ISSN 2073-8412 (PRINT)
ISSN 3034-1485 (ONLINE)

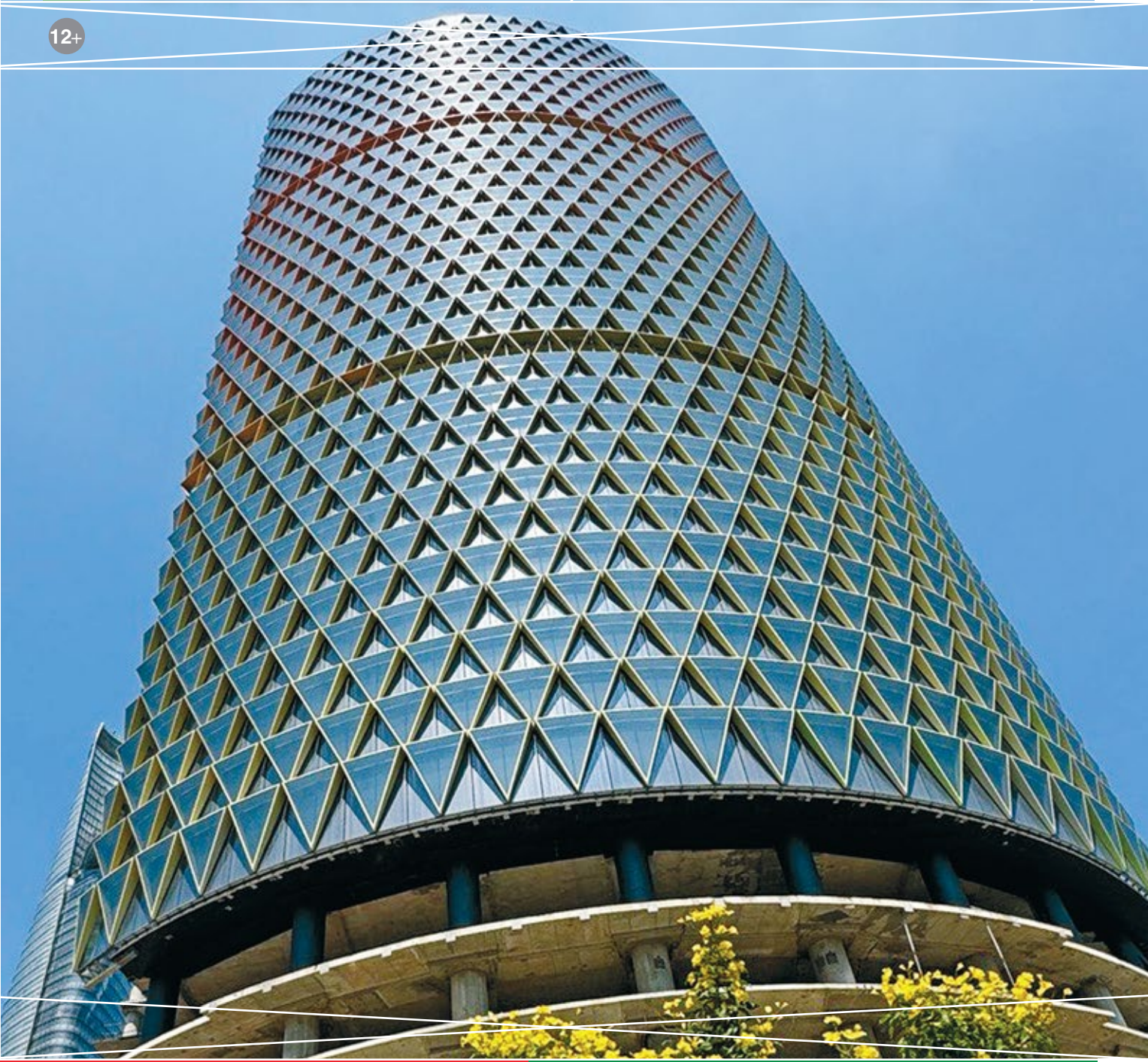
МЕЖДУНАРОДНЫЙ НАУЧНО-ТЕХНИЧЕСКИЙ ЖУРНАЛ

НЕДВИЖИМОСТЬ

ЭКОНОМИКА / УПРАВЛЕНИЕ

3/2024

12+



INTERNATIONAL SCIENTIFIC & ENGINEERING MAGAZINE

REAL ESTATE

ECONOMICS / MANAGEMENT

3/2024

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 Тхыонг (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)
Штефенберг Артур (Австралия)
Якубов Харис Галиулович
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)

© 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 27.09.2024.
Выход в свет 30.09.2024

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: journals@mgsu.ru

На обложке печатаются работы Янковского А.В.



Дорогие читатели!

Быстрый темп перемен является частью сегодняшней жизни в большинстве развитых стран, в том числе и в России. Значительная часть этих перемен относится к области науки, технологий и техники, являясь в большой степени результатом всесторонних и глубоких программ исследований и разработок.

В настоящем номере журнала представлены материалы по итогам прохождения производственной практики студентов НИУ МГСУ за рубежом на крупных строительных объектах Вьетнама и на очень сложном энергоатомном комплексе строительства объектов АЭС-1200 «Аккую» в Турции. Как известно, строительная профессия изменяет человека и оказывает влияние на его индивидуальность. Условия и содержание подобных стажировок студентов позволяют определить им в будущем задачи, проекты и программы в области собственного развития.

Проект — это работа для достижения отдельной, ясно определенной цели, задача — часть проекта, программа — множество проектов, выполняемых некоторой группой (отдел, компания, отрасль промышленности или даже страна в целом).

Именно такие задачи и цели были поставлены перед студентами в рамках летней зарубежной практики, и результатом стало включение будущих инженеров в резерв компаний-застройщиков с приглашением их на работу в эти организации.

С уважением, главный редактор, **Пётр Грабовый**

Редакционная коллегия



О.А. Куракова
научный редактор



С.И. Беляков
редактор



О.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

СОДЕРЖАНИЕ

АКЦЕНТЫ НОМЕРА

Владимирова И.Л., Косарева Ю.Ю., Каллаур Г.Ю., Цыганкова А.А.
Методы оценки эффективности инвестиций в девелопмент значительно усложнились с учетом развития экономических регуляторов инвестиционно-строительной деятельности. В результате процесс финансового моделирования должен включать факторы, характеризующие не только сам проект, но и форму приобретения права на освоение земельного участка

Кущенко И.В., Бочарова Е.А.
Теоретическое и экспериментальное обоснование принципов системы регламентного управления коррозионной защищенностью и живучестью объектов недвижимости способствует продвижению цифровых технологий и платформенных решений технико-экономической защиты на основе целевых показателей качества, надежности и безопасности конструкций и сооружений

Симионов Р.Ю., Кирпиченков А.А.
Для организации системы экологического менеджмента в строительных организациях необходимо формирование системы показателей (индикаторов устойчивости), наличие которой позволит моделировать экологический профиль организации. Экологический профиль позволяет установить баланс внешних запросов и реальных возможностей самой организации. Это требует не только наличия сбалансированной системы экологических показателей организации, но и эталонных значений показателей, обеспечивающих организации повышение конкурентоспособности на рынке подрядных работ

1 РАЗДЕЛ — ОФИЦИАЛЬНЫЙ РАЗДЕЛ

6 **Владимирова И.Л., Косарева Ю.Ю., Каллаур Г.Ю., Цыганкова А.А**
Моделирование эффективности девелоперских проектов с учетом приобретения прав на земельный участок через покупку юридического лица

2 РАЗДЕЛ — ТЕМА НОМЕРА

13 **Моттаева А.Б., Баранова А.С., Валуев Е.И., Варганов И.Е., Грабовой А.Л.**
Новые тренды развития кафедры ОСУН. Как прошла производственная практика студентов МГСУ на АЭС «Аккую»

20 **Янковский А.В., Хромых В.Д., Пономарева А.А., Шокина Я.И., Чернышова А.С.**
Содержание и итоги производственной практики студентов НИУ МГСУ в республике Вьетнам в 2024 году

3 РАЗДЕЛ — ЭКОНОМИКА И МЕНЕДЖМЕНТ НЕДВИЖИМОСТИ

26 **Кущенко И.В., Бочарова Е.А.**
Оценка рисков технико-экономической защищенности на этапах жизненного цикла объектов недвижимости

33 **Симионов Р.Ю., Кирпиченков А.А.**
Экологический менеджмент в строительстве: тенденции, уровни управления, показатели

4 РАЗДЕЛ — ГРАДОРЕГУЛИРОВАНИЕ И УПРАВЛЕНИЕ ЖИЛИЩНО-КОММУНАЛЬНЫМ КОМПЛЕКСОМ

37 **Балашов Е.Б.**
Тренды стратегии развития жилищно-коммунального комплекса

46 **Манухина Л.А., Горский С.В.**
Стратегические направления и перспективы развития рынка индивидуального жилищного строительства в России

51 **Айбазов М.М.**
Особенности устойчивого развития городских территорий

СОДЕРЖАНИЕ

5 РАЗДЕЛ — ТЕХНОЛОГИЯ И ОРГАНИЗАЦИЯ СТРОИТЕЛЬСТВА

Грабовый П.Г., Королев Н.И. 56

Основные особенности строительства объектов недвижимости при формировании системы взаимоотношений участников их возведения

Звонов И.А. 60

Условия и перспективы применения образовательно-технологического задания на предпроектных этапах

Грабовый П.Г., Храбров А.П. 65

Особенности возведения крупных объектов коммерческой недвижимости на этапах жизненного цикла в условиях риска

6 РАЗДЕЛ – ОТЕЧЕСТВЕННЫЙ И ЗАРУБЕЖНЫЙ ОПЫТ

Шотин С., Фомин Н.И., Чун Л. 69

Библиометрический анализ конструкций и типов соединений, широко используемых в сборном строительстве Китая

7 РАЗДЕЛ — ПРАВОВЫЕ И СОЦИАЛЬНЫЕ АСПЕКТЫ

Ершова С.А., Чернышова А.С. 77

Методические подходы к установлению зон ответственности органов власти при подготовке и реализации программ комплексного развития

АКЦЕНТЫ НОМЕРА

Балашов Е.Б.
Достижение стратегических целей развития строительной отрасли и жилищно-коммунальной сферы будет направлено на повышение уровня обеспеченности населения жильем, качества предоставляемых коммунальных услуг и мер государственной поддержки развития сферы жилищно-коммунального хозяйства

Звонов И.А.
В условиях перехода от постиндустриальной к информационной экономике меняется подход к организации образовательного процесса. Концепция нового образования (Образование 3.0) предполагает интеграцию традиционных и цифровых технологий при создании образовательной среды и организации образовательного процесса. При этом Концепция технологического развития ожидает усиления роли ключевых образовательных организаций высшего образования и научных организаций в качестве драйверов технологического развития

Грабовый П.Г., Храбров А.П.
В современных условиях развития строительного производства объективно существует ряд особенностей, связанных с возведением региональных групп коммерческой недвижимости. Они, как правило, определяют внешние условия деятельности строительных предприятий, тип организационно-технологических ситуаций, а также специфику функционирования их на всех этапах жизненного цикла

CONTENTS

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 Madkhu 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 Yankovskyy A.V.

Address: MGSU,
26 Yaroslavskoye shosse, Moscow, 129337
Tel.: +7 (968) 903-00-04;
e-mail: journals@mgsu.ru
On-line version of journal: http://n-eu.iasv.ru/
Signed for printing: 30.09.2024

SECTION 1: OFFICIAL SECTION

6 **Vladimirova I.L., Kosareva Yu.Yu., Kallaur G.Yu., Tsygankova A.A.**
Modelling the efficiency of development projects considering the acquisition of land rights through the purchase of a legal entity

SECTION 2: COVER STORY

13 **Mottaeva A.B., Baranova A.S., Valuev E.I., Varganov I.E., Grabovoi A.L.**
New trends in the development of the MGSU department "Organization of construction and real estate management". How the industrial practice of MGSU students at Akkuyu NPP was held

20 **Yankovsky A.V., Khromykh V.D., Ponomareva A.A., Shokina Ya.I., Chernyshova A.S.**
Content and results of the internship of NRU MGSU students in the Republic of Vietnam in 2024

SECTION 3: PROPERTY ECONOMICS AND MANAGEMENT

26 **Kushchenko I.V., Bocharova E.A.**
Assessment of technical and economic security risks protection at the stages of the life cycle of real estate objects

33 **Simionov R.Yu., Kirpichenkov A.A.**
Environmental management in construction: trends, management levels, indicators

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

37 **Balashov E.B.**
Regional trends in the development of the housing and municipal complex

46 **Manukhina L.A., Gorskii S.V.**
Strategic directions and development prospects of the individual housing construction market in Russia

51 **Aibazov M.M.**
Sustainable development of urban areas

SECTION 5: TECHNOLOGIES AND ORGANIZATION OF CONSTRUCTION

Grabovyy P.G. , Korolev N.I. 56
Main features of construction of real estate facilities in the formation of the system of relations of the participants in their construction

Zvonov I.A. 60
Conditions and prospects for the application of Educational and Technological tasks at the pre-project stages

Grabovyy P.G., Khrabrov A.P. 65
Construction of large commercial real estate objects at life cycle stages under risk conditions

SECTION 6: DOMESTIC AND OVERSEAS EXPERIENCE

Shuoting X., Fomin N.I., Chong L. 69
Bibliometric Analysis of Structures and Connection Types Widely Used in Prefabricated Construction in China

SECTION 7: LEGAL AND SOCIAL ASPECTS

Ershova S.A., Chernyshova A.S. 77
Methodological approaches to establishing areas of responsibility of authorities during preparation and implementation of integrated development programmes

ACCENTS

Vladimirova I.L., Kosareva Yu.Yu., Kallaur G.Yu., Tsygankova A.A.
Methods for assessing the effectiveness of investments in development have become significantly more complex, taking into account the development of economic regulators of investment and construction activities. As a result, the financial modeling process should include factors that characterize not only the project itself but also the form of acquiring the right to develop the land plot

Simionov R.Yu., Kirpichenkov A.A.
To organize an environmental management system in construction organizations, it is necessary to form a system of indicators (sustainability indicators), the presence of which will allow modeling the environmental profile of the organization. The environmental profile allows you to establish a balance between external requests and the real capabilities of the organization itself. This requires not only a balanced system of environmental indicators of the organization, but also reference values of indicators that ensure the organization's competitiveness in the contract market

Zvonov I.A.
In the context of the transition from the post-industrial to the information economy, the approach to the organization of the educational process is changing. The concept of new education (Education 3.0) involves the integration of traditional and digital technologies in creating an educational environment and organizing the educational process. At the same time, the Concept of Technological Development expects to strengthen the role of key educational institutions of higher education and scientific organizations as drivers of technological development

Grabovyy P.G., Khrabrov A.P.
In modern conditions of development of construction production, there are objectively a number of features associated with the construction of regional groups of commercial real estate. They, as a rule, determine the external conditions of the activity of construction enterprises, the type of organizational and technological situations, as well as the specifics of their functioning at all stages of the life cycle

UDC 330.322.5

Vladimirova I.L.
Kosareva Yu.Yu.
Kallaur G.Yu.
Tsygankova A.A.

Modelling the efficiency of development projects considering the acquisition of land rights through the purchase of a legal entity

This paper presents an analysis of developers' approaches to the acquisition of land plots for project implementation, the form, common in modern conditions when a developer acquires 100 % of the shares of a legal entity that has lease rights to a land plot intended for development, is investigated. The multifactoriality of the investment efficiency assessment task is noted, based on financial modelling that takes into account the specifics of the considered project entry option according to the criterion of return on investment. A decision-making procedure in the analysis process is constructed, consisting of eight stages and including calculations of economic, technical, urban planning, social, and other project parameters. Calculations were performed according to the proposed algorithm using a real development project as an example, utilizing current regulatory and analytical information, which confirms the feasibility and advisability of entering the project through the purchase of shares in a legal entity. The formulated requirements for constructing a financial model of the project, taking into account the considered form of land acquisition, have practical significance, including: determining the volume of investments in the project considering project financing, forming the project's profitability indicator based on comparing dividend flows from the project and the cost of acquiring shares in the legal entity, as well as taxation for both the project itself and the developer when receiving dividends.

Keywords: *development project, investments, efficiency assessment, dividends, profitability, acquisition of a legal entity, land plot*



Vladimirova Irina Lvovna,
Doctor of Economics, Professor of the Project and Programme Management Joint Department with Capital Group company; Plekhanov Russian University of Economics (PRUE); 36 Stremyanny Lane, Moscow, 117997, Russian Federation; SPIN-code: 9331-6832, Scopus: 57193004147, ResearcherID: L-1010-2018, ORCID: 0000-0001-6138-5053; kaf-stroy@yandex.ru



Kosareva Yulia Yurevna,
Candidate of Economics, Senior lecturer of the Project and Programme Management Joint Department with Capital Group company; Plekhanov Russian University of Economics (PRUE); 36 Stremyanny Lane, Moscow, 117997, Russian Federation; SPIN-code: 9223-4745; kaf-stroy@yandex.ru



Kallaur Galina Yurevna,
Candidate of Economics, Docent of the Project and Programme Management Joint Department with Capital Group company; Plekhanov Russian University of Economics (PRUE); 36 Stremyanny Lane, Moscow, 117997, Russian Federation; SPIN-code: 6393-0046, Scopus: 57209797341, ResearcherID: ADU-7992-2022, ORCID: 0000-0001-9068-8475; kaf-stroy@yandex.ru



Tsygankova Anna Aristokesovna,
Candidate of Economics, Docent of the Project and Programme Management Joint Department with Capital Group company; Plekhanov Russian University of Economics (PRUE); 36 Stremyanny Lane, Moscow, 117997, Russian Federation; SPIN-code: 6327-6090, Scopus: 57193005125, ResearcherID: C-1760-2017, ORCID: 0000-0001-5828-4083; kaf-stroy@yandex.ru

INTRODUCTION

Increasing investment activity in Russia requires the development of methods for assessing and modelling the efficiency indicators of capital investments, taking into account numerous parameters that determine the general economic, financial, urban planning, technical, technological, social, and other conditions for project implementation, the number of which can reach 30–50 values[1] [1, 2]. Their composition and range vary over the project's life cycle, which can create significant risks [3]. At the same time, investors, developers, and other project participants are interested in indicators of maximum return on their investments, obtained by modelling the optimal combination of project parameters and its environment, subject to compliance with the requirements of federal and regional regulatory legal acts. In this context, the form of acquiring the land plot for construction becomes a significant factor, including whether it is free, built-up, or through the acquisition of a legal entity that has lease rights to the land plot. Each option has its own characteristics that should be taken into account in the investment efficiency assessment model.

To obtain a reliable result of project evaluation, it is necessary to choose a justified range of parameter value changes and the correct decision-making order within the framework of modelling the project's financial results [4–6].

The decision to enter a new project is primarily based on modelling the level of return on investment, which should not be lower than the return on the developer's current portfolio or alternative investment options [7].

METHODS

To form indicators characterizing the efficiency of investments in a development project, this study uses financial modelling, which allows for a multivariate assessment depending on the choice of parameters both at the early stage of project justification and for monitoring its profitability during implementation and closure [8–10]. Also, when using this method, it is possible to take into account all modelling parameters and obtain quantitatively measurable results, in particular, to form cash flows of the project's net profit, which for the developer will be dividends from participation in the project.

As already noted, not only the set of parameters taken into account is important, but also the order of performing calculations and making intermediate and final decisions in the modelling process. In modern conditions of implementing development projects, eight main stages of evaluating their effectiveness have been identified:

1) assessment of the land plot potential, consisting in determining the sellable area of the project;
2) determination of the social load on the project — construction of kindergartens, schools, clinics;
3) determination of the project concept — what class of housing will be implemented on the land plot;
4) based on the concept, determination of the object's height, design and construction costs, and the sale price of residential and commercial premises;

1 Methodological recommendations for assessing the effectiveness of investment projects (Second edition, revised and supplemented) (approved by the Ministry of Economy of the Russian Federation, Ministry of Finance of the Russian Federation and Gosstroy of the Russian Federation on June 21, 1999 No. VK 477).

Table 1. Determination of the project's sellable area

Project Area	SPP in GNS	Sellable Area
Residential part, sq. m	119,000	77,350
Commercial (public and business part, street retail), sq. m	4,000	2,800
Parking, units	–	530
Total (excluding parking), sq. m	123,000	80,150

5) distribution of the project's cash flows, taking into account the pace of construction and sales dynamics;
6) determination of the project's financial result, taking into account the costs of project financing (interest on the project loan), sales promotion costs, and project management costs;
7) determination of return on investment through receiving net profit and dividend payments;
8) calculation of return on investment and comparison with the developer's target rate of return.

The parameters and procedure for assessing investment efficiency proposed in the study are considered using the example of a project where the developer acquires 100 % of the shares of a legal entity that has lease rights to a land plot intended for development. The developer then carries out the design, construction, and sale of a residential object, resulting in profit. To implement the project, the developer attracts project financing in accordance with modern housing construction regulations. Thus, the investment is the payment for acquiring the legal entity, and the return on investment for the developer occurs after receiving net profit from the project in the form of dividends.

At the first stage, an assessment of the land plot potential is carried out based on the GPZU[2]. For the implementation of the studied project, a land plot located in the South-Western Administrative District of Moscow, with an area of 2.5 hectares, was considered. The assessment of the land plot parameters gave the following indicators: the total floor area of the project within the outer walls (SPP GNS) is 123,000 sq. m, of which the residential part is 119,000 sq. m, commercial 4,000 sq. m, the number of parking spaces in the underground parking is 530 units. The maximum height of the object is 100 meters. The useful sellable area is determined by converting SPP GNS with a coefficient of 0.65 for housing and 0.7 for commercial areas and is presented in Table 1.

To implement the project, it is necessary to change the permitted use of the land plot (VRI) from the current (industrial purpose) to residential construction. The amount of payment for changing the VRI[3], taking into account the installment plan under the contract for 6 years with an actual construction period of 13 quarters, amounted to 6,977,048.1 thousand rubles (Table 2). The amount of rent for the land plot, calculated based on the new cadastral value of the land plot, will be 112,993 thousand rubles.

At the second stage of the assessment, the calculation of the project's social load is performed based on the estimated number of residents in the new residential complex, depending on

Table 2. Calculation of the fee for changing the permitted use of the land plot

Cadastral number of the land plot	NNN
Right	lease
Land plot area, sq. m	25,001
Total floor area of the residential part of the capital construction object, sq. m	123,000.0
Current cadastral value of the land plot, rubles	1,148,160,424.58
Cadastral value of the land plot after changing the VRI (593-PP/273-PP), rubles	1,590,697,625.36
Average specific indicator of cadastral value (UPKS) of the land plot for VRI after change, rubles/sq. m	63,625.36
Base cost indicator (residential purpose), rubles/sq. m	203,910.98
Coefficient for calculating the fee for changing the VRI of the land plot, %	298.3 %

2 Urban Planning Code of the Russian Federation (GrK RF) of December 29, 2004 No. 190-FZ (latest edition).

3 Moscow Government Decree 593-PP dated September 10, 2013 "Approval of the Procedure for determining the fee for changing the type of permitted use of a land plot owned by an individual or legal entity to another type of such use, providing for the construction and (or) reconstruction of a capital construction object, and the List of types of capital construction objects of important socio-economic significance for the city of Moscow, during the construction and (or) reconstruction of which the fee for the use of the type of permitted use of the land plot is not charged" (as amended on April 10, 2024).

Cadastral number of the land plot	NNN				
Price change coefficient (set by the Moscow City Property Department)	1.5573				
Profitability / location coefficient	1.000				
Rent coefficient	0.1216				
Fee for changing VRI, rubles	4,744,732,876.92				
Installment period, quarters	24				
Quarterly payment, rubles	197,697,203.21				
Installment rate, %	19.00				
Total fee for changing VRI, including installments for the entire construction period	6,977,048,132.50				
Quarter number	Date	Payment	Rent for the 1st year	Balance + 19 % rate	Payment for the entire period, rubles
1	Nov. 24	197,697,203.21	994,186.02	226,508,183.71	425,199,572.93
2	Feb. 25	197,697,203.21	994,186.02	217,070,342.72	415,761,731.94
3	May 25	197,697,203.21	994,186.02	207,632,501.74	406,323,890.96
4	Aug. 25	197,697,203.21	994,186.02	198,194,660.75	396,886,049.97
5	Nov. 25	197,697,203.21	994,186.02	188,756,819.76	387,448,208.98
6	Feb. 26	197,697,203.21	994,186.02	179,318,978.77	378,010,367.99
7	May 26	197,697,203.21	994,186.02	169,881,137.78	368,572,527.00
8	Aug. 26	197,697,203.21	994,186.02	160,443,296.80	359,134,686.02
9	Nov. 26	197,697,203.21	994,186.02	151,005,455.81	349,696,845.03
10	Feb. 27	197,697,203.21	994,186.02	141,567,614.82	340,259,004.04
11	May 27	197,697,203.21	994,186.02	132,129,773.83	330,821,163.05
12	Aug. 27	197,697,203.21	994,186.02	122,691,932.84	321,383,322.06
13	Nov. 27	2,372,366,438.46	11,930,232.19	113,254,091.86	2,497,550,762.51
–	–	–	23,860,464.38	2,208,454,791.19	6,977,048,132.50

the number of places and visits per shift in social facilities[4, 5] [11] and the standard cost of construction of a social facility approved by the Moscow City Government. In the project under consideration, the average estimated number of residents was 2,380 people, determined as the ratio of SPP GNS of the residential part to the provision standard of sq. m for Moscow, which is 50 sq. m SPP GNS per 1 resident (119,000 sq. m/50 sq. m)[6]. Since the estimated number of places and visits per shift for social facilities for the project under consideration is insufficient for the construction of separate social infrastructure facilities, the project budget includes compensation in cash for the need for social facilities in the Moscow city budget, as shown in Table 3.

At the third stage of the analysis, the housing category is determined. The location of the land plot suggests the construction of a business-class residential object. According to comparable objects, the following specific indicators of construction and sales costs correspond to this class:

- the cost of design and survey works and construction and installation works "turnkey" is 180,00, rubles per sq. m of sellable area;
- the average sale price of 1 sq. m of apartments is 490,00, rubles per sq. m.;
- the average sale price of 1 sq. m of commercial areas is 600,00, rubles per sq. m;
- the average sale price of 1 parking space is 3,300,00, rubles.

4 Appendix to the Moscow Government Decree of December 21, 2021 No. 2151-PP Urban Planning Standards of Moscow in the field of education.

5 Moscow Government Decree of December 21, 2021 No. 2150-PP "Approval of urban planning standards of Moscow in the field of healthcare".

6 Moscow Government Decree of December 21, 2021 No. 2152-PP "Approval of urban planning standards of Moscow in the field of trade, services and ensuring comfortable and favourable living conditions for citizens in residential facilities (as amended on October 20, 2023)".

Table 3. Calculation of the number of places in social facilities and the cost of compensation

Name of the social facilities provision standard	Standard	Unit	Estimated number of places/visits, units	Construction cost per 1 place/ visit, thousand rubles/unit	Amount of compensation for social facilities, thousand rubles
Standard (places/1,000 residents), Secondary school	105	places	250	2,858	714,578
Standard (places/1,000 residents), Preschool	46	places	110	4,198	461,815
Standard (visits/shift) mixed polyclinic	19	places	46	9,170	421,804
Total	–	–	–	–	1,598,197

The financial model provides for contingency reserves of 5 % of the design and construction costs, project management costs of 4 % of the total design and construction costs and contingency reserve, as well as marketing and advertising costs of 3 % of total sales.

RESULTS

At stages 5–8, based on the obtained initial data, financial flows are modeled and project results are determined (Table 4). Within the financial model, project financing parameters are taken into account.

Table 4. Financial model of the project

Item name	Unit	Total	Total per sq. m (excluding parking)
Area of land plots for residential development	ha	2.50	
Total floor area of development in GNS (excluding infrastructure objects)	sq. m	123,000	
Sellable area, including:	sq.m	83,719	
apartments	sq. m	77,350	
public and business part (street retail)	sq. m	2,800	
parking	units	530	
Sellable area (excluding parking)	sq. m	80,150	
Development height	m	100	
Acquisition	thousand rubles; rubles/sq. m	8,688,238	108,400
Fee for changing VRI (including % for installment)	–	6,977,048	87,050
Land plot rent		112,993	1,410
Compensation to Moscow city budget for social facilities		1,598,197	19,940
Design and construction of residential development objects	thousand rubles; rubles/sq. m	14,427,000	180,000
Contingency expenses, 5 %	thousand rubles; rubles/sq. m	721,350	9,000
Overhead costs, including:		3,569,304	44,533
project management, 4 %	thousand rubles; rubles/sq. m	605,934	7,560
marketing, 3 %		1,239,915	15,470
loan interest, including		1,723,455	21,503
bridge loan interest (5 % equity financing), decreasing rate 17–10 %		874,499	10,911
Project financing interest		848,956	10,592
Total Project costs	thousand rubles; rubles/sq. m	27,405,892	341,933
VAT	thousand rubles; rubles/sq. m	53,312	665
Revenue	thousand rubles; rubles/sq. m	41,330,500	515,664
apartments	thousand rubles; rubles/sq. m	37,901,500	490,000
public and business part (street retail)		1,680,000	600,000
underground parking		1,749,000	3,300,000
Income tax (25 %)	thousand rubles; rubles/sq. m	3,467,824	43,267
Profit before tax	thousand rubles; rubles/sq. m	13,871,296	173,067
Net profit	thousand rubles; rubles/sq. m	10,403,472	129,800
Return on sales based on profit before tax, %	–	–	33.6
Net profit margin, %	–	–	25.2

Table 5. Calculation of return on investment

Year	2024	2025	2026	2027	2028	Total
Investments, thousand rubles	–4,000,000	0	0	0	0	–4,000,000
Dividends, thousand rubles	0	0	0	5,201,736	5,201,736	10,403,472
Total	–4,000,000	0	0	5,201,736	5,201,736	6,403,472
Calculated internal rate of return on investment	32 %	–	–	–	–	–

When constructing cash flows, the requirement of most banks for 5 % equity participation in the project is taken into account. The cost of such financing is calculated at the commercial rate for a bridge loan, which decreases from 17 to 10 % due to the prospect of a decrease in the Central Bank of the Russian Federation's key rate. The average bridge loan rate for the entire loan term was 14.02 %.

Project financing interest is calculated based on the distribution of cash flows in the financial model, taking into account the coverage ratio of funds in escrow accounts to the amount of the drawn loan. The average project financing rate was 1.89 %. The project's net profit is received as dividends by the developer within 1.5 years after the facility is commissioned.

Thus, having a schedule of investments and dividend receipts, the return on investment indicator for the developer is calculated. The amount of investment in acquiring 100 % of the shares of the company owning the land plot under lease rights, according to the terms of the share purchase agreement, is 4,000,000,00, rubles.

Calculations showed that, subject to the acquisition of shares in 2024, a project construction period of 13 quarters, and receipt of dividends within 1.5 years after the facility is commissioned, a return on investment schedule is formed, as shown in Table 5.

The calculated internal rate of return on investment was 32 %. With a target rate of return on investment for the developer with a similar term of 25 %, this project is interesting for implementation.

CONCLUSIONS

1. Methods for assessing the effectiveness of investments in development have become significantly more complex, taking into account the development of economic regulators of investment and construction activities. As a result, the financial modelling process should include factors that characterize not only the project itself but also the form of acquiring the right to develop the land plot.
2. In conditions of a shortage of free, investment-attractive land plots, a common form of entering a project for a developer is acquiring shares of a legal entity that has lease rights to a land plot on which the project is subsequently implemented.
3. The financial modelling used to assess the effectiveness of a development project in the studied variant should take into account the following features:
   - from a theoretical and methodological standpoint, we should talk not about assessing the effectiveness of the project, but about assessing the effectiveness of investments in acquiring a legal entity;
   - it is the cost of acquiring the legal entity that should be considered as the volume of the developer's investment in the project, as the developer implements the project entirely through project financing, without paying for project work from their own funds;
   - when modelling financial flows directly related to the project, the cost of acquiring the legal entity should not be taken into account, as these costs do not form the project's cost, which significantly increases the tax burden on the project;
   - when assessing the effectiveness of investments, the cost of acquiring shares should be compared with the amount of net profit from the project, cleared of taxes and received by the developer through dividend payments;
   - the criterion for the project's effectiveness for the developer is the internal rate of return indicator, calculated based on cash flows formed from investments in acquiring shares of the legal entity and their return in the form of dividends as the project's net profit is received upon its implementation;
   - when using the method of entering the project through the purchase of shares of a legal entity, the calculation of investment efficiency should take into account the taxation procedure for both the project itself and the developer when receiving dividends.

REFERENCES

1. Shagiakhmetova E.I., Borovskikh O.N., Nizamova A.Sh. Construction project management based on the formation of a multi-factor efficiency model. Bulletin of Economics, Law and Sociology. 2020; 3:51-55. EDN WKPYPB. (rus.).

2. Vladimirova I.L., Kallaur G.Yu., Morozov D.E. Development projects as a tool for sustainable development of the urban environment. Industry aspects of project management : materials of the student round table within the framework of the XI International Scientific and Practical Conference dedicated to the 25th anniversary of the Department and the 114th anniversary of Plekhanov Russian University of Economics (Moscow, June 16, 2021). Moscow, 2021; 68-77. EDN XSWQMJ. (rus.).

3. Vladimirova I.L., Kosareva Yu.Yu., Kallaur G.Yu., Tsygankova A.A. The precise estimation of development project cost and its life cycle. Bulletin of the Plekhanov Russian University of Economics. 2021; 18(6):5-16. DOI: 10.21686/2413-2829-2021-6-5-16. EDN DATYXG. (rus.).

4. Vladimirova I.L., Kosareva Yu.Yu. Analysis of factors affecting the cost of projects in the conditions of transformation of the housing construction industry. Modern problems of project management in the investment and construction sector and environmental management : materials of the X International Scientific and Practical Conference dedicated to the 113th anniversary of Plekhanov Russian University of Economics. Edited by V.I. Resin. Moscow, Plekhanov Russian University of Economics, 2020; 27-36. URL: https://www.elibrary.ru/item.asp?id=42782805 (rus.).

5. Mokaseev A.V., Malonga U.M., Lunyakov M.A. Methodological aspects of implementing an innovative approach to improving the efficiency of development projects. Real Estate: Economics, Management. 2024; 1:67-72. DOI: 10.22337/2073-8412-2024-1-67-72

6. Vladimirova I., Dmitriev A., Kallaur G., Oleynikova N., Tsygankova A. Trends in the application of "green" standards on the life cycle of capital housing construction objects. E3S Web of Conferences. 2023; 403:02018. DOI: 10.1051/e3sconf/202340302018

7. Vladimirova I.L., Tsygankova A.A., Kosareva Yu.Yu. Transforming housing construction: project cost management challenges. Real estate: economics, management. 2021; 1:14-19. EDN LXVCJA.
8. Dobrovolskienė N., Pozniak A., Tvaronavičienė M. Assessment of the sustainability of a real estate project using multicriteria decision making. Sustainability. 2021; 13(8):4352. DOI: 10.3390/su13084352
9. Manewa A., Siriwardena M., Wijekoon C. Life cycle costing in construction: Current trends and emerging directions. Proceedings of the 9th World Construction Symposium 2021 on Reshaping construction: Strategic: Structural and Cultural Transformations towards the "Next Normal". 2021; 403-412. URL: https://ciobwcs.com/downloads/papers21/35_WCS2021_Proceedings.pdf
10. Baronin S.A., Kulakov K.Yu. Genesis of value management on the basis of life cycle contracts of capital construction objects, taking into account the cost of property ownership as an institutional instrument of economic growth. Real estate: economics, management. 2020; 1:10-14. URL: https://www.elibrary.ru/item.asp?id=42669868
11. Kosareva Yu.Yu. Managing the cost of housing construction projects taking into account the social results of developers activities. Financial Economics. 2023; 8:60-63. EDN AOORVY. (rus.).

Моделирование эффективности девелоперских проектов с учетом приобретения прав на земельный участок через покупку юридического лица

Представлен анализ подходов девелоперов к приобретению земельных участков для реализации проектов, исследована распространенная в современных условиях форма, когда девелопер приобретает 100 % долей юридического лица, имеющего права аренды на земельный участок, предназначенный под застройку. Отмечена многофакторность задачи оценки эффективности инвестиций на основе финансового моделирования с учетом особенностей рассматриваемого варианта вхождения в проект по критерию доходности инвестиций. Построен порядок принятия решений в процессе анализа, состоящий из восьми этапов и включающий расчеты экономических, технических, градостроительных, социальных и других параметров проекта. По предложенному алгоритму выполнены расчеты на примере реального девелоперского проекта с использованием современной нормативной и аналитической информации, которые подтверждают возможность и целесообразность вхождения в проект через покупку долей юридического лица. Практическое значение имеют сформулированные требования к построению финансовой модели проекта с учетом рассматриваемой формы приобретения земельного участка, в том числе: определение объема инвестиций в проект с учетом проектного финансирования, формирование показателя доходности проекта на основе сопоставления потоков дивидендов от проекта и стоимости приобретения долей юридического лица, а также налогообложение как для самого проекта, так и для девелопера при получении дивидендов.

