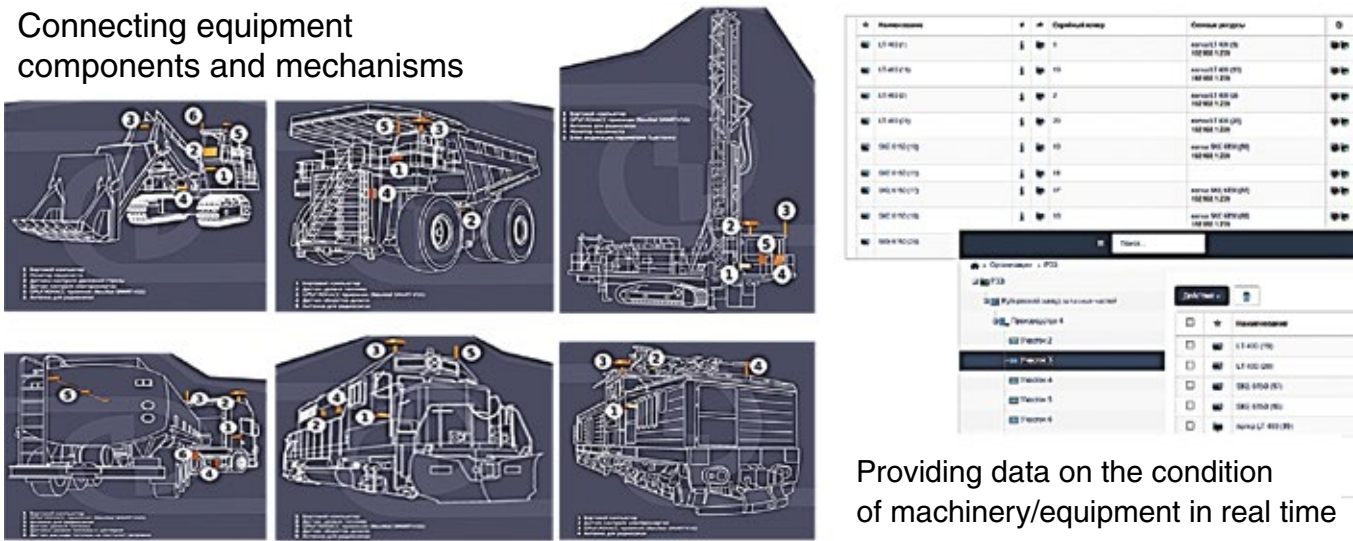


Fig. 6. Monitoring of machinery and equipment

including directly in the workshops and on the sites, as well as quality management and maintenance of manufactured products.

The above mentioned features of the “NS Project” can be used to simplify operation of the construction site itself in the form of maintaining its technically sound condition. In this case, the full functionality of technical maintenance and repair of fixed assets of the task, structure or structure and related equipment, technological and other systems is provided. At the same time, it is possible to connect sensors and dispatching systems like the Internet of Things (IIoT) to visualize an information model on a three-dimensional graph, for example, with coloring of elements and components according to planned and unscheduled maintenance and repairs, or according to the technological principle, taking into account the condition of objects and components of the object in real time (Fig. 7).

The functionality of the software for monitoring maintenance and repair allows to manage and visualize the progress of repair work; to allocate resources, schedule shutdowns and equipment switching, etc. It provides such important instruments as operational monitoring of the progress of the repair program, team-based control of the distribution of work, plan, and fact by stages of work, and analysis of the operating cost of each piece of equipment or subsystem and some other functions.

CONCLUSION

The possibilities of digitalization of the design and construction stage should be fully used for the operation stage. And this is possible under a number of conditions:

- relevance and completeness of the data;

- 3D model of buildings, machinery, equipment, technological and other systems;
- the model allows user to view, create and edit attributes and save them for public access;
- the ability to connect data received from the IIoT subsystem for visualization on the model;
- 100 % up-to-date information;
- search by model;
- coloring of the model for scheduled and unscheduled maintenance and repairs

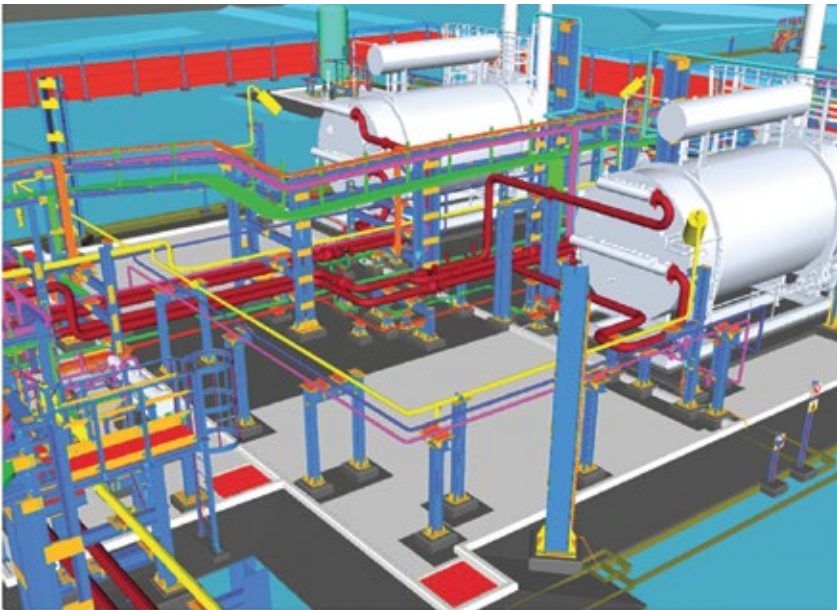


Fig. 7. Creating of digital models for operating services using BIM technologies based on real-time information from objects or/and components status

- full-fledged interoperability of the information model according to the stages of its life cycle;
- the absence of risks of loss, damage and distortion in the data management horizontal due to "white spots" or the use of transport formats;
- the possibility of long-term storage of information model data in an editable format and the transfer of information modeling technologies to a competitive basis with the possibility of replacing them at any point in the information model lifecycle.

REFERENCES

1. Addis B. *Physical Models and Innovation in Architectural and Civil Engineering*. Nexus Network Journal. 2021; 23(4). DOI: 10.1007/s00004-021-00560-1
2. Kraft B., Huhnt W. *Geometrically Complete Building Models*. In *Proceedings of the EG-ICE 2014 conference*, Cardiff University, 16-18 July 2014. DOI: 10.13140/2.1.1702.1123
3. Bilchuk I., Pahl P.J. *Three-dimensional Topological Models of Buildings*. Vestnik, Moscow State University of Civil Engineering. 2012; 69(10):289-296. DOI: 10.22227/1997-0935.2012.10.289-296
4. Bloomberg M., Burney F., Resnik D. *BIM Guidelines*, New York. New York City Department of Design + Construction. 2012; 57.
5. 4th European BIM Summit, March 2018, Barcelona : BIM-2018. European Building Summit Barcelona.
6. Bocharov M.E. *Is BIM an analogue or a prototype of information modeling in Russia? General Director. Management of an industrial enterprise*. 2022; 10. (rus.).

7. Kurbatov V., Rimshin V., Shubin I., Volkova S. *Handbook for Information Modelling and AI in Modern Construction & Housing and Communal Services*. Publishing House ASV. Moscow, 2023; 420. (rus.).
8. Bachurina S. *Information Modelling: Methodology of Usage of Digital Models in the Process of Transition to Digital Design and Construction*. Part 1 : a Handbook. DMK-Press, Moscow, 2021; 112.
9. Steel J., Drogemuller R., Toth B. *Model Interoperability in Building Information Modelling*. Software and Systems Modelling, Springer Berlin, 2012; 1:99-109. DOI: 10.1007/s10270-010-0178-4
10. Huhnt W. *A Digital Environment for Managing Processes in Civil Engineering*. Abstract Volume: 14th International Conference on Computing in Civil and Building Engineering. Publishing House ASV, 2012; 24-25.
11. Pan X., Mateen Kh.A., Eldin S.M., Aslam F., Kashif Ur Rehman S., Jameel M. *BIM adoption in sustainability, energy modelling and implementing using ISO 19650 : a review*. Ain Shams Eng J. 2023; 15(2):102252. DOI: 10.1016/j.asej.2023.102252
12. Aziminezhad M., Taherkhani R. *BIM for deconstruction : a review and bibliometric analysis*. J Build Eng. 2023; 73:106683. DOI: 10.1016/j.jobe.2023.106683
13. Zhou X., Ma Ch., Wang M., Guo M. *BIM product recommendation for intelligent design using style learning*. J Build Eng. 2023; 73(1):106701. DOI: 10.1016/j.jobe.2023.106701
14. Yilmaz G., Akcamete A., Demirors O. *BIM-CAREM: assessing the BIM capabilities of design, construction, and facilities management processes in the construction industry*. Computers in Industry. 2023; 147(3):103861. DOI: 10.1016/j.compind.2023.103861
15. Gartoumi K.I., Zaki S., Aboussaleh M. *Building information modelling (BIM) interoperability for architecture and engineering (AE) of the structural project: a case study*. Materials Today Proceedings. 2023. DOI: 10.1016/j.matpr.2023.05.408

Информационные модели объектов строительства в течение их жизненного цикла

В течение последнего десятилетия информационное моделирование играло ключевую роль в осуществлении революционных и систематических изменений в гражданском строительстве. В данной статье описывается разработка моделей, используемых архитекторами и инженерами, от масштабных моделей эпохи Возрождения до оперативных моделей, поддерживающих построенный объект на протяжении всего его жизненного цикла. Описывается развитие концепции информационного моделирования и ключевая роль инженерных данных и управления данными в процессе информационного моделирования. Анализ существующей концепции OpenBIM, используемой западными вендорами, показывает, что, несмотря на результативную работу на этапе проектирования, управлению данными не хватает эффективности на строительной площадке и в процессе эксплуатации.

Важное свойство интероперабельности также не было достигнуто с помощью базовых отраслевых классов, которые в настоящее время используются в большинстве западных программных продуктов. В существующих условиях у России есть шанс занять лидирующее положение.

Ключевые слова: информационное моделирование, объекты капитального строительства, жизненный цикл, управление данными, интероперабельность

СПИСОК ИСТОЧНИКОВ

1. Addis Bill. *Physical Models and Innovation in Architectural and Civil Engineering* // Nexus Network Journal. 2021. No. 23 (4). DOI: 10.1007/s00004-021-00560-1
2. Kraft B., Huhnt W. *Geometrically Complete Building Models* // In *Proceedings of the EG-ICE 2014 conference*, Cardiff University, 16-18 July 2014. DOI: 10.13140/2.1.1702.1123
3. Bilchuk I., Pahl P.J. *Three-dimensional Topological Models of Buildings* // Vestnik, Moscow State University of Civil Engineering.

2012. No. 69 (10). Pp. 289–296. DOI: 10.22227/1997-0935.2012.10.289-296
4. Bloomberg M., Burney F., Resnik D. *BIM Guidelines*, New York. New York City Department of Design + Construction. 2012. 57 p.
5. 4th European BIM Summit, March 2018, Barcelona : BIM-2018. European Building Summit Barcelona.
6. Бочаров М.Е. *ВМ — аналог или прототип информационного моделирования в России? // Генеральный директор. Управление промышленным предприятием*. 2022. № 10.
7. Курбатов В.Л., Римшин В.И., Шубин И.Л., Волкова С.В. *Информационное моделирование и искусственный интеллект в современном строительстве и жилищно-коммунальном хозяйстве : уч. пособие*. М. : Изд-во АСВ, 2023. 420 с.
8. Бачурина С.С. *Информационное моделирование: методология использования цифровых моделей в процессе перехода к цифровому проектированию и строительству*. Ч. 1 : уч. пособие. М. : Изд-во ДМК-Пресс, 2021. 112 с.
9. Steel J., Drogemuller R., Toth B. *Model Interoperability in Building Information Modelling* // Software and Systems Modelling, Springer Berlin, 2012. Issue 1. Pp. 99–109. DOI: 10.1007/s10270-010-0178-4
10. Huhnt W. *A Digital Environment for Managing Processes in Civil Engineering* // Abstract Volume: 14th International Conference on Computing in Civil and Building Engineering. Publishing House ASV, 2012. Pp. 24–25.
11. Pan X., Mateen Kh.A., Eldin S.M., Aslam F., Kashif Ur Rehman S., Jameel M. *BIM adoption in sustainability, energy modelling and implementing using ISO 19650 : a review* // Ain Shams Eng J. 2023. No. 15 (2). P. 102252. DOI: 10.1016/j.asej.2023.102252
12. Aziminezhad M., Taherkhani R. *BIM for deconstruction : a review and bibliometric analysis* // J Build Eng. 2023. No. 73. P. 106683. DOI: 10.1016/j.jobe.2023.106683
13. Zhou X., Ma Ch., Wang M., Guo M. *BIM product recommendation for intelligent design using style learning* // J Build Eng. 2023. No. 73 (1). P. 106701. DOI: 10.1016/j.jobe.2023.106701
14. Yilmaz G., Akcamete A., Demirors O. *BIM-CAREM: assessing the BIM capabilities of design, construction, and facilities management processes in the construction industry* // Computers in Industry. 2023. No. 147 (3). P. 103861. DOI: 10.1016/j.compind.2023.10386120.
15. Gartoumi K.I., Zaki S., Aboussaleh M. *Building information modelling (BIM) interoperability for architecture and engineering*