Ключевые слова: *девелоперский проект, инвестиции, оценка эффективности, дивиденды, рентабельность, приобретение юридического лица, земельный участок*

СПИСОК ИСТОЧНИКОВ

1. Шагиахметова Э.И., Боровских О.Н., Низамова А.Ш. Управление строительным проектом на основе формирования многофакторной модели эффективности // Вестник экономики, права и социологии. 2020. № 3. С. 51–55. EDN WKPYPB.
2. Владимирова И.Л., Каллаур Г.Ю., Морозов Д.Е. Девелоперские проекты как инструмент устойчивого развития городской среды // Отраслевые аспекты проектного управления : мат. студ. круглого стола в рамках XI Междунар. науч.-практ. конф., посвящ. 25-летнему юбилею кафедры и 114-летию РЭУ им. Г.В. Плеханова (г. Москва, 16 июня 2021 г.). М. : Российский экономический университет имени Г.В. Плеханова, 2021. С. 68–77. EDN XSWQMJ.
3. Владимирова И.Л., Косарева Ю.Ю., Каллаур Г.Ю., Цыганкова А.А. Точность оценки стоимости девелоперского проекта на его жизненном цикле // Вестник Российского экономического университета имени Г.В. Плеханова. 2021. Т. 18. № 6 (120). С. 5–16. DOI: 10.21686/2413-2829-2021-6-5-16. EDN DATYXG.
4. Владимирова И.Л., Косарева Ю.Ю. Анализ факторов, влияющих на стоимость проектов в условиях трансформации жилищного строительства // Современные проблемы управления проектами в инвестиционно-строительной сфере и природопользовании : мат. X Междунар. науч.-практ. конф., посвящ. 113-летию РЭУ им. Г.В. Плеханова / под ред. В.И. Ресина. М. : ФГБОУ ВО РЭУ им. Г.В. Плеханова, 2020. С. 27–36. URL: https://www.elibrary.ru/item.asp?id=42782805
5. Мокасеев А.В., Малонга У.М., Луняков М.А. Methodological aspects of implementing an innovative approach to improving the efficiency of development projects // Недвижимость: экономика, управление. 2024. № 1. С. 67–72. DOI: 10.22337/2073-8412-2024-1-67-72
6. Vladimirova I., Dmitriev A., Kallaur G., Oleynikova N., Tsygankova A. Trends in the application of "green" standards on the life cycle of capital housing construction objects // E3S Web of Conferences. 2023. Vol. 403. P. 02018. DOI: 10.1051/e3sconf/202340302018
7. Владимирова И.Л., Цыганкова А.А., Косарева Ю.Ю. Transforming housing construction: project cost management challenges // Недвижимость: экономика, управление. 2021. № 1. С. 14–19. EDN LXVCJA.
8. Dobrovolskienė N., Pozniak A., Tvaronavičien M. Assessment of the sustainability of a real estate project using multicriteria decision making // Sustainability. 2021. Vol. 13. Issue 8. P. 4352. DOI: 10.3390/su13084352
9. Manewa A., Siriwardena M., Wijekoon C. Life cycle costing in construction: Current trends and emerging directions // Proceedings of the 9th World Construction Symposium 2021 on Reshaping construction: Strategic, Structural and Cultural Transformations towards the "Next Normal". 2021. Pp. 403–412. URL: https://ciobwcs.com/downloads/papers21/35_WCS2021_Proceedings.pdf
10. Baronin S.A., Kulakov K.Yu. Genesis of value management on the basis of life cycle contracts of capital construction objects, taking into account the cost of property ownership as an institutional instrument of economic growth // Real estate: economics, management. 2020. № 1. С. 10–14. URL: https://www.elibrary.ru/item.asp?id=42669868 (rus.)
11. Косарева Ю.Ю. Управление стоимостью проектов жилищного строительства с учетом социальных результатов деятельности застройщиков // Финансовая экономика. 2023. № 8. С. 60–63. EDN AOORVY.

Об авторах: **Владимирова Ирина Львовна** — доктор экономических наук, профессор базовой кафедры управления проектами и программами Capital Group; **Российский экономический университет им. Г.В. Плеханова (РЭУ им. Г.В. Плеханова)**; 117997, г. Москва, Стремянный пер., д. 36; SPIN-код: 9331-6832, Scopus: 57193004147, ResearcherID: L-1010-2018, ORCID: 0000-0001-6138-5053; kaf-stroy@yandex.ru;

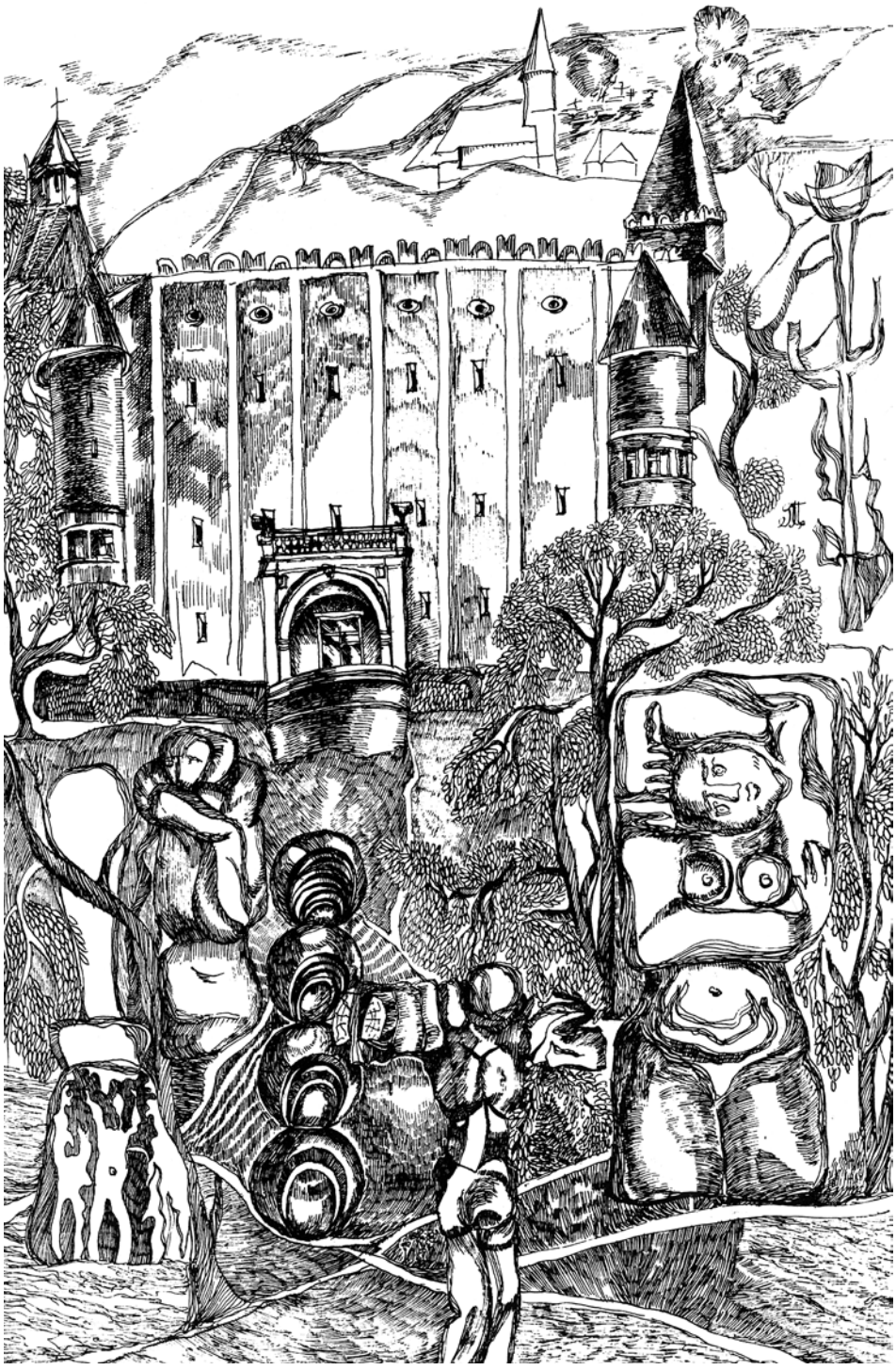
Косарева Юлия Юрьевна — кандидат экономических наук, старший преподаватель базовой кафедры управления проектами и программами Capital Group; **Российский экономический университет им. Г.В. Плеханова (РЭУ им. Г.В. Плеханова)**; 117997, г. Москва, Стремянный пер., д. 36; SPIN-код: 9223-4745; kaf-stroy@yandex.ru;

Каллаур Галина Юрьевна — кандидат экономических наук, доцент базовой кафедры управления проектами и программами Capital Group; **Российский экономический университет им. Г.В. Плеханова (РЭУ им. Г.В. Плеханова)**; 117997, г. Москва, Стремянный пер., д. 36; SPIN-код: 6393-0046, Scopus: 57209797341, ResearcherID: ADU-7992-2022, ORCID: 0000-0001-9068-8475; kaf-stroy@yandex.ru;

Цыганкова Анна Аристокесовна — кандидат экономических наук, доцент базовой кафедры управления проектами и программами Capital Group; **Российский экономический университет им. Г.В. Плеханова (РЭУ им. Г.В. Плеханова)**; 117997, г. Москва, Стремянный пер., д. 36; SPIN-код: 6327-6090, Scopus: 57193005125, ResearcherID: C-1760-2017, ORCID: 0000-0001-5828-4083; kaf-stroy@yandex.ru.

For citation: Vladimirova I.L., Kosareva Yu.Yu., Kallaur G.Yu., Tsygankova A.A. Modelling the efficiency of development projects considering the acquisition of land rights through the purchase of a legal entity. *Real Estate: Economics, Management.* 2024; 3:6-12.

Для цитирования: *Владимирова И.Л., Косарева Ю.Ю., Каллаур Г.Ю., Цыганкова А.А.* Modelling the efficiency of development projects considering the acquisition of land rights through the purchase of a legal entity // Недвижимость: экономика, управление. 2024. № 3. С. 6–12.



Л.И. Павлова. Пьештяны. Дом художника. Офор.

UDC 624.05

Mottaeva A.B.
Baranova A.S.
Valuev E.I.
Varganov I.E.
Grabovoi A.L.

New trends in the development of the MGSU department “Organization of construction and real estate management”. How the industrial practice of MGSU students at Akkuyu NPP was held

This paper tells about how the MGSU department “Organization of construction and real estate management” (OSUN) has started another new unique tradition — the organization of foreign internship of students. In accordance with the agreements, the students of the OSUN Department had a foreign internship at the Akkuyu NPP in the Republic of Turkey. The State Atomic Energy Corporation “Rosatom” is a diversified holding company that unites assets in power engineering, mechanical engineering and construction. Akkuyu NPP is the first nuclear power plant in the Republic of Turkey. The project of the first Turkish NPP includes four power units with Russian-designed VVER-1200 reactors. The construction of Akkuyu NPP is the first project in the world nuclear industry realized by Build-Own-Operate model. The OSUN Department has been operating for more than 90 years, has its own history and established traditions. Keeping up with the times, taking into account the current innovative trends and challenges in the field of construction, economy, education, the department organized a foreign internship for students. What difficulties were encountered and why this “pilot project” is a very valuable, landmark experience not only for the department, but also for NRU MGSU. According to the results of the joint project, it can be noted that the goals and objectives have been achieved. The parties were satisfied with the results, noted the importance of this format of cooperation and planned further relations.
Keywords: *Rosatom State Corporation, NRU MGSU, AKKUYU NÜKLEER ANONİM ŞİRKETİ, foreign internship of students, construction, innovations*

INTRODUCTION

It is known that at all stages of collective development large and small traditions arise, strengthen and unite the collective. “Tradition — (from Latin tradition — transmission), elements of social and cultural heritage, passed from generation to generation and preserved in certain societies and social groups for a long time. Traditions are certain social norms, norms of behavior, values, ideas, customs, rituals, etc. These or those traditions operate in any society and in all areas of social life” [1, p. 364]. Traditions change and are renewed. New tasks facing the team, new ways of solving them become more or less popular over time — this contributes to the emergence of new and erasure of old traditions.

Following this definition, the university should be governed by traditions. The Department of OSUN, which has been operating for over 90 years, which has a unique highly qualified faculty, which has graduated several tens of thousands of doctors and candidates of sciences, specialists in the field of organization and management of construction projects, has its own history and established traditions[1].

Throughout its long history, the main vector of the Department's development has been and remains the desire to provide comprehensive consideration of key aspects of the organization and economics of construction, investment and construction activities, expertise and real estate management within the framework of educational and research activities [2–4].

Today the OSUN department is one of the leading and largest departments of the university, specializing in teaching students the basics of development, project management, expertise of design and estimate documentation, organization and technology of construction, economics and real estate management, risk management in the investment and construction sphere, management of housing and communal facilities and a number of other disciplines related to the implementation of investment and construction projects and management of real estate objects of various levels of complexity.

The department has active international cooperation with the world's leading organizations in the field of construction, development and surveying.

Keeping up with the times, taking into account the current innovative trends and challenges in the field of construction, economy, education, the department continues to multiply its traditions.

An example of this is the birth of a new tradition, another project of the department — foreign internship of students. In the summer of 2024, on the initiative and thanks to the personal connections of the head of the OSUN Department P.G. Grabovyy, an unprecedented in its geographical scope and scientific — practical significance industrial internship was organized for 3rd year students at the Akkuyu NPP in Silifke, Turkey, and Ho Chi Minh City University of Architecture in Ho Chi Minh City, Vietnam.

1 URL: https://mgsu.ru/universityabout/Struktura/Kafedri/OSUN/



Mottaeva Angela Bahauovna,
Candidate of Economic Sciences, Associate Professor, Professor of the Department 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 RISC: 388748, Scopus: 572211934, ResearcherID: AAD-2189-2022, ORCID: 0000-0001-8904-4154; MottaevaAnB@mgsu.ru@mgsu.ru



Baranova Anna Sergeevna,
4th year student of the Bachelor's degree program, 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; 89223099487@mail.ru



Valuev Egor Ivanovich,
4th year student of the Bachelor's degree program, 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; egorvaluev85405@gmail.com



Varganov Ilia Evgenievich,
4th year student of the Bachelor's degree program, 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; 75ilya@gmail.com



Grabovoi Artem Leonidovich,
4th year student of the Bachelor's degree program, 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; artgrabovoyyy@yandex.ru

THE MAIN PART

So, a bit of background: how we organized industrial practice of MGSU students at Akkuyu NPP.

On May 12, 2010 the Governments of the Russian Federation and the Republic of Turkey signed an Agreement on cooperation in the construction and operation of a nuclear power plant at the Akkuyu site in the Turkish province of Mersin[2].

Akkuyu NPP is the first nuclear power plant in the Republic of Turkey. The project of the first Turkish NPP includes four power units with Russian-designed VVER-1200 reactors with a total capacity of 4800 MW. The construction cost is estimated at more than $ 20 billion. After commissioning of all four power units, Akkuyu NPP will generate 40,000 million kWh.

The construction of Akkuyu NPP is the first project in the global nuclear industry to be implemented under the Build-Own-Operate model. Under the terms of the Intergovernmental Agreement between the Russian Federation and the Republic of Turkey, the commissioning of the first power unit of the NPP should take place within 7 years after all permits for the construction of the unit have been obtained. Taking into account the receipt of the license for the construction of power unit No. 1 in 2018, this term means 2025 (Fig. 1)[3].

In 2022, the Ministry of Energy and Natural Resources of the Republic of Turkey, the State Atomic Energy Company Rosatom, AKKUYU NUKLEAR JSC, Russian and Turkish universities signed a Protocol on cooperation in the development of joint educational programmes in higher education. The document envisaged the course of a joint two-year Master's degree programme of MEPhI and Istanbul Technical University (ITU). The first admission to the preparatory department of MEPhI with subsequent enrollment in the joint master's programme was held in 2023[4].

The State Atomic Energy Corporation Rosatom is a diversified holding company that combines assets in power engineering, mechanical engineering, and construction. Its strategy is to develop low-carbon generation, including wind power. ROSATOM is the national leader in electricity generation (about 20 % of total generation) and ranks first in the world in terms of the portfolio of orders for the construction of nuclear power plants: 39 power units (including six small capacity units) in 10 countries are at various stages of implementation. Rosatom's activities also include production of innovative non-nuclear products, logistics and development of the Northern Sea Route, and implementation of environmental projects. The State Corporation unites more than 450 enterprises and organizations, employing over 350 thousand people[5].

The programme of training highly qualified Turkish specialists for Akkuyu NPP is actively continuing. 296 young engineers have already graduated from Russian universities and are gaining interesting professional experience at the largest nuclear construction site in the world.

320 people have already received education in specialized Russian universities (MEPhI, SPbPU), 38 people are currently studying, and another 47 people are planning to enroll next year. In total, according to the plans, about 600 Turkish young specialists are to be trained during the construction period, and then they will work at Akkuyu NPP. These 320 specialists are already members of the team and are successfully working at our project[6, 7].

In the coming years, another 300 Turkish specialists will be trained to join the Akkuyu NPP project team. Training in Russia involves not only theoretical training, but also practical internships at operating nuclear power plants. This allows young Turkish engineers not only to gain knowledge, but also invaluable experience working at nuclear power plants, so that they can successfully develop nuclear technologies in their country [5].

NRU MGSU is one of the leading higher educational institutions in Russia. It trains highly qualified specialists for the construction industry, as well as various sectors of the economy. The mission of NRU MGSU is to create a system of advanced personnel and scientific support of the process of qualitative modernization of the investment and construction complex for the successful solution of priority state tasks of high-tech and social development of Russia based on the formation of innovative scientific and educational base for training of modern builders and architects who create a safe, energy-efficient and comfortable living environment[8] [6].

Within the framework of these tasks, following the example of Russian universities, in 2024 between NRU MGSU and AKKUYU NÜKLEER ANONİM ŞİRKETİ, was concluded an agreement on the organization of practical training and internship of students.

2 Agreement between the Government of the Russian Federation and the Government of the Republic of Turkey on cooperation in the field of construction and Operation of a nuclear power plant at the Akkuyu site in the Republic of Turkey. URL: https://www.mid.ru/ru/foreign_policy/international_contracts/international_contracts/2_contract/45077/

3 About the Akkuyu NPP project. URL: https://akkuyu.com/ru/about/info

4 The joint Russian-Turkish double degree Master's degree educational programme for the training of Turkish engineers at Akkuyu NPP is starting. URL: https://www.atomic-energy.ru/news/2023/06/22/136428 ?ysclid=lzl8lwg45s562555979

5 Rosatom's innovative development programmes. URL: https://www.rosatom.ru/about /

6 Denis Sesemin: unique experience has been gained in the construction of the Akkuyu NPP. URL: ezemin-1957087185.html

7 The fifth group of students from Turkey came to Russia under the Akkuyu NPP specialist training programme. URL: https://www.in-power.ru/news/aes/pyataya-gruppa-studentoviz-turtsii-priehala-v-ro.html

8 Mission of the National Research University (NRU MGSU). URL: https://mgsu.ru/universityabout/



Fig. 1. Akkuyu NPP[3]

WHY WE NEED OVERSEAS INTERNSHIPS FOR STUDENTS

Industrial practice is a great opportunity to show students how work is organized in various companies, to familiarize them with different areas of development and to help them decide on their future profession. Of course, it is difficult to teach something in 4–6 weeks, but it is possible to give students practical knowledge, guide them, and outline a development vector.

After the end of the third year, all students face a difficult choice — where to do their internship. Industrial practice is an important stage in the educational programme. In the process of practice students get the opportunity to work in the construction industry, in the company, where in the future they will be able to work in the future. In practice they can face real production tasks and apply in reality the knowledge gained. It is always exciting, because you want to get as much experience as possible and feel your profession[9].

It is important to show students live people: adequate, experienced, charismatic specialists who are ready to share their knowledge. No one will allow us to tear leading specialists away from their work for at least 1–2 weeks. It is very expensive. Of course, we can hire a special person — a "shepherd" for students, but without project experience and knowledge of technologies, such mentoring will be of little use. And with project experience and knowledge, it is again unreasonably expensive. Is there any way to solve this problem effectively?

I will allow myself to exaggerate a little, but often practice often looks like this: a stern-looking man comes in, shows a machine and says: "Here is the machine, but do not touch it, it is dangerous. This is how I sharpen a part. Got it? Take notes, it might come in handy. Everyone is free, come back in two weeks, I will sign the papers".

But we don't want it that way. The OSUN Department decided to go the other way and show the students how real projects are created, what a real large-scale construction is. And not just an ordinary construction project, but an interstate, strategically important, unique project.

Determination of the place of practice by the management of the department, which offered students such a unique opportunity — to undergo practical training at such large facilities in foreign partner countries, was a pleasant surprise for the students. The practice was organized for 3rd year full-time students of the Institute of Economics, Management and Communications in the field of construction and real estate in the direction of training 08.03.01 Expertise and Real Estate Management and the Institute of Architecture and Urban Planning in the direction of training 07.03.01 Architecture.

Out of many applicants, after passing a difficult selection process, the following students were lucky enough to go on industrial practice in Turkey, to the construction site of the nuclear power plant "Akkuyu": A.L. Grabovyy (IAG-3-53), A.S. Baranova (IEUKSN-3-9), S.S. Barinova (IEUKSN-3-11), E.I. Valueva (IEUKN-3-9), I.E. Varganova (IEUKSN-3-10), Kovtun A.S. (IEUKSN-3-9) (Fig. 2).



Fig. 2. Going to Akkuyu NPP in Silifke, Turkey

9 MIEP MGIMO student Elizaveta Eroshenko — about an internship in Turkey and participation in the international project for the construction of the Akkuyu NPP. URL: https://miep-mgimo.ru/article/view/id/3291

The purpose of the internship was to familiarize MGSU students with NPP facilities, infrastructure projects, to consolidate theoretical knowledge obtained during classroom training and to increase practical new competencies.

Senior students from MGSU are for the first time undergoing industrial practice at Akkuyu NPP. Its important goal is to familiarize students with the social environment of the enterprise in order to acquire personal competencies that they will need in the future for their future employment in their specialty.

The aim and objectives of the internship are to consolidate and expand students' theoretical knowledge obtained at the university, to study the experimental and practical base, as well as the principles of operation of the world's first NPP.

HOW MSCU STUDENTS SPENT THEIR INTERNSHIP DAYS AT AKKUYU NPP

In agreement with the management of Akkuyu NPP, in order to give the students an opportunity to try themselves in different directions, the internship programme was divided into weeks, in each of which a role was assigned to a certain stage of the construction life cycle (Table).

Experienced specialists from Akkuyu NPP were invited as lecturers, ranging from department heads, leading developers, experienced testers.

WHAT WE HAVE LEARNED

Bottom line from the employer:

In addition to the main internship plan, also during the internship period, the following tasks were given to MGSU students, from the internship supervisor from "Akkuyu" side:

1) working with the EPC contract (looking for specific articles to reference in official letters);
2) verification of Technical Cards, regulations and WPP;
3) inspections:
   - concreting Readiness Control 30UMA;
   - monitoring the readiness to start drying of the NW 40UJA;
   - control over the organization of blasting operations;
   - testing of concrete mix B60 W10 SF2;
   - control of approbation of manual method of application of repair composition on ceiling surfaces;

Internship programme for MGSU students at Akkuyu NPP construction site

Period	Outside the divisions	Within divisions
02.07–05.07	• Physical exam	• Familiarization with
Week 1	• safety and security briefings; • introductory; • primary; • targeted; • receipt of PPE; • organizational meeting (D.E. Sezemin, A.V. Kvasha, D.A. Radchenko); • a dialog with the chief inspector about safety culture; • practical seminar "Fire Safety at NPPs", visit to the fire station; • familiarization with the construction site, with the head of the CCD; • familiarization with RMD of CCD and MMF; • familiarization with NTD	• the activities of the units; • RMD Study; • study of PD, WD, OTD; • participation in inspections; • participation in meetings; • Unit Work
08.07–12.07 Week 2	• technical tour of GTV Vostochny: peculiarities of design, erection and operation; • obtaining credentials, familiarization with the Company's corporate resources; • information security briefing; • lectures (3 pcs) "Peculiarities of Work Organization on NPP Construction Projects Abroad". A.Y. Zabrodin, A.P. Pustovgar; • technical tour with TMR: main process systems and equipment of the reactor building (UJA). Features of the TMR	• study of PD, WD, OTD; • participation in inspections; • participation in meetings; • Unit Work
15.07–19.07 Week 3	• technical Tour Training Centre of the General Contractor; • technical tour in Armotseh ta Endustriel: "Production of MS, EP, embedded blocks"; • technical tour with TMR: main process systems and equipment of the turbine building (UMA, engine room) and the desalting unit building (UMX)	• study of PD, WD, OTD; • checking OTD, issuing remarks; • participation in inspections; • attendance at meetings; • Unit Work
22.07–26.07 Week 4	• lecture "Peculiarities of Schedule and Network Planning in NPP Construction"; • BRH Inspectorate; • Construction Laboratory Inspection; • DSU Inspection; • FTA 30UMA Concrete Inspection	• study of PD, WD, OTD; • checking OTD, issuing remarks; • participation in inspections; • attendance at meetings; • Unit Work
29.07–30.07 Week 5	• technical tour: Station staff residential camp in Silifke; • sightseeing tour: port, zone inside containment 10UJA, panorama of 4 blocks, mark +200; • summarizing the practice; • report Formation; • final meeting with the Company's management	• study of PD, WD, OTD; • checking OTD, issuing remarks; • participation in inspections; • attendance at meetings; • Unit Work



Fig. 3. MGSU students during work at different sites



Fig. 4. Concreting process of turbine unit foundation

4) weekly participation in concreting quality meeting (draft meeting minutes);
5) work in the archive (checking completeness, stamping);
6) automation of cumulative statements in excel, creation of graphs;
7) assist in the preparation of formal letters.

These tasks were assigned personally to each individual and it was commended that the students were successful.

OUTCOMES FROM THE STUDENTS THEMSELVES

During the internship we were familiarized with many facilities, including:

- concrete plant;
- in the rebar shop;
- at the firehouse;
- participated in the concreting of the turbine unit slab;
- in the turbine case;
- at the harbor;
- on the crusher;
- at the staff training centre;
- we calculated the volumes for the rooms from the drawings;
- in a staff housing development under construction.

During the internship, specialists of Akkuyu NPP gave very interesting and informative lectures from the plant employees on the following topics: scheduling, interaction of construction participants, introduction to the nuclear industry (Fig. 3).

On the final day of practice, July 31, the students had a rare and unique opportunity to observe the process of concreting the foundation of the turbine unit (Fig. 4)[3].

LEISURE TIME

Despite the busy schedule, and it should be noted here that the working day started with breakfast at 6 a.m., and they left for work from 7 a.m. to 6 p.m., the students still managed to visit the sights located near the NPP. The students visited historical places of Adana and Mersin cities, familiarized themselves with customs and traditions of Turkish people (Fig. 5).

RESULTS

On the eve of the completion of the internship at Akkuyu, a round table was held to discuss the issues of the students' past internship.

Therefore, summarizing the results of our first foreign “pilot” project — industrial practice of MGSU students at Akkuyu NPP, we can conclude that the current industrial practice has shown the need for further bilateral constructive interaction. The students have a unique opportunity to join a significant state project, the opportunity to feel their importance in practice, using the theoretical knowledge obtained at the OSUN Department. For “Akkuyu”, this project provides an opportunity not only to find future employees, but also an excellent format to share their knowledge and experience with young specialists.

Participation of MGSU students in the realization of such a large-scale international project is, first of all, an opportunity to get an exceptional professional experience and knowledge, to open for themselves in the future interesting employment prospects, to put into practice the knowledge gained at MGSU, to practice working and communicating in foreign languages and, of course, to find new friends.

The internship gave students not only a very valuable experience of professional activity abroad, but also an opportunity to plunge into



Fig. 5. Leisure activities. Familiarization with the places of interest in Turkey





Fig. 6. Meeting with the company's executives

the life of a completely different country, as well as to get acquainted with wonderful, talented people, high-class professionals.

The tour around the construction site of Akkuyu NPP made an indelible impression and delight. We studied with interest the four power units under construction, the world's only polar crane with a lifting capacity of 3 tons, and the work of the construction workers, whose number is about 30,000 people.

WHICH WE DID WELL

We developed an interesting and useful format. Judging by the feedback, the students liked the practical orientation and the opportunity to gain experience working on a real project.

Experienced specialists were involved. All lecturers are highly qualified professionals who were able to interest students and answer all their questions. During the internship period various official events were organized, which were attended by S.M. Butskikh, General Director of JSC "Akkuyu Nuclear", D.E. Sezyomin, Construction Director, and A.V. Kvasha, HR Director (Fig. 6).

They showed how work is organized in the company. Students saw how development processes are organized, how interaction between different specialists takes place.

We would also like to express our special gratitude to I. Blinov, the practice supervisor from "Akkuyu", a graduate of MGSU, chief specialist of the construction works department for his tireless attention and participation, organization and control in conducting the practical training of our students.

WHAT MISTAKES WERE MADE

Not optimal distribution of students. It is necessary to divide students into groups in different areas in future years. Each group should be assigned a responsible person and summarize weekly results in the format of a round table.

Interaction with the practice departments of universities is rather rough. **It is not so easy to coordinate documents, approve them with lawyers (ours and those of the universities) and sign them. We need to put more time and resources into this.**

WHAT ARE THE PROS OF INTERNSHIP FOR THE COMPANY?

Presence in higher education institutions. Building a long-term relationship with MGSU. Moreover, the university should be interested in getting the students to some decent place where they will be engaged and interested in themselves.

Student Assistance. We try to respond as quickly as possible to students' requests and help solve problems, including problems with documents.

Next year, when the company needs interns, you **will not have to spend time looking for them.** The company already has a base of students who know and like the company.

FUTURE PLANS:

- **discussion of the possibility of future formation of a personnel reserve on the basis of MGSU for Akkuyu** (roadmap plan for the realization of the "personnel reserve" project);
- **study of social infrastructure development within the framework of the global project "Akkuyu"**, including: housing stock, schools, kindergartens, etc. This item is of particular interest to the department. Understanding of the management system, with a view to the prospects of training students on the basis of the OSUN Department for further employment and participation in the formation of the system of life cycle management of real estate objects in the town under construction for NPP employees;
- **opportunities for long-term cooperation in the formation of scientific and production base.** Develop programmes and conduct systematic professional retraining (additional education) for Akkuyu employees in the areas of "Development", "Housing and utilities", "Forensic examination and management of real estate".

Summarizing the results of the joint project, it is safe to say that the parties were satisfied with the results, emphasized the importance of this format of cooperation and planned to further develop this direction. It is also worth noting that following the results of the internship several of our students were invited to work after graduation. This is very important and indicative!

REFERENCES

1. Efremova T.F. A new dictionary of the Russian language. Explanatory and educational. Moscow, Rus. lang. Publ., 2000; 2:567. (rus.).
2. Organization of construction and real estate development : textbook for students; in 2 parts. P.G. Grabovyy (Ed.). Moscow, ASV; Prosvetitel' Publ., 2018. (rus.).

3. Economics and real estate management : Textbook for Universities in two parts. Part 2: Property Management. 4th ed. reprint. and additional. Grabovyy P.G. (Ed.). Moscow, ASV; Prosvetitel' Publ., 2019; 512. (rus.).
4. Servicing: organization, Expertise, management : Textbook for Universities in three parts. Part III. 2nd ed., reprint. and additional. Grabovyy P.G. (Ed.). Moscow, ASV; Prosvetitel' Publ., 2021; 520. (rus.).
5. Grabovyy P., Sezemin D. Aggregate risk of a large complex construction projects of NPP. International Journal for Computational Civil and Structural Engineering. 2023; 19(4):38-47. DOI: 10.22337/2587-9618-2023-19-4-38-47. EDN UPCJRZ.
6. Grabovyy P.G., Volgin V.V., Kushchenko I.V. et al. Technology of the organization of spatial renewal of urban real estate, concentration and specialization of industrial production : monograph. P.G. Grabovyy (Ed.). Moscow, Prosvetitel' Publ., 2024; 277-289. (rus.).

Новые тренды развития кафедры ОСУН. Как прошла производственная практика студентов МГСУ на АЭС «Аккую»

В статье рассказывается о том, как на кафедре «Организация строительства и управления недвижимостью» (ОСУН) МГСУ было положено начало еще одной, новой уникальной традиции — организации зарубежной производственной практики студентов. В соответствии с достигнутыми договоренностями прошла зарубежная стажировка студентов кафедры ОСУН на АЭС «Аккую» в Турецкой Республике. Государственная корпорация по атомной энергии «Росатом» — многопрофильный холдинг, объединяющий активы в энергетике, машиностроении, строительстве. АЭС «Аккую» — первая атомная электростанция в Турецкой Республике. Проект первой турецкой АЭС включает в себя четыре энергоблока с реакторами российского дизайна ВВЭР-1200. Сооружение АЭС «Аккую» — первый проект в мировой атомной отрасли, реализуемый по модели Build-Own-Operate. Кафедра ОСУН осуществляет свою деятельность на протяжении более 90 лет, имеет свою историю и устоявшиеся традиции. Идя в ногу со временем, принимая во внимание нынешние инновационные тренды и вызовы в сфере строительства, экономики, образования, на кафедре была организована зарубежная стажировка студентов. С какими же трудностями они столкнулись и почему этот «пилотный проект» является очень ценным, знаковым опытом не только для кафедры, но и для НИУ МГСУ в целом. По итогам совместного проекта можно отметить, что поставленные цели и задачи решены. Стороны остались довольны результатами, отметили важность такого формата сотрудничества и запланировали дальнейшие взаимоотношения.

Ключевые слова: *ГК «Росатом», НИУ МГСУ, AKKUYU NÜKLEER ANONİM ŞİRKETİ, зарубежная стажировка обучающихся, строительство, инновации*

СПИСОК ИСТОЧНИКОВ

1. Ефремова Т.Ф. Новый словарь русского языка. Толково-образовательный : в 2 т. М. : Рус. яз., 2000. С. 567.
2. Организация строительства и девелопмент недвижимости : учебник для студентов: в 2 ч. / ред. П.Г. Грабовый. М. : Изд-во АСВ; Просветитель, 2018.
3. Экономика и управление недвижимостью : учебник для вузов в двух частях. Часть 2: Управление недвижимостью : учебник. 4-е изд. перераб. и доп. / под общ. ред. П.Г. Грабового. М. : Просветитель, Изд-во АСВ, 2019. 512 с.
4. Сервейинг: организация, Экспертиза, управление : учебник для вузов в 3-х ч. Т. III. 2-е изд., перераб. и доп. / под общ. ред. П.Г. Грабового. М. : Просветитель, Изд-во АСВ, 2021. 520 с.
5. Grabovyy P., Sezemin D. Aggregate risk of a large complex construction projects of NPP // International Journal for Computational Civil and Structural Engineering. 2023. Vol. 19. No. 4. Pp. 38–47. DOI: 10.22337/2587-9618-2023-19-4-38-47. EDN UPCJRZ.
6. Грабовый П.Г., Волгин В.В., Кущенко И.В. и др. Технология организации территориально-пространственного обновления городской недвижимости, концентрации и специализации промышленного производства : монография / под общ. науч. ред. П.Г. Грабового. М. : Просветитель, 2024. С. 277–289.

Об авторах: **Моттаева Анджела Бахуовна** — кандидат экономических наук, доцент, профессор кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 388748, Scopus: 572211934, ResearcherID: AAD-2189-2022, ORCID: 0000-0001-8904-4154; MottaevaAnB@mgsu.ru;

Баранова Анна Сергеевна — студент 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; 89223099487@mail.ru;

Валуев Егор Иванович — студент 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; egorvaluev85405@gmail.com;

Варганов Илья Евгеньевич — студент 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; 75ilya@gmail.com;

Грабовой Артём Леонидович — студент 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; artgrabovoyyy@yandex.ru.

For citation: Mottaeva A.B., Baranova A.S., Valuev E.I., Varganov I.E., Grabovoi A.L. New trends in the development of the MGSU department “Organization of construction and real estate management”. How the industrial practice of MGSU students at Akkuyu NPP was held. *Real Estate: Economics, Management*. 2024; 3:13-19.

Для цитирования: *Моттаева А.Б., Баранова А.С., Валуев Е.И., Варганов И.Е., Грабовой А.Л.* New trends in the development of the MGSU department “Organization of construction and real estate management”. How the industrial practice of MGSU students at Akkuyu NPP was held // Недвижимость: экономика, управление. 2024. № 3. С. 13–19.

UDC 624.05

Yankovsky A.V., Khromykh V.D.
Ponomareva A.A., Shokina Ya.I.
Chernyshova A.S.

Content and results of the internship of NRU MGSU students in the Republic of Vietnam in 2024

The paper provides information on how the Department of Construction Organization and Real Estate Management (OSUN) of NRU MGSU organized international practice in Vietnam in the context of the development of international cooperation. The partner was Ho Chi Minh City University of Architecture and Coteccons construction company. NRU MGSU and Ho Chi Minh City University of Architecture actively participate in joint scientific and educational events and conferences that are held both in Russia and in Vietnam. Coteccons is one of the most respected private construction companies in Vietnam, which was founded in 2004. The company's goal is to become a world-class engineering and construction group, the leading corporate group in Vietnam in the XXIst century. The results of the past practical training were summed up at Ho Chi Minh City University of Architecture with the participation of Acting Consul General of the Russian Federation, Consul-Adviser Yu. Nemtsov and attache of the Russian Embassy V. Skosyrev. Participation in international practice allows students to gain real work experience in an international environment, get acquainted with modern technologies and construction methods. Working in Vietnam allowed us to immerse ourselves in the unique culture and traditions of the country, as well as improve the professional skills of students and make them more competitive in the labor market.

Keywords: *International practice, Ho Chi Minh City University of Architecture, Coteccons Construction Company, construction in Ho Chi Minh City, construction site control, renewable energy technologies, international cooperation*



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



Khromykh Viktoria Denisovna,
4th year student of the Bachelor's degree programme, 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; viktoriahromih@yandex.ru



Ponomareva Anastasia Aleksandrovna,
4th year student of the Bachelor's degree programme, 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; Anastasiy15.03@mail.ru

INTRODUCTION

The Department of Construction Organization and Real Estate Management (OSUN) was organized in 1930. Throughout its long history, the main vector of the department's development has been and remains the desire to provide comprehensive consideration of key aspects of the organization and economics of construction, investment and construction activities, expertise and management of real estate within the framework of educational and research activities.

Today, the OSUN Department is one of the leading and largest departments of the University of NRU MGSU, specializing in teaching students the basics of development, project management, expertise of design estimates, organization and technology of construction, economics and real estate management, risk management in the investment and construction sector, housing and communal services facilities management and a number of other disciplines related to the implementation of investment projects.-construction projects and real estate management of various levels of complexity. The department conducts active international cooperation with the world's leading organizations in the field of construction, development and maintenance[1] [1–3].

Thanks to the responsible and painstaking work of the head of the Department of OSUN, Candidate of Technical Sciences, Doctor of Economics, Professor Peter Grabovy, it was possible to organize a summer internship for students in the Socialist Republic of Vietnam. The host party was the long-time partner of the NRU MGSU – Ho Chi Minh City University of Architecture (UAH) (Fig. 1)[2].





Fig. 1. Ho Chi Minh City University of Architecture

1 Department of Construction Organization and Real Estate Management. URL: https://mgsu.ru/universityabout/Struktura/Kafedri/OSUN/

2 Official website of Ho Chi Minh City University of Architecture. URL: http://en.uah.edu.vn/





Fig. 2. Meeting at Ho Chi Minh City University of Architecture

MAIN PART

The arrival of MGSU students in the Socialist Republic of Vietnam coincided with the date of the state visit of the President of the Russian Federation Vladimir Putin to this country. Vladimir Putin's visit testifies to the Russian Federation's desire to further deepen the comprehensive strategic partnership between the two countries in the new conditions of complex geopolitical competition. During the state visit of the President of the Russian Federation, 15 Russian-Vietnamese documents were adopted and signed, one of which is the agreement between the Government of the Russian Federation and the Government of the Socialist Republic of Vietnam on cooperation in the field of higher education[3].

It is worth noting that the MGSU National Research University approached the implementation of this agreement in advance and 4 students were sent to Ho Chi Minh City for a summer internship from June 20 to July 20, 2024.

The content of the practice

NRU MGSU and Ho Chi Minh City University of Architecture actively participate in joint scientific and educational events and conferences that are held both in Russia and in Vietnam. The university staff organized a festive evening with traditional Vietnamese food on the occasion of the arrival of Moscow guests, and also talked about working conditions, safety and features of living in the country (Fig. 2).

The next day, the students, accompanied by Vietnamese teachers, went to get acquainted with the company where they were to practice. The partner was one of the largest shareholders in the construction sector of Vietnam, the construction company Coteccons (Construction Joint Stock Company) (Fig. 3)[4, 5].

Coteccons is the most respected private construction company in Vietnam, which was founded in 2004. For more than a decade, Coteccons has been turning the ideas and visions of hundreds of customers into award-winning projects with the aim of exceeding expectations in terms of safety, quality, functionality and providing ready-made projects that will stand the test of time.

The company's goal is to become a world-class engineering and construction group, the leading corporate group in Vietnam in the 21st century.

Responsibility and quality are the key to a company's reputation. Coteccons is committed to providing its customers with state-of-the-art projects at a competitive price, as well as contributing to the growth and development of society through these projects. The company implements many large construction projects.

Famous Coteccons projects (Fig. 4, 5).



Fig. 3. CC Coteccons main office



Fig. 4. The Landmark 81 [4]

3 "Application for a change of the world order": foreign media about Putin's visit to Hanoi. URL: https://tass.ru/mezhdunarodnaya-panorama/211623697. Coteccons official website. URL: https://www.coteccons.vn/en/

4 Official website of Coteccons. URL: https://www.coteccons.vn/en/

5 Vietnam's construction industry. URL: https://www.mordorintelligence.com/ru/industry-reports/vietnam-construction-market



Shokina Yana Ilinichna,
4th year student of the Bachelor's degree programme, 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; shokinayanaa@gmail.com



Chernyshova Angelina Stanislavovna,
4th year student of the Bachelor's degree programme, 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; Ast.chernyshova@yandex.ru



Fig. 5. LEGO Manufacturing Vietnam[6]

This is a residential building in Ho Chi Minh City. Its height is 461.2 meters. It is the tallest building in Vietnam and Southeast Asia. It was completed in 2018. The building has a modern design inspired by bamboo.

This is the company's first carbon-neutral plant focused on using only renewable energy.

For internship, the company provided 2 facilities: "Suntory PepsiCo"[7], which is located in Long An province — a beverage factory (Fig. 6) and Riviera point mixed-use development — a residential complex with commercial premises (Fig. 7)[8].





Fig. 6. PepsiCo Long An





Fig. 7. Riviera point mixed-use development

FEATURES OF THE "SUNTORY PEPSICO" PROJECT

The Long An plant, located on an area of about 20 hectares, is expected to run on renewable energy sources such as biomass fuels and solar energy, which will help significantly reduce greenhouse gas emissions during production. It will also be a place to launch products with packaging made from 100 % recycled plastic, as well as to implement initiatives to conserve natural resources in production.

This project is a major step forward for the company in implementing the commitments of the Vietnamese Government in the field of sustainable development, especially the commitment to reduce net greenhouse gas emissions to zero by 2050[9].

Thanks to the new efficient technologies that are used, the production is environmentally friendly and safe for others. The project uses solutions for heat exchange, economical use of water, and waste recycling. All processes will take place using renewable energy sources such as biomass fuels and solar energy, which will help significantly reduce greenhouse gas emissions during production activities. At the same time, the company will supply products in packaging made of completely recycled plastic and apply initiatives to save natural resources in production.

Responsibilities of students during their internship at Cotecconns: students worked in the Naviswork[10] and Autocad programmes, visualized the building structures of the facility, calculated the volume of the foundation for the estimate documentation and were trained in conducting construction control at the site (Fig. 8).

6 Construction of $ 1 Billion Lego Plant Begins in Vietnam. URL: https://www.vietnews.ru/topnews/vo-vetname-nachalos-stroitelstvo-zavoda-lego-stoimostyu-1-milliard-dollarov (rus.).

7 The main website of Suntory Pepsico. URL: https://www.suntorypepsico.vn/

8 The main website of the Riviera Point The view company. URL: https://theview.rivierapoint.com.vn/vi-VN/default.aspx

9 Amendments and additions to a number of papers of resolutions detailing and regulating the implementation of the Law on Environmental Protection: Government Decree No. 40/2019/ND-CP dated 05/13/2019. URL: http://vbpl.vn/botainguyen/Pages/vbpq-van-ban-goc.aspx ?ItemId=135365) (rus.).

10 Basic information about the Nevisworks programme. URL: https://www.autodesk.com/




Fig. 8. Suntory Pepsico

FEATURES OF THE "THE INFINITI – IVIERA POINT" PROJECT

The residential complex, located in the very centre of the 7th district in Ho Chi Minh City, opens up new horizons in the construction of the premium residential segment in the city. Riviera Point is located between the Saigon River and the Ka Kam River and includes 12 towers of 48 floors, as well as a 400 m long pedestrian walkway.

The project provides technologies for renewable energy, reducing carbon dioxide emissions, sustainable resource recovery and digital smart home connections, all of which are under the control of Keppel, with whose representatives the students managed to communicate and even participate in the presentation of new ideas on the topic of environmental conservation.

The residential complex has several levels inside itself, for example, on the 5th floor there is a 25-meter saltwater pool, an underwater gym, a children's pool and playground, a Jacuzzi, a recreation area with barbecue, a cinema room, and a garden. Tower number 8 on the 26th floor has a special garden where residents can take shelter from the hot weather, there are similar green spaces on other towers of the complex.

The students working at this facility managed to visit the site in full equipment to comply with safet.rules and observe the pouring of concrete into horizontal structures, as well as with the construction control group to check the quality of reinforced concrete structures of the basement (Fig. 9).

Also, during the month of practice in Vietnam, students managed to work in the office in the QA/QC department in the AutoCAD programme, as well as in the Excel programme in the estimates department.

The residential complex, located in the very centre of the 7th district in Ho Chi Minh City, opens up new horizons in the construction of the premium residential segment in the city. Riviera Point is located between the Saigon River and the Ka Kam River and includes 12 towers of 48 floors, as well as a 400 m long pedestrian walkway.

The project provides technologies for renewable energy, reducing carbon dioxide emissions, sustainable resource recovery and digital smart home connections, all of which are under the control of Keppel, with whose representatives the students managed to communicate and even participate in the presentation of new ideas on the topic of environmental conservation.





Fig. 9. Riviera Point




Fig. 10. Meeting of students and teachers of the Department of Architecture and Design

The residential complex has several levels inside itself, for example, on the 5th floor there is a 25-meter saltwater pool, an underwater gym, a children's pool and playground, a Jacuzzi, a recreation area with barbecue, a cinema room, and a garden. Tower number 8 on the 26th floor has a special garden where residents can take shelter from the hot weather, there are similar green spaces on other towers of the complex.

The students working at this facility managed to visit the site in full equipment to comply with safet.rules and observe the pouring of concrete into horizontal structures, as well as with the construction control group to check the quality of reinforced concrete structures of the basement (Fig. 10).

Also, during the month of practice in Vietnam, students managed to work in the office in the QA/QC department in the AutoCAD programme, as well as in the Excel programme in the estimates department.





Fig. 11. The results of the industrial practice summering

CONCLUSIONS

The results of the past industrial practice were summed up at Ho Chi Minh City University of Architecture with the participation of Acting Consul General of the Russian Federation Consul-Adviser Yu. Nemtsov, attache of the Russian Embassy V. Skosyrev and head of practice from MGSU A.V. Yankovsky[11] (Fig. 11).

Participation in international practice allows students to gain real work experience in an international environment, get acquainted with modern technologies and construction methods. Working in Vietnam allowed us to immerse ourselves in the unique culture and traditions of the country, as well as improve the professional skills of students and make them more competitive in the labor market. Students are lucky to make useful business acquaintances and connections that will help strengthen further cooperation between Russia and Vietnam.

REFERENCES

1. Organization, planning and management of construction : textbook, under the general editorship of P.G. Grabovyy and A.I. Solunsky. Moscow, Prospekt, 2013; 528. (rus.).
2. Organization of construction and real estate development : textbook for students: in 2 hours, by ed. P.G. Grabovyy. Moscow, ASV; Prosvetitel. 2018. (rus.).
3. Economics and real estate management. Part I: Real Estate Economics Textbook : 4th ed., and additional, under the general ed. P.G. Grabovyy. Moscow, Publishing house "Prosvetitel", Publishing House ASV. 2019; 504. (rus.).
4. Le Trung Hieu, Nguyen Van Dat, Ngo Xuan Hung. On the Status of BIM Application in the Construction Industry of Vietnam. Bulletin of the Tomsk State University of Architecture and Civil Engineering. 2023; 26(1):96-107. DOI: 10.31675/1607-1859-2023-26-1-96-107. EDN HOUIYJ (rus.).

11 On the participation of representatives of the Consulate General of Russia in Ho Chi Minh City in a joint event of the National Research University of Moscow State University of Civil Engineering and the Ho Chi Minh City Institute of Architecture. URL: https://rusconshcm.mid.ru/ru/press-centre/news/ob_uchastii_predstaviteley_genkonsulstva_rossii_v_khoshimine_na_sovmestnom_meropriyatii_niu_mgsu_i_kh/ (rus.).

Содержание и итоги производственной практики студентов НИУ МГСУ в республике Вьетнам в 2024 году

В статье представлена информация о том, как кафедрой Организации строительства и управления недвижимостью (ОСУН) НИУ МГСУ была организована международная практика во Вьетнаме в контексте развития международного взаимодействия. Партнером выступили Хошиминский архитектурный университет и строительная компания Coteccons. НИУ МГСУ и Хошиминский архитектурный университет активно участвуют в совместных научно-образовательных мероприятиях и конференциях, которые проводятся как в России, так и во Вьетнаме. Coteccons является одной из самых уважаемых частных строительных компаний во Вьетнаме, которая была основана в 2004 году. Цель компании: стать инженерно-строительной группой мирового класса, ведущей корпоративной группой во Вьетнаме в XXI веке. Итоги прошедшей производственной практики подвели в Хошиминском архитектурном университете с участием и.о. генконсула РФ консула-советника Ю. Немцова и атташе российского посольства В. Скосырева. Участие в международной практике позволяет студентам получить реальный опыт работы в международной среде, познакомиться с современными технологиями и методами строительства. Работа во Вьетнаме позволила погрузиться в уникальную культуру и традиции страны, а также улучшить профессиональные навыки студентов и сделать их более конкурентоспособными на рынке труда.

Ключевые слова: *международная практика, Хошиминский архитектурный университет, строительная компания Coteccons, строительство в Хошимине, строительный контроль на площадке, технологии возобновляемой энергетики, международное сотрудничество*

СПИСОК ИСТОЧНИКОВ

1. Организация, планирование и управление строительством : уч. / под общ. ред. П.Г. Грабового и А.И. Солунского. М. : Проспект, 2013. 528 с.
2. Организация строительства и девелопмент недвижимости : уч. для студентов: в 2 ч. / ред. П.Г. Грабовый. М. : АСВ; Просветитель, 2018.
3. Экономика и управление недвижимостью. Ч. I: Экономика недвижимости : уч. 4-е изд. и доп. / под общ. ред. П.Г. Грабового. М. : Изд-во «Просветитель», Изд-во АСВ, 2019. 504 с.
4. Ле Чунг Хиеу, Нгуен Ван Дат, Нго Суан Хунг. К вопросу о состоянии применения BIM-технологий в строительной отрасли Вьетнама // Вестник Томского государственного архитектурно-строительного университета. 2023. Т. 26. № 1. С. 96–107. DOI: 10.31675/1607-1859-2023-26-1-96-107. EDN HOUIYJ.

Об авторах: **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;

Хромых Виктория Денисовна — студентка 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; viktoriahromih@yandex.ru;

Пономарева Анастасия Александровна — студентка 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; Anastasiy15.03@mail.ru;

Шокина Яна Ильинична — студентка 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; shokinayanaa@gmail.com;

Чернышова Ангелина Станиславовна — студентка 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; Ast.chernyshova@yandex.ru.

For citation: Yankovsky A.V., Khromykh V.D., Ponomareva A.A., Shokina Ya.I., Chernyshova A.S. Content and results of the internship of NRU MGSU students in the Republic of Vietnam in 2024. *Real Estate: Economics, Management*. 2024; 3:20-25.

Для цитирования: *Янковский А.В., Хромых В.Д., Пономарева А.А., Шокина Я.И. Чернышова А.С.* Content and results of the internship of NRU MGSU students in the Republic of Vietnam in 2024 // Недвижимость: экономика, управление. 2024. № 3. С. 20–25.



Л.И. Павлова. Москва. Гостиница Метрополь. Рисунок, тушь

UDC 624.014:620.193

Kushchenko I.V.
Bocharova E.A.

Assessment of technical and economic security risks protection at the stages of the life cycle of real estate objects

Introduction. An innovative approach to the sustainable development of real estate objects based on a comprehensive analysis of the requirements of resource conservation, technical and economic protection and safe operation is presented. The shortcomings of the current standards for the design of corrosion protection measures are identified, which do not allow modelling the calculation of the life cycle cost (LC). It is shown that it is necessary to expand the calculation and analytical indicators of the expertise of design solutions in order to prevent negative consequences in case of corrosion failure.
Materials and methods. The object of the study is a regulatory management system for which algorithms for making effective decisions on corrosion protection construction projects are developed. A technique for reserving technical and economic protection based on computational models of quality, reliability and safety of structures and structures is proposed. Functional and temporary redundancy of resistance to aggressive influences is carried out taking into account the requirements for operation and safety of the ISO/TC 267 Facility Management (FM) standard. A holistic perception of the criteria of technical and economic protection is achieved with the help of indicators of the expertise of design solutions and the regulations of the housing and communal services for a given level of corrosion hazard (KI – KV) or protection (ZI – ZIV).
Results. The approbation of the principles and conditions of the regulatory reservation of technical and economic protection measures was carried out by setting direct and inverse survivability tasks. The programme of definitive tests included monitoring, risk diagnostics and management of indicators for calculating the cost of housing and communal services. The risk assessment was carried out on the basis of the HAZOP (Hazard and Operability Study) method. The proposed approach provides a scenario analysis of the possibilities and identification of threats to the use of new materials and technologies in accordance with the provisions of the *Lean Six Sigma* concept of "lean management".
Conclusions. The theoretical and experimental substantiation of the principles of the regulatory management system for corrosion protection and survivability of real estate objects contributes to the promotion of digital technologies and platform solutions for technical and economic protection based on target indicators of quality, reliability and safety of structures and structures.
Keywords: *sustainable development, real estate, life cycle, parametric design, technical and economic protection, monitoring, risk-oriented management*



Kushchenko Igor Vladimirovich,
Candidate of Technical Sciences, Acting Rector; Pryazovskyi State Technical University (PSTU); 7 Universitetskaya St., Mariupol, 287642, Donetsk People's Republic, Russian Federation; ORCID: 0000-0002-3338-6793; kigorvlad@yandex.ru



Bocharova Elena Anatolievna,
Pryazovskyi State Technical University (PSTU); 7 Universitetskaya St., Mariupol, 287642, Donetsk People's Republic, Russian Federation; elena270915v@yandex.ru

INTRODUCTION

Current trends in sustainable real estate management are represented in international agreements that form the basic principles of the 2030 Agenda for Sustainable Development, as well as the UN Geneva Charter on Sustainable Housing[1]. Among the priority tasks, it is necessary to highlight the development of building codes and technical standards for the application of regulations that contribute to the sustainability of the life cycle (LC), the implementation of technical and economic protection measures based on an assessment of the risks of negative impacts.

In accordance with the requirements of regulatory legal acts, the National Association of Designers of the Russian Federation has prepared recommendations, according to which LC determines the time period during which engineering surveys, design, construction (including conservation), operation (including ongoing repairs), modernization, reconstruction, major repairs, demolition of the building are carried out or structures. In accordance with the provisions of the methodology [1], the main task of calculating the cost of LC is to estimate the total cost of design solutions, justify the choice of effective materials and technologies, and reduce operating costs. At the same time, the planned period of operation (service life T = 30 years) is set before the start of the first major renovation of the building. The final criterion for evaluating an effective construction project is the present cost of ownership, equal to the ratio of the total cost to its planned period of operation.

The need to introduce and develop a management system for LC of capital construction facilities using information modelling technologies is defined in the Strategy for the Development of the construction industry until 2030[2]. Taking into account the presence of a certain discrepancy between quality indicators (input control), reliability and safety (construction control and supervision), measures are envisaged for digital transformation in the field of sustainable design, operation and management, the creation of an integrated system for evaluating

1 Policy Framework for Sustainable Real Estate Markets Geneva, 2019. A principle-based framework for the development/ECE/HBP/202 United Nations Economic Commission for Europe. Real Estate Market Advisory Group, Geneva, 2019 United Nations. P. 42. URL: https://unece.org/DAM/hlm/documents/Publications/2019_Policy_Framework_for_Sustainable_Real_Estate_Markets.pdf

2 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. URL: trategiia-razvitiia-stroitelnoi-otrasli-i/ (date of request: 02.15.2024).

technical solutions at various stages of LC (especially at the operational stage).

The purpose of the paper is to substantiate the expert assessment of life cycle indicators for the selection of effective materials and technologies for managing the corrosion protection of construction facilities.

In the context of contradictions, the search for rational criteria for technical and economic protection, taking into account the safety of technical solutions, resource conservation and minimization of operating costs, is carried out by considering the following research objectives:

- develop principles of regulatory management based on balanced life cycle indicators;
- systematize the structure of the information description and data models that determine the protection and stability of construction facilities under negative impacts;
- perform an analysis of the effectiveness of design solutions for the routine reservation of technical and economic protection measures.

The research paradigm is based on managing the risks of technical and economic protection by reserving, as a universal method of ensuring reliability, to achieve the sustainability of LC of real estate objects [2–4].

MATERIALS AND METHODS

Studies aimed at timely identification and prevention of modern challenges and threats that impede the effective use of funds involved in the investment and construction cycle, saving resources and increasing the durability of real estate objects are devoted to the problem of sustainable development of the construction sector of the economy [5, 6]. Issues of introducing technological innovations are inextricably linked with the improvement of methods are technical and economic assessment (TEA) and Life Cycle Cost Analysis (LCCA) [7, 8]. Sustainable efficiency of construction projects implies responsible consumption and production, according to the set of technical and economic protection measures (Sustainable Development Goal 12).

The key aspects of the examination of construction projects are related to the transition to the parametric method of rationing [3, 9], information modelling of indicators of LC stability [10, 11], comprehensive justification of technical and economic protection [12], risk-oriented management of design solutions [13–15].

In accordance with the developed approach, the technical and economic protection of construction facilities, along with the requirements of structural safety (passive barrier), is determined by technological safety measures (active barrier). Activated barriers are installed on the basis of five DMAIC principles (Define, Measure, Analyze, Improve, Control), which allow monitoring and risk diagnostics of the technical condition of structures. Technological safety management includes justification, planning, provision, improvement and maintenance of operational parameters of structures and structures that affect the stability of real estate facilities LC.

The strategy of technological safety measures is based on the five principles of DMAIC and includes:

- risk-taking, monitoring, maintenance on the actual condition of structures and structures;
- risk minimization, the use of risk diagnostics and the effect of risk diversification.

It is proposed to consider means and methods of ensuring technological safety as a unifying platform for a comprehensive analysis of the problem of corrosion hazard and measures of effective protection against corrosion.

As is known, technological protection characterizes the degree of protection of a person, society, objects and the environment from threats associated with the unjustified creation or non-creation of technical systems, technological processes and materials that ensure the achievement of the main national interests of the state. As an important structural element, the technological safety of an enterprise characterizes a system of measures to maintain operability, improve the operational properties of structures and structures that have completely or largely exhausted their regulatory resource. Such facilities are considered as sources of potential danger during modernization (technical re-equipment), reconstruction and extension of their service life.

The formed approach was adopted to determine the signs of technical and economic protection:

- corrosion hazard — a condition or situation (threat) in which the probability of damage or that which may affect the amount of damage increases;
- corrosion protection — the ability of the anticorrosive protection system of constructions (APSC) to meet specified quality, reliability and safety requirements based on organizational and technical measures established for a sustainable LC of a construction facility.

It is proposed to carry out the justification of technical and economic protection measures based on the use of principles that determine the requirements of durability (a systematic approach) and regulatory survivability (a process approach).

The principle of durability. Corrosion protection is determined by the parameters of the calculation model of quality and reliability level of APSC.

The principle of survivability. The operability of structures depends on the criteria of corrosion protection (danger), qualimetric monitoring of risks (threats and vulnerabilities), the calculated situation of risk diagnostics of buildings and structures LC.

The subject of the study includes the management of technical and economic risks of corrosion protection of structures by reserving reliability (mechanical safety) and operational suitability (functional safety). The formation of a system of regulatory management of technical and economic protection measures is carried out on the basis of the requirements for the operation and safety of real estate objects in accordance with GOST R ISO 41001–2023[3].

RESULTS

The task of modelling the cost of LC in the scenario justification of technical and economic protection options is formulated as follows. The costs ΔC_1 are estimated of option $S(R1)$ of implementing secondary protection measures. For option $S(R2)$, the costs ΔC_2 for primary and secondary protection measures are set. For each option, the cost of LC and the possible risks associated with negative impacts are assessed. Out of all the options, the least expensive one is chosen, which ensures the established level of APC APSC reliability with an acceptable risk value throughout the LC of the construction object.

3 GOST R ISO 41001–2023. Management of real estate objects.

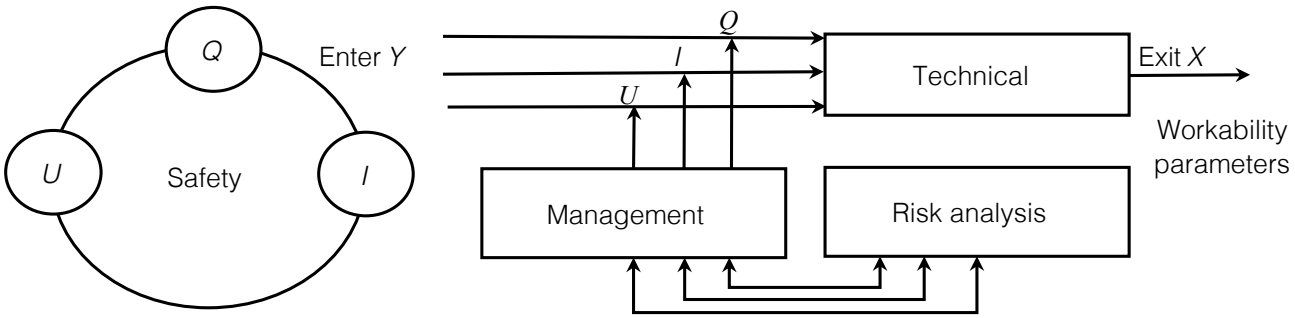


Fig. 1. LC sustainability management scheme for construction facilities: technical Q, information I and management U components

The stability and continuity of business processes under negative impacts is ensured by the conditions of economic protection, which can be represented as:

$$\begin{cases} \sum_{i=1}^{N} U_i \geq \sum_{i=1}^{N} \left(S_{d,i} + S_{c,i} \right); \\ \sum_{i=1}^{N} U_i = \sum_{j=1}^{M} f\left(T_{v,j} \right) \Rightarrow \min, \end{cases} \quad (1)$$

where U_i — the cost of maintaining the i-th structural element of the sample (N) in working condition, ensuring acceptable risk requirements, ₽/year; $S_{d,i}$ — losses caused by physical wear, ₽/year; $S_{c,i}$ — losses as a result of moral aging, ₽/year; $T_{v,j}$ — the maintainability indicator, which determines the period of time (year) to restore operability at minimum cost of the j-th structural element of the sample (M), with a risk level higher than the permissible damage value.

The amount of damage associated with the risk of implementing primary and secondary protection measures is determined by the formula:

$$R_c = \sum_{i=1}^{n} \sum_{j=1}^{m} g_{ij}(V) P_j P_i(j, z_j) X_i, \quad (2)$$

where $g_{ij}(V)$ — the probability of choosing an LC model, with the probability of an unfavourable situation P_j and the law of loss distribution $P_j(j,z_j)$; $P_i(j, z_j)$ — the conditional probability of possible damage X_i(₽) upon the occurrence of a negative event of type j, taking into account the costs z_j(₽) of protective measures to eliminate it.

The developed regulation of balanced life cycle indicators (Fig. 1) combines the capabilities of a systematic analysis of design data (input parameters of durability) and a process approach to managing the operational characteristics of a technical condition (survivability criteria).

A comparative analysis of the means of technical and economic protection is proposed to be carried out in accordance with the methodology [5] of assessing the readiness coefficient (K_g). At the same time, the task of determining the K_g coefficient is formulated as the calculation of structures according to the limit conditions for durability and survivability according to risk diagnostics of primary and secondary protection options for a given level of corrosion protection (hazard).

Functional redundancy of LC stability under the conditions of primary and secondary protection is achieved by setting the required level of reliability of the construction object, taking into account the data in Table 1, 2.

Time redundancy includes the regulation of reliability and operational suitability using the results of the calculation of indicators and the cost of LC of technical and economic protection measures (Fig. 2).

The availability coefficient K_g has been adopted as a comprehensive indicator of reliability and maintainability for scenario analysis of technical and economic protection measures. The K_g coefficient reveals the variability of redundancy conditions in terms of corrosion hazard (KI – KV) or corrosion protection (ZI – ZIV), as well as the possibilities of scenario iterative control of structures and objects LC.

Table 1. Generalized reliability level matrix of APSC

Identification of impacts	Interval estimates of the coefficient of readiness of anticorrosive protection K_g and the degree of aggressiveness of impacts C, mm/year				
	$0 < K_g \leq 0.1$	$0.1 < K_g \leq 0.3$	$0.3 < K_g \leq 0.5$	$0.5 < K_g \leq 0.7$	$0.7 < K_g \leq 1.0$
MA	Mildly aggressive $0.01 < K \leq 0.05$				
	KI	ZIV	ZIII	ZII	ZI
LA	Low aggressive $0.05 < K \leq 0.15$				
	KII	KI	ZIV	ZIII	ZII
HA	Highly aggressive $0.15 < K \leq 0.30$				
	KIII	KII	KI	ZIV	ZIII
VHA	Very highly aggressive $0.30 < K \leq 0.50$				
	KIV	KIII	KII	KI	ZIV
VA	Very aggressive $K > 0.50$				
	KV	KIV	KIII	KII	KI

Table 2. Classification of signs of technical and economic protection of construction objects LC

APSC condition	Hazard class	Name of the risk	Loss characteristics	Risk level (R_i, mark)	The amount of damage, minimum wage
Corrosion hazard	1	Catastrophic	Partial or complete destruction of structures and constructions	9–10	> 72,500
	2	Critical	The losses exceed the estimated gross income of the restoration of facilities	7–8	25,000–72,500
Corrosive protection	3	Allowable	Losses do not exceed the estimated amount of profit when extending the resource and technological renovation of facilities	5–6	2,500–25,000
	4	Acceptable	The losses do not exceed the cost of maintaining quality during the life of the facility	1–4	< 2,500

The choice of effective materials and technologies for corrosion protection management is based on balanced LC indicators, the determination of which requires the accumulation and processing of a significant amount of experimental data reflecting the requirements for the quality of materials, reliability and safety of capital construction facilities.

Balanced indicators represent a set of system-structured indicators to achieve sustainable LC under negative impacts. Two groups of technical and economic indices should be distinguished, representing characteristics established by measuring the required quality indicators of primary and secondary protection, as well as management indicators that form criteria for choosing calculation models and situations for assessing reliability and safety,

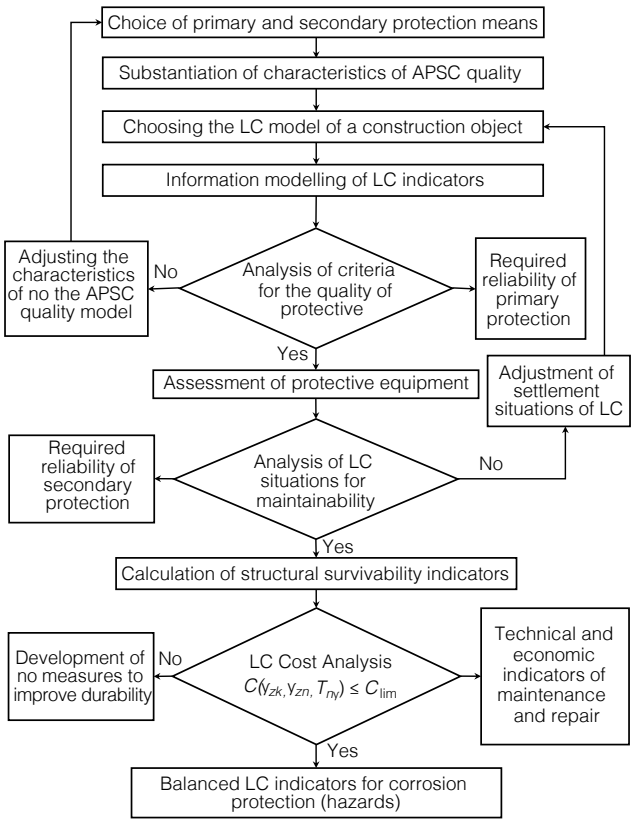


Fig. 2. Parametric modelling of balanced indicators of constructions LC

depending on a given cycle of sustainable development of technical and economic protection measures.

In the period from 2009 to 2018, bench and accelerated corrosion tests of reference samples and fragments of structures with protective coatings were performed (Fig. 3) to create a database of operational parameters of APSC durability:

- at the Southeastern Research Station for zoning the coastal territory and zoning enterprises of the Donetsk region according to signs of corrosion hazard (protection) according to the requirements GOST 9.905–82[4], GOST 9.906–83[5];
- in the testing laboratory (TL) "Antikor-Don" of the Donbass Centre for Technological Safety (DONTSTB) LLC Ukrinstalcon named after V.N. Shimanovsky, accredited according to the ISO/IEC17025 standard.

With the participation of PSTU, interested enterprises and organizations, technical regulations for risk-based safety management of a number of mining, metallurgical, chemical enterprises of production facilities have been developed, taking into account the increase in the level of corporate social responsibility of business. The risk assessment is carried out in accordance with the requirements of ISO/IEC 31010[6] based on the HAZOP (Hazard and Operability Study) method, aimed at identifying threats and opportunities of planned measures to maintain the operational state of APSC.

Regulatory requirements for the stability of cycles of development of technical and economic protection and experimental data of definitive tests allowed, based on the results of monitoring and risk diagnostics of construction facilities, to form a unified system of LC indices for corrosion protection management.

The theoretical and experimental approbation of the principles of durability and survivability allowed us to formulate the conditions for direct and inverse tasks of technical and economic protection. The direct task reflects the requirements of structural safety: according to the specified indicators of the APSC reliability matrix (see Table 1) determine the resistance to negative influences. The principle of durability allows you to adjust the level of corrosion protection, provides the possibility of scenario selection of alternative means of primary and secondary protection. Constructive safety management is carried out by justifying the maximum redundancy of technical and economic protection resources. The justification of the design indicators of the durability of structures is carried out according to the developed methodology, taking into account the reliability coefficients of primary γ_{zk} and secondary protection γ_{zn}, the specified service life of the object T_{yn}.

4 GOST 9.905–82. A unified system of protection against corrosion and aging. Corrosion testing methods.

5 GOST 9.906–83. Climate testing stations. Unified system of corrosion and ageing protection. Test climatic stations. General requirements.

6 ISO/IEC 31010:2009. Risk management — Risk assessment techniques.



a *b*

Fig. 3. Justification of LC stability indicators during definitive tests: a — bench corrosion tests; b — bench strength tests

Survivability defines a system of measures to counteract degradation processes until partial or complete restoration of working condition to ensure the stability of LC of construction facilities. The inverse problem forms the criteria of technological safety: according to the expert assessment of monitoring indicators and risk diagnostics (see Table 2) to justify the routine reservation of corrosion protection. The principle of survivability establishes performance limitations, provides an assessment of technical and economic protection measures based on an acceptable level of risk in case of corrosion failure.

The economic feasibility of regulatory corrosion protection management throughout LC is associated with the sustainable development of the real estate market. The determining factor in the creation of an effective technological safety management system is the extraction of profit and an increase in the capital return coefficient of the functioning of infrastructure facilities.

To structure the input data in assessing the risks of technical and economic protection, an integral indicator is needed that determines the basic basis for analysis and decision-making. The complex criterion of the indicator of the level of risk of corrosion protection (LRCP) has the form:

$$LRCP : CCPS / CCCL, \quad (3)$$

where CCPS — the cost of a corrosion protection system, ₽; CCCL — a compensatory component of corrosion losses, ₽.

The CCPS and CCCL indicators (in monetary units) are calculated on a single natural unit of measurement characterizing the compared structures (pcs., t, m^3, m^2, m). The LRCP index varies from zero to one, above which the risk is not justified. The analysis of the LRCP allows you to normalize its interval values by groups of objects.

It is proposed to consider corrosion protection management based on risk analysis in accordance with the size of the rate of return of innovations:

$$RR = (CCCL - CCPS) / CCPS = CEPE / CCPS, \quad (4)$$

where CEPE — cost-effectiveness of protective equipment, ₽.

The indicator approach is primarily related to the need to assess the effective use of materials and technologies. The essence of LC stability management through risk analysis of corrosion protection is determined by the justification of the required CCPS, taking into account the definition of CCCL and LRCP. By adopting the LRCP as a basis, we get the opportunity to increase the effectiveness of technical and economic protection for the main classification groups of real estate objects.

The expert assessment of LC indicators is aimed at reserving technical and economic protection measures, changing the assessed state of corrosion hazard (KI – KV) and switching to the corrosion protection regime of a construction facility (ZI – ZIV). Functional redundancy involves the management of primary and secondary protection measures. Time redundancy includes the regulation of durability and survivability using calculation and measurement methods.

A balanced application of the technical and economic protection measure, depending on the required level of reliability, is carried out by substantiating (coordinating) the index coefficient of the combination of corrosion protection elements (CCPE):

$$CCPE_{I,(II)} = CCPS_{I,(II)} / CCCL, \quad (5)$$

where $CCPS_{(I)}$ — cost of the primary corrosion protection system, ₽; $CCPS_{(II)}$ — cost of a secondary corrosion protection system, ₽.

The development of index characteristics in the parametric design of technical and economic protection ensures cost management of LC of capital construction facilities with minimal operating costs.

CONCLUSIONS

The improvement of the sustainable LC management system reflects the need to create a unified system of balanced indicators for the expert assessment of the required measures of technical and economic protection of real estate. The formulated principles of substantiation of durability and survivability in conditions of negative impacts are aimed at improving regulatory and technical requirements, providing new opportunities for expert evaluation of design solutions, reserving technical and economic protection measures.