(AE) of the structural project : a case study // *Materials Today Proceedings*. 2023. DOI: 10.1016/j.matpr.2023.05.40821

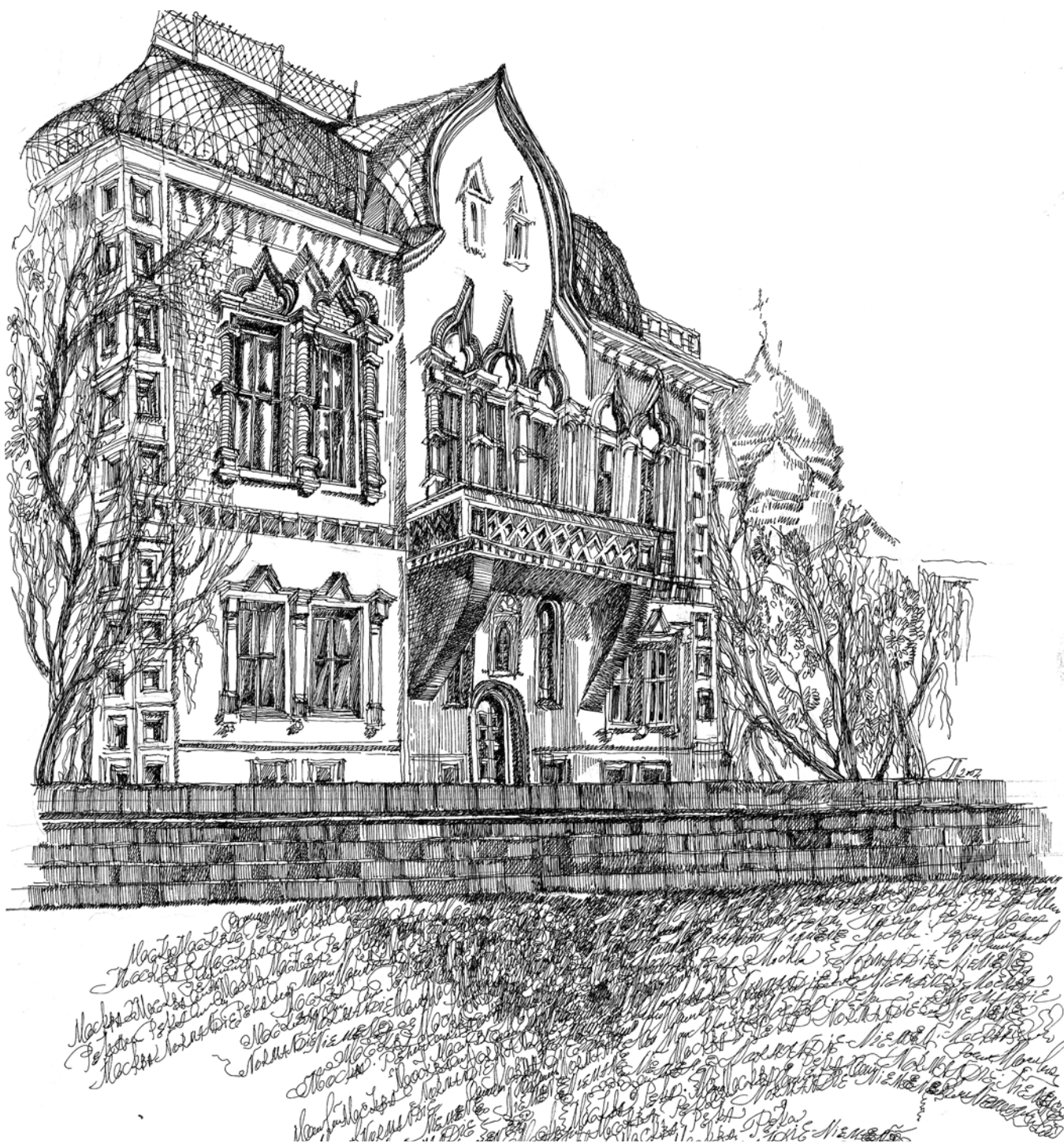
Об авторах: **Галишникова Вера Владимировна** — доктор технических наук, доцент, PhD, проректор; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 294267, Scopus: 55303553900, ResearcherID: AAA-7515-2022; GalishnikovaVV@mgsu.ru;

Бочаров Михаил Евгеньевич — кандидат технических наук,

исполнительный директор; **СиСофт Разработка (CSoft)**; 115533, г. Москва, Нагатинская Набережная, д. 18, кор. 1; SPIN-код: 2974-4449; Bocharov.mihail@csoft.ru.

For citation: Galishnikova V.V., Bocharov M.E. Information models of construction objects during their life cycle. *Real Estate: Economics, Management*. 2024; 2:65-72.

Для цитирования: **Галишникова В.В., Бочаров М.Е.** Information models of construction objects during their life cycle // *Недвижимость: экономика, управление*. 2024. № 2. С. 65–72.



Л.И. Павлова. Москва. Дом Васнецова. Рисунок, тушь, перо.

UDC 004.045

Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development

In the last few years in Russia there has been an active updating of construction legislation and regulatory and technical base. This has manifested itself in the adoption and abolition of dozens of regulatory and normative-technical documents, in the introduction of various amendments to existing acts, in the adjustment of technical regulations and sets of rules, in the revision of national and interstate standards. Primarily, these updates are aimed at reducing existing administrative barriers, reducing the time and cost of construction, and improving the quality of construction products. One of the directions of this development is the transition to the parametric method of standardization, which will be a continuation of the movement towards a more efficient and innovative technical standardization system in the industry, while guaranteeing the safety of technical solutions. At the same time, the construction industry of our country is preparing to introduce the registry principle of maintaining technical requirements, which is also one of the tasks of improving the system of technical regulation. It is determined that the principle will be ensured through the formation of an integral system of regulatory documents establishing uniform mandatory requirements at all stages of the life cycle of the capital construction object. Some normative acts already include mechanisms for the implementation of the registry principle and the formation of a system of management of safety and quality requirements of capital construction objects based on the creation and maintenance of digital registers of requirements in the industry.

Do these two innovations influence each other? Are they intended to achieve a single goal? The paper considers and analyzes the necessity and possibility of mutual integration and joint development of parametric method of norming and registry principle in construction.

Keywords: Digital registers of requirements, parametric rationing method, prescriptive rationing method, organization standard, functional and technological requirements, building information models, professional competencies

TOWARDS PARAMETRIC NORMING

Modern regulatory support in the construction industry, under the influence of socio-economic factors, needs gradual qualitative changes. It should become more flexible and oriented to changes in the conjuncture and consumer demands in relation to the formed environment and its elements. The efficiency of regulatory support determines the increasing indicators of the industry development, the level of satisfaction of consumers of construction products with the formed conditions for human life and activity. Revision of the regulatory legal framework in order to transition from the prescriptive to the parametric method of rationing, as well as the development of alternative ways and mechanisms to substantiate the compliance of design values and characteristics of a building or structure with safety requirements, is one of the main activities of the Strategy for the development of the construction industry and housing and communal services of the Russian Federation for the period up to 2030 with a forecast up to 2035 [1]. Obviously, the new concept of regulatory requirements becomes one of the most important tasks in the field of standardization for the construction industry. With this method of standardization, there are many alternative ways in the realization of the capital construction object, and the task of performers, including designers and experts, is to choose and justify the most effective way, rather than to rigidly follow all the requirements of the current regulations [2].

The existing system of regulatory documents in construction is an organized structure of interrelated

documents applied at all stages of the life cycle of capital construction projects to protect the rights and interests of their consumers, society and the state. In this regard, in 2024 the Ministry of Construction and Housing and Communal Services of the Russian Federation and the Federal Autonomous Institution 'Federal Center for Norming, Standardization, and Technical Conformity Assessment in Construction' plan to develop a code of practice on parametric norming. But despite the advantages of parametric standardization — flexibility and adaptability; cost reduction; stimulation of innovations; improvement of construction quality; ensuring sustainable development, the transition to it in practice is difficult for various reasons.

The parametric method assumes that the basis for standardization is the goal that a specific normative requirement is trying to achieve. Many alternatives for achieving this goal are allowed, from which the most effective/suitable one must be chosen [3].

The prescriptive method of rationing that existed until now, based on the action of building codes, and later code of practice, neither implied the formulation of the goal nor allowed variability in its achievement, i.e. it meant the necessity of strict adherence to the normative requirements. But with the emergence of new technologies, changing conditions of activity and the environment in which it is necessary to comply with the norms, the demand for flexibility increases. The parametric method of norming is designed to provide it, because it is oriented to the result and the optimal trajectory of its achievement, and it also involves

Zvonov I.A.
Kashirina N.V.



Zvonov Ilya Alexandrovich,
Director of the scientific and educational centre "Digital construction and operation"; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 6197-7370, Scopus: 57204363101, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru



Kashirina Natalia Vladimirovna,
Joint Stock Company "Kodeks", Curator; University Information Support project; 3 X Instrumentalnaya st., Saint Petersburg, 197376; Russian Federation; SPIN-code: 2752-6270, ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru

► the formation of a system of requirements, in which there are more general requirements (corresponding to laws, legal acts) and more specific (which relate to the enforcement of laws), which in turn allow to qualitatively and quantitatively determine the requirements and parameters¹.

The principles of parametric standardization in general terms can exist in conditions when the objectives are set by regulatory legal acts and technical regulations, and it is possible to implement them in different ways, for example, relying on code of practice or organizational standard. But even here there is a paradox: if there is only one standard, the contractor has nothing to choose from, the principle of flexibility does not work.

On the way to parametric standardization there are difficulties of different order. One of them concerns the creation of standards: there is no established system in which the standard developed by self-regulating organizations is protected by intellectual property rights and acquired by interested parties, as it happens in foreign countries. This results in low interest in the development of their own standards, the number of standards remains small, there is no variability, and there is no competition between developers, which, in turn, affects the improvement of the "quality" of the requirements set out in the standard and designed, among other things, to reduce costs and ensure sustainable development¹.

Other difficulties are related to the use of organizational standards. Foreign company standards, developed on the basis of ISO, become part of the contract, and the requirements become norms for a specific object. In these conditions there is a need to select the necessary requirements from some generalized database (register of requirements)². In the Russian Federation there is no such principle, so in this context the issue of converting standards of voluntary application into machine-readable form becomes debatable. At the same time, combining parametric standardization, the conversion of norms into a machine-readable format and the establishment of SMART standards, the interconnection of norms, and their integration with pricing, procurement, etc., into a unified system will greatly enhance process optimization, elevate work quality, and boost overall efficiency.

However, there are difficulties of another order — they relate to the culture of work processes and full-fledged technological competencies. In order to determine the correct parameters and their values, highly qualified personnel and technological development of construction science, including applied science, are required³. Under the parametric method the developer can independently determine in accordance with which documents he will ensure the safety of the capital construction facility, but the habit of referring to the standard as the only correct option for solving certain production problems reduces the ability to make decisions, the likelihood of new and innovative technologies, etc. The situation is aggravated by the fact that due to the transfer of regulatory and technical documents to the sphere of voluntary application, "a whole generation of customers and designers has grown up, who have formed the principle of selective application of code of practice" [3].

Difficulties in the transition to parametric normalization can be solved, among other things, if the specialists of the construction industry have developed technological competences. Since

technological competence includes knowledge of modern and promising technologies, experience of their use in practice on the basis of acquired technological knowledge, technological skills, taking into account the personal significance (value) of professional activity [4]. If we simplify this definition, it turns out that a full-fledged technological competence includes the ability to realize some technological process, relying on the knowledge of how this process is realized, why and how it is necessary to perform each stage of this process. Among the main tasks of the conformity assessment system development, experts cite the need to improve the level of professional competence of experts, specialists and officials involved in conformity assessment, including innovative, or alternative solutions in the parametric system of norming by developing and improving the mechanisms of accreditation of educational programs of continuous training and conducting independent qualification assessment (certification) of experts and specialists⁴. Unfortunately, full-fledged technological competencies are not often found, as their principles are partially or not always correctly executed, which eventually affects the whole process. Partly this tendency can be observed in normative documents: often there is no information about why it is necessary to do it this way and not another way, not always the steps (the more detailed and evidentiary) that need to be done in order to get the expected result by implementing this or that technology. With the emergence of new technologies, the situation becomes even more complicated — there is a technology, but no standard. There is a standard, but it does not fully describe the technology. Because the technology is not described in detail and the reasons for performing certain actions in the appropriate sequence are not described, important information is lost and incomplete. As a result, at lower levels of execution the technology cannot be realized fully and qualitatively, as well as transferred from one level of performers to another. It is impossible to work in high-tech production by trial and error.