The theoretical justification of the methodology of system analysis and the process approach in assessing the cost of LC opens up new opportunities for building an information data structure and

digital modelling of resource conservation tasks, technical and economic protection and safe operation of construction facilities. The results of the work are aimed at implementing the requirements of the ISO/TC 267[7] Facility Management standard, contribute to the improvement of parametric design methods based on balanced LC indicators, the creation of laboratories for input quality control, examination of compliance with reliability and safety indicators, digitalization of the tasks of estimating the value of LC of real estate.

The essence of the justification of technical and economic protection measures is revealed, including the conditions for regulatory confirmation of compliance with quality indicators and risk-oriented management of functional and temporary redundancy of LC stability indicators of structures and objects.

The introduction of the procedure for reserving technical and economic protection into technical regulations and norms will reduce the cost of repairing fixed assets by 5–15 % and reduce the risks of emergency situations. The regulatory management system provides information modelling of LC cost according to the provisions of the *Lean Six Sigma* concept.

REFERENCES

1. Methodology for calculating the life cycle of a residential building taking into account the cost of total costs. Moscow, 2014; 72. (rus.).
2. Korolev V.P., Ryzhenkov A.A., Korolev P.V. Evolution of conceptual approaches to management of corrosion protection of steel structures and facilities. Industrial and civil engineering. 2022; 8:32-40. DOI: 10.33622/0869-7019.2022.08.32-40 EDN WNDTAD (rus.).
3. Korolev V.P., Kushchenko I.V., Bocharova E.A. Parameterization of corrosion protection requirements of steel structures. Construction and Reconstruction. 2023; 4(108):33-46. DOI: 10.33979/2073-7416-2023-108-4-33-46 (rus.).
4. Kushchenko I.V., Korolev V.P. Methodological aspects of corrosion hazard prevention during operation of steel structures of industrial facilities. Modern Construction and Architecture. 2023; 10(41). DOI: 10.18454/mca.2023.41.2 (rus.).
5. 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/192/297
6. Wood R., Hertwich E.G. Economic modelling and indicators in life cycle sustainability assessment. The International Journal of Life Cycle Assessment. 2012; 18(9):1710-1721. DOI: 10.1007/s11367-012-0463-2
7. Giacomella L. Techno-Economic Assessment (TEA) and Life Cycle Costing Analysis (LCCA): discussing methodological steps and integrability. Insights into Regional Development. 2021; 3(2):176-197. DOI: 10.9770/ird.2021.3.2(2)
8. Enhassi A., Kochendoerfer B., Ghoul H.A. Factors affecting sustainable performance of construction projects during project life cycle phases. International Journal of Sustainable Construction Engineering & Technology. 2016; 7(1):50-68.
9. 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/203/308
10. Dorosinsky L.G., Zvereva O.M. Information technologies for product life cycle support. Ulyanovsk, Zebra Publ., 2016; 243. (rus.).
11. Galishnikova V.V., Bocharov M.E. Information models of construction objects during their life cycle. Real Estate: Economics, Management. 2024; 2:65-72. URL: https://n-eu.iasv.ru/index.php/neu/article/view/202/307
12. Trofimov V.T., Korolev V.A. Engineering protection of territories and buildings in the system of engineering and environmental protection. Moscow University Geology Bulletin. 2012; 67(1):52-57. DOI: 10.3103/S0145875212010103
13. Banaitiene N., Banaitis A. Risk management in construction projects. 12 September 2012. DOI: 10.5772/51460
14. Volgin V.V. Risk management in the implementation of investment and construction projects. Real Estate: Economics, Management. 2024; 2:20-26. URL: https://n-eu.iasv.ru/index.php/neu/article/view/194/299
15. 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/198/303

7 ISO/TC 267. Facility Management Technical Committee.

Оценка рисков технико-экономической защищенности на этапах жизненного цикла объектов недвижимости

Введение. Представлен инновационный подход к устойчивому развитию объектов недвижимости на основе комплексного анализа требований ресурсосбережения, технико-экономической защиты и безопасной эксплуатации. Выявлены недостатки действующих норм проектирования мер защиты от коррозии, не позволяющие производить моделирование расчета стоимости жизненного цикла (ЖЦ). Показана необходимость расширения расчетно-аналитических индикаторов экспертизы проектных решений с целью предотвращения негативных последствий при коррозионном разрушении.

Материалы и методы. Объект исследования представляет систему регламентного управления, для которой разработаны алгоритмы принятия эффективных решений строительных проектов по защите от коррозии. Предложена методика резервирования технико-экономической защищенности на базе расчетных моделей качества, надежности и безопасности конструкций и сооружений. Функциональное и временно́е резервирование устойчивости к агрессивным воздействиям осуществляется с учетом требований к эксплуатации и безопасности стандарта ИСО/ТК 267 Фасилити менеджмент (ФМ). Целостное восприятие критериев технико-экономической защиты достигается с помощью индикаторов экспертизы проектных решений и регламента ЖЦ для заданного уровня коррозионной опасности (KI – KV) или защищенности (ZI – ZIV).

Результаты. Апробация принципов и условий регламентного резервирования мер технико-экономической защиты выполнена путем постановки прямой и обратной задач живучести. Программа определительных испытаний включала мониторинг, риск-диагностику и управление индикаторами расчета стоимости ЖЦ. Оценка рисков осуществлена на основе метода HAZOP (Hazard and Operability Study). Предложенный подход обеспечивает сценарный анализ возможностей и идентификацию угроз применения новых материалов и технологий согласно положениям концепции «бережливого хозяйствования» *Lean Six Sigma*.

Ключевые слова: *устойчивое развитие, объекты недвижимости, жизненный цикл, параметрическое проектирование, технико-экономическая защита, мониторинг, риск-ориентированное управление*

СПИСОК ИСТОЧНИКОВ

1. Методика расчета жизненного цикла жилого здания с учетом стоимости совокупных затрат. М., 2014. 72 с.
2. Королёв В.П., Рыженков А.А., Королёв П.В. Эволюция концептуальных подходов к управлению коррозионной защищенностью стальных конструкций и сооружений // Промышленное и граж-

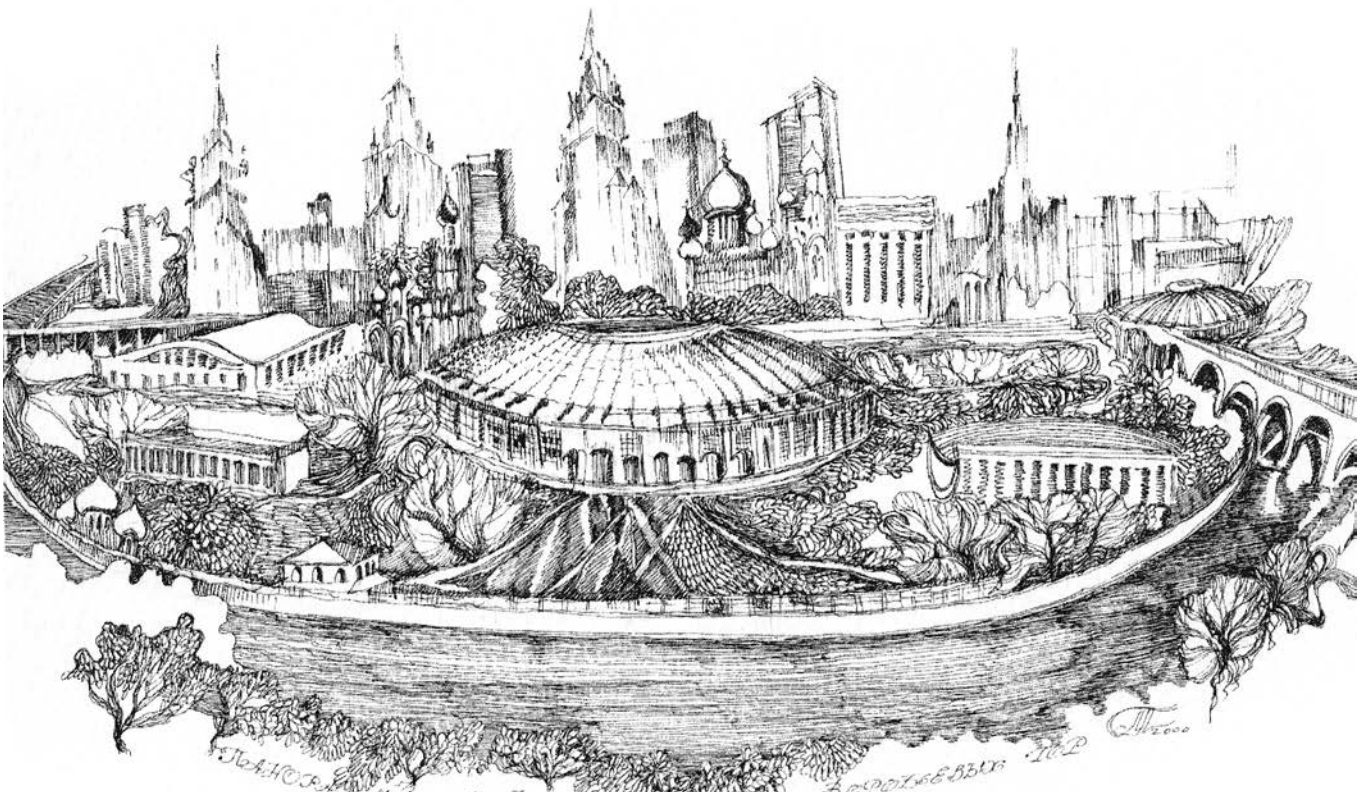
данское строительство. 2022. № 8. С. 32–40. DOI: 10.33622/0869-7019.2022.08.32-40 EDN WNDTAD
3. Королёв В.П., Кущенко И.В., Бочарова Е.А. Параметризация требований коррозионной защищенности стальних конструкцій // Строительство и реконструкция. 2023. № 4 (108). С. 33–46. DOI: 10.33979/2073-7416-2023-108-4-33-46
4. Кущенко И.В., Королёв В.П. Методические аспекты предотвращения коррозионной опасности при эксплуатации стальных конструкций промышленных объектов // Современное строительство и архитектура. 2023. № 10 (41). DOI: 10.18454/mca.2023.41.2
5. 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/192/297
6. Wood R., Hertwich E.G. Economic modelling and indicators in life cycle sustainability assessment // The International Journal of Life Cycle Assessment. 2012. Vol. 18. No. 9. Pp. 1710–1721. DOI: 10.1007/s11367-012-0463-2
7. Giacomella L. Techno-Economic Assessment (TEA) and Life Cycle Costing Analysis (LCCA): discussing methodological steps and integrability // Insights into Regional Development. 2021. Vol. 3. No. 2. Pp. 176–197. DOI: 10.9770/ird.2021.3.2(2)
8. Enshassi A., Kochendoerfer B., Ghoul H.A. Factors affecting sustainable performance of construction projects during project life cycle phases // International Journal of Sustainable Construction Engineering & Technology. 2016. Vol. 7. No. 1. Pp. 50–68.
9. 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/203/308
10. Дорошинский Л.Г., Зверева О.М. Информационные технологии поддержки жизненного цикла изделия. Ульяновск : Зебра, 2016. 243 с.
11. Галишникова В.В., Бочаров М.Е. Information models of construction objects during their life cycle // Недвижимость: экономика, управление. 2024. № 2. С. 65–72. URL: https://n-eu.iasv.ru/index.php/neu/article/view/202/307
12. Trofimov V.T., Korolev V.A. Engineering protection of territories and buildings in the system of engineering and environmental protection // Moscow University Geology Bulletin. 2012. Vol. 67. No. 1. Pp. 52–57. DOI: 10.3103/S0145875212010103
13. Banaitiene N., Banaitis A. Risk Management in construction projects // Published: 12 September 2012. DOI: 10.5772/51460
14. Волгин В.В. Risk management in the implementation of investment and construction projects // Недвижимость: экономика, управление. 2024. № 2. С. 20–26. URL: https://n-eu.iasv.ru/index.php/neu/article/view/194/299
15. Хрусталев 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. URL: https://n-eu.iasv.ru/index.php/neu/article/view/198/303

Об авторах: **Кущенко Игорь Владимирович** — кандидат технических наук, и.о. ректора; **Приазовский государственный технический университет (ПГТУ)**; 287642, Донецкая Народная Республика, г. Мариуполь, ул. Университетская, д. 7; ORCID: 0000-0002-3338-6793; kigorvlad@yandex.ru;

Бочарова Елена Анатольевна — **Приазовский государственный технический университет (ПГТУ)**; 287642, Донецкая Народная Республика, г. Мариуполь, ул. Университетская, д. 7; elena270915v@yandex.ru.

For citation: Kushchenko I.V., Bocharova E.A. Assessment of technical and economic security risks protection at the stages of the life cycle of real estate objects. *Real Estate: Economics, Management*. 2024; 3:26-32.

Для цитирования: *Кущенко И.В., Бочарова Е.А.* Assessment of technical and economic security risks protection at the stages of the life cycle of real estate objects // Недвижимость: экономика, управление. 2024. № 3. С. 26–32.



Л.И. Павлова. Панорама Москвы с Воробьевых гор. Рисунок, тушь, перо.

UDC 504.75.05

Simionov R. Yu.,
Kirpichenkov A.A.

Environmental management in construction: trends, management levels, indicators

Preservation of the natural environment largely depends on increasing the environmental responsibility of construction organizations. Statistical data show that recent years are characterized by an increase in the volume of work in the type of economic activity “Construction”, which requires organizational, legal, economic, technological, and technical measures implemented at the state, sectoral levels and in the management system of construction organizations aimed at rational environmental management. These measures relate not only to the stage of construction of facilities, but also to the period of operation of real estate, which is due to the significant resource intensity of real estate both during construction and operation throughout the life cycle. The study of the problem leads to the conclusion that the mechanism of environmental management should be formed taking into account the specifics of construction activities, ensuring safety at the stage of designing facilities, organization of the construction site, development of the construction area, implementation of process innovations in construction. In resource saving management, in addition to the investment value of an object, it is necessary to manage the costs of operating the object, which account for 75 % of the cost of ownership of the object. The principles of environmental efficiency should be reflected in the evaluation indicators of investment projects. Environmentally responsible investment can become one of the trends in the implementation of national projects, since the goals of national projects correspond to the concept of sustainable development and the balance of economic, social and environmental factors. Barriers to ESG investment in the domestic economy were identified, in particular, underestimation of the impact of these factors on the long-term financial performance of the organizations themselves. To organize an environmental management system in construction organizations, it is necessary to form a system of indicators (sustainability indicators), the presence of which will allow modelling the environmental profile of the organization. The environmental profile allows to establish a balance between external requests and the real capabilities of the organization itself. This requires not only a balanced system of environmental indicators of the organization, but also reference values of indicators that ensure the organization's competitiveness in the contract market.

Keywords: *construction industry, environmental problems, environmental safety, state and industry regulation, environmental management of an organization, areas of improvement, indicators of system stability*



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: 8057-5850;
radomir@rambler.ru



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

The current state of the natural environment largely depends on increasing the environmental responsibility of construction organizations. Statistical data show that recent years are characterized by an increase in the volume of work by the type of economic activity “Construction”: in 2021 volume growth compared to the previous year amounted to 107.0 %, in 2022 — 107.5 %, and in 2023 — 107.9 %[1]. This increases the impact on the environment, and the consumption of non-renewable natural resources increases. There is a need to increase the costs of environmental protection measures. In particular, the index of physical volume of environmental protection expenditures, starting from 2019 is increasing: in 2019 and 2020 the growth to the previous year amounted to 103.4 %, in 2021 — 104.8 %. Despite this, the problems are not completely solved, but only increasing[1].

The process of tightening environmental requirements is irreversible and the environmental management subsystem of the construction industry should be developed, forecasting, long-term planning, formation of environmental control system is necessary. It is necessary to develop a system of indicators of the ecological block in a comprehensive analysis of the economic activities of construction organizations. To preserve the natural environment, a system of organizational, legal, economic, technological, and technical measures is needed, implemented at the state, sectoral levels and in the management system of construction organizations aimed at rational environmental management and environmental safety. These measures relate not only to the stage of construction of facilities, but also to the period of operation of real estate, which is due to the significant resource intensity of real estate both during construction and operation throughout the life cycle.

The environmental safety management system provides for full engineering and environmental surveys, which should provide a comprehensive study of the engineering and environmental conditions of urban development activities and forecast possible changes. The results of engineering and environmental surveys are the basis for assessing the environmental impact of construction projects, developing environmental protection measures for capital construction projects and linear facilities, as well as land reclamation and conservation projects[2].

The concept of “investment value” includes the cost of design and survey work, construction and installation work, an engineering and technical support system, connections to outdoor networks, landscaping and gardening of the adjacent territory, and the cost of purchasing a land plot. The necessity of resource conservation management throughout the life cycle of an object is considered, when, in

1 Federal State Statistics Service. URL: https://www.gks.ru (rus.).

2 A set of rules. Engineering and environmental surveys for construction. SP 502.1325800.2021. Date of introduction: 01.17.2022. (rus.).

addition to the investment cost, operation (including current repairs), reconstruction, major repairs, and demolition of the object are taken into account[3]. Research shows that the cost of operating a real estate object accounts for 75 % of the cost of owning an object, while only 25 % falls on the design, construction and disposal of the object[4].

Construction is a vivid example of anthropogenic activity, which often has a serious negative impact not only on individual components of the environment and their safety, but also on the stability of the ecosystem as a whole. Today, the state of the environment largely depends on the environmental regulation of the activities of construction contractors and resource-providing industries. Greening of construction involves the adoption of a system of organizational, legal, economic, technological, technical and other measures aimed at improving the efficiency of environmental management, reducing negative impacts on the natural environment, ensuring a favorable environment and environmental safety when providing natural facilities for construction and throughout the life cycle of a building or structure.

Sustainable development management, unlike the existing model, should be proactive and based on long-term programmes that should not be reduced to simple regulation. The legislative and legal framework, which will be developed and developed at the global, national and regional levels, should also have a preventive character.

The research identifies two interrelated levels of environmental management [1]. At the level of economic entities, environmental management is considered as a management subsystem focused on the development of environmental policy, minimizing the negative consequences of production, monitoring the use of resources, analyzing and evaluating environmental results, and continuously improving the system. At the global level, environmental objectives are formed by the State in the form of standards, which establishes regulations for activities and control.

The following mechanisms for stimulating resource conservation in housing management are being considered at the state and regional levels [2]:

- formation of a resource-saving regional policy, taking into account the specifics of the region;
- development and constant updating of standards for the management of apartment buildings;
- involving businesses in investing in projects aimed at implementing progressive resource-saving technologies;
- development of the public-private partnership system in the modernization of the housing stock.

As one of the directions, the implementation of "control over control" is considered, i.e. the development of methods for checking the environmental supervision authorities themselves and situations of environmental crime [3].

The study of the problem leads to the conclusion that the mechanism of environmental management should be formed taking into account the specifics of construction activities, the peculiarities of resource supply and other factors [1, 4–6]. In particular, the environmental management system should focus on:

- implementation of environmental measures in the design of facilities;
- environmental safety of the building materials used;
- environmental aspects of the construction site organization;
- environmental aspects of the development of the building area;
- environmental safety of waste disposal;
- environmental safety of construction production technologies;
- environmental safety of process and product innovations in construction.

At the design stage, both direct and feedback of environmental factors should be taken into account[2]. The zones of impact of the projected object are highlighted, when negative environmental impacts may occur during construction and operation of the facility, and permissible impact levels are determined. Zones with environmental restrictions, engineering and environmental conditions as a set of factors affecting urban development activities are highlighted.

Engineering and environmental surveys should be sufficient to provide a comprehensive assessment of the environmental conditions of the construction site or development area, evaluate direct and feedback, and create a basis for informed recommendations[2]. Recommendations can be focused either on preventing negative effects or on banning construction. The document contains a detailed list of the composition of engineering and environmental surveys, but does not exclude that additional surveys may be carried out at the initiative of the developer. The limitation period for existing research results is established.

"Green" construction is regulated and stimulated by the state[3]. The requirements of the standard are aimed at reducing the consumption of energy resources, the use of non-traditional, renewable and secondary energy resources, rational water use, reducing harmful effects on the environment during the construction and operation of a building, including the adjacent territory, while ensuring a comfortable human habitat and adequate economic profitability of architectural, structural and engineering solutions. The concept of "investment value" includes the cost of design and survey work, construction and installation work, an engineering and technical support system, connections to outdoor networks, landscaping and greening of the adjacent territory, and the cost of purchasing a land plot.

During the construction and reconstruction of buildings and structures, it is necessary to monitor the condition of environmental components. This is reflected in the composition of the environmental reporting of construction organizations. It is necessary to comply with the norms of allotment and targeted use of land, soil protection and land reclamation. Since 2021, all construction sites have been divided into certain categories, which determines the list, content and timing of providing statistical reports of an environmental orientation. Construction projects with a duration of work up to 6 months are classified in the 4th category, and with a construction period of more than 6 months in the 3rd category[5]. In particular, the 4-OS form provides for the submission of information on the organization's costs for environmental protection[6]. It is also envisaged that there is a programme of industrial environmental control, which should contain information on: official staff units and/or departments responsible for controlling the ecology of production; about the availability of their own and/or hired laboratories that have the appropriate accreditation according to the legislation of Russia; methods and degree of regularity of control, sampling points and measurement methods.

3 GOST R 54964–2023. Conformity assessment. Environmental requirements for real estate objects. Approved. By order of the Federal Agency for Technology Regulation and Metrology No. 1488-st dated 11.29.2023. (rus.).

4 Calculation of the cost of construction taking into account the life cycle of the building. URL: https://tula.profnastil.com/news/raschet-stoimosti-stroitelstva-s-uchetom-zhiznennogo-tsikla-zdaniya (rus.).

5 Reporting on the ecology of construction sites from 2021. URL: https://all4eco.ru/отчетность-по-экологии-объектов-строительства-с-2021-года (rus.).

6 Form 4-OS "Information on current environmental protection costs" (Appendix 5 to the order of Rosstat dated 07/31/2023 No. 369). URL: https://normativ.kontur.ru/document?moduleId=44&documentId=46678 (rus.).

The transition to "green" construction requires additional and sometimes significant costs. In particular, the use of wooden structures in construction instead of reinforced concrete leads to an increase in price by 5–7 %, but pays off due to energy efficiency during the operation of the facility [7].

The principles of environmental efficiency should be reflected in the indicators of investment projects [8]. Environmentally responsible investment can become one of the trends in the implementation of national projects, since the goals of national projects correspond to the concept of sustainable development and the balance of economic, social and environmental factors. Barriers to ESG investment in the domestic economy are identified, in particular: misunderstanding of the aggravation of the ESG problem and the impact of taking into account these factors on the long-term financial performance of the organizations themselves [8].

Achieving ESG goals, including in the field of ecology, requires additional costs and leads to a decrease in the profitability of production, but ensures the growth of the company's business reputation, which in the future will lead to an increase in business profitability, strengthening competitive positions [9].

GOST R 54964–2023 discloses the concept of basic categories reflecting the essence of environmental requirements for real estate, and also provides evaluation criteria within each basic category. In particular, the state of environmental management is assessed in the following sections[3]:

- organization of an environmental management and monitoring system;
- optimization of design solutions;
- monitoring the fulfillment of resource saving requirements;
- reliability during commissioning of the facility;
- control and monitoring of the main indicators of the facility;
- optimization of the shape of the building, taking into account the direction of air flows, which involves taking into account climatic features.

Basic levels of electricity and heat consumption are developed, taking into account the area of the facility and the number of floors. A mandatory methodology for calculating the energy characteristics of buildings has been developed, taking into account regional and political conditions.

In some studies, the institutionalization of socio-environmental responsibility of the construction business is considered as a necessary condition for the development of the investment and construction sector, in particular: the development of forms of interaction between participants in investment and construction processes; the development of tools for environmental and economic management and regulation [10].

To organize an environmental management system in construction organizations, it is necessary to form a system of indicators (sustainability indicators) that must meet the following requirements:

- possibility of using it at the macro level on a national scale;
- combine environmental, social and economic aspects of the company's activities;
- provide an unambiguous interpretation for decision makers;
- have a quantitative expression;
- rely on the existing system of national statistics and the reporting of enterprises themselves;
- ensure the possibility of applying a system of comparative measurements at the industry level;
- possibility of evaluation in time dynamics.

The availability of an indicator system will make it possible to implement one of the most effective tools for developing a sustainable development strategy taking into account environmental factors: building an environmental profile of an organization. The construction of an environmental profile is based on a rational combination of qualitative and quantitative analysis methods, which creates opportunities to identify strategic reserves. The environmental profile allows you to establish a balance between external requests and the real capabilities of the organization itself. This requires not only a balanced system of environmental indicators of the organization, but also reference values of indicators that ensure the organization's competitiveness and compliance with environmental standards. The following values can be taken as reference values:

- level of changes planned by the organization itself due to the implementation of environmental measures;
- level of performance provided by advanced construction production technologies;
- level of requirements for organizations in the competitive selection process;
- environmental performance of enterprises with a high rating in the contracting market.

It is necessary to increase the information transparency of the activities of construction organizations for investors, consumers and business partners. The competitiveness index as an aggregated indicator should contain, along with other components, indicators of environmental responsibility, reflecting the availability of environmentally friendly building materials, their production technology, construction production technology, resource conservation at the stage of operation of the property.

The following can be considered as separate subsystems of indicators capable of reflecting the environmental conditions of management [11]: the degree of greening of all links of economic activity; the degree of progressiveness of resource conservation and ecological purity of technologies; the cost of natural resources; the level of environmental payments; the degree of environmental safety of the population.

Environmental factors are practically not taken into account when making management decisions both in the organization itself and by investors making decisions on financing projects. For internal management purposes, the state of the environmental management subsystem can be represented by a relatively wide range of indicators that provide guidance for making strategic and operational decisions in the field of construction products, construction technologies, and the real estate market. This requires the development of an environmental management system in the management of a construction organization with a focus on measures implemented at the state, regional and sectoral levels within the framework of the concept of sustainable development.

REFERENCES

1. Kosyakova I.V., Kapmar I.V. Environmental innovations at industrial enterprises as a factor in achieving balanced development of society. Fundamental research. 2017; 9(2):455-459. (rus.).
2. Sevka V.G., Polukhina M.N. Methodological approaches to assessing the security of the housing stock management system with material and technical resources. Creative economy. 2023; 17(1):385-404. DOI: 10.18334/ce.17.1.117061. EDN IKAKIK. (rus.).
3. Rudenko M.N., Subbotina Yu.D. The state of environmental safety at the present stage of development. Economic security. 2023; 6(1):347-366. DOI: 10.18334/ecsec.6.1.117556. EDN UPWGQM. (rus.).
4. Akhmetova K.M., Kuzminykh N.A. Efficiency assessment of environmental innovation management. Economics and Management: a scientific and practical journal. 2021; 4(160):43-51. DOI: 10.34773/EU.2021.4.7. EDN XIJHAY. (rus.).
5. Yakovleva E.A., Titova E.V., Stepanova Yu.N. Methodological approaches to assessing the role of innovations in the "green"

development of the economy. Actual Problems of Scientific Research of the 21st Century: Theory and Practice. 2023; 11(3(62)):107-121. (rus.).
6. Arsky A.A. Environmental aspects of construction and operation of logistics transformation centers. Herald of MASI. 2022; 2:11-14. DOI: 10.52470/2224669X_2022_2_12. EDN UPFBAE. (rus.).
7. Petrova E.A., Korshunov A.F. Prospects for the construction of environmentally friendly buildings. Modern construction and architecture. 2022; 1(25):14-19. DOI: 10.18454/mca.2022.25.2 (rus.).
8. Shemyakina T.Y. Application of ESG factor standards in innovative construction projects. Bulletin of the University. 2021; 1:132-139. DOI: 10.26425/1816-4277-2021-3-132-139 (rus.).
9. Ovechkin D.V. Reporting investments: the impact of the ESG rating on the rating market and the expected result in the global market. Scientific journal of the ITMO Research Institute. 2021; 1:44-52. DOI: 10.17586/2310-1172-2021-14-1-43-53 (rus.).
10. Buzyrev V.V., Nuzhina I.P., Zolotareva M.V. The influence of sociological and environmental factors on urban planning in developing urbanized territories. Problems of the modern economy. 2017; 3(63): 210-214. (rus.).
11. Sheremet A.D. Comprehensive analysis of indicators of sustainable development. Economic analysis: theory and practice. 2014; 45(396):106-118.

Экологический менеджмент в строительстве: тенденции, уровни управления, показатели

Сохранение окружающей природной среды во многом зависит от повышения экологической ответственности строительных организаций. Статистические данные показывают, что последние годы характеризуются ростом объемов работ по виду экономической деятельности «Строительство», что требует организационных, правовых, экономических, технологических и технических мер, реализуемых на государственном, отраслевом уровнях и в системе управления строительными организациями, направленных на рациональное природопользование. Эти меры относятся не только к стадии строительства объектов, но и периоду эксплуатации объектов недвижимости, что обусловлено значительной ресурсоемкостью объектов недвижимости как в процессе строительства, так и эксплуатации в течение всего жизненного цикла. Исследование проблемы приводит к выводу, что формировать механизм экологического менеджмента следует с учетом специфики строительной деятельности, обеспечивая безопасность на стадии при проектировании объектов, организации строительной площадки, освоении территории застройки, внедрении процессных инноваций в строительстве. В управлении ресурсосбережением кроме инвестиционной стоимости объекта необходимо управлять затратами на эксплуатацию объекта, которые составляют 75 % затрат владения объектом. Принципы экологической эффективности должны находить отражение в показателях оценки инвестиционных проектов. Ответственное с позиций экологии инвестирование может стать одним из трендов реализации национальных проектов, поскольку цели национальных проектов соответствуют концепции устойчивого развития и сбалансированности экономических, социальных и экологических факторов. Выявлены барьеры препятствий ESG-инвестированию в отечественной экономике, в частности недооценка влияния названных факторов на долгосрочные финансовые показатели самих организаций. Для организации системы экологического менеджмента в строительных организациях необходимо формирование системы показателей (индикаторов устойчивости), наличие которой позволит моделировать экологический профиль организации. Экологический профиль позволяет установить баланс внешних запросов и реальных возможностей самой организации. Это требует не только наличия сбалансированной системы экологических показателей организации, но и эталонных значений показателей, обеспечивающих организации повышение конкурентоспособности на рынке подрядных работ.

Ключевые слова: *строительство, экологические проблемы, экологическая безопасность, государственное и отраслевое регулирование, экологический менеджмент организации, направления совершенствования, индикаторы устойчивости системы*

СПИСОК ИСТОЧНИКОВ

1. Косякова И.В., Капмар И.В. Экологические инновации на промышленных предприятиях как фактор достижения сбалансированного развития общества // Фундаментальные исследования. 2017. № 9 (ч. 2). С. 455–459.
2. Севка В.Г., Полухина М.Н. Методические подходы к оценке обеспеченности системы управления жилищным фондом материально-техническими ресурсами // Креативная экономика. 2023. Т. 17. № 1. С. 385–404. DOI: 10.18334/ce.17.1.117061. EDN IKAKIK.
3. Руденко М.Н., Субботина Ю.Д. Состояние экологической безопасности на современном этапе развития // Экономическая безопасность. 2023. Т. 6. № 1. С. 347–366. DOI: 10.18334/ecsec.6.1.117556. EDN UPWGQM.
4. Ахметова К.М., Кузьминых Н.А. Оценка эффективности управления экологическими инновациями // Экономика и управление: научно-практический журнал. 2021. № 4 (160). С. 43–51. DOI: 10.34773/EU.2021.4.7. EDN XIJHAY.
5. Яковлева Е.А., Титова Е.В., Степанова Ю.Н. Методические подходы к оценке роли инноваций в «зеленом» развитии экономики // Актуальные проблемы научных исследований 21-го века: теория и практика. 2023. Т. 11. № 3 (62). С. 107–121.
6. Арский А.А. Экологические аспекты строительства и эксплуатации логистических трансформационных центров // Вестник МАСИ. 2022. № 2. С. 11–14. DOI: 10.52470/2224669X_2022_2_12. EDN UPFBAE.
7. Петрова Е.А., Коршунов А.Ф. Перспективы строительства экологически чистых зданий // Современное строительство и архитектура. 2022. № 1 (25). С. 14–19. DOI: 10.18454/mca.2022.25.2
8. Шемякина Т.Ю. Применение ESG-факторов в инновационно-строительных проектах // Вестник университета. 2021. № 1. С. 132–139. DOI: 10.26425/1816-4277-2021-3-132-139
9. Овечкин Д.В. Ответственные инвестиции: влияние ESG-рейтинга на рентабельность фирм и ожидаемую доходность на фондовом рынке // Научный журнал НИУ ИТМО. 2021. № 1. С. 44–52. DOI: 10.17586/2310-1172-2021-14-1-43-53
10. Бузырев В.В., Нужина И.П., Золотарева М.В. Влияние социологических и экологических факторов на градостроительную деятельность на развивающихся урбанизированных территориях // Проблемы современной экономики. 2017. № 3 (63). С. 210–214.
11. Шеремет А.Д. Комплексный анализ показателей устойчивого развития // Экономический анализ: теория и практика. 2014. № 45 (396). С. 106–118.

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: 8057-5850; radomir@rambler.ru;

Кирпиченков 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: Simionov R.Yu., Kirpichenkov A.A. Environmental management in construction: trends, management levels, indicators. *Real Estate: Economics, Management.* 2024; 3:33-36.

Для цитирования: *Симионов Р.Ю., Кирпиченков А.А.* Environmental management in construction: trends, management levels, indicators // Недвижимость: экономика, управление. 2024. № 3. С. 33–36.

UDC 332.81.87

Balashov E.B.

Regional trends in the development of the housing and municipal complex

The relevance of ensuring sustainable functioning of the housing and communal services (HCS) sets the task of studying its state and problems of functioning with the development of strategic approaches to an effective model of transformation and acceleration of modernization of engineering and communal infrastructure facilities. It is shown that the most significant influence on the state of the HCS is the level of potential of various types of cities, interconnected with the activities of enterprises and organizations, demographic forms of settlement and the living environment. It is proven that the largest cities with a population of over a million have a high potential for further development of the HCS, in this regard, the urgent task is to determine the models and drivers of their long-term development. Based on the analysis of the genesis of the development of the modern HCS system, certain structural shifts achieved in solving priority tasks in the HCS sphere are highlighted for further implementation of programmes for the resettlement of citizens from unsuitable housing, regional programmes for major repairs of common property in apartment buildings, implementation of targeted municipal programmes for the modernization of utility networks, adopted legislative acts promoting the development of concession mechanisms for attracting investment and implementing infrastructure projects. The features of the socio-economic and technological system of housing and communal services are highlighted and a set of modern problems and factors critically influencing the degree of adequacy of the housing and communal services structure that meets the needs of residents is revealed. The trends in the state and functioning of the housing and communal services system in the regions are determined, an analysis of the existing trends in the development of housing and communal services in a number of major cities is carried out. The key trends in the strategy for the development of housing and communal services are substantiated, allowing to improve the state of the infrastructural potential of housing and communal services and ensure accelerated development of the infrastructure of comfortable living conditions and the quality of life of the population.

Keywords: *potential, problems, analysis, criticality, imbalance, instability*



Balashov Eugeniy Borisovich,
Candidate of Law, Professor of the Department of Urban Studies; Moscow Polytechnic University; 38 Bol'shaya Semenovskaya st., Moscow, 107023, Russian Federation; Head; Moscow Analytical Centre in the field of urban management; 13/1 Filipovsky lane, Moscow, 119019, Russian Federation; balashov.evgenii@gmail.com

INTRODUCTION

To substantiate the methodological basis for a comprehensive study of trends in the development of the socio-economic complex of housing and communal services, it is necessary to highlight the key categories and, first of all, the concepts of behavioural economics and rationality of the population, as owners of residential real estate, the cost of the life cycle of its ownership from the standpoint of their well-being, comfort of living, quality of life, growing contradictions between the profitability of utilities and the cost of utilities, the need for harmonization and balance of interests of residents and management and utility companies.

The specifics of the activities of the housing and communal services sector, as a unique socio-economic-technological system, take into account the influence of such factors as the activities and financial results of public utilities, the balance of interests of consumers and service providers, tariff pricing, communication interaction between management organizations and residents, the quality of technical maintenance and repair of housing, the activities and financial results of utilities, the balance of interests of consumers and service providers, communication interaction between management organizations and residents, the quality of technical maintenance and repair of housing, etc. A special feature of the socio-housing and communal economy is the equal attitude to the social and economic principles of life support in the implementation of the reproductive processes [1].

Achieving the strategic goals of the development of the construction industry and the housing and communal sphere will be aimed at increasing the level of housing provision for the population, the quality of utilities provided and measures of state support for the development of the housing and communal services sector[1, 2].

Modern housing and communal services, being the most important structure-forming socially significant territorial-sectoral system of the city, is in constant organizational, technological and economic development due to the formation of various target trajectories of growth in the number of urban population and types of cities, the structure and specialization of their economies, and the urbanization of territories. Forms of territorial-spatial settlement and changes in urban development models associated with the formation of new centres of attraction in the largest cities and agglomerations create new competitive advantages over other regions [4, 5]. Based on the analysis of the genesis of the development of the modern housing and communal services system, presented in Fig. 1, the study of research and scientific approaches to

1 Decree on national development goals of the state for the period up to 2030 and for the future up to 2036. The document was published on May 7 on the Kremlin website.

2 Strategy for the development of the construction industry and housing and communal services of the Russian Federation until 2030 with a forecast until 2035.

the development of the housing and communal services system, a set of modern problems and mechanisms of regulatory impact on the processes of synchronization of the digital transformation of management and sustainable development and functioning of the housing and communal services is determined [6–9].

The achieved positive structural shifts in solving priority problems in the housing and communal services sector are aimed at further implementation of the programme for the resettlement of citizens from dilapidated housing, long-term regional programmes for the overhaul of common property in apartment buildings. As part of the integrated development of territories, targeted municipal programmes for the modernization of utility networks are being implemented [10].

The adopted legislative acts contribute to the development of concession mechanisms for attracting investment and implementing infrastructure projects in the housing and communal services sector. A comprehensive renovation of existing residential buildings is being carried out. In 2023, most regions adopted programmes for the modernization of utility infrastructure for the period 2023–2027. To monitor the progress of the programmes, the Ministry of Construction of Russia holds meetings to discuss the weekly results of the implementation of programmes in the regions. The instruments of state policy that stimulate innovation processes and infrastructure development using public-private partnership mechanisms are development institutions. The Unified Development Institute in the Housing Sphere is aimed at developing mortgage housing lending and housing construction, developing and implementing mechanisms to increase the investment attractiveness of the housing sector, developing the market for mortgage securities and other financial instruments.

METHODS

The study of modern processes of development of housing and communal services is based on the reproductive approach to the implementation of the mechanism of investment provision taking into account the internal resource potential of housing and communal services and the nature of the influence of the external environment based on the synchronization of their cyclical activity [11–14]. Let us highlight the features of the socio-economic and technological system of housing and communal services, including the following indicators [15].

Territorial and regional unevenness of development of housing and communal services systems, which arose in the process of contradictions of the administrative-planning system characterized by the absence of certain types of public services, unsatisfactory quality of drinking water, low rates of development of the urban environment of municipalities an.rural settlements.

The criticality of the technical condition of public utilities is confirmed by high physical wear and tear (more than 45 %) of the network economy. At the same time, according to Rosstat, if the dynamics of accidents in water supply networks tends to decrease, then the number of accidents at heat supply sources, steam and heating networks, as well as the share of heat losses in the total amount of heat supplied to the network characterize the growth trends of these indicators.

Asynchrony of the development trajectories of various types of regional housing and communal infrastructure of municipalities, housing and operational processes, production and provision of utilities, implementation of target regional and municipal programmes and projects are factors of varying development efficiency and low attractiveness for external investors, which requires the development of a methodology for investment synchronization and transformation of the housing and communal services management system.

The imbalance of the physical condition and functioning of individual subsystems and types of housing and communal services elements determines the need to implement a strategy for synchronizing development and mechanisms for ensuring advanced rates of modernization of communal infrastructure facilities.

The instability of the functioning of the housing and communal services is expressed in changes in the system parameters of the urban environment during periods of sharp quantitative and qualitative changes. Management of the transformation of the integrated development of the urban environment forms a tendency towards the sustainability of the functioning of the housing and communal services as a whole and is a factor in investment attractiveness. There is an inextricable connection and interdependence of the complex transformation and sustainable functioning of the production-technical, organizational-economic and social infrastructure of the urban housing and communal services, which presupposes certain proportions in their development, giving stability to cities. At the same time, the most significant influence on the state of the urban housing and communal services is the level of potential of various types of cities, interconnected with the activities of enterprises and organizations, demographic forms of settlement and the living environment[3] [16].

Currently, the housing and communal infrastructure of most Russian regions and major cities are being rebuilt to meet modern standards of quality and accessibility.

The positive dynamics of housing construction structurally in the context of regions has a trend in average housing provision per one person/sq. m, shown in Fig. 1.

The largest and major cities have a high potential for further development of the housing and utilities sector, in this regard,

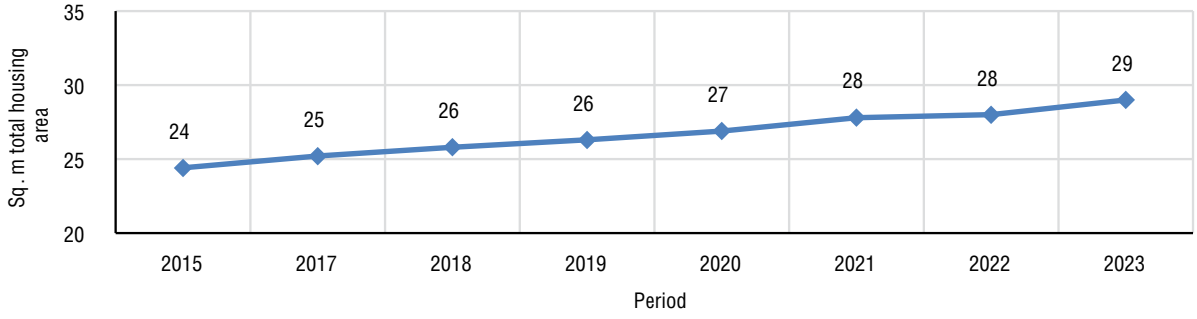


Fig. 1. Trend of average housing provision per one person/sq. m of total housing area

3 Analytical Center of Moscow. URL: https://ac-mos.ru/analytics/demography

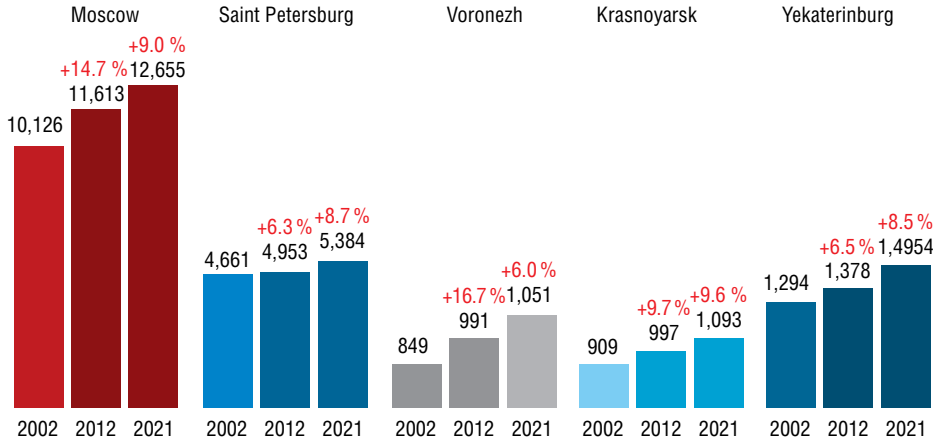


Fig. 2. Dynamics of population growth, thousand people (in % of the previous period)

an urgent task is to determine the models and drivers of their future development. The most significant cities in terms of potential are the largest cities with a population of over one million people, in which about 30 % of the urban population and almost 23 % of the total population of Russia currently live (Fig. 2)[3, 4].

The largest cities make a significant contribution to the socio-economic development of the regions and are the centres of development and dissemination of innovations in all spheres of the economy [3]. Their attractiveness is explained by a diversified labour market, developed economy and quality of life. In Russia, the rate of migration of people to large cities is approximately the same as in the world [4].

RESULTS

Based on the analysis of the genesis of the development of the modern housing and communal services system, presented in Fig. 3, the study of scientific research and scientific approaches to the development of the housing and communal services system, a set of modern problems has been identified that suggest mechanisms for regulatory impact on the processes of formation of digital transformation of management and ensuring sustainable development and functioning of the housing and communal services. The availability of housing and communal infrastructure of the urban economy is a basic factor in the development of agglomerations (Fig. 4). The components of such infrastructure are the engineering and urban planning system, the principles of placement, operation and design of utility networks, equipment that provide comfortable living and conditions for the sustainable development of urbanized areas. In order to ensure maximum impact on economic growth with the centralized selection of infrastructure construction projects, it is necessary to make interconnected decisions on the creation and placement of transport, energy, engineering and social infrastructure facilities of federal significance, and in conjunction with them, the corresponding infrastructure of regional and local significance.

It is important to update the basic principles and approaches to the creation of engineering infrastructures in settlements of various sizes, balance the development and condition of housing and communal infrastructure with population growth, updated sanitary and technological requirements for the formation of engineering

Stage 1 (1990–1995) of development of the modern housing and utilities system defined the new housing policy of Russia in terms of liberalization of the housing and utilities market, aimed at developing private property, attracting extra-budgetary sources of financing, and developing competition

Stage 2 (1996–2000) of development of the modern housing and utilities system is characterized by the transition from budget subsidies to full payment for housing and utilities by consumers, subject to ensuring social protection for low-income families and economic incentives for improving the quality of service, economic incentives for improving the quality of service

Stage 3 (2001–2005) of the development of the modern housing and utilities system defined the goals and directions of reforming the housing and utilities sector in the regions of Russia and coordinating compliance with the deadlines for its implementation

Stage 4 (2006–2010) of development of the modern housing and communal services system is marked by the adoption and implementation of the Complex of measures to reform the housing and communal services of the Russian Federation for 2007–2008, the current stage of reforming the housing and communal services

Stage 5 (2011–2020) of development of the modern housing and communal services system is characterized by the adoption and implementation of the Federal Target Programme Comprehensive Programme for the Modernization and Reform of Housing and Communal Services for 2010–2020

The current 6th stage (2021–2025) of development of the modern housing and communal services system defines new conceptual directions for increasing the intensification of processes, increasing the efficiency and effectiveness of regional management systems based on the introduction of new progressive technologies, including digitalization, the Internet, neural networks and artificial intelligence

Fig. 3. Algorithm of genesis of development of the modern housing and communal services system

4 COLLECTION Housing 2024. Collection Regions CITIES of Russia 2022.

equipment and their installation, complex laying of networks in the context of new construction and renovation of existing buildings.

The presence of significant volumes of dilapidated housing stock poses the task of accelerating the implementation of programmes for the demolition of such housing (Fig. 4).

The housing and communal services of most Russian regions and major cities are being restructured to meet modern quality and accessibility standards. At the same time, it is necessary to highlight the factors that critically affect the degree of adequacy of the housing and communal services structure that meets the needs of residents, such as high wear and tear and obsolescence, insufficient resource efficiency, network losses and accidents in engineering systems, the ecology of the collection and processing of municipal waste, legal restrictions, insufficient funding to ensure modern standards of operation of facilities, etc. Identification of the technical condition of residential buildings and communal infrastructure facilities is shown in Fig. 5–11.

As the analysis of the cyclical development of the housing and communal services sector at the stage of the decade of the 1990s shows, the functioning of the housing and communal services sector was maintained in the minimum standard mode of operation of residential buildings and communal infrastructure. At the same time, in the modern period of recovery and active growth of the largest and largest cities, the housing and communal services system increases the economic potential within the framework of urban development of the territories of the urban environment, the construction of innovatively provided high-rise residential complexes,

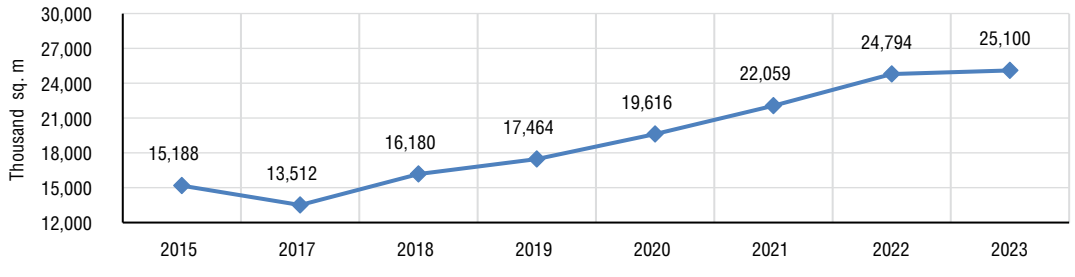


Fig. 4. Dynamics of demolition of dilapidated housing stock, thousand sq. m

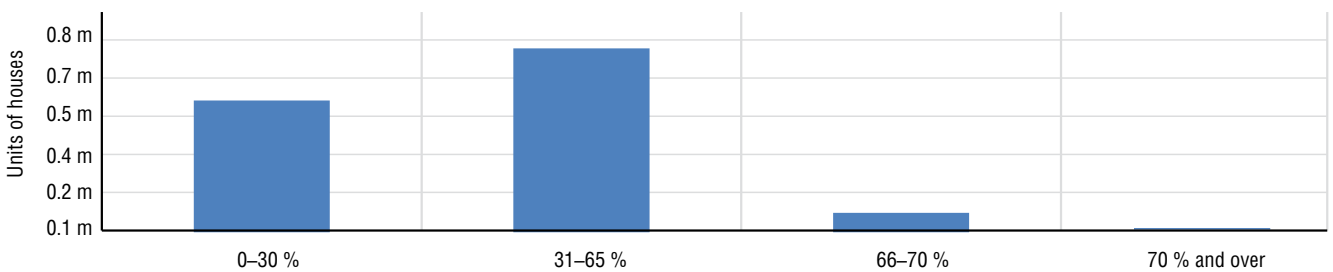


Fig. 5. Distribution of housing stock by physical depreciation

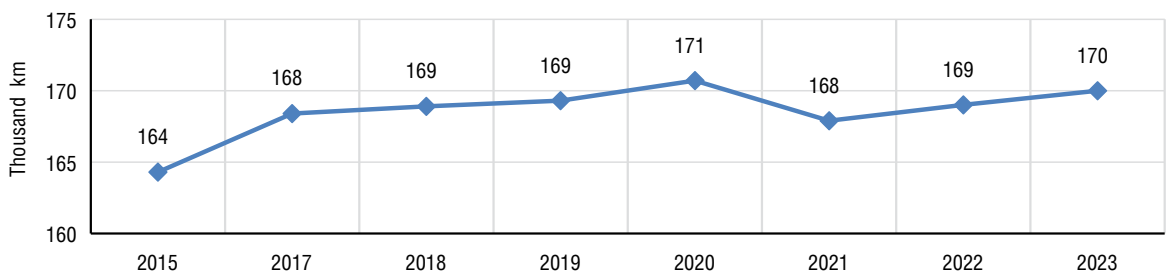


Fig. 6. Street water supply network in need of replacement, thousand km

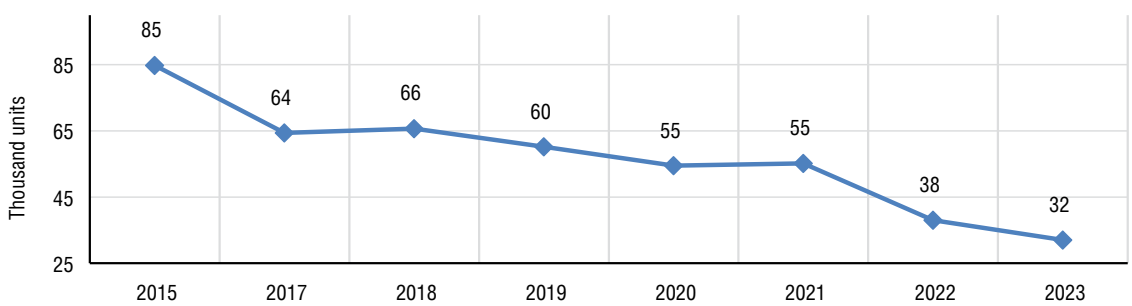


Fig. 7. Dynamics of reduction of accidents in water supply networks, thousand units

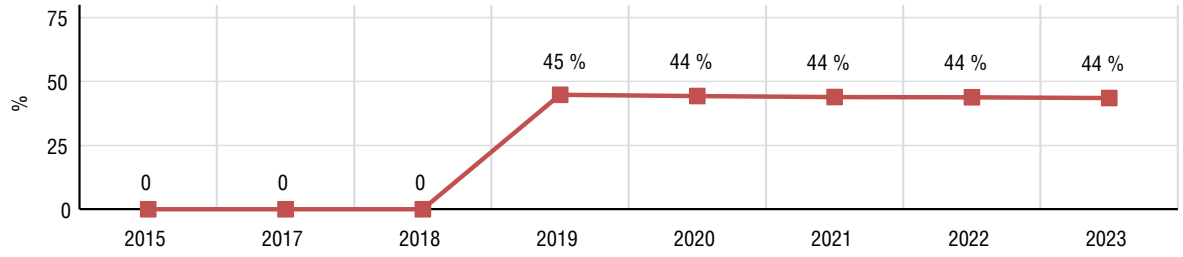


Fig. 8. The proportion of street sewerage networks requiring replacement, %

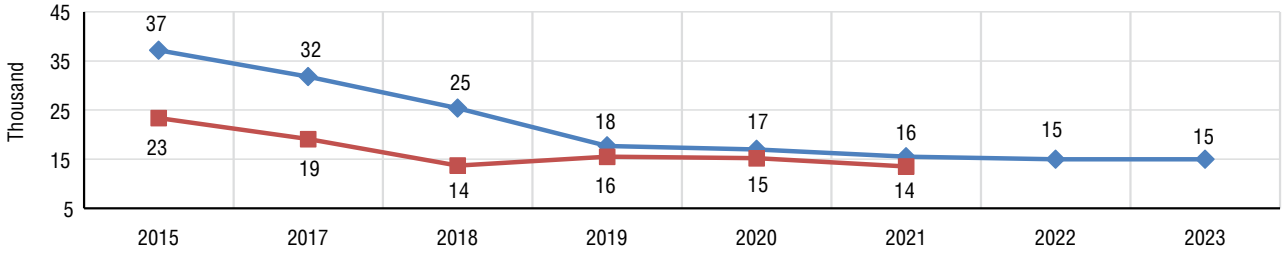


Fig. 9. Number of sewerage failures, thousand

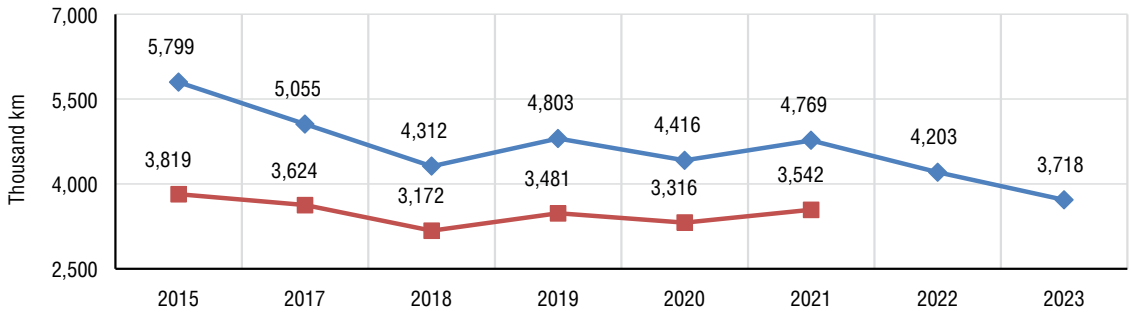


Fig. 10. Number of accidents at heat supply sources, steam and heating networks

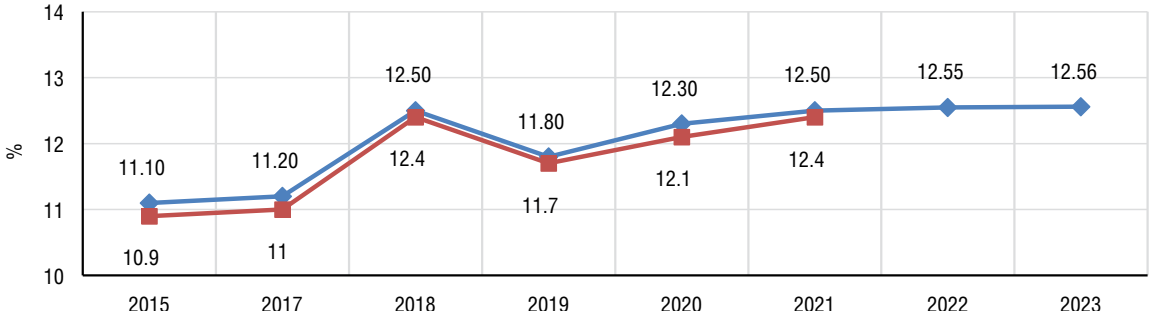


Fig. 11. Specific weight of thermal energy losses in the total amount of heat supplied to the network, %

renovation and modernization measures and major repairs of the housing stock.

The concept of housing and communal services management and its functioning presupposes the need to take into account new principles of development of processes interdependent with the need to accelerate work, improve the efficiency and manageability of business processes, the development of outsourcing in the communal infrastructure, adaptation to digital technologies, and the aggregation of operational work.

The lack of own resources underlies the key category of challenges in ensuring sustainable development of the housing and communal services sector. The need to overcome the investment deficit in the development of housing and communal services does not allow for economically efficient management of effective development models. An important trend of the current stage of development of the housing and communal services sector is significant municipal divergence, which increases the dependence of problem

areas with low provision of housing and communal services on external sources of financing.

The problem cannot be solved by equalizing the levels of development of housing and communal infrastructure through only the redistribution of financial resources. Significant amounts of financial resources provided by the federal government to problem regions and municipalities for the development and modernization of communal infrastructure do not cover the needs for the required volumes of renewal of communal infrastructure.

Taking into account the various differentiation of the technical condition and quality of functioning of housing and communal services, an analysis of the current trends in the development of housing and communal services in a number of major cities was conducted.

An assessment of the introduction of fixed assets and their availability indicates maximum values of indicators for the cities of Moscow, Novosibirsk and St. Petersburg with some dynamics of their decrease. In the remaining major cities included in the analysis, there is a slight increase in the commissioning of assets, which, without reducing the overall state of depreciation of assets and the proportion of completely depreciated fixed assets, indicates a medium-term negative trend in the renewal of fixed assets in the housing and utilities sector (Fig. 12, 13).

It is necessary to highlight the rather high rates of depreciation of fixed assets for housing and communal services in the largest cities: for the cities of Moscow and St. Petersburg within 35–43 %, in other cities over 50–60 % (Fig. 14).

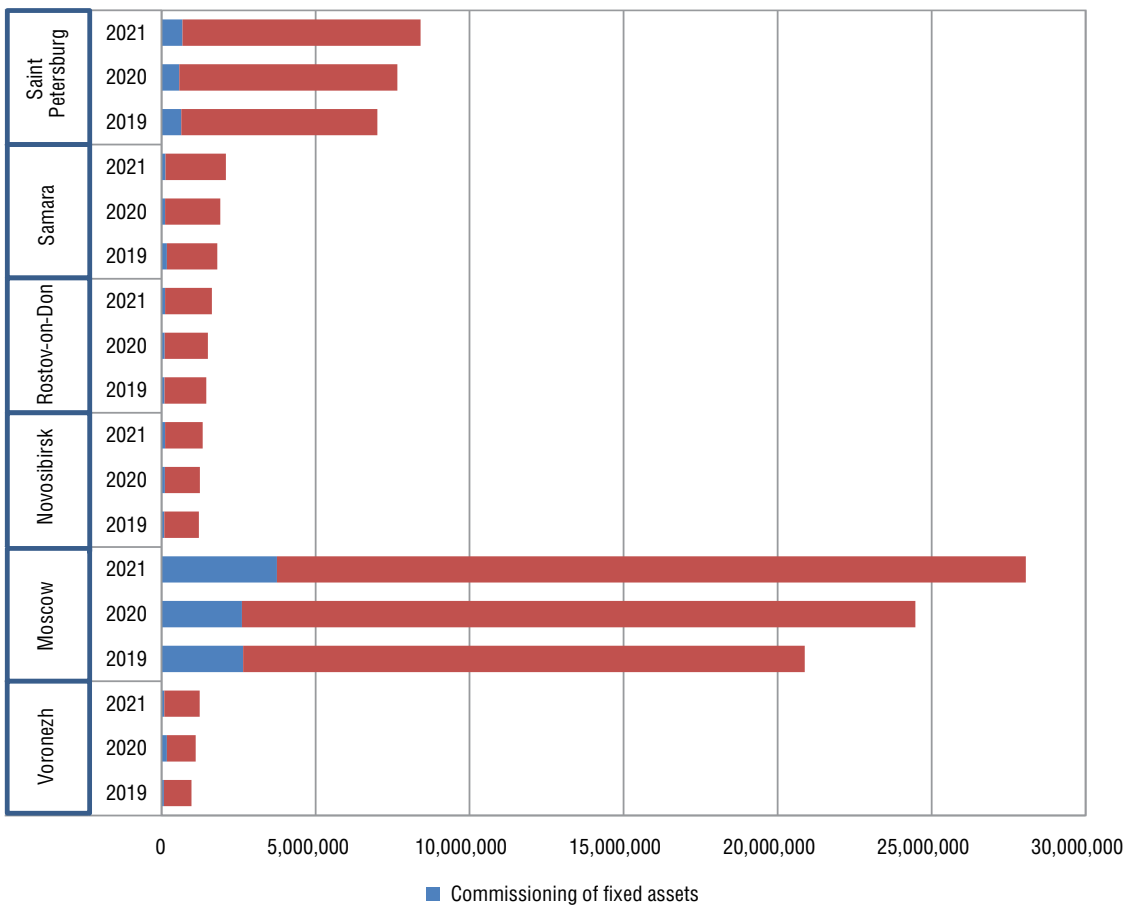


Fig. 12. Dynamics of commissioning of fixed assets in the total volume of fixed assets in the context of the largest cities, %

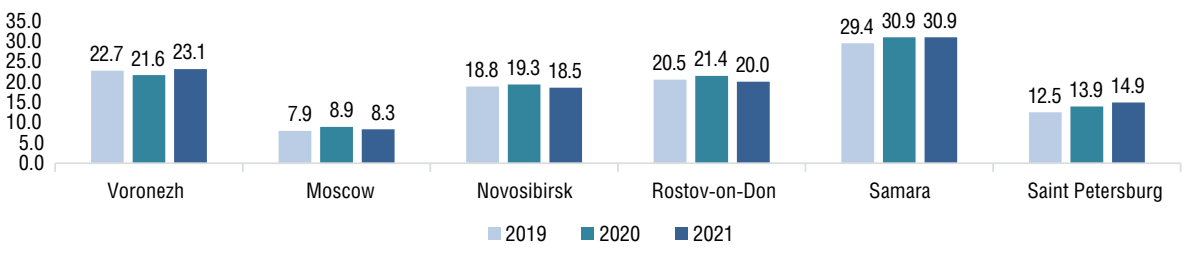


Fig. 13. The share of worn-out assets in the total volume of fixed assets in the context of the largest cities, %

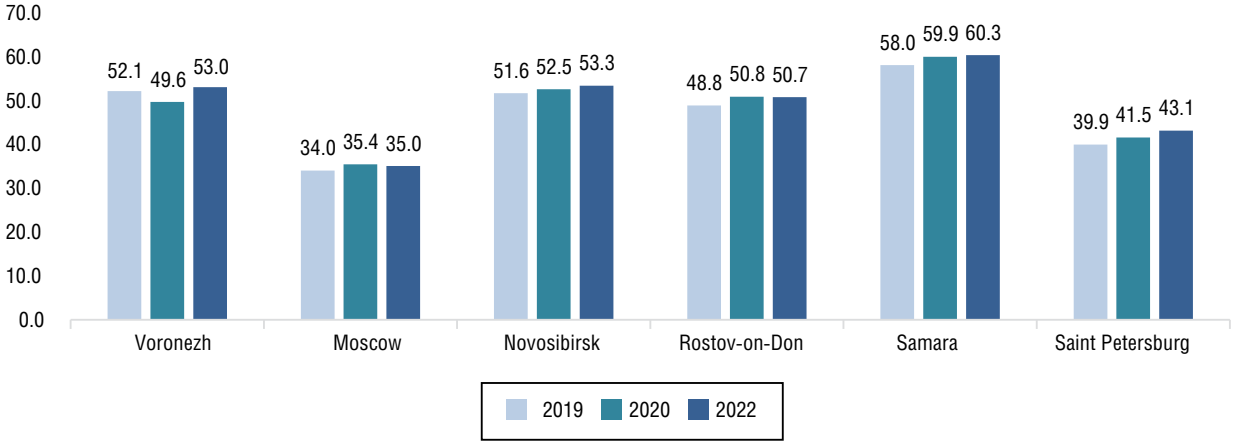


Fig. 14. Indicators of depreciation of fixed assets by major cities, %

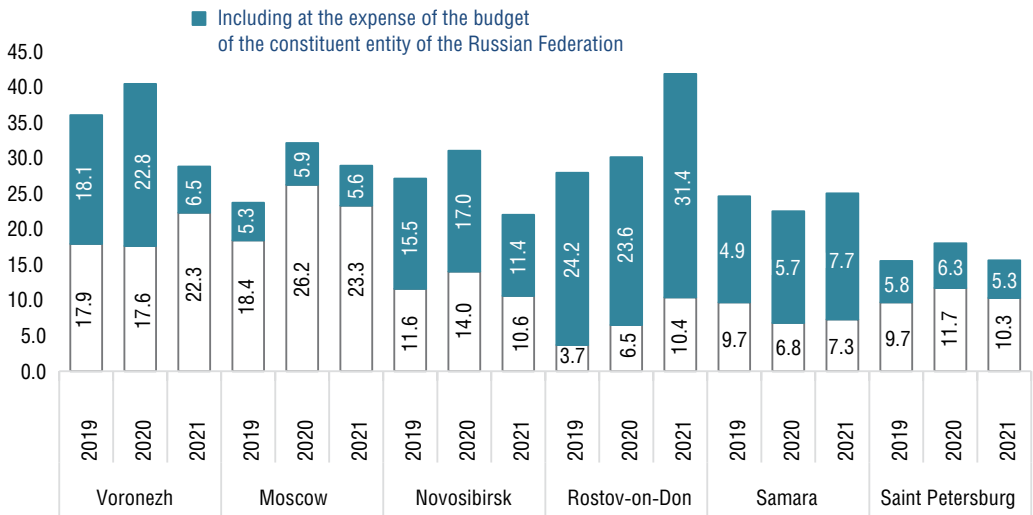


Fig. 15. The share of investments in fixed capital financed from the federal budget and budgets of the constituent entities of the Russian Federation, broken down by largest cities by year, %

The key problem of housing and communal services even for the largest cities is the deficit of investments in the communal infrastructure, which is confirmed by the decrease in the share of investments in fixed capital financed by budgetary funds, including by the federal budget, and the need to expand the organizational and legal field for the application of public-private mobilization partnership mechanisms (Fig. 15). Based on the general analysis of the state and functioning of the housing and communal services system and the assessment of some established trends in the development of housing and communal services in the largest cities, we note that the problems of the development and functioning of life-support systems have characteristic signs of insufficient financial stability, high physical depreciation and deficit of attracted investments for the modernization of communal infrastructure facilities with a degree of physical depreciation of 60 % or more, discrepancies in the volume and quality of work carried out to update housing and communal infrastructure facilities with the required actual needs and recommended standards.

CONCLUSION

The key trends of the housing and communal services development strategy in the regions, which allow solving the problem of improving the state of the housing and communal services infrastructure potential and the accelerated development of infrastructure for comfortable living conditions and quality of life of the population, are proposed:

- optimization of models of regulatory impact on investment synchronization and balance of innovation and integration processes of reproduction of housing and communal services development in the structure of a single reproduction construction and housing and communal services cycle of each region, taking into account the specified level of resource constraints and the required planned volume of financing for projects for the construction of utility capacities, implementation of municipal programme measures for the modernization of public utilities networks, development of scenarios for combining public and private investments, which creates opportunities for the implementation of large investment projects of

a strategic nature and eliminating imbalances in the development of housing and communal services;

- formation and implementation of effective models for transformation of the housing and communal services management system and scenario stages of planned implementation of stages of transformation into a service-digital economy, network Internet economy and Internet economy of artificial intelligence, taking into account territorial differences in the location of facilities, resource capabilities, population, different conditions of the housing and communal services infrastructure and development prospects of regions and settlements. It is proposed to create a single intelligent centre for monitoring, regulating and managing the functioning of the housing and communal services system to ensure the quality and reliability of services provided, rational use of resources, acceleration of management decisions, analytical research of incidents and forecasting of repair strategies;
- expansion of the currently existing organizational and economic mechanism of inter-municipal interaction for the development of areas of housing and communal integration, which allows for a set of measures to eliminate imbalances in the development of housing and communal services in individual municipalities to update the inter-municipal communal infrastructure and social facilities, development and renovation renewal, primarily, inter-municipal communal infrastructure and waste management systems, creation of inter-municipal territories of investment attractiveness based on the digital platform of inter-municipal integration in order to more fully utilize the potential of resource and production integration and the use of digital technologies. The composition and structure of these mechanisms are determined by the combined potential of infrastructure and technical provision and the state of funds, the developed strategy and investment attractiveness of regional housing and communal services, as well as labour, production and technological, innovative, financial, institutional, consumer development potential.

REFERENCES

1. Rakhmeeva I.I., Chesnyukova L.K. Methodology of moral and socio-cultural economics. Scientific Works of the Free Economic Society of Russia. 2024; 245(1):165-175. DOI: 10.38197/2072-2060-2024-245-1-165-175 (rus.).
2. Makarevich L.O., Ulezko A.V. Balanced development of economic systems: essence and principles of provision. Vestnik of Voronezh State Agrarian University. 2018; 4(59):141-147. DOI: 10.17238/issn2071-2243.2018.4.141 (rus.).
3. Popov A.A. Transformation of the housing and utility management system model in the conditions of the fourth industrial revolution. Journal Bulletin of the Altai Academy of Economics and Law. 2021; 11-1:52-65. DOI: 10.17513/vaael.1895 (rus.).
4. Balashov E.B., Vlasov D.N., Geras'kin Yu.M., Gogina E.S., Grabovyy P.G., Kankhva V.S. et al. Housing and communal services and communal infrastructure: organization, technologies, management. Textbook and practical training in 6 parts. 3rd rev. and enlarge. P.G. Grabovyy (ed.). Moscow, ASV Publishing House, Prosvetitel Publ., 2023; 1264. (rus.).
5. Baranov D.N. Strategic directions of digital transformation and potential of application of digital technologies in housing and communal services of the city of Moscow. Bulletin of the Moscow University named after S.Yu. Witte. Series 1. Economics and Management. 2019; 3(30):102-107. DOI: 10.21777/2587-554X-2019-3-102-107 (rus.).
6. Demenko O.G., Tikhomirov A.O. Digital transformation of housing and communal household in Russia. Vestnik Universiteta. 2018; 5:59-63. DOI: 10.26425/1816-4277-2018-5-59-63 (rus.).
7. Anttiroiko A.V., Valkama P., Bailey S.J. Smart cities in the new service economy: building platforms for smart services. AI & Society. 2014; 29(3):323-334. DOI: 10.1007/s00146-013-0464-0
8. Balashov E.B. Management of the process of modernization of communal infrastructure. IOP Conference Series Materials Science and Engineering. 2021; 1079(5):052043. DOI: 10.1088/1757-899X/1079/5/052043
9. Kirillova A.N. Main challenges and directions of strategic development of housing-and-communal complex. Industrial and Civil Construction. 2016; 9:50-56. EDN WWIGVZ. (rus.).
10. Popov R.A., Sekisov A.N., Gura D.A., Nehay B.A. Economic and technological factors of improvement of building and conditioning systems. Revista Turismo Estudos & Práticas. 2020; S3:14. EDN TXQMFP.
11. Bogomolova I.S., Zhertovskaya E.V. Forming a system of evaluation of regional reproduction proportions in terms of their impact on the efficiency of labor. Fundamental Research. 2014; 11-6:1344-1349. EDN SYEGHF (rus.).
12. Zinnurova G.R. Intermunicipal interaction as a priority of territorial development. Bulletin of Eurasian Science. 2018; 6:13-19. EDN YXYTQL.
13. Balashov E.B. Methods of regulatory influence as a tool to ensure the sustainable development of the housing and communal services. Bulletin of the Russian Academy of Sciences. 2023; 2:132-136. DOI: 10.52531/1682-1696-2023-23-2-132-136 EDN TFYPMS.
14. Bell D., Groen D., Ozik J., Mustafee N., Strassburger S. Hybrid simulation development — is it just analytics? 2019 Winter Simulation Conference (WSC). 2019; 1352-1365. DOI: 10.1109/WSC40007.2019.9004923
15. Hartmann A., Reymen I.M.M.J., van Oosterom G. Factors constituting the innovation adoption environment of public clients. Building Research & Information. 2008; 36(5):436-449. DOI: 10.1080/09613210802028386 (rus.).
16. Shulgina O.V. Russia's cities-millionaires: geographical patterns of distribution and factors of development in the 20th–21st centuries. Bulletin of MGPU. Natural Sciences Series. 2018; 1(29):56-71. EDN YSJAHD.

Тренды стратегии развития жилищно-коммунального комплекса

Актуальность обеспечения устойчивого функционирования жилищно-коммунального хозяйства (ЖКХ) ставит задачу исследования его состояния и проблем функционирования с выработкой стратегических подходов к эффективной модели трансформации и ускорения модернизации объектов инженерно-коммунальной инфраструктуры. Показано, что наиболее существенным является влияние на состояние ЖКХ уровня потенциала различных типов городов, взаимоувязанных с деятельностью предприятий и организаций, демографическими формами расселения и средой жизнедеятельности. Доказано, что крупнейшие города-миллионники обладают достаточно высоким потенциалом для дальнейшего развития ЖКХ, в связи с этим актуальной задачей является определение моделей и драйверов их перспективного развития. На основе анализа генезиса развития современной системы ЖКХ выделены достигнутые определенные структурные сдвиги в решении приоритетных задач в сфере ЖКХ по дальнейшей реализации программ переселения граждан из непригодного жилья, региональных программ капитального ремонта общего имущества в многоквартирных домах, реализации целевых муниципальных программ модернизации коммунальных сетей, принятых нормативно-правовых документов, создающих условия для использования механизмов государственно-муниципально-частного партнерства, роста инвестиций и возведения инфраструктурных объектов. Рассмотрены характерные особенности жилищно-

коммунального хозяйства и определен комплекс современных проблем и факторов, негативно влияющих на качество деятельности организаций и предприятий ЖКХ. Выявлены параметры технического состояния жилищно-коммунальной инфраструктуры и надежности функционирования системы ЖКХ регионов и ряда крупнейших городов. Обоснованы ключевые тренды стратегии развития ЖКХ, позволяющие улучшить состояние инфраструктурного потенциала ЖКХ и обеспечить опережающее развитие инфраструктуры комфортных условия проживания и качество жизнедеятельности населения.