As we mentioned above, a prescriptive method defines norms and requirements, but does not explain what the purpose of meeting the norm is or why the quantitative parameter of the norm should be the way it is. This information remains with the developer of the standard and also remains unchanged if technology changes, unless changed by the same developer [3]. But in the conditions of changing socio-economic environment, including rapid technological development, and the emergence of new requirements for designed objects due to changes in the purposes of their construction and functions, difficulties arise when there is no understanding that it would be better to move away from the prescribed norm or there is no way to justify the transition to another norm.

What is needed at this time is a school that will create technology, what is needed is an environment in which the preconditions for the creation of technology can emerge in order to meet the challenges of technological sovereignty [5, 6]. Nevertheless, a detailed description of construction processes and their requirements in standards can solve some of the problems described. This is where the advantage of parametric standardization can be seen, which is designed to help achieve the objective in the most efficient way by creating a new standard or selecting appropriate requirements.

1 Why doesn't parametric normalization work? URL: <https://www.all-smety.ru/company/news/pochemu-parametriceskoe-normirovanie-ne-rabotaet/?ysclid=luz3n1kew921267842> (rus.).

2 Parametric norming in construction. URL: <https://exinco.ru/news/parametriceskoe-normirovanie-v-stroitelstve/?ysclid=luzqzas54538324753> (rus.).

3 Pustovgar A.P. Prospects of transition of the construction industry to the norms based on the parametric method of rationing. URL: <https://smeta-na.ru/tehnologii/perspektivy-perehoda-stroitelnoj-otrasli-na-normy-osnovannye-na-parametriceskom-metode-normirovaniya/?ysclid=luz8cngf3408612912> (rus.).

4 Barinova L.S. On the directions of reforming the system of technical standardization and regulation in the construction industry. URL: https://profi.erzrf.ru/upload/iblock/cd6/L.S.-Barinova_-O-napravleniyakh-reformirovaniya-sistemy-tekh-normirovaniya.pdf?ysclid=lv2pqugo1m604218151 (rus.).

The key principle in this case will be to match the requirements to a specific object or type of work.

PARAMETRIC METHOD OF STANDARDIZATION AND THE REGISTRY PRINCIPLE IN CONSTRUCTION

A detailed consideration of the features and advantages of the registry principle in construction was carried out by the authors in previous publications. In the following we will establish the relationship between the parametric method of standardization and the registry principle. The transition to working with requirements in digital form is one of the key tasks in the digitalization of the construction industry. The transition to the registry principle is planned to start from April 2024 [7]. This is due not only to the need to link specific requirements to the information model, but also to provide conditions for the automation of this process, as well as the process of control over the requirements (search, relevance check, conformity assessment, etc.) [8]. But the transition to working with requirements involves certain difficulties, in particular:

1. Misunderstanding among implementers (industry) of what constitutes a digital registry, what is meant by a requirements registry, what is a requirement.
2. Uncertainty associated with the use of neural networks (artificial intelligence) in the process of extracting requirements from regulatory documents and forming registers.
3. Lack of ready-to-use registers of requirements.
4. Lack of methods and opportunities for linking the register of requirements to design solutions.
5. Lack of algorithms, methods and capabilities to integrate registers of requirements into digital information models.

In accordance with the Provisions of the Decree of the government of the Russian Federation from 06.02.2021 No. 128 and from 26.08.2023 No. 1389 it is supposed to create registers of mandatory requirements on the resource "Sroycomplex.RF", also the developers of Information reference systems are engaged in the creation of registers of requirements of technical regulations, which would be convenient to work with in a single information space (system "Tehexpert: SMART-designing"). But these registers are created, first of all, for normative requirements that are mandatory for fulfillment, which is logical. However, functional and process requirements remain uncovered. It is also important for the industry to have access to registers of those requirements that are used in the work and prescribed in the company's internal documentation. In practice, it turns out that realizing the benefits of the registry principle is delayed over time.

Meanwhile, the application of the registry principle may significantly affect the possibility of implementing the parametric rationing method. Before defining the mechanism of such interaction it is necessary to define the terms.

Requirement is a provision of a normative document containing criteria that must be met. Traditionally, in normative and technical documentation used in the construction industry, there is no clear structure of the text of the standard, where each paragraph corresponds to one requirement; there are complex requirements; a requirement can be an illustration, a table; there are collisions of requirements (regulatory guillotine). Also the requirement may be unmeasurable quantitatively, and the degree of compliance with the requirement is not specified (i.e. variability of its achievement is assumed, as we mentioned when describing the method of parametric standardization).

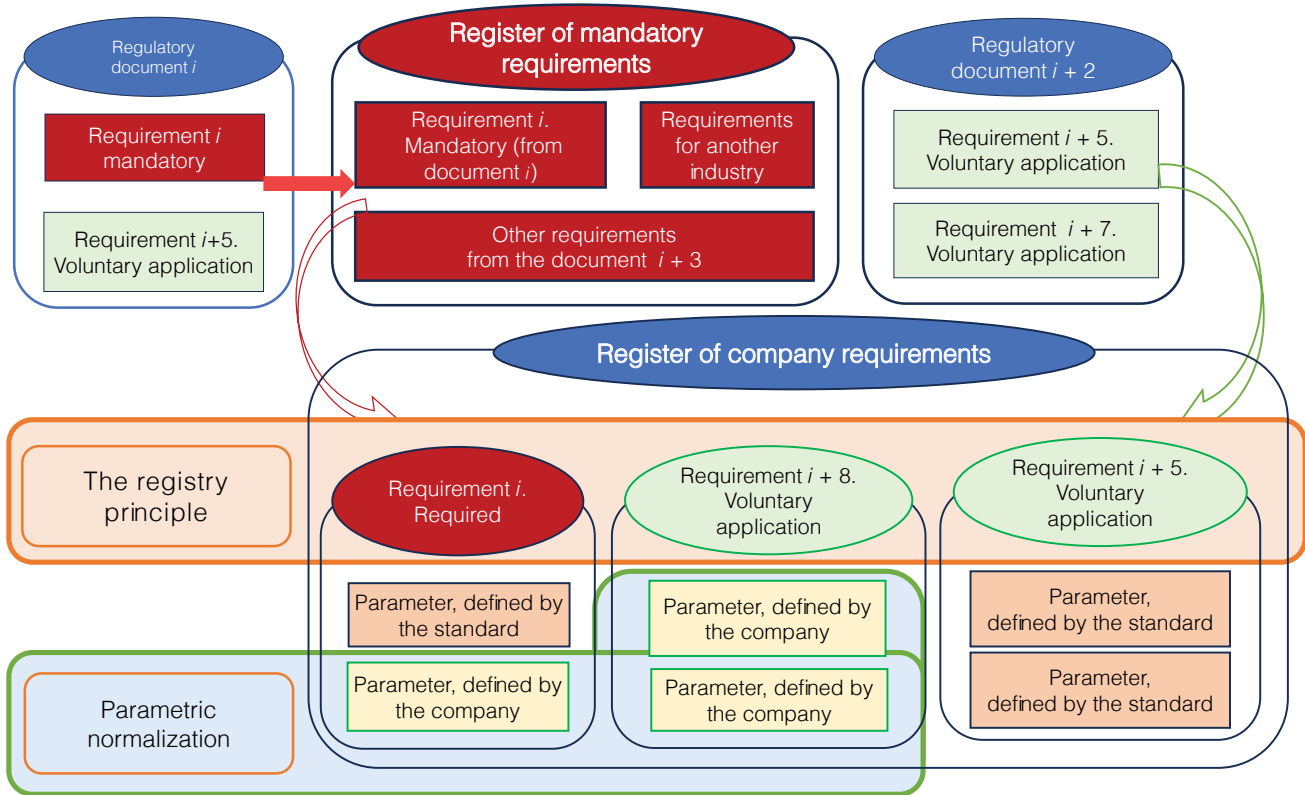
A parameter is a feature, usually quantitative, but on the basis of which something is evaluated, defined or classified, a measure of evaluation. A parameter can also be some significant measurable characteristic of a system.

Based on these definitions, the parameter is a component of the requirement and serves to define the characteristics that must be achieved to fulfill the stated requirements. The concept of a parameter is important in the creation of requirement registries for several reasons:

1. A parameter, especially a quantitative one, is easy to formalize (make understandable to the information system) and hence to integrate into an information model.
2. Formalized parameters can be collected in a database (for example, in *xml format), set up between them logical relationships and provide automation of various practical tasks. Based on such a principle, the authors have developed an algorithm for assessing the compliance of performed works with the norms [9].
3. If the parameter is not specified in the requirement specifically, the performer can determine the appropriate parameter by himself, adapting it to his capabilities and applied technologies.
4. Functional and technological parameters can be flexibly customized (if the normative requirement does not specify certain characteristics) depending on the needs and requests of the functional customer. Functional parameters are given not by chance, because according to the Strategy for the Development of the Construction Industry and Housing and Utilities Sector: "parametric method of normalization" — a method of establishing regulatory requirements, in which the establishment of mandatory requirements applies only to the operational (functional) characteristics of the object of technical regulation, including quantitative parameters, regardless of its design and performance.

As a result, in the array of parameters extracted from the normative requirements, respectively, there may be mandatory parameters, parameters of voluntary execution, as well as parameters defined by technical or functional customers "for themselves". At this stage parametric normalization appears. As we have already mentioned above, in the conditions of technology development and appearance of new requirements to designed objects, there is often a need to justify the transition from the prescribed norm or realization of this norm using more technological solutions. It is possible to justify such a transition, among other things, by defining new parameters to achieve the required result.

If we summarize the above, we can outline the following hierarchy of rationing levels (Fig.). The upper level is the objectives of rationing, they are defined by the laws and should realize the relevant socially important objectives. In our case, this level will include registers of mandatory requirements defined by the regulator. The next level is the parameters of mandatory requirements or requirements of voluntary application. The next level is the parameters that allow to achieve regulatory requirements, but defined taking into account the capabilities and needs of the performer. These can be parameters of architectural and construction, engineering and technical, functional and technological and operational requirements. It follows that parametric standards are of great importance in all phases of the building life cycle. In this connection The Ministry of Construction and Housing and Communal Services has included in the list of the main directions of work on the transition to the parametric method further digitalization of urban planning processes, reformatting of the evidence base of the Technical Regulations on the Safety of Buildings Technical Regulations on the Safety of Buildings and Structures, ►



Schematic diagram of the formation of parameters

strengthening the role and responsibility of project engineer and chief project architect and much more⁵.

Requirements and parameters can also be formalized in registers or databases, added to organizational standards, technical specifications, process maps or other company documentation. Thanks to this approach, users of register of regulatory requirements get all the advantages of both the registry principle and parametric standardization: optimization and automation of work processes, increased efficiency, cost reduction, improved product quality and labour productivity⁶. Including, due to more active work with requirement registers, there are prospects for the transition to “smart” SMART-standards.

CONCLUSIONS

In conclusion, it can be stated preliminarily that parametric normalization has great prospects for implementation and effects of use. But it is necessary to develop a concept that will describe this method and its applications, including a clear definition of concepts. In order to ensure the relationship between the parameters in the information model, it is necessary to understand what exactly will be the parameters, what will be the characteristics, how to build the architecture of connections between the parameters so that the resulting virtual model is flexible and changes after adjusting the selected parameters. Therefore, a reformatted norming system could more successfully address the challenges confronting the construction industry and ensure the improvement of safety of construction products, their reliability and quality, increase

the energy efficiency of buildings, labor conditions and living conditions of citizens. It can be considered that the development of parametric standardization and the registry principle are the most important tasks in the field of standardization in the construction industry.

REFERENCES

1. On Approval of the Strategy for the Development of the Construction Industry and Housing and Communal Services of the Russian Federation for the Period until 2030 with a Forecast until 2035 : Order of the Government of the Russian Federation No. 3268-r dated October 31, 2022. URL: <https://AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf> (rus.).

2. The parametric method of rationing in construction requires the training of personnel of completely new formations. URL: <https://maistro.ru/novosti/parametricheskij-metod-normirovaniya-v-stroitelstve-trebuetsya-podgotovki-kadrov-sovershenno-novykh-formacij> (rus.).

3. Kolubkov A.A. Parametric normalization method. Constant desire for change. ABOK. 2023; 8. URL: https://www.abok.ru/for_spec/papers.php?nid=8588&ysclid=luzq6dcrsf648338703 (rus.).

4. Kashkin S.N. Development of the model of professionally oriented continuous technological education of the future specialist : abstract of the dissertation of the candidate of pedagogical sciences. Voronezh, 2006; 23. (rus.).

5. Concept of technological development for the period until 2030 : Order of the Government of the Russian Federation dated 20.05.2023 No. 1315-r. URL: <http://pravo.gov.ru/proxy/ips/?docbody=&prevDoc=605718545&backlink=1&nd=605445497> (rus.).

6. Strategy of Scientific and Technological Development of the Russian Federation : Decree of the President of the Russian

5 The basis for a new approach to construction in Russia may be approved by April. URL: <https://taufcc.ru/press-tsentr/novosti/bazu-dlia-novogo-podkhoda-k-stroitelstvu-v-rossii-mogut-utverdit-do-aprelia>

6 The transition to parametric rationing in construction will start with the underlying code of practice. URL: <https://gkkodeks.cntd.ru/news/read/perehod-na-parametricheskoe-normirovanie-v-stroitelstve-nachnetsya-s-osnovopolagaushego-sp/novosti-stroitelnoy-otrasli>

Federation dated 28.02.2024 No. 145. URL: <http://pravo.gov.ru/proxy/ips/?docbody=&firstDoc=1&lastDoc=1&nd=102416645> (rus.).
7. The unified construction requirements register will be fully digitized by 2026. URL: <https://www.vedomosti.ru/politics/news/2023/10/03/998481-edinii-reestr-v-stroitelstve> (rus.).
8. Zvonov I.A., Kashirina N.V. Register of normative requirements in the structure of digital twin. *Real Estate: Economics, Management*.

2023; 3:255-257. URL: <https://n-eu.iasv.ru/index.php/neu/issue/view/27/34> (rus.).
9. Zvonov I.A., Kashirina N.V. The registry principle and SMART documents as conditions for the digital transformation of technical building operation. *Real Estate: Economics, Management*. 2023; 1: 49-53. DOI: 10.22337/2073-8412-2023-1-49-53 URL: <https://n-eu.iasv.ru/index.php/neu/article/view/117/139>

Перспективы применения параметрического метода нормирования в условиях реестрового принципа разработки технических требований

В последние несколько лет в России происходит активное обновление строительного законодательства и нормативно-технической базы. Это выразилось в принятии и отмене десятков нормативно-правовых и нормативно-технических документов, во внесении различных изменений в действующие акты, в проведении корректировок технических регламентов и сводов правил, пересмотре национальных и межгосударственных стандартов. Преимущественно эти обновления нацелены на сокращение существующих административных барьеров, уменьшение сроков и стоимости строительства, повышение качества строительной продукции. Одним из направлений данного развития является переход на параметрический метод нормирования. Ожидается, что это станет продолжением движения в сторону более эффективной и открытой к инновациям системы технического нормирования в отрасли, гарантирующей при этом соблюдение безопасности технических решений.

Одновременно с этим в строительной отрасли нашей страны готовится внедрение реестрового принципа ведения технических требований, что тоже является одной из задач совершенствования системы технического регулирования. Определено, что принцип будет обеспечиваться посредством формирования целостной системы нормативных документов, устанавливающей единые обязательные требования на всех этапах жизненного цикла объекта капитального строительства.

В отдельные нормативные акты уже включены механизмы реализации реестрового принципа и формирования системы управления требованиями безопасности и качества объектов капитального строительства на основе создания и ведения цифровых реестров требований в отрасли.

Влияют ли эти два нововведения друг на друга? Призваны ли они достичь единой цели? В статье рассмотрены и проанализированы необходимость и возможность взаимной интеграции и совместного развития параметрического метода нормирования и реестрового принципа в строительстве.

Ключевые слова: цифровые реестры требований, параметрический метод нормирования, предписывающий метод нормирования, стандарт организации, функциональные и технологические требования, информационные модели зданий, профессиональные компетенции

СПИСОК ИСТОЧНИКОВ

1. Об утверждении Стратегии развития строительной отрасли и жилищно-коммунального хозяйства РФ на период до 2030 г. с прогнозом до 2035 г. : распоряжение Правительства РФ от 31 октября 2022 г. № 3268-п. URL: <https://AdmXczBBUGfGNM8tz16r7RkQcsgP3LAm.pdf> (government.ru).

2. Параметрический метод нормирования в строительстве требует подготовки кадров совершенно новых формаций. URL: <https://maistro.ru/novosti/parametricheskij-metod-normirovaniya-v-stroitelstve-trebuets-podgotovki-kadrov-sovershenno-novykh-formacij>
3. Kolubkov A.A. Параметрический метод нормирования. Постоянное стремление к изменениям // *АВОК*. 2023. № 8. URL: https://www.abok.ru/for_spec/articles.php?nid=8_588&ysclid=luzq6dcrsf648338703
4. Кашкин С.Н. Разработка модели профессионально ориентированного непрерывного технологического образования будущего специалиста : автореф. дис. ... канд. пед. наук. Воронеж, 2006. 23 с.
5. Концепция технологического развития на период до 2030 года : распоряжение Правительства Российской Федерации от 20 мая 2023 г. № 1315-п. URL: <http://pravo.gov.ru/proxy/ips/?docbody=&prevDoc=605718545&backlink=1&nd=605445497>
6. Стратегия научно-технологического развития Российской Федерации : Указ Президента РФ от 28.02.2024 № 145. URL: <http://pravo.gov.ru/proxy/ips/?docbody=&firstDoc=1&lastDoc=1&nd=102416645>
7. Единый реестр требований в строительстве полностью оцифруют к 2026 году. URL: <https://www.vedomosti.ru/politics/news/2023/10/03/998481-edinii-reestr-v-stroitelstve>
8. Звонов И.А., Каширина Н.В. Реестр нормативных требований в структуре цифрового двойника // *Недвижимость: экономика, управление*. 2023. № 3 (приложение). С. 255–257. URL: <https://n-eu.iasv.ru/index.php/neu/issue/view/27/34>
9. Zvonov I.A., Kashirina N.V. The registry principle and SMART documents as conditions for the digital transformation of technical building operation // *Недвижимость: экономика, управление*. 2023. № 1. С. 49–53. DOI: 10.22337/2073-8412-2023-1-49-53 URL: <https://n-eu.iasv.ru/index.php/neu/article/view/117/139>

Об авторах: **Звонов Илья Александрович** — директор научно-образовательного центра «Цифровое строительство и эксплуатация»; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 6197-7370, Scopus: 57204363101, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru;

Каширина Наталия Владимировна — куратор проекта информационной поддержки ВУЗов; **АО «Кодекс»**; 197376, г. Санкт-Петербург, ул. Инструментальная, д. 3, лит. X; SPIN-код: 2752-6270, ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru.

For citation: Zvonov I.A., Kashirina N.V. Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development. *Real Estate: Economics, Management*. 2024; 2:73-77.

Для цитирования: Звонов И.А., Каширина Н.В. Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development // *Недвижимость: экономика, управление*. 2024. № 2. С. 73–77.

Sezemin D.E.



**Sezemin
Denis Evgenievich,**

Candidate of the degree of
Candidate of Technical Sciences;
Moscow State University of Civil
Engineering (National Research
University) (MGSU); 26 Yaroslavs-
koe shosse, Moscow, 129337,
Russian Federation; Director for
Construction and Production Man-
agement; Akkuyu Nükleer Anonim
Sirketi; Mahall Ankara, Mustafa
Kemal Mah. Dumlup. nar Blv. B
Blok 274/7 Kat: 11, No: 117, 06530
Çankaya/Ankara/Turkey;
9540184@mail.ru

“Green Square”, innovation and sustainability of energy infrastructure of the modern urban ecosystem

The purpose of the research of the presented scientific and practical paper is to identify, systematize and analyze the basic principles of modern sustainable construction, study innovative and technical solutions in the field of ecology and management of urban real estate creation projects, infrastructure projects that ensure the functioning of cities. The author of the paper solves the problems of actualization of modern ecosystem problems faced by the urban planning industry all over the world. The methods used in the presented paper are the empirical method, methodological apparatus of cross-cutting analysis, as well as the development of classifications according to the principles inherent in the object of study. In addition to the general scientific approach to the study of problems of eco-sustainability of construction. The author provides experimental conclusions about the convenience of applying specific means of achieving the goals of eco-sustainability of projects. The author has also presented his own definition of sustainable construction taking into account the increasing world energy consumption, including those aimed at cooling the air against the background of global climate warming, the increasing consumption of food and water against the background of planetary population growth, the trend towards diversification of waste treatment. The paper identifies key drivers for the active implementation of innovative technologies in the industry.
Keywords: *ecosystem, sustainable construction and innovation, effective innovation and technical solutions*

INTRODUCTION

In formulating the key problems of the study, the author asks such research questions as the existence of interrelationships: what is common and what is different in the energy efficient approach and “green” construction — the so-called term-trend of the first quarter of the 21st century. Moreover how nuclear power projects, largely characterized by international scepticism, can become the basis for sustainable urban planning. Is only the issue of safety of nuclear power projects a key factor to overcome in order to scale up the implementation of innovative NPP projects already implemented in some countries of the world (Turkey, Bangladesh, Hungary, etc.) that incorporate ecosystem infrastructure solutions, including RES, “smart city”, integrated infrastructure development of territories (hereinafter — IIDT)? The bright hypothesis of the presented scientific and practical research is that NPP projects can become the central axis of urban ecosystem, transferring the projection of Reimers’ ecosystem approach, where the central role is given to the Sun, to the modern sustainable City, Agglomeration, State and World.

MATERIALS AND METHODS

For completeness of the research the author provides a cross-cutting analysis of the development of innovation theory in science, such scientists as B. Twiss, B. Santo, N. Kondratiev, J. Schumpeter, F. Nixon, S. Kuznets, C. Glazyev, G. Itskovitz, L. Leydesdorf devoted their works to the study of innovation [1–3].

Systematizing various approaches, the author gives his own definition of innovation, which is reduced to the concept of “an innovation introduced to improve the efficiency of production and (or)

the quality of goods and services that corresponds to current socio-cultural needs, and a documented innovation is a patent”.

It is important to note that according to the theoretical foundations of “innovativeness” (innovation theory), the following should be distinguished as a result of analyzing different types of innovation situations leading to the emergence of innovations (so-called innovation situations):

- development of methods for earlier risk assessment (classification);
- production-related situations;
- marketing mistakes;
- errors related to financial and economic support;
- innovation needs related to the human resources of the organization and management;
- innovations of legal information support for the project;
- political errors due to changes in the political environment;
- environmental, related to the consequences of natural disasters;
- brought in, consisting in the formation of innovation policy by governmental bodies [4, 5].

There are three main innovation models of development, on the basis of which national innovation systems (hereinafter referred to as NIS) of states are built, namely:

- the European model, including all stages of the innovation process;
- the Asian model, excluding fundamental research;
- the triple helix model, providing for the interaction of three institutional sectors — universities, business and government.

The Triplex Helix Model is the basis for cluster development (Silicon Valley, Erisunn region — Danish-Swedish cluster, Medicon Valley in Western Europe, etc.), which combines the collective interaction of enterprises with unique market conditions for the development of certain industries of goods and services. The cluster model based on the triple helix model also finds application in the theoretical foundations of the “green square” model, in which the cooperation of “clusters-energizations” has a complementary, synergistic vector and result rather than a competing one.

In the early 2020s, in addition to geometry and time-cost characteristics of construction projects, 6D- and 7D-modelling technologies have entered the practice of construction process management, in which the 6th dimension presents the study of building sustainability in the aspect of the environment, justifying the relevance of eco-sustainability of construction objects by introducing this fact into the model. The 7th dimension is applied to the life cycle management of building objects and urban environment. Thus, the 6D and 7D models take into account factors such as energy efficiency analyses, lighting coefficients, geographical features of the project, various components and details of buildings.

The application of construction modelling technologies in the design of objects with the use of “green technologies” due to the possibilities of integration and analysis of environmental problems in architectural and construction projects is especially useful.

Construction modelling technologies solve such problems as increasing the degree of eco-sustainability of the construction industry by improving the accuracy of data analysis, allowing to take into account the multifactor nature of design tasks, including the inclusion in the project of the world practice of solving environmental problems, improving the logistics of resources, reducing costs, thereby reducing the negative impact on the environment and the ecosystem as a whole, increasing the degree of consistency between the sections of the project documentation, thereby reducing the number of possible project risks that may have negative consequences for the sustainability of the construction project.

A vivid example of mankind's aspirations to create an environmentally sustainable construction project in the world practice is the adaptation in 1999–2001 of a large energy facility — four gas-holders (namely, in the part of gas gauges of gasholders dated 1896–1899) for a multifunctional complex — a modern space for living. The former energy facilities — coke oven gas storage facilities — were mothballed in 1984 due to the transition to natural gas, which does not require storage. Thus, four renowned architects created residential, office and retail infrastructure on the territory of

the cylindrical-shaped buildings, with a concert hall, a cinema, an archive, as well as their own community (Fig. 1, 2).