Ключевые слова: *потенциал, проблемы, анализ, критичность, несбалансированность, неустойчивость*

СПИСОК ИСТОЧНИКОВ

1. Рахмеева И.И., Чеснюкова Л.К. Методология нравственной и социокультурной экономики // Научные труды вольного экономического общества России. 2024. Т. 245. № 1. С. 165–175. DOI: 10.38197/2072-2060-2024-245-1-165-175
2. Макаревич Л.О., Улезько А.В. Сбалансированное развитие экономических систем: сущность и принципы обеспечения // Воронежский государственный аграрный университет. 2018. № 4 (59). С. 141–147. DOI: 10.17238/issn2071-2243.2018.4.141
3. Попов А.А. Трансформация модели системы управления жилищно-коммунального хозяйства в условиях четвертой промышленной революции // Журнал Вестник Алтайской академии экономики и права. 2021. № 11–1. С. 52–65. DOI: 10.17513/vaael.1895
4. Балашов Е.Б., Власов Д.Н., Гераськин Ю.М., Гогина Е.С., Грабовый П.Г., Канхва В.С. и др. Жилищно-коммунальное хозяйство и коммунальная инфраструктура: организация, технологии, управление : учебник и практикум в 6 ч. 3-е изд. перераб. и доп. / под общ. науч. ред. проф. П.Г. Грабового. М. : Изд-во АСВ, Просветитель, 2023. 1264 с.
5. Баранов Д.Н. Стратегические направления цифровой трансформации и потенциал применения цифровых технологий в жилищно-коммунальном хозяйстве города Москвы // Вестник Московского университета имени С.Ю. Витте. Серия 1. Экономика и управление. 2019. № 3 (30). С. 102–107. DOI: 10.21777/2587-554X-2019-3-102-107
6. Деменко О.Г., Тихомиров А.О. Цифровая трансформация жилищно-коммунального хозяйства в России // Вестник университета. 2018. № 5. С. 59–63. DOI: 10.26425/1816-4277-2018-5-59-63
7. Anttiroiko A.V., Valkama P., Bailey S.J. Smart cities in the new service economy: building platforms for smart services // AI & Society. 2014. Vol. 29. Pp. 323–334. DOI: 10.1007/s00146-013-0464-0
8. Balashov E.B. Management of the process of modernization of communal infrastructure // IOP Conference Series Materials Science and Engineering. 2021. Vol. 1079. Issue 5. P. 052043. DOI: 10.1088/1757-899X/1079/5/052043
9. Кириллова А.Н. Основные вызовы и направления стратегического развития жилищно-коммунального комплекса // Промышленное и гражданское строительство. 2016. № 9. С. 50–56. EDN WWIGVZ.
10. Popov R.A., Sekisov A.N., Gura D.A., Nehay B.A. Economic and technological factors of improvement of building and conditioning systems // Revista Turismo Estudos & Práticas. 2020. Vol. S3. P. 14. EDN TXQMFP.
11. Богомолова И.С., Жертовская Е.В. Формирование системы показателей оценки региональных воспроизводственных пропорций в контексте их влияния на эффективность труда // Фундаментальные исследования. 2014. № 11-6. С. 1344–1349. EDN SYEGHF.
12. Зиннурова Г.Р. Межмуниципальное взаимодействие как приоритет территориального развития // Вестник евразийской науки. 2018. № 6. С. 13–19. EDN YXYTQL.
13. Балашов Е.Б. Методы регулирующего воздействия как инструмент обеспечения устойчивого развития жилищно-коммунального хозяйства // Вестник РАЕН. 2023. № 2. С. 132–136. DOI: 10.52531/1682-1696-2023-23-2-132-136 EDN TFYPMS.
14. Bell D., Groen D., Ozik J., Mustafee N., Strassburger S. Hybrid simulation development — is it just analytics? // 2019 Winter Simulation Conference (WSC). 2019. Pp. 1352–1365. DOI: 10.1109/WSC40007.2019.9004923
15. Hartmann A., Reymen I.M.M.J., van Oosterom G. Factors constituting the innovation adoption environment of public clients // Building Research & Information. 2008. Vol. 36. Issue 5. Pp. 436–449. DOI: 10.1080/09613210802028386
16. Шульгина О.В. Города-миллионеры России: географические закономерности распространения и факторы развития в XX–XXI вв. // Вестник Московского городского педагогического университета. Серия: Естественные науки. 2018. № 1 (29). С. 56–71. EDN YSJAHD.

Об авторе: **Балашов Евгений Борисович** — кандидат юридических наук, профессор кафедры урбанистики; **Московский политехнический университет (Московский Политех)**; 107023, г. Москва, ул. Большая Семеновская, д. 38; руководитель; **Московский аналитический центр в сфере городского хозяйства (МАЦ)**; 119019, г. Москва, Филипповский пер., д. 13/1; balashov.evgenii@gmail.com.

For citation: Balashov E.B. Regional trends in the development of the housing and municipal complex. *Real Estate: Economics, Management*. 2024; 3:37-45.

Для цитирования: *Балашов Е.Б.* Regional trends in the development of the housing and municipal complex // Недвижимость: экономика, управление. 2024. № 3. С. 37–45.

UDC 332.8

Manukhina L.A.
Gorskii S.V.

Strategic directions and development prospects of the individual housing construction market in Russia

The relevance of the issues discussed in this paper is due to the significant growth in demand for individual residential houses, which necessitates the creation of attractive and favourable conditions for all market participants. Major construction companies are actively developing the segment of individual housing construction (IHC), while small enterprises, due to the relatively low entry threshold, are rapidly entering this market. However, the lack of clear rules and regulatory mechanisms complicates long-term planning and the implementation of IHC projects. This paper examines the key aspects and prospects for the development of the individual housing construction market in Russia. Special attention is given to the legislative framework, particularly the draft federal law No. 471420–8 "Construction of Residential Houses under Construction Contracts Using Escrow Accounts", which aims to create a legal foundation for the development of the IHC market, as well as GOST R 71392–2024 "Green" Standards. "Green" Individual Housing Construction. Methodology of Assessment and Criteria for Design, Construction, and Operation".

Keywords: *individual housing construction (IHC), escrow accounts, planning, government regulation, green standards, environmental sustainability and energy efficiency*



Manukhina Lyubov Andreevna,
Candidate of Economics Sciences, Associate Professor of 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: 7435-9741, Scopus: 57194450337, ORCID: 0000-0003-4300-7002; ManuhinaLA@mgsu.ru



Gorskii Sergey Vladimirovich,
Graduate student of 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; sergei@gorskii.com

At the current stage of development of the construction sector in Russia, the market for individual housing construction (IHC) is gaining increasing importance. With the growing demand from citizens, large developers are actively exploring this segment. Due to the relatively low entry threshold (compared to the construction of apartment buildings), small companies both new and those not yet established in the market rapidly appear.

Among the key issues facing the IHC market at the current stage of development are the following: first, how to create a transparent and predictable IHC market that meets the requirements of all market participants (including the state, business, and consumers); and second, how to develop an effective financial model for the sustainable development of the sector, which will allow for medium and long-term planning[1]. Solving these issues has not only practical but also scientific significance, as it contributes to the formation of theoretical foundations for the further development and optimization of mechanisms for regulating and financing the IHC market[2]. While the second issue, concerning the development of a financial model, is natural for market economy conditions and will likely find its solution in the course of natural development, the first issue requires active participation and regulation by the state.

By "transparency and predictability" of the IHC market, it is primarily understood as the ability to forecast the volumes of individual housing construction and analyze the market growth potential. This includes forecasting the number of square meters built annually and assessing how much ready housing can be constructed in the future (for a planning period of 5–10 years or more).

For example, by the end of 2023, the volume of private house construction exceeded the volume of apartment construction by 13 %. However, despite this growth, the supply still does not fully meet the demand in the market[3]. According to analysts from M2 agency, the potential demand is 14 million houses, while only 440 thousand houses are built annually. This significant gap between supply and demand underscores the need to develop and implement strategies aimed at stimulating construction and meeting the population's needs.

The leading regions in the commissioning of individual housing construction projects in 2023 continue to hold their positions in 2024. Last year, growth in individual house construction was recorded in the North Caucasus, Siberian, Ural, Southern, and Far Eastern federal districts. A slight decline in construction rates was observed in the Central, North-Western, and Volga federal districts. Nevertheless, these regions remain leaders in terms of square meters commissioned. Specifically, the Central Federal District accounted for over 28 % of all areas commissioned in Russia in 2023[4].

Analysts' forecasts indicate that in 2024, the territorial dynamics of private house commissioning will contribute to increased demand for country houses, which will be facilitated by the development of local tourism and increased interest in living outside large cities.

Meanwhile, the share of IHC in the mortgage portfolio is increasing due to outstripping growth

1 Official website of the Federation of Individual Housing Construction. URL: https://federationigs.ru/ (Accessed: 21 July 2024).

2 Housing in Russia. 2022 : statistical collection, Rosstat. Moscow, 2023; 83. URL: torage/mediabank/Jil_hoz_2022.pdf

3 Official website of the Ministry of Construction, Housing, and Utilities of the Russian Federation. URL: http://www.minstroyrf.ru/ (Accessed: 14 April 2024).

4 Unified Information System in Construction. Housing input in 2023. URL: https://наш.дом.рф//аналитика/ввод_жилья

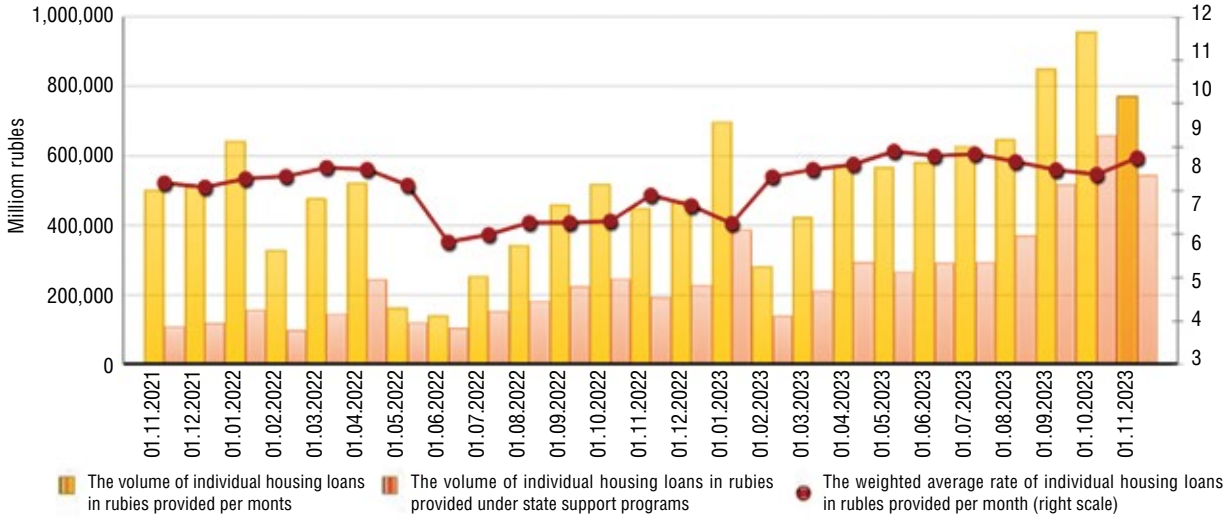


Fig. 1. Overview of the mortgage housing lending market 2022–2024

rates of lending in this segment. According to the Bank of Russia, in 2023, the total mortgage portfolio grew by 53 % in terms of the number of loans and 62 % in terms of the amount of funds issued, while the IHC segment grew 2 and 2.3 times, respectively, over the same period (Fig. 1).

The median age of a borrower in the IHC segment is 38 years (Fig. 2). As a rule, suburban real estate is purchased by families with an income level not lower than average. At the same time, the population's solvency improved in 2023 (according to Rosstat, the growth of real disposable monetary incomes of the country's population was 5.4 %).

According to analytical data from DOM.RF, more than 16 % of the total volume of mortgage financing was directed to the purchase and construction of IHC facilities in 2023 (5 percentage points more compared to 2022). The average transaction cost in Moscow and the Moscow region increased by 8 % in the new building segment, 12 % in the secondary market, and 18 % in the IHC segment (data for 2023). The analysis of current trends and statistical data in the real estate market indicates high investment attractiveness and development prospects of the individual construction market[5].

The most important aspect of state regulation of the individual housing construction market is adherence to the principle of "do no harm to business while maximally protecting the consumer". This involves implementing a soft control system whose main task is preventive control to prevent unfinished construction and the erection of low-quality houses that do not meet current standards and regulations (SNiP, CP, etc.). The scientific significance of this approach lies in the development and improvement of regulatory mechanisms capable of ensuring a balance between stimulating economic activity in the construction sector and protecting the interests of end consumers.

From a business perspective, the clarity and predictability of the IHC market can be expressed by the phrase: "Explain the rules to us, and we will find ways to develop". Large companies capable of investing significant funds cannot do so due to the lack of clear

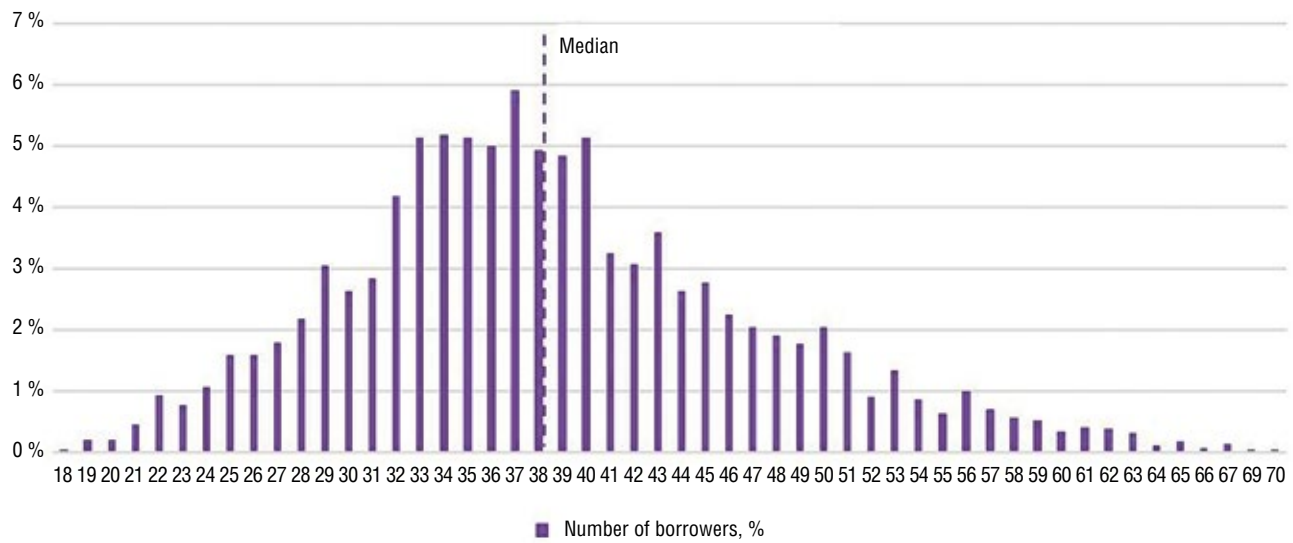


Fig. 2. Median age of a borrower in the IHC segment

5 Unified Resource of Developers. URL: https://erzrf.ru/news/

and transparent rules. Consequently, the sooner these rules are established, the faster the market will grow and develop.

One of the most promising tools for solving these problems is the use of escrow accounts in the construction of individual houses. Currently, the use of escrow accounts is being implemented in a pilot mode, relying on the experience of multi-apartment housing construction [1]. This mechanism ensures transaction security and guarantees that houses will be completed and meet standards.

Currently, the draft federal law No. 471420–8 "Construction of residential houses under construction contracts using escrow accounts" is actively being discussed and has been adopted in the first reading[6]. This law has a framework character and provides market participants with the opportunity to adapt to new rules. However, for successful implementation, additional measures are needed, such as including the concept of "IHC project documentation" along with "house kits" and "standard project documentation" for the transition period. This will avoid legal uncertainty and simplify the law's application. Conducting a large-scale information campaign aimed at explaining the processes and benefits of introducing escrow accounts is necessary to increase potential consumers' awareness of the security and reliability of this mechanism. Informing citizens about the benefits of using escrow accounts strengthens confidence in the individual housing construction market, which in turn stimulates demand and investment in this sector [2]. Additionally, conducting information campaigns helps reduce risks associated with misunderstandings and underestimation of the importance of escrow accounts, which is essential for preventing possible negative consequences in the implementation of construction projects. The analysis and evaluation of the effectiveness of such companies provide valuable information for further research in the field of marketing communications and project management in the construction industry [3]. Ultimately, successful information support is an integral element of a comprehensive approach to the development of the IHC market, integrating scientific achievements and practical solutions for the sector's sustainable growth.

Another significant step in the development of the individual housing construction market in Russia was the approval of the green standard for the construction of private houses — GOST R 71392–2024[7]. This standard, introduced on August 1, 2024, is developed considering international systems like LEED and BREEAM, as well as the green GOAST R 70346–2022[8] for apartment buildings and the comprehensive territorial development standard "DOM.RF"[9].

The new GOST R[7] for IHC provides developers with an assessment methodology and criteria for designing, constructing, and operating environmentally sustainable private houses. The standard aims to improve the energy efficiency and sustainability of the buildings, enhance living quality, and reduce the negative impact on the environment [4]. The application of this standard by developers is already possible, which will accelerate the introduction of environmentally sustainable practices in individual house construction. The "green" standard includes eight assessment categories covering various aspects of environmental sustainability and comfort, namely:

- architecture;
- environmental safety and site organization;
- infrastructure;
- construction organization and management;
- comfort and quality of the indoor environment;
- energy efficiency and atmosphere;
- building engineering support;
- material quality and resource efficiency;
- waste production and consumption.

Depending on the number of criteria met, an IHC project will receive one of three ratings: "gold", "silver", or "bronze". A project can score a maximum of 90 points. To achieve the highest "gold" rating, at least 63 points are required; "silver" is awarded for 54 points, and "bronze" for meeting the basic criteria. A key criterion for meeting the minimum "bronze" rating is the ability for year-round living in an individual house, requiring connection to water supply, sewage, gas supply, and electrical networks.

The introduction of the "green" standard GOST R 71392–2024[7], focused on environmental sustainability and energy efficiency, opens new opportunities for improving construction quality and living conditions. This standard, developed based on best international practices, contributes not only to reducing the negative impact on the environment but also to increasing consumer confidence in the IHC market.

Additionally, DOM.RF[9] has proactively developed a methodology for determining the energy efficiency class of IHC objects. This methodology considers the thermal energy consumption for heating, heat supply, ventilation, hot water supply, and the electrical energy consumption of household appliances, and also promotes the determination of necessary measures to improve the energy efficiency of a residential house. The system can also account for renewable energy generation in the building's energy balance (if available).

The development and approval of the green standard GOST R 71392–2024[7] are crucial for the development of the IHC market in Russia. Firstly, it promotes a higher level of environmental responsibility among developers and encourages the use of innovative technologies and materials. Secondly, the standardization of green construction increases consumer confidence in new housing, boosting demand for environmentally sustainable houses. Finally, it improves the quality of life for residents, reducing utility costs and providing healthier living conditions.

It is worth noting separately that the application of the green standard for individual housing construction (IHC) is intended to improve the quality of construction and living in suburban areas, as well as to reduce energy resource costs [5]. Russian Deputy Prime Minister Marat Khusnullin noted: "The application of the new national standard in the construction of individual residential houses will enhance the quality and comfort of living in private houses, reduce energy costs, and decrease the need for new generating capacities, which will positively impact the environment". Additionally, the implementation of this standard will give a new impetus to the development of transport and social infrastructure in suburban areas.

Currently, green construction in the Russian Federation is at the initial stage of its development. For example, in countries such as the USA, green projects occupy about 20 % of the market, and in Europe, this figure is approximately 15 %, while in Russia, green construction accounts for no more than 2 %. This creates a promising field for further development towards the greening of

6 List of instructions following the meeting with members of the Government. URL: http://www.kremlin.ru/acts/assignments/orders/56012 (Accessed: 20 July 2024).

7 GOST R 71392–2024. "Green" standards. "Green" individual housing construction. Methodology for assessment and criteria for design, construction, and operation.

8 GOAST R 70346–2022. "Green" standard. "Green" residential building. Assessment method and criteria for design, construction and maintenance.

9 The comprehensive territorial development standard "DOM.RF". URL: tandards/printsipy-kompleksnogo-razvitiya-territoriy/

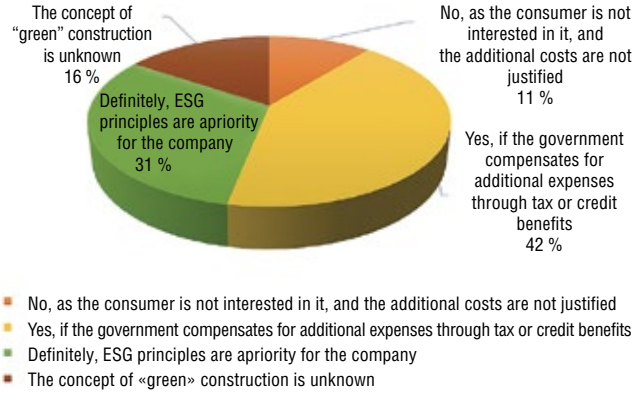


Fig. 3. Survey results on developer willingness to apply Green building standards in Russia

construction [6]. One of the main constraining factors for increasing the volume of green construction (including industrial construction) is the high cost of certification. Often, developers in Russia consider the costs of certification to be unjustified. Moreover, high-tech, environmentally friendly building materials that meet green standards significantly increase the investment cost of a project [7].

According to a sociological survey of developers, most respondents (42.2 %) expressed their willingness to implement the principles of green construction provided that the state compensates for additional costs through tax incentives or preferential credit terms. Another 31.3 % of survey participants noted that they would definitely implement environmentally sustainable practices and ESG principles, while 26.5 % of developers reported their unpreparedness to transition to green construction (Fig. 3).

At DOM.RF[9], it is believed that meeting the requirements of the green GOST for mass development will not lead to a significant increase in project costs, as confirmed by pilot projects [8]. Although green standard construction has not yet become widespread, such houses will significantly differ from many existing standards, offering improved environmental and energy characteristics [9]. Therefore, stimulating green construction and implementing the green GOST is a relevant issue for the development of the IHC market in Russia.

A comprehensive approach, including legislative and financial initiatives, as well as the adoption of green standards, will ensure the stable and sustainable development of the individual housing construction market in Russia.

REFERENCES

1. Berezkina V.S., Shelkovich M.T. Effectiveness of legislation in the field of equity participation in construction using the escrow account. Legal Almanac. 2021; 3(7):20-26. EDN RUGYQY. (rus.).
2. Kuschev I.E., Putilova S.M. The effectiveness of using the escrow account in construction on the example of the federal districts of the Russian Federation. Construction Economics. 2024; 2:110-115. EDN FQPNGH. (rus.).
3. Beliakov 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. EDN GXBWMC.
4. Manukhina L.A., Cherepanova T.D. Analysis of this direction of development of "green" construction in Russia. Economics and Entrepreneurship. 2023; 11(160):170-174. DOI: 10.34925/EIP.2023.160.11.030 EDN PDCJMG. (rus.).
5. Prykina L.V., Manukhina L.A. Ecological and systemic interconnections of the development of urbanized territories and transport networks. Economics and Entrepreneurship. 2022; 1(138):497-501. DOI: 10.34925/EIP.2022.138.1.097 EDN HCNZNU. (rus.).
6. Artamonova Y.S., Baronin S.A., Benuzh A.A., Budanov I.V., Volgin V.V., Volkov R.V. et al. Sustainable development of territories based on ecologically-oriented life cycles of construction. Penza, Penza State University of Architecture and Construction, 2022; 588. EDN LRMLXQ. (rus.).
7. Telichenko V.I., Benuzh A.A., Morozov D.N. Creating a national system of "green" standards in the Russian Federation. Construction Materials, Equipment, Technologies of the XXI Century. 2019; 3-4(242-243):10-11. EDN IYDTGW. (rus.).
8. Baronin S.A., Artyushin A.I., Ilyin A.Y. Characteristics of sustainable construction and eco-development based on foreign experience of green standards. Housing Strategies. 2024; 11(2):155-172. DOI: 10.18334/zhs.11.2.120941 EDN ADZHSM. (rus.).
9. Manukhina L.A., Yakubov H.G. Analysis of current trends in the greening of urbanized territories. Real Estate: Economics, Management. 2023; 1:11-15. EDN MMKHBW.

Стратегические направления и перспективы развития рынка индивидуального жилищного строительства в России

Актуальность рассмотренной в статье проблематики обусловлена значительным ростом спроса на индивидуальные жилые дома, что требует создания привлекательных и выгодных условий для всех участников рынка. Крупные строительные компании активно осваивают сегмент индивидуального жилищного строительства (ИЖС), а малые предприятия, благодаря относительно низкому порогу вхождения, стремительно выходят на этот рынок. Однако отсутствие четких правил и регуляторных механизмов затрудняет долгосрочное планирование и реализацию проектов ИЖС. В рамках данной статьи рассмотрены ключевые аспекты и перспективы развития рынка индивидуального жилищного строительства в России. Особое внимание уделено изучению законодательной базы, в частности проекту Федерального закона № 471420–8 «О строительстве жилых домов по договорам строительного подряда с использованием счетов эскроу», который призван создать правовую основу для развития рынка ИЖС, а также ГОСТ Р 71392–2024 «Зеленые» стандарты. «Зеленое» индивидуальное жилищное строительство. Методика оценки и критерии проектирования, строительства и эксплуатации».

Ключевые слова: *индивидуальное жилищное строительство (ИЖС), эскроу счета, планирование, государственное регулирование, зеленые стандарты, экологическая устойчивость и энергоэффективность*

СПИСОК ИСТОЧНИКОВ

1. Березкина В.С., Шелкович М.Т. Эффективность законодательства в сфере долевого участия в строительстве с использованием счета эскроу // Правовой альманах. 2021. № 3 (7). С. 20–26. EDN RUGYQY.
2. Кущев И.Е., Путилова С.М. Эффективность использования счета эскроу при строительстве на примере федеральных округов Российской Федерации // Экономика строительства. 2024. № 2. С. 110–115. EDN FQPNGH.
3. 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. EDN GXBWMC.
4. Манухина Л.А., Черепанова Т.Д. Анализ существующих тенденций развития «зеленого» строительства в России //

Экономика и предпринимательство. 2023. № 11 (160). С. 170–174. DOI: 10.34925/EIP.2023.160.11.030 EDN PDCJMG.
5. Прыкина Л.В., Манухина Л.А. Эколого-системные взаимосвязи развития урбанизированных территорий и транспортных сетей // Экономика и предпринимательство. 2022. № 1 (138). С. 497–501. DOI: 10.34925/EIP.2022.138.1.097 EDN HCNZNU.
6. Артамонова Ю.С., Баронин С.А., Бенуж А.А., Буданов И.В., Волгин В.В., Волков Р.В. и др. Устойчивое развитие территорий на основе эколого-ориентированных жизненных циклов строительства. Пенза : Пензенский государственный университет архитектуры и строительства, 2022. 588 с. EDN LRMLXQ.
7. Теличенко В.И., Бенуж А.А., Морозов Д.Н. Создание национальной системы «зеленых» стандартов в РФ // Строительные материалы, оборудование, технологии XXI века. 2019. № 3–4(242-243). С. 10–11. EDN IYDTGW.
8. Баронин С.А., Артюшин А.И., Ильин А.Ю. Особенности устойчивого строительства и экодевелопмента на основе зарубежного опыта зеленых стандартов // Жилищные стратегии. 2024. Т. 11. № 2. С. 155–172. DOI: 10.18334/zhs.11.2.120941 EDN ADZHSM.
9. Манухина Л.А., Якубов Х.Г. Analysis of current trends in the greening of urbanized territories // Недвижимость: экономика, управление. 2023. № 1. С. 11–15. EDN MMKHBW.

Об авторах: **Манухина Любовь Андреевна** — 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; РИНЦ ID: 676588, Scopus: 57194450337, ORCID: 0000-0003-4300-7002; ManuhinaLA@mgsu.ru;

Горский Сергей Владимирович — аспирант кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; sergei@gorskii.com.

For citation: Manukhina L.A., Gorskii S.V. Strategic directions and development prospects of the individual housing construction market in Russia. *Real Estate: Economics, Management*. 2024; 3:46-50.

Для цитирования: *Манухина Л.А., Горский С.В*. Strategic directions and development prospects of the individual housing construction market in Russia // Недвижимость: экономика, управление. 2024. № 3. С. 46–50.



Л.И. Павлова. Москва. МХТ им. Чехова. Рисунок, тушь, перо.

UDC 338.49

Aibazov M.M.

Sustainable development of urban areas

Sustainable development of cities and rural settlements is one of the main tasks of urban planning and design, which is relevant not only in Russia. The paper raises the issues of ensuring sustainable development of urban areas, as well as the main problems standing in the way of achieving its goals, which is one of the most urgent topics of modern technogenic society. The criteria necessary for a comprehensive objective assessment of the sustainability of urban areas development are defined. Based on the analysis of numerous studies of the theory of sustainable urban development, five main regularities are highlighted. The analysis has shown that in relation to urbanistic concepts, the consideration of the regularities of urban development of city territories reduces the competitiveness and investment attractiveness of the urban environment. In this regard, the regularities of urban space development have dual and economic nature, on the one-hand taking into account the peculiarities and diversity, economic activity of urban economic systems on the other hand, the tendencies of equalization and convergence of sustainable development of urban areas. The study explains the essence of the regularities of the socio-economic and technological system of the city. The main regularities of urban development as a basis for the formation of a new managerial functionality of sustainable development of urban territories are highlighted. Studying the conditions and principles of ensuring sustainable urban development, the author came to the conclusion that a systemic solution to emerging and multiplying problems of urban development cannot be provided without the priority of the city as a self-developing system over its components, and the synthesis of the main directions of urbanistics: technological, social and aesthetic. The logical consequence of ensuring systemic unity will be the expansion of the subject area of urbanism and the development of urban planning concepts, which are based on the goals of restructuring the real estate of urban spaces.

Keywords: *sustainable development of territories, principles of sustainable development, urban planning, the territory of urban settlements, urban spaces*



Aibazov
Magomed Mustafayevich,
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;
doptaganka@yandex.ru

INTRODUCTION

Sustainable development of cities and rural settlements is one of the main tasks of urban planning and design, which is relevant not only in Russia. Currently, several scientific concepts underlying its solution are widespread: the concept of sustainable development, biosphere concept or technogenic concept.

Currently, more than half of humanity lives in cities. There are conditions for economic growth, development of creative thought and activity, creation of knowledge-intensive technologies, improvement of industrial production, satisfaction of socialization needs are created, therefore, most of the population of various countries, including Russia, is concentrated in cities. Creating a comfortable and safe environment for human life in the implementation of urban planning activities is defined by the Urban Planning Code of the Russian Federation as the main task, the realization of which should be carried out on the basis of the principle of ensuring sustainable development of territories[1].

In the Urban Planning Code of the Russian Federation "sustainable development of territories" is characterized as ensuring safety and favourable conditions for human life in the implementation of urban planning activities, limiting the negative impact of economic and other activities on the environment and ensuring the protection and rational use of natural resources in the interests of present and future generations[2, 3]. I.e. sustainable development is positioned as an activity aimed at creating favourable conditions for life and activity.

In today's world, increased attention has been paid to the issues of sustainable development of urban areas. This is especially true for developing countries, which are entering the era of mass urbanization. The process of sustainable development can provide a significant increase in productivity and living standards; however, it can generate environmental and other risks that can largely negate the achieved positive results [1–3]. Sustainable development implies economic growth, development of civilization, modern technologies and the quality of human life in general should take place in harmony with the natural environment and prevent the depletion of its resources. However, at the current level of socio-economic development it is not possible to achieve this [4–6].

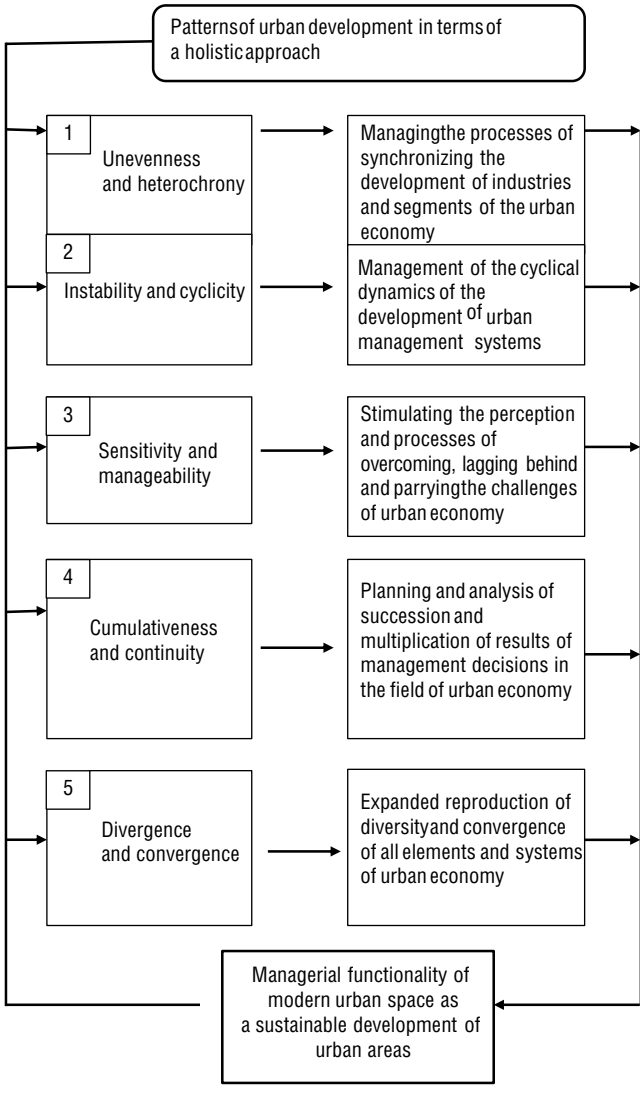
MAIN PART

One of the most sustainable development trends of the second millennium of the planet is the movement of population to cities. People's desire to improve their living conditions has led to the rapid development of urban spaces [7].

1 Town-planning Code of the Russian Federation, official site "Consultant Plus". URL: http://www.consultant.ru/popular/gskrf/15_1.html#p45

2 Territories of advanced socio-economic development in the Russian Federation : Federal Law of December 29, 2014 No. 473-FZ.

3 Industrial Policy in the Russian Federation : Federal Law of December 31, 2014 No. 488-FZ.



Patterns of urban development as the basis for the formation of a new managerial functional for the sustainable development of urban areas (developed by the author)

At present, as a result of numerous studies of the theory of sustainable urban development, there are five synthesized basic patterns presented in Figure.

The analysis of scientific works has shown that in relation to urbanistic concepts, the consideration of the regularities of urban development of urban areas of the city, in general, reduces the competitiveness and investment attractiveness of the urban environment. In this regard, the regularities of development of urban spaces have dual and economic nature, on the one hand, taking into account the peculiarities and diversity, economic activity of urban economic systems on the other hand, the tendencies of equalization and convergence of sustainable development of urban areas[4] [8, 9].

Following the objectives of the study, let us explain the essence of some regularities of the socio-economic and technological system of the city, which includes:

- the *uneven development of the urban environment*, which emerged as a result of the historical past of the city, currently leads to the emergence of development contradictions that particularly affect the competitiveness of urban space;
- *cyclicality of* urban systems development is inherently connected with its instability. For the city it is expressed in transformations of system parameters of urban environment in periods of sharp qualitative changes. Management of transformations forms a tendency to sustainability;
- *cumulativeness and continuity* affect the multiplication of results of management decisions in the sphere of urban economy;
- the *divergence and convergence of* urban development is manifested in an increase in the diversity of lifestyles, and hence in the diversity of urban economic systems and types of urban real estate.

The selectivity of the consumer segment of the urban environment, as shown by the analysis, is currently concerned:

- the current state of the utility infrastructure;
- housing quality and affordability;
- development of street and road network and business environment of the territories;
- the share of green urban areas;
- the level of development of public and business infrastructure;
- availability of necessary social and leisure infrastructure;
- qualities of citywide spaces, etc.

At the same time, as it was emphasized in the Shanghai Declaration [8], the stratification of urban population becomes a factor of social instability, volatility and falling competitiveness of urban environment, and equality of opportunities — an additional argument of investment activity of business and residential environment.

RESULT AND DISCUSSION

Based on the identified regularities of the practical implementation of the holistic approach, let us formulate the main intrinsic properties of urban areas of the established city, bearing in mind that it is, first of all, the community of people living within the specified territorial boundaries and contributing to the revitalization of living spaces. Let us combine the properties into a Table and decompose them by levels of research.

The properties listed in Table together determine the "way of being of the city" as a whole and its territories, acting in the complex as a unity of productive forces concentrated in the city and formed production economic relations.