1. The use of construction process automation and the application of robotics and robotic technologies is the next building block of sustainable construction. A number of examples of robotic applications substantiate the understanding of the necessity and, most importantly, the possibility to reduce human participation in hazardous construction processes, such as welding works, assembly of heavy metal structures, masonry works and the speed of their production, plastering and levelling works, lifting works, conveyor-type works, high-rise works, works at depth, as well as works in the zone of high (low) temperature conditions. Also widely applicable technologies for printing parts and entire objects on 3D printers, in particular, the existence of the practice of printing a house, a bridge in its entirety. The use of 3D printing in construction reduces the cost of construction and reduces the time of work, thereby increasing the environmental sustainability of the project, reducing resources. The use of already known numerical control (NC-technologies) allows to schedule the work of equipment according to a predetermined plan-programme without human participation in the very process of work production, the process of equipping construction equipment with programmable devices is one of the fundamental in the organization of automation and robotization of construction production and strengthening the role in the eco-sustainability of the construction industry as a whole.

2. Expanding the scope of information technology, cloud services, artificial intelligence, digital twins, the internet of things and the use of big-data technologies as integrated measures play a major role in the modernization process of the construction industry, increasing its transparency, manageability, efficiency and environmental sustainability.

For example, the use of sensors connected to the Internet and forming a unified system of monitoring and control of engineering systems of construction projects and the entire urban system, providing high standards of energy efficiency and optimizing operating costs in monetary, time and quality terms, thereby increasing the sustainability of building systems and the industry as a whole. Digital twin models allow for virtual testing of different object states, thereby predicting differentiated scenarios and thus optimizing current object states in real time.

The use of artificial intelligence (hereinafter referred to as AI) in the formation of sustainable projects in the field of urban planning allows to optimize project calculations, simulate scenarios, thereby developing risk-reducing solutions. The main advantage of AI



Fig. 1. Photograph of gasometers A, B, C, D in Vienna [6]



Fig. 2. Photograph of a multifunctional complex in Vienna, Austria, after gasometer reconstruction [7–9]

application is the ability to analyze a large amount of data with minimal time consumption, global arrays of which can make it difficult to make the most balanced decisions.

Connecting design, construction and operational systems to cloud services and mobile solutions allows to unite specialists from different industries and geography in a single urban planning project, allow to get advice, expert opinion of unique specialists, without face-to-face presence in the design, working group.

3. Integrated solutions in the field of ecology and safety — such solutions in the field of energy-saving technologies using renewable energy and waste recycling are called “green construction” and affect labour safety. Thus, technologies based on exoskeletons, augmented reality systems, “smart” work wear — clothes with built-in sensors that increase the safety of construction workers and reduce possible occupational injuries — are becoming widely used. The use of cameras, laser scanners, aerial and underwater drones, and other non-contact quality control methods help to reduce the level of environmental threats during project implementation, including increasing the environmental sustainability of the project and the entire ecosystem around it.

A separate block in the study should be devoted to innovative technological solutions combining traditional types of energy with “green” ones. Thus, according to the new concept of energy security in the scope of eco-sustainability of urban systems is the concept of “green square”, developed by SC “Rosatom” in 2024 [10].

For example, according to the head of Rosatom, climate goals can only be achieved by combining wind, solar, nuclear and hydropower, and the concept presented by A. Likhachev at the session “Nuclear Power and Renewable Energy for a Carbon Neutral Future” at the COP26 conference in Glasgow was widely supported. The concept presented by A. Likhachev at the session “Nuclear Power and Renewable Energy Sources for a Carbon Neutral Future” at the COP26 conference in Glasgow was widely supported. The term ‘green square’ combines four low-carbon energy sources, namely nuclear, hydro, wind and solar.

According to A. Likhachev, “climate goals can only be achieved by combining wind, solar, nuclear and hydropower”.

In the context of the presented “green square” concept, the nuclear power project as an element of environmental sustainability is assigned a special role — the role of the core of a safe energy system, which is complemented by the inclusion in the grid of the generated energy from the use of solar panels on the roofs and facades of urban buildings, when such panels are used as a modern “facing” material, as well as hectares of land covered with ridges of solar panels [10–14]. In this case, the NPP object acts as a source of electricity and a place for the location of renewable energy sources (hereinafter — RES). Since the total area of the NPP site is large, modern wind turbines are recommended to be installed on the project land allotment.

As a separate element of the infrastructure of an eco-resistant city, whose energy sector is built according to the “green square” system, prospective urban planning projects should provide for the development of environmentally friendly modes of transport, both individual and public, as well as charging infrastructure to them.

Currently, with the support of major state corporations, working groups are being set up to develop a single international standard for sustainable construction in order to unify the requirements and, most importantly, the procedures for preparing, approving and implementing construction projects in urban agglomerations and beyond.

The author of the presented scientific and practical paper concludes that the theory of ecosystem approach in addition to ecological science is applicable, according to the author of the presented paper, to the analysis of urban planning process, urban ecosystems, as well as the construction industry in general [15].

The concept of “ecosystem” was first proposed in 1935 by Arthur Tansley and further actively developed by Vasily Dokuchaev, the world’s leading scientists, developed in the direction of unity and diverse interaction between living and non-living environments, organisms and inorganic materials. The main feature of an ecosystem is its ability to self-organization, self-regulation and self-development. The ecosystem of the urban environment without human participation is impossible, which, by its intrinsic feature, provides the ecosystem with the “self”-possibilities described above. Let us consider the flowchart of the ecosystem approach in scientific research (Fig. 3).

Next, we should systematize the main features of ecosystems, which are as follows:

1. Sustainability and existence of internal laws of development.
2. Existence of interacting links between elements.
3. Ability to self-development, self-organization and self-regulation.
4. Presence of organic and inorganic, living and non-living elements.

Composition of ecosystems:

1. Organic (living) part.
2. Inorganic (non-living part).

Types of ecosystems by origin:

1. Natural.
2. Artificial (man-made).

Thus, a building ecosystem refers to an artificial type of ecosystem. In addition to the ecosystem type under study, there are other types of artificial ecosystems such as:

1. Banking ecosystem, e-commerce ecosystem — characterized by inter-connectedness of mostly virtual services with the possibility to receive offline services with the condition of

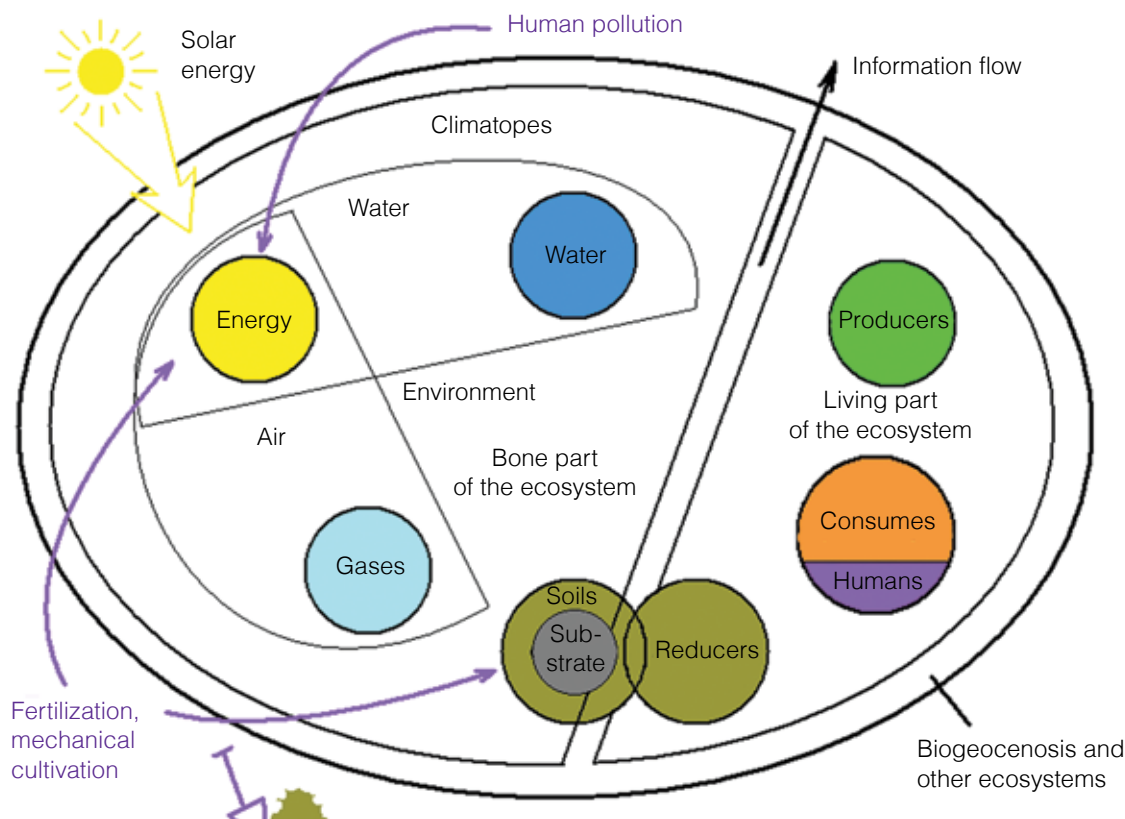


Fig. 3. Ecosystem structure according to Reimers' theory

receiving additional bonuses and then spending them within the ecosystem.

2. Urban ecosystem.
3. International ecosystem.

An interesting classification of ecosystems is given by scientist Eugene Odum, dividing them by energy type into:

1. Natural — sun-driven, non-subsidized.
2. Natural — driven by the sun, subsidized by another energy source or by humans.
3. Industrial-urban, fuel-driven, both fossil, other organic, and nuclear fuels.
4. In his work, the scientist proposed the concept of ecological niche, comparing it to a profession — the ecological purpose of a species in an ecosystem, and a habitat — to the address. Such a comparison allows us to scientifically substantiate the ecosystem approach to economic and other human activities, as well as in the man-made organization of the man-made environment surrounding humans. The presented paper develops the ideas of the ecosystem approach to the general planning of cities, the fundamental energy basis for the development of which are energy-nuclear facilities.

And in the basics of land ecology (otherwise, geoecology) V.G. Marachevsky introduces the ranking of ecosystems, dividing them into facies, tracts, landscapes, geographical areas, geographical regions, biomes and biosphere, thus laying the foundation for the modern understanding of the ecosystem of the urban environment

Urban ecosystem is a complex functional complex of man-made artificial habitat, including cities with their agglomerations, smaller settlements, urbanized areas outside settlements and cities, characterized by uniform management laws.

An interesting example is the formation of the so-called banking ecosystem, which is an example of an innovative form of organization of banking business due to the trend towards digitalization of modern society, the global digital transformation of commercial, financial and lending activities, and the growing popularity of the ecosystem approach in general.

At the same time, according to the author of the presented paper, the banking ecosystem is an element of the urban ecosystem in terms of the digital "superstructure" of the economic processes of the urban economy.

Urban territory and infrastructure has been formed everywhere for many centuries. Today it represents a system of the following elements:

- industrial buildings;
- administrative buildings;
- residential buildings;
- various life support systems (including hospitals, clinics, schools, kindergartens, educational institutions);
- elements of transport infrastructure, including road network, transport interchanges, bridges, tunnels;
- utilities and buildings;
- green space areas;
- other city facilities.

The growth of land costs in the central districts and large cities gradually led to the need to design buildings with higher storeys, and with the increase in the height of the construction object, the problems of safety and life support began to increase. In these conditions, there was a necessity to solve problems in the multi-tasking mode, which can be solved with the help of automated control systems that take on the functions of prompt response to

► changes in the modes of operation of a large number of technical devices that ensure the normal operation of buildings, structures or complex of objects. From the technical point of view, the way to solve these problems is to develop a system, which is conventionally called "*Intelligent system of building facility operation*", consisting of a set of four main subsystems:

- 1) distribution of energy resources;
- 2) technological;
- 3) security;
- 4) "smart home" systems, including multi-room.

Let us consider the specific features of sustainable construction depending on the climatic zone where the object of analysis is located. Thus, due to the specific climatic conditions of the Russian territory, the subject of primary concern in large cities is the length of heat and gas networks, overhead high-voltage and cable lines, which sometimes reach hundreds and thousands of kilometres within the urban area.

Regardless of the climatic zone, the basic condition for the normal functioning of urban ecosystems is the availability of a modern road network that provides convenient and accessible transport services for citizens, including underground and elevated facilities for the safe movement of citizens and high-speed movement of all types of transport. Thus, to improve traffic flow, new radial and ring roads are being created to bypass the city centre districts. They are accompanied by motor transport services (petrol stations, campsites, roadside hotels, parking garages for temporary and permanent storage of cars and road equipment, etc.), with accommodation of road maintenance and other services with posts of specialized road safety stations.

In the process of reconstruction of the road network, if necessary, existing railway tracks can be effectively used with the use of rolling stock of the "land metro" type with the equipment of transfer stations, taking into account the maximum proximity of passenger flows to other modes of transport.

The normal operation of water supply and sewerage systems with obligatory provision of necessary requirements to the quality of drinking water and the level of wastewater treatment has an important place in the urban economy. The vulnerability of water supply sources from technogenic impacts should be reduced, the issues of sanitary cleaning of the city should be solved with the organization of incinerators and recycling plants, construction of sewage treatment systems, land reclamation, installations for melting snow removed from city roads, and enterprises for processing biological waste should be organized.

Residential and industrial stock on the territory of the existing development is modernized and reconstructed in accordance with modern requirements by means of redevelopment of premises, improvement of sanitary equipment, installation of attics and lifts, increase of storeys, improvement of thermal and physical characteristics of enclosing structures. Engineering solutions for the development of underground spaces for the construction of garages, warehouses, pedestrian crossings, shops, etc. should be considered as a special topic in the structure of urban renewal.

DISCUSSION

The main controversial issue that the author raises in this study is the question of how to assess the contribution of the infrastructure component to the sustainability of an urban development project. In the concept of "green square", where 1/4 each of atomic, hydro, solar and wind energy belongs, it is necessary to take into account climatic and geographical peculiarities of this or that region where the infrastructure project is located: for example,

the construction of hydroelectric power plants requires a powerful waterway, the construction of wind power plants requires an analysis of wind loads and environmental impact.

CONCLUSIONS

Implementation of urban planning plans for reconstruction, revitalization, rehabilitation and renewal of the existing urban development should be addressed as a systemic task, including:

- coordination of architectural and construction developments and implementation of effective structural, production, investment, financial, tariff and tax policies, development of priority areas and spheres of urban economy and infrastructure for the perspective period;
- ensuring accounting, registration, assessment and efficient use of city property, including land plots and other real estate objects;
- organization of interaction between city authorities and market infrastructure entities (commercial banks, stock exchanges, insurance companies, etc.) on issues related to real estate objects that are both privately and publicly owned;
- attracting investment in housing construction through sales of housing, construction in progress, land lease rights, private investment, etc.;
- creation and development of an investment and loan system and mortgage lending with the issue of municipal bonded housing loans, etc.;
- the energy infrastructure of the "green square" of the modern urban ecosystem is a balance of innovation and eco-sustainability.

REFERENCES

1. Zhukov P.V., Matveeva L.G. *Environmental friendliness of products as a priority in the activities of industrial corporations. Humanities and socio-economic sciences*. 2019; 2(105):125-129. DOI: 10.23683/1997-2377-2019-105-2-125-129 (rus.).
2. Sergeeva S.A., Ternov K.D. "Green" procurement in construction: improvement of energy-efficient environmentally oriented construction. *Innovations and Investments*. 2023; 11:468-471. (rus.).
3. Medvedeva O.N. Analysis of the development of energy-efficient construction in Russia. *Trends in the development of science and education*. 2022; 92-12:121-123. DOI: 10.18411/trnio-12-2022-583
4. Bushmanova E.D. Energy-efficient technologies in construction. *Engineering Personnel — the Future of Innovative Economy of Russia*. 2022; 1:570-572. (rus.).
5. Fetisov A.S. Review of modern energy-efficient technologies in the construction of public buildings. *Economics and Entrepreneurship*. 2022; 2(139):1086-1089. DOI: 10.34925/EIP.2022.139.2.215 (rus.).
6. Gabitov A.I., Gaisin A.M., Udalova E.A., Salov A.S., Yamilova V.V. Energy efficient technologies for the construction and buildings reconstruction. *IOP Conf. Series: Materials Science and Engineering*. 2020; 753(2):022086. DOI: 10.1088/1757-899X/753/2/022086
7. Usmanova S.R. Methodology of energy-efficient solutions in construction. *Vector of scientific thought*. 2023; 4(4):15-17. (rus.).
8. Palm J., Bryngelson E. Energy efficiency at building sites: barriers and drivers. *Energy Efficiency*. 2023; 16(2). DOI: 10.1007/s12053-023-10088-7
9. Kirsanov G.G., Markov R.A. Prospects for the development of energy-efficient construction in the industrial sector. *Resource saving and ecology: agro industrial complex, design and construction : collection of scientific papers of the All-Russian scientific-practical conference of young scientists, postgraduates, masters and bachelors. Kursk, 2023*; 251-253. (rus.).
10. Tolstikov V.V., Gaidar K.M., Borokhovskiy E.F. Group reliability of the nuclear power plant operational shift : conceptual understanding.

South Russian Journal of Social Sciences. 2020; 21(1):121-134. DOI: 10.31429/26190567-21-1-121-134

11. Guseva E.S. Development of the international market of nuclear power plant construction in the context of the study of social acceptability of nuclear power. *Economics and Management*. 2024; 30(1):105-114. DOI: 10.35854/1998-1627-2024-1-105-114 (rus.).

12. Alekseev V.A., Goncharova N.L. Organisational support of the management process of sustainable development of nuclear power in the context of the impact of nuclear power plant on the environment. *Competitiveness in the Global World: Economics, Science, Technology*. 2023; 2:93-96.

13. Makhalova S.A. Akkuyu nuclear power plant is an object of strengthening relations between Russia and Turkey, symbol of science. *International Scientific Journal*. 2024; 1(3-1):81-83.

14. Promyslov V.G., Semenov K.V., Shumov A.S. Synthesis of cybersecurity architecture for control systems of nuclear power plants. *Management Problems*. 2019; 3:61-71. DOI: 10.25728/ps.2019.3.7 (rus.).

15. Yestemessova A.S., Altayeva Z.N., Yesselbayeva A.G. Energy-efficient lightweight concrete for green construction. *Bulletin of Kazakh Leading Academy of Architecture and Construction*. 2023; 2(88):153-161. DOI: 10.51488/1680-080X/2023.2-17

«Зеленый квадрат», инновации и экоустойчивость энергетической инфраструктуры современной городской экосистемы

Целью исследования представленной научно-практической статьи является выявление, систематизация и анализ основных принципов современного экоустойчивого строительства, изучение инновационно-технических решений в области экологии и управления проектами создания городской недвижимости, инфраструктурными проектами, обеспечивающими функционирование городов. Автор статьи решает задачи актуализации современных экосистемных проблем, с которыми сталкивается градостроительная отрасль всего мира. В качестве методов в представленной статье используются эмпирический метод, методологический аппарат сквозного анализа, а также разработка классификаций по принципам, присущим объекту исследования. Помимо общенаучного подхода к изучению проблем экоустойчивости строительства, автор приводит экспериментальные выводы об удобстве применения конкретных средств достижения целей экоустойчивости проектов. Также автор представил собственное определение экоустойчивого строительства с учетом нарастающего мирового энергопотребления, в том числе направленного на охлаждение воздуха на фоне глобального потепления климата, возрастающего потребления продуктов питания и воды на фоне общепланетарного роста численности населения, тенденции на диверсификацию переработки отходов. В статье определяются ключевые драйверы для активного внедрения инновационных технологий в отрасли.

Ключевые слова: экосистема, экоустойчивое строительство и инновации, эффективные инновационно-технические решения в строительстве

СПИСОК ИСТОЧНИКОВ

1. Жуков П.В., Матвеева Л.Г. Экологичность продукции как приоритет в деятельности промышленных корпораций // *Гуманитарные и социально-экономические науки*. 2019. № 2 (105). С. 125–129. DOI: 10.23683/1997-2377-2019-105-2-125-129
2. Сергеева С.А., Терновых К.Д. «Зеленые» закупки в сфере строительства: совершенствование энергоэффективного экологически ориентированного строительства // *Инновации и инвестиции*. 2023. № 11. С. 468–471.
3. Медведева О.Н. Анализ развития энергоэффективного строительства в России // *Тенденции развития науки и образования*. 2022. № 92–12. С. 121–123. DOI: 10.18411/trnio-12-2022-583
4. Бушманова Е.Д. Энергоэффективные технологии в строительстве // *Инженерные кадры — будущее инновационной экономики России*. 2022. № 1. С. 570–572.
5. Фетисов А.С. Обзор современных энергоэффективных технологий при строительстве общественных зданий // *Экономика и предпринимательство*. 2022. № 2 (139). С. 1086–1089. DOI: 10.34925/EIP.2022.139.2.215
6. Gabitov A.I., Gaisin A.M., Udalova E.A., Salov A.S., Yamilova V.V. Energy Efficient Technologies for the Construction and Buildings Reconstruction // *IOP Conf. Series: Materials Science*

and Engineering 2020. No. 753 (2). P. 022086. DOI: 10.1088/1757-899X/753/2/022086

7. Усманова С.Р. Методология энергоэффективных решений в строительстве // *Вектор научной мысли*. 2023. № 4 (4). С. 15–17.

8. Palm J., Bryngelson E. Energy efficiency at building sites: barriers and drivers // *Energy Efficiency*. 2023. No. 16 (2). DOI: 10.1007/s12053-023-10088-7

9. Кирсанов Г.Г., Марков Р.А. Перспективы развития энергоэффективного строительства в промышленном секторе // *Ресурсосбережение и экология: агропромышленный комплекс, проектирование и строительство : сб. науч. ст. Всеросс. науч.-практ. конф. молодых ученых, аспирантов, магистров и бакалавров. Курск, 2023. С. 251–253.*

10. Tolstikov V.V., Gaidar K.M., Borokhovskii E.F. Group reliability of the nuclear power plant operational shift: conceptual understanding // *South Russian Journal of Social Sciences*. 2020. Vol. 21. No. 1. Pp. 121–134. DOI: 10.31429/26190567-21-1-121-134

11. Гусева Е.С. Развитие международного рынка строительства атомных электростанций в контексте исследования социальной приемлемости атомной энергетики // *Экономика и управление*. 2024. Т. 30. № 1. С. 105–114. DOI: 10.35854/1998-1627-2024-1-105-114

12. Алексеев В.А., Гончарова Н.Л. Организационное обеспечение процесса управления устойчивым развитием атомной энергетики в контексте воздействия атомной электростанции на окружающую среду // *Конкурентоспособность в глобальном мире: экономика, наука, технологии*. 2023. № 2. С. 93–96.

13. Makhalova S.A. Akkuyu nuclear power plant is an object of strengthening relations between Russia and Turkey // *Symbol of Science: International scientific journal*. 2024. Vol. 1. No. 3–1. Pp. 81–83.

14. Проmysлов В.Г., Семенов К.В., Шумов А.С. Синтез архитектуры кибербезопасности для систем управления атомных электростанций // *Проблемы управления*. 2019. № 3. С. 61–71. DOI: 10.25728/ps.2019.3.7

15. Естемесова А.С., Алтаева З.Н., Есельбаева А.Г. Энергоэффективный легкий бетон для зеленого строительства // *Bulletin of Kazakh Leading Academy of Architecture and Construction*. 2023. № 2 (88). С. 153–161. DOI: 10.51488/1680-080X/2023.2-17

Об авторе: **Сезёмин Денис Евгеньевич** — соискатель степени кандидата технических наук; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; директор по строительству и промышленному инжинирингу; **АО Аккую Нуклеар**; Махалл Анкара, квартал Мустафа Кемаль, бульвар Думлупынар, блок Б, ул. 274/7, этаж 11, № 117, 06530, Чанкая, Анкара; 9540184@mail.ru.

For citation: Sezemin D.E. “Green Square”, innovation and sustainability of energy infrastructure of the modern urban ecosystem. *Real Estate: Economics, Management*. 2024; 2:78-83.

Для цитирования: **Сезёмин Д.Е.** “Green Square”, innovation and sustainability of energy infrastructure of the modern urban ecosystem // *Недвижимость: экономика, управление*. 2024. № 2. С. 78–83.

Panin V.V.



Panin Victor Viktorovich,
Lecturer of the Department of
Construction Organization and Real
Estate Management; Moscow State
University of Civil Engineering
(National Research University)
(MGSU); 26 Yaroslavskoe shosse,
Moscow, 129337,
Russian Federation;
panin_v@mail.ru

Legal aspect of corruption impact on the state of environmental security, environmental sustainability and environmental risks in the construction industry

This scientific paper examines an important aspect of modern issues — the influence of corruption on the state of environmental security of the country, environmental sustainability, and risks in the construction sector. The author investigates how the penetration of corruption into the construction industry has a negative impact on the environment, increasing the likelihood of environmental disasters and emergencies. The study analyzes the current state of environmental security issues in the Russian Federation in the modern conditions of the global economic crisis and the sanctions pressure from Western countries, including restrictions on access to internationally friendly innovative technologies, materials, and equipment. As a result of the research, the conclusion is drawn about the inseparable connection between the legal level of fighting against corruption and ensuring the environmental security of the country, emphasizing the importance of taking measures to strengthen legal mechanisms for fighting against corruption in the construction sector to ensure sustainable environmental development and prevent negative consequences for the environment. The material contains significant analysis that can serve as a basis for the development of effective strategies to improve environmental sustainability and reduce environmental risks in the construction sector through countering corruption, as well as practical recommendations for improving the regulatory framework and strengthening control and supervision measures in the construction industry to reduce environmental risks and enhance the level of environmental security of the country.