As follows from the analysis of scientific literature [4–7, 9], long economic cycles of development characterize the evolution of ways of being a city as the basis for the formation of the theoretical basis for ensuring sustainable urban development with inherent:

- urban environment;
- population structure;
- real estate structure;
- the structure of production and service capacities;
- social and housing and communal infrastructure, etc.

In fact, the integral urban space is heterogeneous. The levels of development of individual urban areas are different, and this applies not only to architectural appearance and environmental characteristics. The social profile of urban areas and even neighborhoods varies significantly. Consequently, *there is a demand for management*

4 Gagarina E.S. Sustainable development of urbanized territories : textbook-methodology. Construction. Novgorod, NNGASU, 2022; 36. URL: https://bibl.nngasu.ru/electronicresources/uch-metod/landscape_arch/876459.pdf

Interpretation of properties of territories of the historically developed city by levels of epistemological analysis (compiled by the author)

Properties	Statistical level	Programme level	Problem level
Embeddedness of the city TC functioning processes in the spatial vectors of development and national goals	Key performance indicators (KPI) of the established city (TC) territories	Distribution of KPI by programmes and projects	Synchronization of KPI of different levels of urban economy
Integral existence of material and immaterial, subjective and objective, animate and inanimate, objective and subjective	Balance models of the city TC development	Characterization of strategic initiatives software	Structuring of accumulated imbalances
Constellation of phenomena, processes, elements of the city, spatial synchronization and relative stability of spatial configuration	System of indicators of sustainable growth KPI of the city TC	Indicators of programme interoperability of the city TC	Identification of depressive zones of urban development
Self-sufficiency and balance (resource, spatial, subjective) of preservation and cyclic development of ascending type	Dynamics of indicators of sustainable growth of KPI of TC of the city	Dynamic characteristics of development software	Fixing dynamics of turbulence zone parameters
Self-optimization and self-regulation as conscious, as well as the reverse as spontaneous movement of resource flows towards the optimum	Development outcomes dependent on the urban areas' own capacities	Development indicators included in projects of district significance	Deviations from the set strategic priorities
Concentration and complexification of urban environment elements	Results of the creation of microcomplexes on the city's TC	Indicators of implementation of integrated education programmes	Parameters of sedimentation from complexation
Manageability as the ability to achieve goals	Indicators of economic reliability of the control object	System of resource characteristics of the control system	Indicators of development resource scarcity

functionality to mitigate inequality, equalize the level of comfort of districts and territories of the city. For conceptual identification it is important to take into account as much as possible all the variety of internal structural differences. Moreover, they are not just diverse, but can be represented in the form of some foreseeable order. In this case, *the notion of diversity should be supplemented by the notion of structured diversity.* Consequently, any urban "spatial fragment" can be studied:

- by a complex of assessments: level of convenience, level of housing availability, quality of services, feelings of safety, ease of breathing, aesthetics, quality of resources, beauty, etc., i.e. from the position of sensory perception;
- assessing the value of urban assets localized within a spatial format, i.e. in terms of an integrated dimension;
- structure/"profile" of residents by age, employment, living conditions, availability of benefits;
- the speed of educational, career, housing and business elevators, etc.

Moreover, a modern understanding of urban sustainability is not possible without realizing the potential of information and communication technologies and aligning the interests of all actors, namely:

- international organizations;
- governments;
- municipalities;
- public associations;
- business communities;
- scientific associations and organizations;
- populations, etc.

Modern cities generally consolidate the interests of residents, businesses and authorities. At the same time, the system-forming factor of the city is obviously the population as a subject, implying the focus of innovations on its vital activity and future development. It is obvious that the city is a systemic, complexly organized object, the initial element of which is the population. Providing its vital activity, namely housing, jobs, educational, sports and entertainment facilities, transportation, energy and other real estate objects becomes the most important target of urban environment development [7, 8, 10, 11].

It is important to note that the goals of the authorities for sustainable urban development cannot be isolated from the external environment. The exchange of substance, information, energy, innovations, ideas, cultural values is becoming more and more important every year as a factor determining the strategic goals of sustainable urban development.

From the author's point of view, it is the four main projections that define urban vitality as a reflection of modern views on the system-forming conceptual apparatus that characterizes urban development[4] [10, 12].

Summarizing the implementation of best practices, let us highlight a number of features of maintaining the vitality of the city. Their systematization allows us to highlight the need to ensure:

- openness. Despite the fact that the city is a relatively independent complexly organized economic entity, it is necessary to ensure its openness, which means the possibility of resource flows into and out of the city. It is the resource turnover that ensures dynamic growth of key indicators of urban development. Resources fill the development projects of the transportation system, housing and communal infrastructure, green and public spaces, cultural and recreational complexes, education system, etc., meeting the growing needs of present and future generations;
- hierarchy. Being a complex heterogeneous system, ensuring the manageability of urban economy requires the formation of subordinate levels of management, i.e. hierarchy, provided that they are mutually consistent with the general target orientation. In this case, the interaction of the city with the region and the national economy, both in the economic and cultural context, is of paramount importance. Functional hierarchy is

also inherent in the main subsystems of urban economy (energy, transportation, etc.);

- emergent. The diversity of interactions between subsystems of the urban environment, forming a single whole — urban space, creates the potential of emergent nature as the excess of the whole over the sum of its parts. For example, the value of the assets of the urban development area, supplemented by the natural component, forms a market value that exceeds the value of buildings and structures. It is in all cases higher than the simple sum of its parts, and if we take into account the intellectual potential or the value of human capital as a whole, the city assets will significantly exceed the simple sum of parts;
- predictability, as a prospective determination of urban processes, including the continuous growth of population, fixed assets, intellectual potential, etc., in the city.

Achieving the target areas of sustainable urban development implies the organization of continuous monitoring in order to timely adjust urban plans, as well as the timely identification of tasks as events that initiate change occur [12, 13].

The highlighted properties of the city as a system also allow us to generalize the previous studies of socio-economic projections of urban planning. Among them it is proposed to emphasize:

- the relationship between society (man) and nature;
- relationship between society (human) and cultural heritage and development;
- financial and economic condition of the city territory;
- the relationship between society (human beings) and industry;
- demographic development of the city territory;
- geopolitical and migration condition of the city territory;
- infrastructural condition of the city territory aimed at human development in all spheres, its health saving and safety.

Thus, the close relationship between urban planning and socio-economic development of the city has a dual nature of interaction, defined by historical periods, which are essentially discrete projections of each other. It is proved that urban planning activity affects the social and economic life of the country in the long term.

CONCLUSION

Summarizing the study of the evolution of theoretical views on ensuring sustainable urban development, we state that the *city is a chaotic system of joint life activity of all urban subjects in space, subjected to controlling influences of a developing type*. In this context, the *city becomes a control (power) centre, which regulates processes and ensures the evolution of the city's way of being*. At the same time, diffuse processes change the way of being of the city, opening new opportunities for development and creating smart, sustainably developing urban spaces. In this context, the author's interpretation of the decomposition of the concept of "sustainable urban development", the target orientation of which is determined by the creation of an image of investment-attractive object as a basis for competitiveness of attracting development resources to meet the growing needs of production and consumer segments of the urban economy. At the same time, it is important to take into account the territorial section, bearing in mind that even strategic decisions should be made taking into account the *local phenomena of the territories of the established city*.

Thus, in the study as a theoretical basis for ensuring sustainable spatial-territorial urban is understood as a cyclically formed, innovative type of development, which is based on the use of information and communication, environmental, socio-economic and production technologies that improve the quality of life and the level of accessibility of housing of different classes and increase the efficiency of urban works and services, providing investment attractiveness and competitiveness, underlying the satisfaction of the increasing needs of present and future generations in natural, climatic, economic, housing, social, and cultural benefits.

REFERENCES

1. Surveying: organization, expertise, management : textbook for Universities in three parts. 2nd edition, revised and supplemented. Vol. Part III. Management module in the servicing system. Ed. by Prof. P.G. Grabovyy. Moscow, Publ. "Illuminator", ASV Publishing House, 2021; 520 (rus.).
2. Grabovyy P.G. Genesis and evolution of a multi-profile territorial cluster. The main directions of development of land and property complex of urban agglomerations. By ed P.G. Grabovyy, M.A. Lunyakov, A.B. Mottaeva. Moscow, ASV Publishing House, 2020; 240. (rus.).
3. Surveying: organization, expertise, management : textbook in three parts. By ed. A. Laur, S.A. Baronin, S.I. Belyakov et al. 2nd edition, revised and supplemented. Moscow, ASV Publishing House, 2021; 520. (rus.).
4. Boykov A.I., Mottaeva A.B. New paradigm of regional economy development. Economics and Entrepreneurship. 2014; 11-2(52): 174-178. EDN SZXFZX. (rus.).
5. Shlafman A.I., Mottaeva A.B. Interindustry and interregional innovations in the Russian economy. Internet journal Naukovedenie. 2013; 6(19):114. URL: https://naukovedenie.ru/PDF/98EVN613.pdf (rus.).
6. Lukinov V.A., Mottaeva A.B. Conceptual bases of convergence of conditions for the development of regions in the national economy. Internet journal Naukovedenie. 2014; 2(21):54. EDN SJFLQP. URL: https://naukovedenie.ru/PDF/115EVN214.pdf (rus.).
7. Vagin V.S., Sheina S.G., Chubarova K.V. Principles and factors of sustainable development of urban areas. Internet journal Naukovedenie. 2015; 7(3). URL: http://naukovedenie.ru/PDF/91EVN315.pdf; http://dx.doi.org/10.15862/91EVN315 (rus.).
8. Xinta Liu, Chernikova L.P. Historical review of Sino-Russian cooperation within the framework of the Shanghai Five (SCO): a view from China. Achievements and difficulties. Bulletin of Tomsk State University. History. 2022; 80:114-124. DOI: 10.17223/19988613/80/13 (rus.).
9. Mottaeva A.B., Shalunova V.A. Shalunova, Shuvaev D.A. Organization of investment design of housing and utilities facilities, A.B. Mottaeva. Economics and Entrepreneurship. 2022; 10(147): 740-743. DOI: 10.34925/EIP.2022.147.10.142. EDN TETLVX (rus.).
10. Sustainable urban development : a collective monograph, ed. by K.V. Papenov, S.M. Nikonorov, K.S. Sitkina. Moscow, Faculty of Economics of Lomonosov Moscow State University, 2019. 288. (rus.).
11. Grabovyy P.G. Organization of construction and real estate development. Part II: Real Estate Development. 4th ed., revision and supplement. Moscow, Publishing House ASV, IIA "Illuminator", 2018; 608. (rus.).
12. Grabovyy P.G., Lapidus A.A. Construction Management. Part two. Integrated development and development of the construction area. Moscow, ASV Publishing House. 2022; 620.
13. Mottaeva A.B., Al Malul R.M. Digital design as a trend of construction industry rejuvenation. Financial Markets and Banks. 2024; 5:44-49.

Особенности устойчивого развития городских территорий

Устойчивое развитие городов и сельских поселений — одна из главных задач градостроительного планирования и проектирования, которая актуальна не только в России. В статье поднимаются вопросы обеспечения устойчивого развития городских территорий, а также основные проблемы, стоящие на пути достижения его целей, что является одной из наиболее актуальных тем современного техногенного об-

щества. Определены критерии, необходимые для комплексной объективной оценки устойчивости развития городских территорий. На основе анализа многочисленных исследований теории устойчивого городского развития выделены пять основных закономерностей. Проведенный анализ показал, что применительно к урбанистическим представлениям, учет закономерностей городского развития территорий города снижает конкурентоспособность и инвестиционную привлекательность городской среды. В этой связи закономерности развития городских пространств имеют дуальную и экономическую природу, с одной стороны, учитываются особенности и разнообразие, экономической деятельности систем городского хозяйства, с другой, тенденции выравнивания и конвергенции устойчивого развития городских территорий. В исследовании дано пояснение сущности закономерностей социально-экономической и технологической системы города. Выделены основные закономерности городского развития как основы формирования нового управленческого функционала устойчивого развития городских территорий. Исследуя условия и принципы обеспечения устойчивого развития городов, автор пришел к выводу, что системное решение возникающих и множащихся проблем городского развития не может быть обеспечена без приоритета города как саморазвивающейся системы над его составляющими, и синтеза основных направлений урбанистики: технологического, социального и эстетического. Логическим следствием обеспечения системного единства станет расширение предметной области урбанистики и развитие градостроительных концепций, в основе которых цели реструктуризации недвижимости городских пространств.

Ключевые слова: *устойчивое развитие территорий, принципы устойчивого развития, градостроительство, территории городских поселений, городские пространства.*

СПИСОК ИСТОЧНИКОВ

1. Сервейинг: организация, экспертиза, управление : учеб. для вузов в 3-х частях. 2-е изд., перераб. и доп. Том. Часть III. Управленческий модуль в системе сервейинга / под общ. ред. проф. П.Г. Грабового. М. : Изд-во «Просветитель», Изд-во АСВ, 2021. 520 с.
2. Грабовый П.Г. Генезис и эволюция многопрофильного территориального кластера. Основные направления развития земельно-имущественного комплекса городских агломераций / П.Г. Грабовый, М.А. Луняков, А.Б. Моттаева. М. : Изд-во АСВ, 2020. 240 с.
3. Сервейинг: организация, экспертиза, управление : учеб. в трех частях / А. Лаур, С.А. Баронин, С.И. Беляков и др. 2-е изд., перераб. и доп. М. : Изд-во АСВ, 2021. 520 с.
4. Бойков А.И., Моттаева А.Б. Новая парадигма развития региональной экономики // Экономика и предпринимательство. 2014. № 11-2(52). С. 174–178. EDN SZXFZX.
5. Шлафман А.И., Моттаева А.Б. Межотраслевые и межрегиональные инновации в экономике России // Интернет-журнал «Науковедение». 2013. № 6 (19). С. 114. URL: https://naukovedenie.ru/PDF/98EVN613.pdf
6. Лукинов В.А., Моттаева А.Б. Концептуальные основы сближения условий развития регионов в национальной экономике // Интернет-журнал «Науковедение». 2014. № 2 (21). С. 54. EDN SJFLQP. URL: https://naukovedenie.ru/PDF/115EVN214.pdf
7. Вагин В.С., Шеина С.Г., Чубарова К.В. Принципы и факторы устойчивого развития городских территорий // Интернет-журнал «Науковедение». 2015. Т. 7. № 3. URL: http://naukovedenie.ru/PDF/91EVN315.pdf;http://dx.doi.org/10.15862/91EVN315
8. Лю Синта, Черникова Л.П. Исторический обзор китайско-российского сотрудничества в рамках «Шанхайской пятерки» (ШОС): взгляд из Китая. Достижения и трудности // Вестник Томского государственного университета. История. 2022. № 80. С. 114–124. DOI: 10.17223/19988613/80/13
9. Моттаева А.Б., Шалунова В.А., Шуваев Д.А. Организация инвестиционного проектирования объектов ЖКХ // Экономика и предпринимательство. 2022. № 10 (147). С. 740–743. DOI: 10.34925/EIP.2022.147.10.142. EDN TETLVX.
10. Устойчивое развитие городов : коллективная монография / под ред. К.В. Папенова, С.М. Никонорова, К.С. Ситкиной. М. : Экономический факультет МГУ им. М.В. Ломоносова, 2019. 288 с.
11. Грабовый П.Г. Организация строительства и девелопмент недвижимости. Часть II: Девелопмент недвижимости. 4-е изд., перераб. и доп. М. : Издательский дом АСВ, ИИА «Просветитель», 2018. 608 с.
12. Грабовый П.Г., Лапидус А.А. Управление строительством. Часть 2-я. Комплексное освоение и развитие территории застройки. М. : Изд-во АСВ, 2022. 620 с.
13. Моттаева А.Б., Аль Малюль Р.М. Цифровой дизайн как тренд омоложения строительной отрасли // Финансовые рынки и банки. 2024. № 5. С. 44–49.

Об авторе: **Айбазов Магомед Мустафаевич** — аспирант кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; doptaganka@yandex.ru.

For citation: Aibazov M.M. Sustainable development of urban areas. *Real Estate: Economics, Management*. 2024; 3:51-55.

Для цитирования: *Айбазов М.М.* Sustainable development of urban areas // Недвижимость: экономика, управление. 2024. № 3. С. 51–55.

UDC 69.05: 658.

Grabovyy P.G.
Korolev N.I.

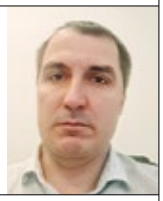
Main features of construction of real estate facilities in the formation of the system of relations of the participants in their construction

The paper deals with the issues of identification, assessment and accounting of the main features of the construction of real estate objects and the activities of construction enterprises. The main trends and approaches that need to be used and implemented at the present time in the construction of multi-storey real estate in the housing market have been identified. In particular, an assessment is given of such indicators as the total area of units under construction, the number of facilities under construction, the average area of real estate under construction in Moscow, etc. The research methods are theoretical analysis and empirical research, in particular the analysis of statistical data, as well as the description and grouping of data. The information base for the analysis of this problem was the literature sources on the activities of construction organizations, scientific papers, monographs, electronic resources, legal sources. Scientific methods such as description and classification served as the methodological basis for the implementation of the paper. For the effective operation of enterprises in the housing market, it is necessary to create a set of legislative, legal and economic standards, conduct various activities on organizational and technological processes that most fully take into account the interests of each participant in the process and allow them to form an effective system of their relationships based on the transition to technological and organizational innovations.

Keywords: *construction features, multi-storey real estate objects, types of specializations, new technologies and forms of organization of construction production, participants in the construction of construction facilities*



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 RISC: 302471, Scopus: 57164862700, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@mgsu.ru



Korolev Nikolay Igorevich,
General manager, OOO BARS-M; Moscow, Volokolamskoe shosse, 71/22, pom. 59; ORCID: 0009-0007-4165-2098; SPIN-код: 5309-3075; nikorolev@bk.ru

PROBLEM STATEMENT AND RESEARCH

The current stage of development of the construction industry is associated with significant changes that have occurred recently. This is, first of all, the transfer of the most labour-intensive construction and installation works from the construction site, which is associated with the need to perform them under the influence of environmental factors (climate, relief, seasonality, ecology, risks, uncertainty of the development of production processes, etc.) to the factory conditions of the construction industry enterprises. In turn, this transition is associated with the need to take into account the nature of the formation and development of various markets in the industry (housing, production of building materials, agriculture, transport, etc.) [1–3]. In addition, it requires increasing the degree of mobility and sustainability of the functioning and development of all types of production processes based on the use of modern technologies and rational forms of material production in the functioning and development of enterprises of the investment and construction complex, taking into account their specialization of types of risks. These features require their assessment and consideration when constructing multi-storey real estate objects and forming a system of relationships between all participants in their construction in the housing market in Moscow and other regions of Russia[1] [3–5]. In this regard, it can be concluded that in modern conditions of development of construction production, there are objectively a number of features associated with the functioning of the housing market ("territorial", "sectoral"), as well as with the construction of multi-storey housing facilities ("subject", "technological"). They, as a rule, determine the external environment of enterprises (participants in the process of building a real estate object). That is why the importance of their assessment and accounting is a prerequisite for the development of new approaches in the field of technology use and flow forms of organization of material production.

RESULTS

The analysis of the main indicators of the development of the construction industry in the housing market in Moscow showed the presence of positive dynamics in the commissioning of real estate, the main type of housing of which is multi-storey real estate, as well as the presence of some problems in this market. Many indicators in recent years have tended to fluctuate sharply over the years. These include entering the total area of units under construction, the number of facilities under construction, and others. The dynamics of changes in the commissioning of residential buildings by organizations in Moscow can be presented in the form of Table and Fig. 1.

The analysis of this dynamics shows that the change in the number of commissioning of residential buildings by organizations of various forms of ownership and the population in Moscow during the analyzed period was uneven. In the course of scientific and practical research, it was revealed that the main developers are: PIK Group, Samolet Group,

1 Construction : Federal State Statistics Service. URL: https://rosstat.gov.ru/folder/14458 (date of access: 01/21/2022).

Commissioning of residential buildings by organizations of various forms of ownership and the population in Moscow

Commissioning of residential buildings		2020		2021		2022	
		Thousand square metres of total area	Specific weight in the total volume of input, %	Thousand square metres of total area	Specific weight in the total volume of input, %	Thousand square metres of total area	Specific weight in the total volume of input, %
1	In total, residential buildings have been put into operation	4979.4	100	7807.3	100	6797.3	100
including by form of ownership:							
2	State	490.4	9.8	1564.8	20	974.2	14.3
in it:							
2.1	Federal	–	–	219.7	2.8	16.5	0.2
2.2	Property of the subjects of the Russian Federation	490.4	9.8	1345.1	17.2	957.7	14.1
3	Private	3752.7	75.4	4742	60.8	4712.1	69.3
4	Mixed Russian	68	1.4	–	–	–	–
5	Joint Russian and foreign ownership	79.3	1.6	477.5	6.1	274.6	4
6	Foreign	85	1.7	298.6	3.8	43.8	0.7
7	Citizens' property	504	10.1	724.4	9.3	792.6	11.7

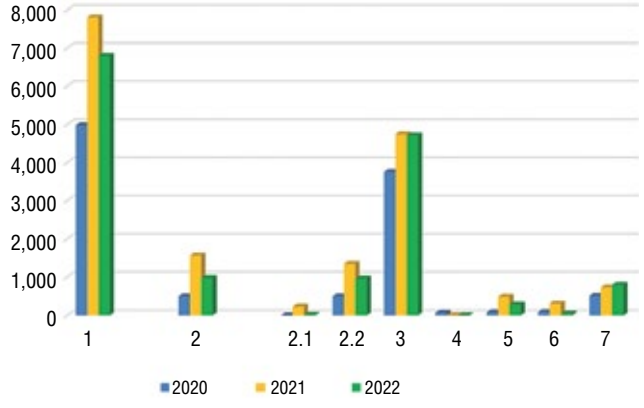


Fig. 1. Dynamics of commissioning of residential buildings by organizations of various forms of ownership and the population in Moscow

LSR Group and Setl Group Holding, which annually build up more than 10 % of the total area in the Russian Federation, mainly in the territories of the Moscow and Leningrad regions. Moreover, almost the entire TOP15 builders, which annually accounts for more than 20 % of the volume of work, are concentrated in Moscow and St. Petersburg [6–8]. At the same time, the dynamics of commissioning of residential buildings in Moscow by year shows (Fig. 2) that there is stability in the development of enterprises of the Moscow construction complex, as well as a tendency for the cost to rise per one sq. m of constructed facilities. These factors indicate the presence of problems in the housing market [9–11].

In addition, many developers are not ready for these changes in construction in recent years, do not apply enough efforts to develop a high-quality long-term system of relationships between all

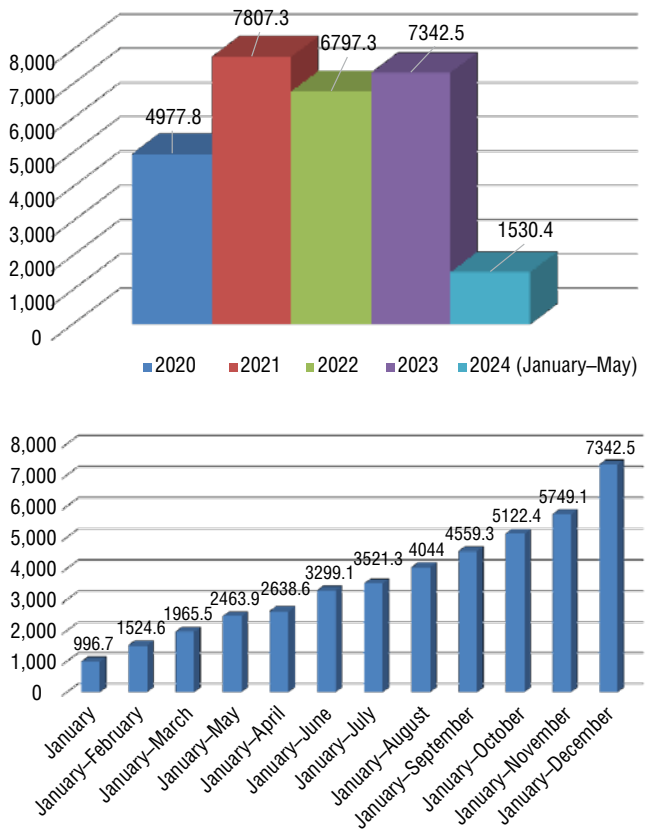


Fig. 2. Commissioning of residential buildings for 2023 in Moscow, thousand square metres of the total area of residential premises by year and month

participants by forming it under the influence of various types of risk, uncertainty factors in production processes [12–14].

CONCLUSION

Based on the results of the analysis, trends were identified that allowed us to draw the following main conclusions:

1. The main problems of the functioning and development of construction production in the construction and operation of multi-storey real estate objects are identified, namely: the presence of a number of features and the presence of new approaches that need to be taken into account when introducing technologies and flow-through forms of organization of material production in the main, auxiliary and servicing production processes.

2. The number of developers working in the housing market in Moscow and other regions of the country is constantly changing and tends to decrease, as well as their withdrawal from the construction sector of enterprises demonstrating insufficient stability in the medium and long term.

3. An analysis of the functioning and development of housing markets in the construction of multi-storey real estate objects has shown the insufficiency of the existing system of mutual relations between participants in the process of their construction in conditions of risk across the regions of the country.

4. It is established that the process of forming a system of relationships between participants in the construction of multi-storey real estate in construction is influenced by the peculiarities of their construction, a large number of factors of the external and internal environment, which must be identified and taken into account in further research on the basis of creating the necessary organizational and technological reserves when introducing flow forms of material production in the activity construction organizations, taking into account their depth of specialization in risk conditions.

REFERENCES

1. Runeson G. Research methods: a practical guide for students and researchers. Construction Economics and Building. 2018; 18(1):83-84. DOI: 10.5130/AJCEB.v18i1.5979

2. Chatterjee U., Biswas A., Mukherjee J., Majumdar S. Advances in urbanism, smart cities and sustainability. Taylor & Francis Group, CRC Press, 2022; 520. DOI: 10.1201/9781003126195

3. Grebenshchikov V.S., Grabovyy P.G., Belyakov S.I. Risks in the investment and construction sector : monograph. Moscow, Moscow State University of Civil Engineering, EBS DIA, 2017; 160. (rus.).

4. Hayward D. Housing construction industry, competition and regulation. International Encyclopedia of Housing and Home. 2012; 395-403. DOI: 10.1016/B978-0-08-047163-1.00229-0

5. Hellmuth R. Update approaches and methods for digital building models — literature review. Journal of Information Technology in Construction. 2022; 27:191-222. DOI: 10.36680/j.itcon.2022.010

6. Sarhan S., Pretlove S. Lean and sustainable construction: state of the art and future directions. Construction Economics and Building. 2021; 21(3). DOI: 10.5130/ajceb.v21i3.7854

7. Opoku A., Akotia J. Special issue: urban regeneration for sustainable development. Construction Economics and Building. 2020; 20(2). DOI: 10.5130/ajceb.v20i2.7191

8. Khrustalev B.B., Moiseeva A.A. The main features of the scientific organization of construction of low-rise residential real estate. Real Estate: Economics, Management. 2018; 3:74-80. EDN YMBLHN (rus.).

9. Korolev N.I., Khrustalev B.B., Kargin A.A., Kagdipa A.A., Zakharov S.V. Facility life cycle management during operation with application of an information model. E3S Web of Conferences. 2024; 535. DOI: 10.1051/e3sconf/202453502017

10. Korolev N.I. The influence of the enterprise risk management system on the formation of relationships between participants in the investment process of construction. Actual Problems of Science and Practice in Various Sectors of the National Economy : collection of reports of the VII National Scientific and Practical Conference. Section 5, Technical sciences. Penza, PGUAS, 2024; 29-33. (rus.).

11. Grabovyy P.G., Yankovsky A.V. Evaluation of factors influencing the choice of developer strategy in urban spatial-territorial redevelopment projects. Real Estate: Economics, Management. 2024; 1:14-20. URL: https://n-eu.iasv.ru/index.php/neu/article/view/173/286

12. Khrustalev B.B., Valchuk E.V. Theoretical aspects of finance of construction organizations. Real Estate: Economics, Management. 2019; 2:20-23. URL: https://n-eu.iasv.ru/index.php/neu/article/view/173/286 (rus.).

13. Grabovyy P. Digitalization of the world economy — A factor in the development of society. E3S Web of Conferences. 2019; 135:04058. DOI: 10.1051/e3sconf/201913504058 EDN DZHSGC.

14. Korolev N.I. Basic principles and formation stages of the system of relations between participants of the investment process under risk conditions. Real Estate: Economics, Management. 2024; 1:31-35. URL: https://n-eu.iasv.ru/index.php/neu/article/view/176/289

Основные особенности строительства объектов недвижимости при формировании системы взаимоотношений участников их возведения

В статье рассматриваются вопросы выявления, оценки и учета основных особенностей возведения объектов недвижимости и деятельности строительных предприятий. Выявлены основные тенденции и подходы, которые необходимо использовать и реализовывать в настоящее время при возведении многоэтажных объектов недвижимости на рынке жилья. В частности, дана оценка таким показателям, как совокупная площадь строящихся единиц, количество возводимых объектов, средняя площадь строящихся объектов недвижимости в г. Москве и другим. Методами исследования являются теоретический анализ и эмпирическое исследование, в частности анализ статистических данных, а также описание и группировка данных. Информационной базой для анализа данной проблемы стали литературные источники по вопросам деятельности строительных организаций, научные статьи, монографии, электронные ресурсы, источники правового характера. Методологической основой при выполнении статьи послужили такие научные методы, как описание, классификация. Для эффективной работы предприятий на рынке жилья необходимо создание комплекса законодательных, правовых и экономических нормативов, проведение различных мероприятий на организационно-технологических процессах, которые наиболее полно учитывают интересы каждого участника процесса и позволяют формировать эффективную систему их взаимоотношений на основе перехода к технологическим и организационным новшествам.

Ключевые слова: *особенности строительства, многоэтажные объекты недвижимости, виды специализаций, новые технологии и формы организации строительного производства, участники возведения объектов строительства*

СПИСОК ИСТОЧНИКОВ

1. Runeson G. Research methods: A practical guide for students and researchers // Construction Economics and Building. 2018. Vol. 18. No. 1. Pp. 83–84. DOI: 10.5130/AJCEB.v18i1.5979

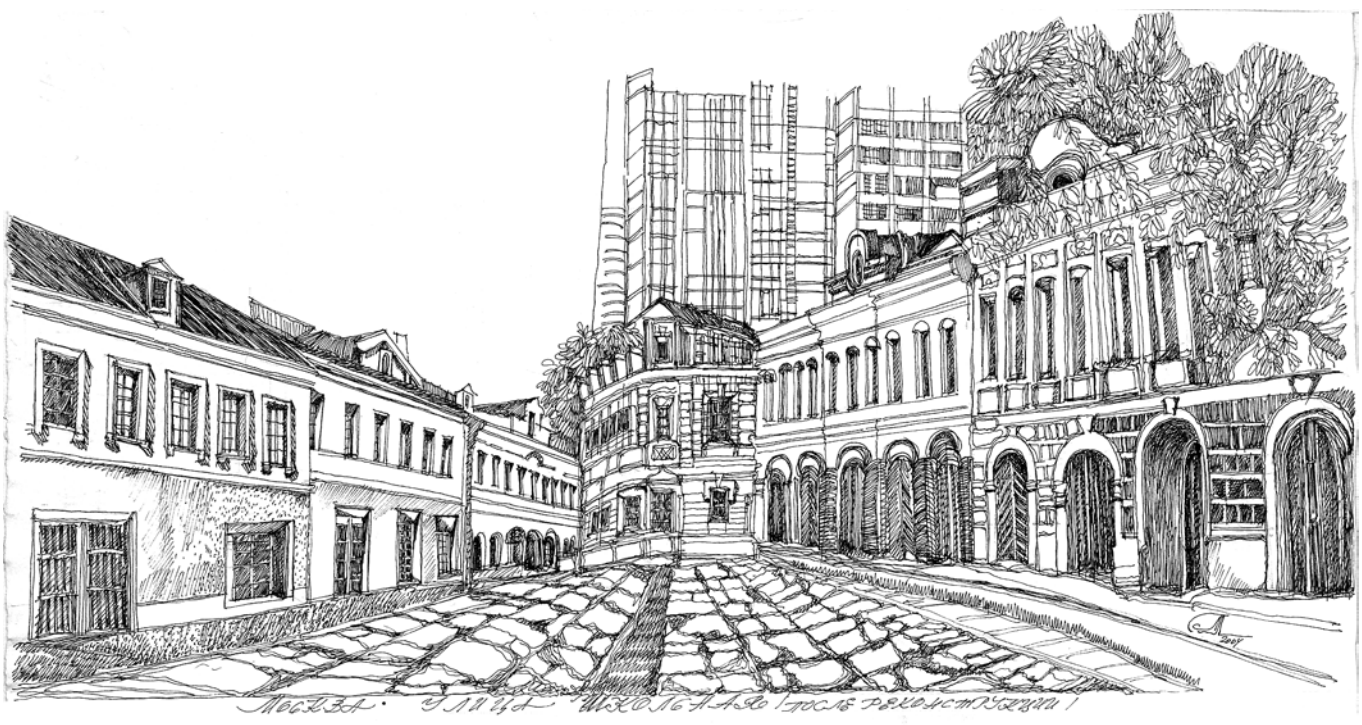
2. Chatterjee U., Biswas A., Mukherjee J., Majumdar S. Advances in urbanism, smart cities and sustainability. Taylor & Francis Group, CRC Press, 2022. 520 p. DOI: 10.1201/9781003126195
3. Гребенщиков В.С., Грабовый П.Г., Беляков С.И. Риски в инвестиционно-строительной сфере : монография. М. : Изд-во Московский государственный строительный университет, ЭБС АСВ, 2017. 160 с. URL: https://erzrf.ru/issledovaniya (дата обращения: 17.01.2022).
4. Hayward D. Housing construction industry competition and regulation // International Encyclopedia of Housing and Home. 2012. Pp. 395–403. DOI: 10.1016/B978-0-08-047163-1.00229-0
5. Hellmuth R. Update approaches and methods for digital building models — literature review // Journal of Information Technology in Construction. 2022. Vol. 27. Pp. 191–222. DOI: 10.36680/j.itcon.2022.010
6. Sarhan S., Pretlove S. Lean and sustainable construction: state of the art and future directions // Construction Economics and Building. 2021. Vol. 21. No. 3. DOI: 10.5130/ajceb.v21i3.7854
7. Opoku A., Akotia J. Special issue: urban regeneration for sustainable development // Construction Economics and Building. 2020. Vol. 20. No. 2. DOI: 10.5130/ajceb.v20i2.7191
8. Хрусталев Б.Б., Моисеева А.А. Основные особенности научной организации строительства малоэтажных объектов жилой недвижимости // Недвижимость: Экономика, управление. 2018. № 3. С. 74–80. EDN YMBLHN
9. Korolev N.I., Khrustalev B.B., Kargin A.A., Kargina A.A., Zakharov S.V. Facility life cycle management during operation with application of an information model // E3S Web of Conferences. 2024. Vol. 535. DOI: 10.1051/e3sconf/202453502017
10. Королев Н.И. Влияние системы риск-менеджмента предприятий на формирование взаимоотношений между участниками инвестиционного процесса строительства // Актуальные проблемы науки и практики в различных отраслях народного хозяйства : сб. докладов VII Национальной научно-практической конференции. Секция 5, технические науки. Пенза, ПГУАС, 2024. С. 29–33.
11. Грабовый П.Г., Янковский А.В. Evaluation of factors influencing the choice of developer strategy in urban spatial-territorial redevelopment projects // Недвижимость: экономика, управление. 2024. № 1. С. 14–20. URL: https://n-eu.iasv.ru/index.php/neu/article/view/173/286
12. Хрусталев Б.Б., Вальчук Е.В. Теоретические аспекты финансов строительных организаций // Недвижимость: экономика, управление. 2019. № 2. С. 20–23. URL: https://n-eu.iasv.ru/index.php/neu/article/view/173/286
13. Grabovyy P. Digitalization of the world economy — A factor in the development of society // E3S Web of Conferences. 2019. Vol. 135. P. 04058. DOI: 10.1051/e3sconf/201913504058. EDN DZHSGC.
14. Королев Н.И. Basic principles and formation stages of the system of relations between participants of the investment process under risk conditions // Недвижимость: экономика, управление. 2024. № 1. С. 31–35. URL: https://n-eu.iasv.ru/index.php/neu/article/view/176/289

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, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@gic.mgsu.ru;

Королев Николай Игоревич — генеральный директор, ООО «БАРС-М», Москва, Волоколамское шоссе, д.71/22, пом. 59; ORCID: 0009-0007-4165-2098; SPIN code: 5309-3075; nikorolev@bk.ru.

For citation: Grabovyy P.G., Korolev N.I. Main features of construction of real estate facilities in the formation of the system of relations of the participants in their construction. *Real Estate: Economics, Management*. 2024; 3:56-59.

Для цитирования: *Грабовый П.Г., Королев Н.И.* Main features of construction of real estate facilities in the formation of the system of relations of the participants in their construction // Недвижимость: экономика, управление. 2024. № 3. С. 56–59.



Л.И. Павлова. Москва. Школьная улица. Рисунок, тушь, перо.

UDC 004.045

Zvonov I.A.