Keywords: *corruption, environmental security, environmental risks, environmental sustainability of construction, environmental crime, construction management, environment, resource conservation*

Environmental security plays a key role for the state in the modern world, as it is directly related to ensuring sustainable development and the well-being of society. It is no secret that the state of the environment affects human health, economic development, and social stability. Therefore, the pursuit of environmental security becomes a priority for any state. Construction and environmental security are closely interrelated, as the activities of the construction industry have a significant impact on the environment and require compliance with environmental standards to minimize negative impacts on nature, timely identification, and prevention of possible environmental risks (ER). Corruption in the construction industry can seriously undermine environmental security, leading to negative consequences for the environment, human health, and sustainable development of regions. Fighting against corruption and supporting transparency in construction play an important role in ensuring environmental sustainability and preserving natural resources. Modern construction faces numerous challenges and tasks, among which the need to ensure the environmental sustainability of construction (ESC) stands out as an area of particular significance. The importance of ESC is particularly high for projects implemented in the urbanization process of large cities, which are experiencing accelerating trends towards increased population density and construction in urban areas, dynamic development of infrastructure and the economy, educational and scientific activities, tourism, and other service sectors. The explanation is simple — each year, society becomes more aware of environmental problems, and consumers

become more demanding of the construction projects they support. This increasing awareness, along with climate change, depletion of natural resources, and environmental crisis, makes ESC essential criteria in the planning and implementation of projects, and issues such as identifying environmental risks at early stages of construction, finding effective ways to minimize them, and preventing potential consequences become the most priority directions for scientific research, providing motivation for the construction industry to review its methods and approaches. For a more detailed analysis of the conceptual apparatus and the disclosure of the topic, it will be necessary to consider the main definitions and mentions of such concepts as “environmental sustainability”, “environmental risks”, “environmental security”, “corruption” in scientific materials and regulatory legal acts.

In the International Standard ISO 6707-3:2022 “Buildings and civil engineering works — Vocabulary — Part 3: Sustainability terms”, the following definition of “sustainable development” in relation to construction is given: “development aimed at meeting contemporary environmental, social, and economic needs without compromising the ability of future generations to meet their own needs” [1]. In ecological scientific literature, the concept of “ecological sustainability” was introduced in 1973 by the famous Canadian biologist and ecologist C.S. Holling to better understand and study the nonlinear dynamics observed in ecosystems [2]. He defined ecological sustainability as “the degree of disturbance an ecosystem can withstand without changing its self-organizing processes and structures (defined as alternative stable states)”.

Since then, the concept of ESC, although frequently encountered in popular scientific literature, still does not have a unified scientific interpretation and is based on characteristic ecological principles adhered to by most scientists, specialists, and practitioners from various fields of activity: environmental preservation, resource conservation, reduction of harmful impact on nature, and creating healthy, comfortable conditions for people [3–5]. In general, the main idea of ESC is to minimize the negative impact of construction on the environment while creating objects that are sustainable, energy-efficient, safe for residents, and harmoniously integrated into the natural environment. The process of the overall development of a sustainable system can only be ensured by processes of coordinated development of all its elements. It is enough for one undeveloped element, remaining in a state of “stability”, to stop the whole system from developing.

It should be noted that the current legislation of the Russian Federation does not contain the concept of “ecological sustainability” but widely uses the terms “environmental risk” and “environmental security”. Compliance with and protection of citizens' constitutional right to a favorable environment (Art. 42 of the Constitution of the Russian Federation) is a fundamental condition for the implementation of any economic activity with negative environmental consequences [6]. The term “environmental risk” is used in various domestic regulatory legal acts, but its legal definition is enshrined in Article 1 of the Federal Law “On Environmental Protection” dated January 10, 2002, No. 7-FL — this is the probability of an event with adverse consequences for the environment caused by the negative impact of economic and other activities, emergencies of a natural and man-made nature [7]. Unfortunately, the law does not contain anything more to disclose the essence of this construct, as well as the absence of mechanisms, methods, and technologies for assessing environmental risks, a system and methodology for managing such risks. In the modern scientific environment, environmental risk is most often understood as a measure of danger characterizing the probability of possible negative consequences for humans and the environment [4, p. 450]. However, there is still no strict definition of the concept of environmental risk in science. This is primarily due to the fact that environmental risk is a multifactorial system based on its causes and effects, and different scientists and experts have different views on how to define, measure, and manage environmental risks, which leads to inevitable discussions and debates in the scientific community [3–5]. Environmental risks can be classified conditionally based on a multitude of grounds: by the degree of risk spread (local and global), by the level of permissibility (permissible and unlawful), by the type of risk perception recipient (risks accompanying dangerous consequences for humans, for nature, for the economy), and so on. The most important classification to the author seems to be the classification of environmental risks by the source of danger. The source can be: a dangerous natural phenomenon independent of humans; large technological accidents and disasters; economic activities of people. With regard to each of these sources, the legislator takes a series of measures to prevent a risky situation or minimize its consequences.

The term “environmental security” in Russian legal practice is a variety of a broader concept — “security”. Thus, the Federal Law of December 28, 2010, No. 390-FL “On Security” not only includes the need to ensure security in all areas of life but also includes environmental security as the subject of its regulation. Essentially, this

is also reflected in section 1. The Strategy of Environmental Security of the Russian Federation until 2025: “The environmental security of the Russian Federation (hereinafter — environmental security) is an integral part of national security” [9]. However, despite the impressive number of regulatory legal documents related to ensuring environmental security and environmental protection, at the highest level, the legislator often does not differentiate between these categories, using one of them as an integral part of the other. The same Federal Law of January 10, 2002, No. 7-FL “On Environmental Protection” reflects the need to ensure environmental security as a goal and content of the state policy in the field of environmental protection. Ensuring environmental security is an integral part of environmental regulation (Article 19), environmental certification (Article 31). Economic entities are obliged to take a series of measures to ensure and maintain environmental security (Articles 34, 35, 40, 44, 48, and others) [7]. Ensuring environmental security directly or indirectly affects other regulatory legal acts. For example, the Federal Law of November 23, 1995, No. 174-FL “On Environmental Expertise” obliges to take into account the requirements for ensuring environmental security when conducting environmental expertise of economic entities [10]. In general, it can be noted that the level and quality of legal regulation in terms of ensuring environmental security in our country largely have a formal nature, a unified view on the legal nature of the concept of “environmental security” has not been developed, the current state of regulation of public relations is characterized by a wide range of uses of the legal institution of environmental security and the absence of clear mechanisms and criteria for ensuring it.

In the Strategy of Environmental Security of the Russian Federation until 2025, along with such global challenges as, for example, the reduction of biological diversity (which leads to irreversible consequences for ecosystems, destroying their integrity), there are internal challenges, including significant criminalization and the presence of a shadow market in the field of nature management [9]. To a large extent, this situation is determined by the construction industry, where significant financial resources are involved. According to Rosstat, the volume of construction works in Russia in 2023 amounted to 15.1 trillion rubles, increasing by 7.9 % in comparable prices compared to 2022¹. The year 2024 promises to be significant for the Russian construction industry. The announced state initiatives and economic trends push this sector towards new horizons of growth and development. This is also related to global external and internal political processes in which our state is involved. On September 30, 2022, the President of Russia V.V. Putin signed agreements with the leadership of the Donetsk People's Republic, Lugansk People's Republic, Zaporozhye, and Kherson regions on their admission to the Russian Federation as new regions. The Constitutional Court of Russia on October 2 found the documents in compliance with the Basic Law of the country. After that, the State Duma and the Council of the Federation of the Federal Assembly of the Russian Federation unanimously ratified the agreements and adopted draft federal constitutional laws on the accession of new territories to the country and the formation of new entities within it. In light of the recent decisions, the question of the urgent restoration of the infrastructure of the new regions of the Russian Federation, which suffered as a result of hostilities, becomes acute. According to the deputy head of the budget committee of the Federation Council of Russia, Sergey Ryabukhin, the restoration of housing, infrastructure facilities, and roads only in

the DPR and LPR will cost 1.5 trillion rubles over three years, or nearly 20 billion dollars². At the same time, a series of large-scale state programmes have been launched in Russia: modernization of housing and utilities infrastructure, road construction, construction of social facilities, street-road networks, multifunctional complexes, greenhouse complexes in agricultural regions, purchase of public transport, etc. According to the head of the Ministry of Construction of the Russian Federation, Irek Fayzullin, starting from 2022, within five years, the Government plans to allocate about 750 billion rubles for the housing and utilities modernization programme. The most acute problems require solutions — the growth of debts for communal payments and the wear and tear of infrastructure, including heat networks. According to some estimates, the deficit of funds for the modernization of housing and utilities actually amounts to about 4.6 trillion rubles³. About 33.4 billion rubles from the federal budget is allocated for subsidizing loans under the preferential mortgage programme this year, and it is expected that this will help improve housing conditions for at least 46,000 citizens of the Russian Federation. About 7.15 billion rubles will be allocated this year from the federal budget to subsidize interest rates on loans issued to system-forming organizations in the commercial real estate construction sector and organizations belonging to their group of companies for the implementation of investment projects (Government Order of the Russian Federation of April 28, 2022, No. 1046-r)⁴. The synergy of expanding various state programmes and investments in housing and utilities creates a unique field of opportunities for construction companies. It is expected that the total volume of construction works in the country will reach a new record of 14.4 trillion rubles, which is 8.5 % higher than the previous indicators. The total funding for the five-year road construction programme, according to Deputy Prime Minister of the Russian Government Marat Khusnullin, will amount to 13.2 trillion rubles. Of these, 5.4 trillion will come from the Federal Road Fund, 7.2 trillion will come from regional funds, and 436 billion from the National Wealth Fund. During this period, it is planned to build about four thousand kilometers of roads. Within five years, 85 % of the Russian road network will be put in order. The Deputy Prime Minister noted that the Government expects to fulfill the President of Russia Vladimir Putin's instructions in the field of road construction ahead of schedule⁵.

Against the backdrop of the record sums of money and plans mentioned above, as well as existing domestic corrupt practices of “arranging matters”, there is no doubt that embezzlement in the construction industry, which occurs at all stages from selecting a site for construction to tenders, obtaining permits from various authorities, distributing multimillion investments, selecting contractors and subcontractors, etc., will continue to multiply. The economic crisis and the sanctions pressure from Western countries only exacerbate the situation as the threat of restricting access to foreign environmentally friendly innovative technologies, materials, and equipment is forming due to the policy of containment towards the Russian Federation. Of course, for the average resident of Russia, who often hears about corruption in housing and communal services, in the system of public procurement, in the police, education systems, healthcare, etc., it may be unusual to hear that

corruption can also impact the environment. However, the fact remains: it is precisely corrupt practices in the field of natural resource management and construction that cause greater harm to the environment, and therefore, not only to the well-being but also to the health of the country's residents.

By the way, many legal scholars in their research talk about the significant influence of corruption on environmental damage. For example, T.V. Rednikova [11] in her study raises issues of organized environmental crime and names corrupt connections in nature conservation authorities as one of the reasons for its existence and development, S.A. Bogolyubov analyzes legal liability for corrupt violations in environmental legal relations [12]. In Russian criminal law and criminology, the concept of corruption is a subject of discussion. The main difference lies in the interpretation of the term “corruption”. Supporters of a narrow interpretation define corruption as bribery of government officials. For example, A.I. Dolgova and S.V. Vanyushkin understand corruption as a “social phenomenon characterized by bribery of state and other officials and the selfish use by them, in personal or narrow group, corporate interests of their official powers related to authority and opportunities” [13, p. 501]. Supporters of a broad understanding of corruption focus not so much on the criminal deal between a public official and a private individual but on any selfish behaviour of an official. B.V. Volzhenkin believed that corruption is “...a social phenomenon that involves the decay of power, where state (municipal) officials and other persons authorized to perform state functions use their official position, status, authority of the position held for personal enrichment or in group interests” [14, p. 47].

The official definition of corruption is given in Article 1 of the Federal Law of December 25, 2008, No. 273-FL “On fighting against Corruption”. According to the provisions of the law, corruption is: “a) abuse of official position, giving a bribe, receiving a bribe, abuse of authority, commercial bribery or other illegal use by an individual of their official position contrary to the lawful interests of society and the state to obtain a benefit in the form of money, valuables, other property or services of a property nature, other property rights for themselves or for third parties or unauthorized provision of such benefit to the specified person by other individuals; b) committing acts specified in subparagraph “a” of this paragraph on behalf or in the interests of a legal entity” [15]. Most violations of environmental legislation and citizens' rights to a favorable environment are based on corrupt crimes of officials — whether it is issuing illegal permits for the construction of environmentally hazardous facilities, falsifying project documentation, manipulating the results of public hearings, implementing costly and dubious programmes for “improvement”, which result in the destruction of greenery. Thus, the connection between corrupt offenses in the construction industry and environmental security, ESC and ER is evident.

As an example of successful international experience in addressing this issue, one can mention one of the world's cleanest countries (ranked 10th in 2022) — the Kingdom of the Netherlands⁶, which is also considered one of the least corrupt countries in the world (ranked 8th in 2023)⁷. This was made possible primarily

2 Goncharuk D. Senator Ryabukhin: The restoration of the infrastructure of Donbass will require about 1.5 trillion rubles. URL: enator-riabuhin-vosstanovlenie-infrastruktury-donbassa-potrebuuet-okolo-15-trln-rublej.html

3 Meeting of the Presidium of the State Council. URL: <http://www.kremlin.ru/events/president/transcripts/68687>

4 The government has allocated another 49.6 billion rubles to subsidize preferential mortgage programs. URL: <http://government.ru/docs/45454/>

5 Meeting on the development of road construction. URL: <http://www.kremlin.ru/catalog/persons/625/events/68558>

6 Environmental Performance Index by country 2024. URL: <https://worldpopulationreview.com/country-rankings/environmental-performance-index-by-country>

7 Corruption Perceptions Index. URL: <https://www.worldeconomics.com/Indicator-Data/Corruption/Corruption-Perceptions-Index.aspx>

thanks to the country's modern anti-corruption legislation and related regulations aimed at protecting the environment. Just four decades ago, the Netherlands faced seemingly insurmountable challenges in ensuring environmental safety. These were not just local problems of damage to specific areas, but a global environmental crisis affecting entire regions of Western Europe and the basins of international rivers flowing through it. The powerful environmental and industrial boom, the use of coal as the main energy resource, led to total environmental pollution and had a detrimental impact on plant and animal life. The rapid pace of industrialization, the lack of free spaces, and a critical population level resulted in high levels of noise in cities from street and railway transport, airports, and air pollution. The consequences of uncontrolled discharge of tens of tons of oxidizing substances into Dutch waters led to the water becoming poisoned and foul-smelling. Many species of fish and other representatives of ichthyofauna completely disappeared. There was a shortage of water suitable for agricultural use, and serious problems arose in providing drinking water to the country's population. Additionally, due to the geographical location of the country, a huge amount of pollutants from neighboring countries entered its territory along with the river flows of the Rhine and Meuse. In such complex conditions in the 1980s, the public authorities of the Netherlands were forced to urgently adopt a series of legislative acts ensuring environmental safety for the population, including the Water Surface Pollution Act as the main source of norms regulating the maximum allowable concentrations of discharges into water bodies, the Housing Act providing for the implementation of an eco-usage strategy, the Air Pollution Act defining requirements for air purity, and the Waste Management Act regulating issues including their recycling. For violations of environmental legislation, the state provided for the strictest measures of criminal, administrative, and civil responsibility. For example, in accordance with Article 173a of the Dutch Criminal Code, a person who intentionally and illegally places any substance on the soil or introduces it into the soil, air, or surface water is subject to imprisonment for up to 12 years, and in cases of danger to another person's life or death, the punishment is increased to up to 15 years. For causing harm to the environment that poses low public danger, legal accountability measures include arrest for up to 14 days or a fine of up to 2,000 euros (Article 429(4) of the Dutch Criminal Code). In accordance with the country's new environmental policy, environmental protection has become one of the main priorities of the Dutch police. In the circumstances that unfolded, in 2001, the state was also forced to adopt new anti-corruption legislation, declaring that the main task of the authorities in anti-corruption measures is to protect the public sector from the influence of the criminal world. In order to protect public institutions from aiding crime or being involved in money laundering, a special state organization was created. Its task includes providing public institutions with information about the companies they intend to do business with, specifically who in these companies is responsible for decision-making, where their capital comes from, whether they comply with the law, etc. An important structural level in the anti-corruption system is the so-called Public Prosecution Service, which has 19 regional offices, each with its own public prosecutor handling criminal investigations. As a result of all the measures taken, the volume of emissions into the atmosphere decreased by 70 % overall, and the total volume of harmful substance emissions decreased by 40 % [16]. This experience can undoubtedly be useful for Russia.

In conclusion, it is important to note that alongside the implementation of the Strategy for Environmental Security of the Russian

Federation until 2025 [9], and the National Anti-Corruption Plan for 2021–2024, approved by Presidential Decree No. 478 of August 16, 2021 [17], both the state and society should take effective measures now to address the issue outlined in the article. To reduce the impact of corruption on the environmental security of the state, the environmental sustainability of construction, and environmental risks, the following set of measures needs to be implemented at both legislative and practical levels:

1. Improvement of existing legislation: it is necessary to review the existing legal acts ensuring environmental security, making necessary changes and adopting new laws considering successful international experience, as well as specifying the necessary conceptual apparatus; link the state's anti-corruption legislation with regulatory acts aimed at protecting the environment; strengthen penalties for violations in the field of ecology, including the degree of criminal responsibility for serious violations.
2. Strengthening the system of control and supervision: ensure maximum transparency and openness in the processes of issuing permits for construction, various approvals, certifications, etc.; enhance monitoring by environmental inspections, alternative public, and independent organizations for compliance with environmental standards in construction; independent environmental impact assessment should become a mandatory stage for any construction project.
3. Active development of anti-corruption education and awareness in environmental issues, education, and propaganda: training and informing the population, leaders of construction companies with wide use of anti-corruption programmes, environmental awareness activities focusing on the development of necessary values and competencies aimed at promoting an intolerant civic attitude towards corruption, awareness of the importance of environmental protection, and maintaining environmental safety.

REFERENCES

1. ISO 6707-3:2022. *Buildings and civil engineering works. Vocabulary. Part 3: Sustainability terms. 2nd Ed. 2022.*
2. Holling C.S. *Resilience and stability of ecological systems. Annual Review of Ecology and Systematics. 1973; 4:1-23. DOI: 10.1146/ANNUREV.ES.04.110173.000245*
3. Park Albert Sanghun. *Understanding resilience in sustainable development: a call for unity or a sirens' song? Sustainable Development. 2023; 1-15. DOI: 10.1002/sd.2645*
4. *Organization of Real Estate Construction and Development. Volume 2. Real Estate Development : textbook in 2 volumes and practical work (volume 3), 5th ed., revised and supplemented. P.G. Grabovoy (Ed.). Moscow, ASV Publishing House, Prosveshchenie Publ., 2024; 708. (rus.).*
5. Vaganov P.A., Man-Son I.M. *Environmental Risks : textbook, 2nd ed. St. Petersburg, Publishing House of St. Petersburg State University. 2001; 152.*
6. *Constitution of the Russian Federation : adopted by a popular vote on 12.12.1993 with amendments approved during the all-Russian vote on 01.07.2020.*
7. *On Environmental Protection : Federal Law of 01.10.2002 No. 7-FL.*
8. *On Safety : Federal Law of 12.28.2010 No. 390-FL.*
9. *Strategy of Environmental Security of the Russian Federation until 2025 : Decree of the President of the Russian Federation dated 04.19.2017 No. 176.*
10. *On Environmental Impact Assessment : Federal Law of 23.11.1995 No. 174-FL.*
11. Rednikova T.V. *Organized environmental crime in Russia and abroad: criminological characteristics and countermeasures. LEX RUSSICA. 2018; 9:98-111. DOI: 10.17803/1729-5920.2018.142.9.098-111 (rus.).*

12. Bogolyubov S.A. Features of legal responsibility in the system of environmental legal relations. *Russian Law Journal*. 2019; 4:105-119. (rus.).
13. *Criminology : textbook for legal universities*. A.I. Dolgova (Ed.). Moscow, NORMA-INFRA-M Publ., 1999; 784. (rus.).
14. Volzhenkin B.V. *Official crimes : Commentary on legislation and judicial practice*. Saint Petersburg, Publishing house of R. Aslanov "Legal Center Press". 2005; 560. (rus.).

15. On Counteracting Corruption : Federal Law of 12.25.2008 No. 273-FL. (rus.).
16. Kislukhin V.A., Makarov A.N. Legal aspects of environmental security of the Kingdom of the Netherlands. *Bulletin of the Nizhny Novgorod Academy of the Ministry of Internal Affairs of Russia*. 2008; 1(8):84-88.
17. National Anti-Corruption Plan for 2021-2024 : Decree of the President of the Russian Federation No. 478 of 08.16.2021.

Правовой аспект влияния коррупции на состояние экологической безопасности государства, экологическую устойчивость и экологические риски в строительной сфере

Данная научная статья рассматривает важный аспект современной проблематики — влияние коррупции на состояние экологической безопасности государства, экологическую устойчивость и риски в строительной сфере. Автор исследует, как проникновение коррупции в сферу строительства оказывает негативное воздействие на окружающую среду, увеличивая вероятность возникновения экологических катастроф и чрезвычайных ситуаций. В исследовании анализируются текущее состояние вопросов экологической безопасности в Российской Федерации в современных условиях глобального экономического кризиса и санкционного давления западных стран, в том числе через ограничения доступа к международным экологически чистым инновационным технологиям, материалам и оборудованию. В результате исследования делается вывод о неотъемлемой связи между правовым уровнем борьбы с коррупцией и обеспечением экологической безопасности государства, подчеркивается важность принятия мер по укреплению правовых механизмов борьбы с коррупцией в сфере строительства для обеспечения устойчивого экологического развития и предотвращения негативных последствий для окружающей среды. Материал содержит значимый анализ, который может послужить основой для разработки эффективных стратегий по улучшению экологической устойчивости и снижению экологических рисков в строительной сфере через противодействие коррупции, а также практические рекомендации по совершенствованию нормативной базы и укреплению мер контроля и надзора в строительной отрасли с целью снижения экологических рисков и повышения уровня экологической безопасности государства.

Ключевые слова: коррупция, экологическая безопасность, экологические риски, экологическая устойчивость строительства, экологическая преступность, управление строительством, окружающая среда, ресурсосбережение

СПИСОК ИСТОЧНИКОВ

1. ISO 6707-3:2022. *Buildings and civil engineering works. Vocabulary. Part 3: Sustainability terms*. 2nd Ed. 2022.
2. Холлинг К.С. Устойчивость и стабильность экологических систем // Ежегодный обзор экологии и систематики. 1973. № 4. С. 1–23. DOI: 10.1146/ANNUREV.ES.04.110173.000245
3. Park Albert Sanghun. *Understanding resilience in sustainable development: a call for unity or a sirens' song?* // *Sustainable Development*. 2023. Pp. 1–15. DOI: 10.1002/sd.2645

4. Организация строительства и развития недвижимости. Том 2. Развитие недвижимости : учебник в 2 томах и практикум (том 3). 5-е изд., перераб. и доп. / под общ. ред. П.Г. Грабового. М. : Изд-во АСВ, Просвещение. 2024. 708 с.
5. Ваганов П.А., Ман-Сон И.М. Экологические риски : уч. пос., 2-е изд. СПб. : Изд-во Санкт-Петербургского государственного университета, 2001. 152 с.
6. Конституция Российской Федерации : принята всенародным голосованием 12.12.1993 с изменениями, одобренными в ходе общероссийского голосования 01.07.2020.
7. Об охране окружающей среды : Федеральный закон от 10.01.2002 № 7-ФЗ.
8. О безопасности : Федеральный закон от 28.12.2010 № 390-ФЗ.
9. Стратегия экологической безопасности Российской Федерации до 2025 года : Указ Президента Российской Федерации от 19.04.2017 г. № 176.
10. Об экологической экспертизе : Федеральный закон от 23.11.1995 № 174-ФЗ.
11. Редникова Т.В. Организованная экологическая преступность в России и за рубежом: криминологическая характеристика и меры противодействия // *LEX RUSSICA*. 2018. № 9. С. 98–111. DOI: 10.17803/1729-5920.2018.142.9.098-111
12. Боголюбов С.А. Особенности юридической ответственности в системе экологических правоотношений // *Журнал российского права*. 2019. № 4. С. 105–119.
13. Криминология : учеб. для юрид. вузов / под общ. ред. д-ра юрид. наук, проф. А.И. Долговой. М. : НОРМА-ИНФРА-М., 1999. 784 с.
14. Волженкин Б.В. *Служебные преступления : Комментарий законодательства и судебной практики*. СПб. : Изд-во Р. Асланова «Юридический центр Пресс», 2005. 560 с.
15. О противодействии коррупции : Федеральный закон от 25.12.2008 № 273-ФЗ.
16. Кислухин В.А., Макаров А.Н. Правовые аспекты экологической безопасности Королевства Нидерландов // *Вестник Нижегородской академии МВД России*. 2008. № 1 (8). С. 84–88.
17. Национальный план противодействия коррупции на 2021–2024 годы : Указ Президента РФ № 478 от 16.08.2021 г.

Об авторе: Панин Виктор Викторович — преподаватель кафедры организации строительства и управления недвижимостью; Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ); 129337, г. Москва, Ярославское шоссе, д. 26; panin_v@mail.ru.

For citation: Panin V.V. Legal aspect of corruption impact on the state of environmental security, environmental sustainability and environmental risks in the construction industry. *Real Estate: Economics, Management*. 2024; 2:84-88.

Для цитирования: Панин В.В. Legal aspect of corruption impact on the state of environmental security, environmental sustainability and environmental risks in the construction industry // *Недвижимость: экономика, управление*. 2024. № 2. С. 84–88.