Conditions and prospects for the application of Educational and Technological tasks at the pre–project stages



Zvonov Ilya Alexandrovich,
Director of the scientific and Educational centre "Digital Construction and Operation", senior lecturer of the Department "Organization of Construction and Real Estate Management"; 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

At present, the Russian economy faces significant challenges in the field of technological development. Science and technology are acquiring a new role as fundamental elements in solving many national and global problems. It is expected that in the next 10–15 years, the priorities of Russia's scientific and technological development will be those areas that will enable the achievement of new scientific and scientific-technical results, the creation of technologies that form the foundation for the innovative development of the domestic market for products and services, the country's stable position in the external market, and, among other things, ensure the transition to advanced digital, intelligent manufacturing technologies, and high technologies. Consequently, systemic changes in approaches to the scientific and technological development of regions are necessary to achieve technological sovereignty in critical and cross-cutting technologies. This requires the consolidation of efforts by federal government authorities, regional government bodies, the scientific-educational and entrepreneurial community, and civil society institutions to create favourable conditions for the development and application of scientific and technological achievements in the interests of Russia's socio-economic development. And if the key universities and scientific organizations are defined as the drivers of technological development in our country, then, given the demand for a new institutional environment, the concept of modern campuses should more accurately be called the driver of technological development.

Keywords: *educational environment, material and spatial environment, design assignment, normative and technical documents, functional and technological requirements, educational and technological task, functional model of the building*

INTRODUCTION

In the transition from a post-industrial to an information economy, the approach to organizing the educational process is changing. The concept of new education (Education 3.0) involves integrating traditional and digital technologies in the creation of the educational environment and the organization of the educational process. Accordingly, the scientific and technological development of the country must occur in the changed realities [1]. At the same time, the Concept of Technological Development expects the strengthening of the role of key higher education institutions and scientific organizations as drivers of technological development [2].

Today, the Ministry of Education of the Russian Federation sets the following tasks for domestic universities:

- the use of advanced technologies in the educational process: artificial intelligence, VR/AR, blockchain, etc.;
- training personnel for high-tech industries;
- providing conditions for conducting scientific research and development in priority areas of Russia's scientific and technological development, the list of critical technologies of the Russian Federation, and other areas of scientific research and development ensures the implementation of measures within the framework of national projects, federal projects, including initiatives for the socio-economic development of the Russian Federation [3];
- ensuring conditions for the implementation of the target model indicators of educational organizations;
- providing conditions for personnel training in accordance with the goals of the regional socio-economic development strategy and the needs of strategic projects;
- ensuring the possibility of implementing educational programmes with practical training jointly with industry leaders or industrial partners, and network educational programmes;
- ensuring the possibility of creating intellectual property (IP) and high-tech products in accordance with the commitments made by educational organizations and/or scientific organizations — campus residents, based on the planned laboratory and technology park equipment;
- creating conditions and providing opportunities for testing new technologies and creating university startup projects;
- providing comfortable living and learning conditions that exceed regulatory standards, as well as safety throughout the territory;
- ensuring the creation of innovative products, technologies, and patents based on the campus research infrastructure;
- providing the opportunity to create (locate) on-campus structural units of educational organizations in collaboration with external partners.

At the same time, cities, regions, industries, and businesses are forming their demands not only for graduates but also for the educational and research

activities of universities, their infrastructure, and their campuses. In recent years, there has been an increasing demand for the multifunctionality of campuses, ensuring the implementation of practice-oriented and advanced training of personnel, flexible educational trajectories, the possibility of conducting exploratory and applied research, and the development of student startups [4]. Against this backdrop, the infrastructure and campuses of universities need to be organically integrated into the urban environment and regions to ensure mutual integration. Thus, university campuses must provide density and intensity of communication, quality of space (openness to the city, modernity, convenience), flexibility, the ability to reorganize and experiment, diversity of non-academic functions (including for city residents), and an effective economic and management model (management based on business principles, incorporating a business component into the campus strategy) [5].

DESIGN ASSIGNMENT

From the above, it follows that the modern development of higher education and science leads to the development and, accordingly, the complication of the material and spatial environment of university campuses. The concept of the "material and spatial environment" and the disclosure of its parameters was the focus of one of the previous publications [6]. It was established that the mismatch of the material and spatial environment of the university with the modern way of life, the realities of high-tech, knowledge-intensive, and "smart" production reduces students' motivation to choose a scientific trajectory, lowers the prestige of scientific professions, repels high-performing and creative companies in the real sectors of the economy from cooperation, and also hinders the formation of a scientific and technological elite, contributing to the outflow of scientific personnel abroad. In these conditions, universities, as functional clients responsible for creating a modern educational environment and ensuring a range of socio-economic effects and analytical indicators at the national, regional, and institutional levels, face a number of problems [7].

First, the university does not have sufficient information, skills, or understanding of how to prepare or formulate the necessary initial data for preparing a design assignment for a capital construction project in accordance with the Order of Ministry of Construction, Housing and Utilities of the Russian Federation dated April 21, 2022, No. 307/pr. "The approval of the form of the developer's or technical customer's assignment for the design of a capital construction object, the construction, reconstruction, and major repairs of which are carried out with the involvement of funds from the budget system of the Russian Federation" [8].

Second, universities currently do not have the necessary, objective tools for forming requirements for the educational process, research activities, educational environment, and corresponding spatial environment, which would be sufficient for further preparation of the technical assignment.

Third, universities are unable, during the coordination process, to establish the exhaustiveness of the design assignment, the compliance of the prepared design solutions with it, as well as to justify certain individual design conditions that may be necessary given the request for the transformation of the educational environment to meet the needs of advanced development and knowledge-intensive production.

Fourth, universities usually do not have the experience, skills, or effective tools for objectively evaluating the prepared design materials, especially the section "Requirements for the safe operation of the capital construction object" [9].

From the above, it follows that universities, as functional clients, are currently very limited in the tools available to them.

Now let's turn to the main developer of the design specification according to Order No. 307/pr. It turns out that when preparing the design specification for a higher education institution, the technical client also faces a number of difficulties, which ultimately affect the degree to which the campus or even its individual facilities meet the expectations of the functional client or the parameters of the functional model. The technical client lacks the necessary knowledge and understanding of the functional, technological, and operational properties of the created material-spatial environment, as well as the requirements for its flexibility and multifunctionality. The current form of the design specification does not allow for the reflection of which functions the university performs, in what scale and combinations, how they are linked within the space, and what material base is needed to ensure these functions are fulfilled. Moreover, there is not always the possibility or justification for preparing a traditional technological design specification for an educational facility [10]. In most cases, no matter how complex the functional-technological saturation of the campus is, its description and parameters can only be described by item 20, "Requirements for Technological Solutions", in the approved design specification form [8]. However, the technical client must oversee the parametrization when developing the project documentation for the construction or reconstruction of the campus, as well as the creation and maintenance of information models of its facilities.

As a result, in most cases, already established and often outdated approaches to the design of educational institutions are used in the preparation of the design specification. These approaches lack tools for parametric standardization, mechanisms, and rules for determining, forecasting, and describing the properties and parameters of the created modern, multifunctional, efficient, and safe material-spatial environment of campuses.

EDUCATIONAL-TECHNOLOGICAL ASSIGNMENT

In search of solutions to the identified issues, a systematic analysis was conducted, which revealed the existence and successful application of a specialized tool, the "Medical-Technological Specification", within Moscow's healthcare system. The work with this document is defined by the Moscow Government Decree dated July 29, 2021, No. 1148-PP [11]. This decree defines the structure and procedure for the preparation, coordination, and approval of medical-technological specifications for the design of capital construction projects, construction, or reconstruction financed by the Moscow city budget or non-profit organizations. The medical-technological specification is essentially a "doctor's specification" and a system of initial data for the preparation of the architectural-design specification. The document emphasizes the purpose, technical characteristics of the building, technical-economic and special conditions, and this is essentially the first step in developing project documentation [12]. Sometimes the term "Medical-Technological Specification" is replaced with the term "Medical-Technical Specification", which sounds closer to the familiar term "Technical Specification" [13]. Essentially, these are identical documents, but formally, the "Medical-Technological Specification" is closer to the considered functional-technological characteristics of the future healthcare facility. And it is the one that is implemented by an official regulatory act.

Similarly, to address the issues described in the first part of the paper, a pathway for the formation, development, and subsequent application of an "Educational-technological assignment" (ETA) is proposed, which will allow for the variation of functional and

technological requirements in design, depending on the specific needs of the functional customer. The approach to developing the ETA is based on the "implemented function", i.e., the type, scale, characteristics, and parameters of the educational or research processes.

The foundation of the ETA is proposed to be the synthesis of parameters of the material and spatial environment, the implemented educational process, research and production activities, applied educational and research technologies, properties of infrastructure elements, and engineering and technological equipment. The ETA can be oriented towards individual buildings and groups with various functional and technological configurations within new construction, reconstruction, and major repairs. It is evident that the ETA will allow for the alignment of the design assignment and the design solutions themselves with the types of services provided by universities, the products they produce, the educational programmes they implement, the forms of project-based learning they develop, the startups they nurture, and the number of students, professors, faculty, and researchers they attract.

In this paper, the author proposes the following definition of the ETA for the first time: it is a document that contains the initial data for design, including a set of fundamental functional, technological, and operational requirements established by regulatory documents, developed educational and technological conditions, and the target model of the educational organization. In previous publications, it was determined that, from a qualitative point of view, educational and technological conditions represent a system of engineering parameters — metrics of an efficient, safe, and comfortable educational environment [5]. Similar to the "Medical-technological assignment", the ETA is rational for implementation as the basis and part of the design assignment, as well as within the framework of the relevant procedures for the development, approval, and examination of design documentation. To achieve these goals, the ETA should be based on the following principles: enhancing the functional flexibility of the university environment; increasing the organizational and technological sustainability of the university during operation; improving comprehensive safety and resource conservation; ensuring the predictability of the personnel policy of the operational system, and more.

ETA STRUCTURE

Adhering to the position that the ETA is part of the design assignment and complements it, its structure should predominantly focus on issues that are absent or insufficiently covered in the standard assignment. Primarily, these are questions of functional zoning of buildings, floors, and rooms, as well as technological trajectories. It is necessary to reflect the functional model for the future development of the university. Requirements for organizing the flow of students, faculty, and researchers within functional and auxiliary zones. Requirements for functional efficiency, safety, and comfort related to the types of products produced and services rendered. Requirements for automated and high-tech workplaces. Lists of equipment and furniture linked to activities. Requirements for microclimate by room and zone. Restrictions related to the operational parameters of buildings. With the development of the ETA tool, the expansion of its structure is expected.

ETA APPLICATION PROSPECTS

Since the ETA can be considered a tool at the intersection of educational and architectural-construction design tasks, its primary, already evident prospects for application can be divided into two parts.

Solving tasks set by the education system:

- the ETA can take into account the requirements for the space and technical equipment of a university, considering the possibility of using high technologies in the educational process;
- the ETA can outline the types of activities and characteristics that the space and technical equipment of universities should meet (educational and research infrastructure) [3];
- within the framework of the ETA, the need for specific design solutions can be justified;
- the ETA can be applied in cases where a university does not have a clear understanding of the material and spatial base it needs to implement its forms of education;
- the ETA can disclose the functional model of the university in conditions of its further development and interaction with external partners [14];
- with the help of the ETA, functional and parametric planning of the university's activities can be ensured.

Solving tasks set by the architectural-construction design system:

- the ETA contributes to a more accurate and complete filling of points 10, 11.5, 11.6, 13, 19, 20, 21, 24.1, 24.2, 26, 28, 31, 37, 38, 39, 40, 43, 46.1 of the design assignment [8];
- by correlating in the ETA the parameters of the spatial environment and the university's requests for the functionality and zoning of this environment, it becomes possible to justify, during the examination, design solutions that exceed their parameters beyond regulatory and technical requirements;
- the ETA for the technical customer is a tool that allows correlating the requests of the functional customer and the generated design solutions;
- reduction of labour intensity and cost of design, including the preparation of digital information models.

CONCLUSIONS

At first approximation, it can be concluded that the ETA is a necessary modern tool for the functional and technical customer, as it contains and correlates two main components:

- functions necessary for the transformation of the educational environment to meet modern tasks and advanced development [15];
- parameters of the material-spatial environment and technical equipment that are subject to selection and composition within the design tasks.

The application of the ETA is a more universal trajectory since the method of parametric regulation can be taken as a basis, which will ensure greater adaptability and resilience of university campuses and infrastructure.

REFERENCES

1. Mynbayeva A.K. Review of the latest theories of education: pedagogy 2.0, education 3.0 and eutagogy (eutagogy). Bulletin of the Kazakh National University. The Pedagogical Sciences series. 2019; 61(4):4-16. DOI: 10.26577/JES-2019-4-p1 EDN YEDNGL (rus.).
2. The concept of technological development for the period up to 2030 : Approved by the decree of the Government of the Russian Federation dated May 20, 2023 No. 1315-r. URL: http://static.government.ru/media/files/KlJ6A00A1K5 t8Aw93NfRG6P8OlbBp18F.pdf (rus.).
3. The standard of innovative educational environment (campuses). URL: https://прокампус.рф/documents/download?id=36 (rus.).

4. Blinov V.I., Satdykov A.I., Osadcheva S.A., Krasovsky N.A. Advanced vocational training: formation of system forming components. DOI: 10.22394/2078-838X-2020-4-84-93 URL: https://edpolicy.ranepa.ru/core-components (rus.).
5. Zvonov I.A., Kashirina N.V., Molchina N.A. Educational and technological conditions as a factor of university environment development. Real Estate: Economics, Management. 2024; 1:63-66. URL: https://n-eu.iasv.ru/index.php/neu/article/view/183 (rus.).
6. University campuses and the city: cooperation for the sake of competitiveness, August 2021 VEB RF University 20.35 USSR. URL: https://www.csr.ru/upload/iblock/3f0/kbpm276p3tau6knlzdla3d6ozz0fve0e.pdf (rus.).
7. On approval of the list of socio-economic effects and Analytical indicators at the national, regional and Institutional Levels and Methods for calculating socio-economic effects (analytical indicators) for evaluating campuses of the federal project "Creation of a network of modern campuses" : Order No. 1 of the Ministry of Education and Science of the Russian Federation No. 293-Z dated July 26, 2023. URL: https://прокампус.рф/documents/download?id=3 (rus.).
8. Approval of the Assignment Form of the developer or technical customer for the design of a capital construction facility, construction, reconstruction, capital repairs of which are carried out with the involvement of funds from the budget system of the Russian Federation : Order of the Ministry of Construction and Housing and Communal Services of the Russian Federation dated April 21, 2022 No. 307/pr, (with amendments and additions). URL: https://base.garant.ru/404808053/ (rus.).
9. The composition of sections of project documentation and requirements for their content : Decree of the Government of the Russian Federation No. 87 dated February 16, 2008. URL: https://ivo.garant.ru/#/document/12158997/paragraph/32608/doclist/2338/1/0/0/ппрф%2087:1 (rus.).
10. Technological task for the design and construction of the facility. URL: https://dirstroy.dogm.mos.ru/legislation/help-zastroy/Технологическое%20задание.pdf (rus.).
11. The preparation, coordination and approval of technological (medical and technological) tasks for the design of capital construction facilities, the construction and (or) reconstruction of which are carried out at the expense of the budget of the city of Moscow, funds of non-profit organizations, the founder of which is the city of Moscow : Resolution of the Government of Moscow dated July 29, 2021 No. 1148-PP. URL: https://www.garant.ru/products/ipo/prime/doc/402545718/ (rus.).
12. Recommendations for the preparation of technical specifications for the design of medical institutions. URL: http://osnova-pro.ru/stati/rekomendatsii-po-podgotovke-tekhnicheskogo-zadaniya-na-proektirovanie-meditsinskikh-uchrezhdeniy/ (rus.).
13. Medical and technical specifications for the design of an ultraviolet bactericidal installation. URL: https://base.garant.ru/4181458/b89690251be5277812a78962f6302560/ (rus.).
14. Passport of the federal project "Creation of a network of modern campuses". URL: https://прокампус.рф/documents/download?id=29 (rus.).
15. Materials of the University 2035 website. URL: https://www.2035.university/ (rus.).

Условия и перспективы применения образовательно-технологического задания на предпроектных этапах

В настоящий момент перед российской экономикой стоят большие вызовы в области технологического развития. Наука и технологии обретают новую роль как основополагающие элементы решения многих национальных и глобальных проблем. Ожидается, что в ближайшие 10–15 лет приоритетами научно-технологического развития России станут те направления, которые позволят получить новые научные и научно-технические результаты, создать технологии, являющиеся основой инновационного развития внутреннего рынка продуктов и услуг, устойчивого положения страны на внешнем рынке, и обеспечат, в том числе, переход к передовым цифровым, интеллектуальным производственным технологиям и высоким технологиям. Соответственно, становятся необходимы системные изменения подходов к научно-технологическому развитию регионов для достижения технологического суверенитета в области критических и сквозных технологий. А это требует консолидации усилий федеральных органов государственной власти, органов государственной власти субъектов РФ, научно-образовательного и предпринимательского сообщества, институтов гражданского общества по созданию благоприятных условий для развития и применения достижений науки и технологии в интересах социально-экономического развития России. И если драйверами технологического развития нашей страны определяются ключевые вузы и научные организации, то с учетом запроса на новую институциональную среду драйвером технологического развития точнее будет назвать концепцию современных кампусов.

Ключевые слова: *образовательная среда, материально-пространственная среда, задание на проектирование, нормативно-технические документы, функционально-технологические требования, образовательно-технологическое задание, функциональная модель здания*

СПИСОК ИСТОЧНИКОВ

1. Мынбаева А.К. Обзор новейших теорий образования: педагогика 2.0, образование 3.0 и хьютагогика (эвтагогика) // Вестник Казахского национального университета. Серия педагогические науки. 2019. Т. 61. № 4. С. 4–16. DOI: 10.26577/JES-2019-4-p1 EDN YEDNGL.
2. Концепция технологического развития на период до 2030 года : утверждена распоряжением Правительства Российской Федерации от 20.05.2023 № 1315-р. URL: http://static.government.ru/media/files/KlJ6A00A1K5 t8Aw93NfRG6P8OlbBp18F.pdf
3. Стандарт инновационной образовательной среды (кампусов). URL: https://прокампус.рф/documents/download?id=36
4. Блинов В.И., Сатдыков А.И., Осадчева С.А., Красовский Н.А. Опережающая профподготовка: формирование системообразующих компонентов. DOI: 10.22394/2078-838X-2020-4-84-93 URL: https://edpolicy.ranepa.ru/core-components
5. Звонов И.А., Каширина Н.В., Молчина Н.А. Educational and technological conditions as a factor of university environment development // Недвижимость: экономика, управление. 2024. № 1. С. 63–66. URL: https://n-eu.iasv.ru/index.php/neu/article/view/183
6. Университетские кампусы и город: кооперация ради конкурентоспособности, август 2021. ВЭБ РФ Университет 20.35 ЦСР. URL: https://www.csr.ru/upload/iblock/3f0/kbpm276p3tau6knlzdla3d6ozz0fve0e.pdf
7. Об утверждении перечня социально-экономических эффектов и аналитических показателей национального, регионального и институционального уровней и методик расчета социально-экономических эффектов (аналитических показателей) по оценке кампусов федерального проекта «Создание сети современных кампусов» : Распоряжение № 1 Минобрнауки России от 26.07.2023 № 293-З. URL: https://прокампус.рф/documents/download?id=3
8. Об утверждении Формы задания застройщика или технического заказчика на проектирование объекта капитального строительства, строительство, реконструкция, капитальный ремонт которого осуществляются с привлечением средств бюджетной системы Российской Федерации (с изменениями и дополнениями) : Приказ Министерства строительства и жилищно-коммунального хозяйства РФ от 21.04.2022 № 307/пр. URL: https://base.garant.ru/404808053/
9. О составе разделов проектной документации и требованиях к их содержанию : Постановление Правительства РФ от 16.02.2008 № 87. URL: https://ivo.garant.ru/#/document/12158997/paragraph/32608/doclist/2338/1/0/0/ппрф%2087:1
10. Технологическое задание на проектирование и строительство объекта. URL: https://dirstroy.dogm.mos.ru/legislation/help-zastroy/Технологическое%20задание.pdf

11. О подготовке, согласовании и утверждении технологических (медико-технологических) заданий на проектирование объектов капитального строительства, строительство и (или) реконструкция которых осуществляются за счет средств бюджета города Москвы, средств некоммерческих организаций, учредителем которых является город Москва : Постановление Правительства Москвы от 29.07.2021 № 1148-ПП. URL: https://www.garant.ru/products/ipo/prime/doc/402545718/

12. Рекомендации по подготовке технического задания на проектирование медицинских учреждений. URL: http://osnova-pro.ru/stati/rekomendatsii-po-podgotovke-tekhnicheskogo-zadaniya-na-proektirovanie-meditsinskikh-uchrezhdeniy/

13. Медико-техническое задание на проектирование ультрафиолетовой бактерицидной установки. URL: https://base.garant.ru/4181458/b89690251be5277812a78962f6302560/

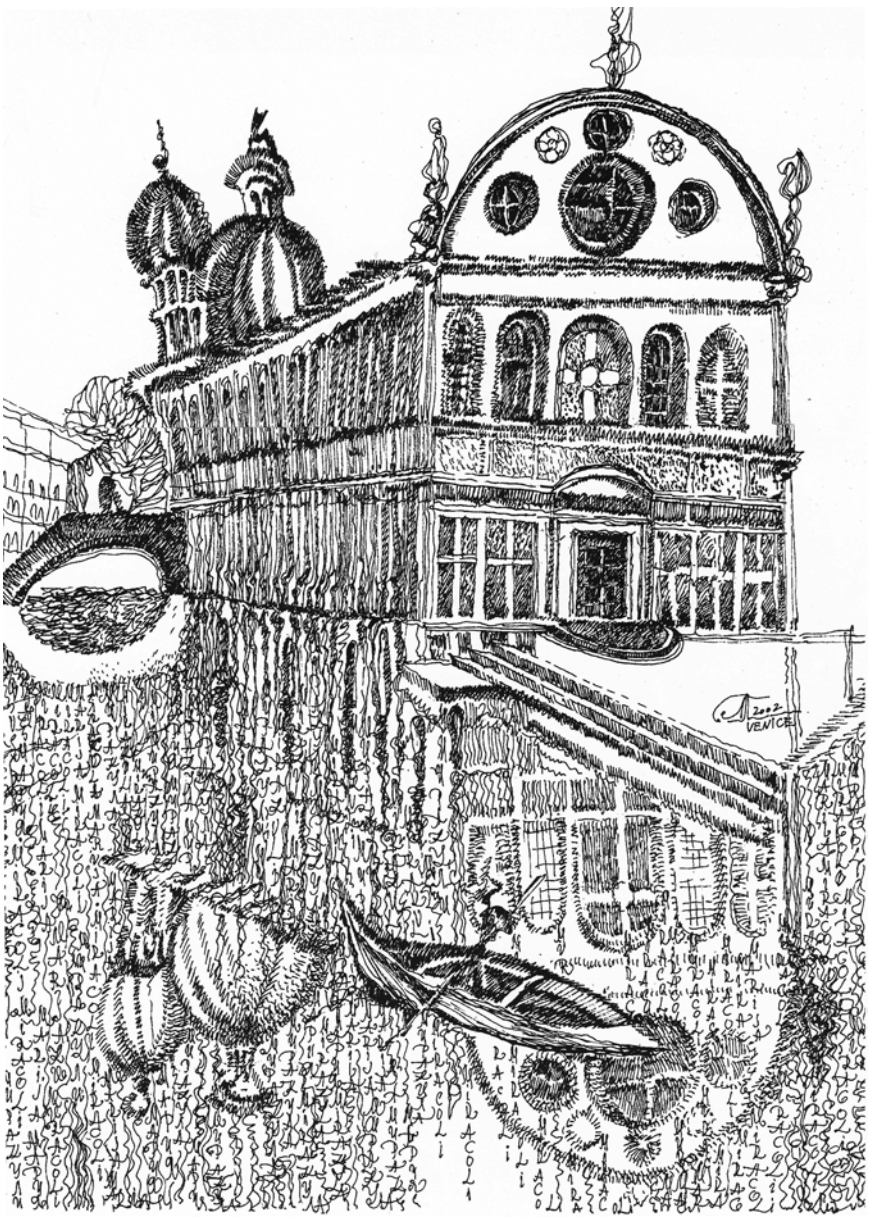
14. Паспорт федерального проекта «Создание сети современных кампусов». URL: https://прокампус.рф/documents/download?id=29

15. Материалы сайта «Университет 2035». URL: https://www.2035.university/

Об авторе: **Звонов Илья Александрович** — директор научно-образовательного центра «Цифровое строительство и эксплуатация», старший преподаватель кафедры организации строительства и управления недвижимостью; **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.

For citation: Zvonov I.A. Conditions and prospects for the application of Educational and Technological tasks at the pre-project stages. *Real Estate: Economics, Management*. 2024; 3:60-64.

Для цитирования: *Звонов И.А.* Conditions and prospects for the application of Educational and Technological tasks at the pre-project stages // Недвижимость: экономика, управление. 2024. № 3. С. 60–64.



Л.И. Павлова. Венеция. Церковь Марии Мираккули. Рисунок, тушь, перо.

UDC 69.05: 658

Grabovyy P.G.
Khrabrov A.P.

Construction of large commercial real estate objects at life cycle stages under risk conditions

The paper deals with the identification of the main features of the construction of commercial real estate objects and the activities of construction enterprises. The main tendencies and approaches to be used in the construction of multifunctional large real estate objects (shopping centres) in the housing market are revealed. The following basic scientific methods were used in the research: “dialectical”, “systemic”, “dynamic”, “variant”, “balance”, “modelling”. The information base for the analysis of the given problem became literary sources on the activity of construction organizations, scientific papers, monographs. Scientific methods such as description and classification served as the methodological basis for the paper. For the effective work of enterprises in the construction of such objects in the housing market it is necessary to create a set of legislative, legal and economic regulations, carrying out various measures on the production, which are aimed at the construction of such complex and large homogeneous objects in the form of regional groups in the regions, which most fully take into account the interests of each participant in the process and allow to influence all production processes in the conditions of flow forms of organization and management of material production at all stages.
Keywords: *peculiarities of construction, commercial real estate objects, types of production process, risks, life cycle, participants of construction of commercial non-residential real estate objects*



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 RISC: 302471, Scopus: 57164862700, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@mgsu.ru



Khrabrov Anton Pavlovich,
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; 5067844@gmail.com

PROBLEM STATEMENT AND RESEARCH

The implementation of national projects “Affordable Housing” in each region of Russia is solved differently, based on their territorial and sectoral specifics of its development. One of the most important reasons for the regionalization of Russia is different prospects for the economic and social development of each of the regions. They are forced to rely on their own basic production resources and their capabilities, which leads to the differentiation of many regions in terms of the level and pace of their development and determines their specialization[1] [1, 2].

At the same time, there is a common problem — in what conditions this development should be carried out and how to ensure the comfort of living of the population in this region. One of the directions of such development is the creation of various commercial real estate facilities, the main of which are: office; retail; warehouse; industrial; gas stations; garages and parking lots, underground and multi-storey parking lots; multifunctional commercial real estate. The existing peculiarities of the construction of such facilities are characterized by the spatial fixation of their construction products, the presence of a variety of production links, the dispersion of objects and their remoteness from material and technical bases, the duration of life cycles when creating final products. In addition, the system of commercial real estate objects should provide for their placement in places of concentration of consumers of these products in a specific territory of the region, with preference given to large commercial real estate objects, for example, large shopping malls (Fig. 1).

At the same time, the influence of the external and internal environment on their construction process leads to the formation of various types of risks that significantly affect all stages of their life cycles, as well as the stability of the functioning and development of all production processes in space and time.

These features require their own consideration and create all the necessary conditions and prerequisites for their construction on the basis of the formation of regional groups of commercial real estate for various purposes, as well as the transfer of their construction to production-line forms of organization of material production. In this regard, it can be concluded that in modern conditions of development of construction production, there are objectively a number of features associated with the construction of regional groups of commercial importance. They, as a rule, determine the external conditions of the activity of construction enterprises, the type of organizational and technological situations, as well as

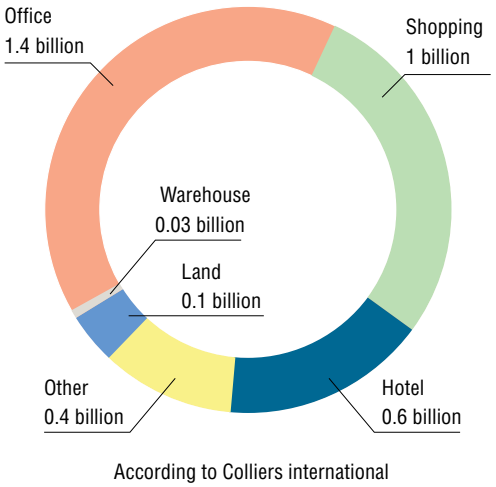


Fig. 1. Distribution of investments by commercial real estate segments, USD

1 Construction. Federal State Statistics Service. URL: https://rosstat.gov.ru/folder/14458 (date of access: 01.21.2022). (rus.).

the specifics of their functioning at all stages of the life cycle. That is why the importance of accounting for them is the basis for the use of modern technologies, forms of organization and management at all stages of the life cycle in order to reduce them in space and time, especially in risk conditions [3–5].

RESULTS

The analysis of modern construction production in the housing market in Moscow and other regions of Russia showed the presence of positive dynamics in the commissioning of commercial real estate, the main type of which are multifunctional trade centres. At the moment, as residential facilities are being commissioned, the number and production capacity of commercial real estate facilities themselves is growing, primarily multifunctional shopping centres. This ensures the development of industrial and social spheres and their infrastructures, which contributes to the formation of not only individual residential neighborhoods in cities, but also satellite cities themselves. For example, a large developer of the CH "Thermodom" (Penza) built separate commercial facilities for the needs of residents of the satellite city of Penza, designed for 125 thousand residents, such as shopping multifunctional centres: "Raduzhny", "Auchan" (Fig. 2, 3).

The construction of such complex commercial real estate objects in modern conditions depends on the coordinated work of all sections of investment and construction activities of their construction and enterprises, which determine the presence and specifics of the stages of the life cycle of the real estate object and the nature of the functioning and development of all types of production processes on them.

The main participants include:

1. Investors who act as creditors, customers, buyers, etc.

2. Designers, manufacturers and suppliers of basic production resources (material, technical, technological, etc.).

3. Developers who determine the location and territory of the construction of regional groups of residential and commercial real estate.

4. Construction and installation organizations that convert production resources into commercial real estate. They also combine the activities of investors, customers, designers, suppliers of material and technical resources in a rational combination of their interests among themselves.

5. Innovative organizations that develop scientific and technical innovations and innovations for the purpose of their subsequent use in production processes for the creation of fixed capital.



Fig. 2. "Raduzhny" multifunctional shopping centre in the satellite city of Penza



Fig. 3. "Auchan" multifunctional shopping centre in the satellite city of Penza

6. Logistics firms that ensure the process of moving and concentrating all types of resources in production processes and bringing goods and services to consumers in the housing and commercial real estate markets.

7. Transport organizations. In addition, any enterprise in the construction industry has a certain organizational and technological potential, which it uses in the process of its activities in order to satisfy its interests. At the same time, each enterprise strives to minimize its costs and maximize its final result (volume of products, profit) with the shortest possible time for their receipt and manufacture, which directly affects the entire course of development of the stages of the life cycle of commercial real estate objects. The life cycle of such objects is the time from the moment when the need for their creation in a specific territory of the region is justified until the moment when it is impractical for their further operation in space on this territory.

The construction system, as a rule, is open and subject to the influence of the external environment, which is negative at the moment. This does not allow this system and all its participants to fully realize their accumulated potentials and achieve the desired results [6–8].

At the same time, the process of formation of uncertainty and risk factors under the influence of the external and internal environment is observed in the construction system, which leads to the fact that the production processes of the construction of commercial real estate (multi-functional shopping centres) significantly deviate in time and space from the normal course of their sustainable development. The sustainability of the development of production processes is determined by the presence and rational combination of basic, auxiliary and service processes, the characteristics of which are given in Table.

In addition, it is necessary to consider the main sources of the formation of various uncertainty factors and ways to take them into account when evaluating the effectiveness of construction projects for the construction of large commercial real estate. There are three main ways to assess the accounting of uncertainties [9, 10]:

1. Checking the sustainability of the construction project.

2. Adjustment of project parameters and production, economic norms at all stages of the life cycle of the facility construction.

3. Formalized description of uncertainty.

"Uncertainty" should be understood as incompleteness or inaccuracy of information about the conditions for the implementation of the entire investment project at all stages of the life cycle. At the same time, the uncertainty associated with the possibility of the formation of complex, unstable organizational and technological situations and consequences is characterized by the concept of risk. Construction projects for the construction of large commercial real estate objects

Characteristics of production processes in the construction of commercial real estate

Name of the production process	Characteristics of the production process	Types of main works
Main	A part of the finished final product is created, the objects of labour are transformed into finished products characteristic of construction	Underground works, aboveground works, finishing works, construction and installation works, special works
Supportive	The final product is created, which is not typical for the main process, but contributes to the production of the main product on it	Repair of construction machinery, quality control of the object of labour, manufacture of tools for their own needs, repair of fixed assets, etc.
Attendant	Conditions are being created for the sustainable development and functioning of the main and auxiliary processes	Warehousing and transportation of raw materials, materials and products, implementation of technical control. Creation of production infrastructure (transport communications, engineering networks)

during their implementation are characterized by the following types of uncertainty and risks:

1. Risk associated with the instability of economic legislation and the current situation, investment conditions and the use of profits.

2. Foreign economic risk (the possibility of imposing restrictions on trade and supplies, closing borders, etc.).

3. Uncertainty of the political situation, the risk of adverse socio-economic changes in the country or region.

4. Incompleteness or inaccuracy of information on the dynamics of technical and economic indicators, parameters of new equipment and technology.

5. Fluctuations in market conditions, prices, exchange rates, etc.

6. Uncertainty of natural and climatic conditions, the possibility of natural disasters.

7. Production and technological risk (accidents and equipment failures, manufacturing defects, etc.).

8. Uncertainty of the goals, interests and behavior of the participants.

9. Incompleteness or inaccuracy of information about the financial position and business reputation of participating enterprises (the possibility of non-payments, bankruptcies, failures of contractual obligations).

Therefore, the system must respond to all these changes accordingly in full. It is advisable to reduce the negative impact of these factors of uncertainty and risk of the external environment on the basis of the transition of the construction of such large complex shopping centres of the same type in the form of regional groups; the formation of flexible organizational structures; risk management at the enterprise; the use of modern technologies and forms of organization in all production processes, taking into account the specifics of each stage of the life cycle of the facility real estate.

CONCLUSION

According to the results of the conducted analysis of foreign and domestic experience on this problem the following main conclusions are revealed:

1. It has been established that the development of commercial real estate objects is characterized by the presence of a number of objective features that should be taken into account in their construction in the form of regional groups in specific territories of the housing market. Consideration of these features allows to establish the degree of compliance of the internal environment of commercial real estate with the external conditions of their activity and to link the interests of all participants in the housing market in a rational combination of them among themselves [11–13].

2. It is established that the most effective form of production activity of construction enterprises is the implementation of options for integrated management of commercial real estate objects in the implementation of construction projects at all stages of the life cycle on the basis of providing them with the required organizational and technological reliability.

3. Depending on the influence of external and internal environment factors, the presence of existing features of functioning and development of commercial real estate objects and construction organizations to implement the process of formation of various organizational and technological mechanisms in the main directions (sectoral, territorial, investment and innovation) of commercial real estate development [14].

4. It is established that the construction process of multifunctional commercial property is influenced by a large number of factors of external and internal environment, which should be identified and taken into account in further research.

REFERENCES

1. Volgin V.V. Modelling of locally integrated management in the system of spatial-territorial development of industrial parks of the "green field" type. Real estate: economics, management. 2022; 4:18-26. (rus.).
2. Volgin V.V., Baronin S.A. Modelling of life cycles of accelerated development of industrial real estate reproduction in industrial parks based on eco-development models (Using ecodevelopment models to simulate the life cycles of the reproduction of accelerated development of industrial real estate at industrial parks). Real estate: economics, management. 2022; 1:23-31. DOI: 10.22337/2073-8412-2022-1-23-31 (rus.).
3. Grabovyy P.G. Organization of construction and development of real estate. Part I: Development of real estate. 4th ed., revised and enlarged. Moscow, Publishing house ASV, IIA "Prosvetitel", 2018; 608. (rus.).
4. Gusakova E.A., Pavlov A.S. Fundamentals of organization and management in construction: textbook and practical training for universities. 2nd ed., revised and enlarged. Moscow, Publishing house Yurait, 2022; 648. (rus.).
5. Lapidus A.A., Safaryan G.B. Organizational and technological reliability of production and logistics processes. Science and business: development paths. 2019; 3(93):148-152. EDN XWSYGA. (rus.).
6. Mishchenko V.Ya., Emelianov D.I., Tikhonenko A.A. Justification of the feasibility of using genetic algorithms in optimizing resource allocation in construction scheduling. Industrial and civil engineering. 2013; 10:69-71. EDN RIUMXT. (rus.).
7. Oleynik P.P. Organization, planning and management in construction : textbook. 2nd ed., revised. Moscow, ASV Publishing House, 2017; 242. (rus.).
8. Ostashko V.Ya. Life cycle management of enterprises of the investment and construction complex: theory and practice : monograph, ASV. Moscow, 2003; 285. (rus.).
9. Ushakova E.A. Analysis of the duration of construction processes taking into account the indicators of the OTN of construction production. Modern construction and architecture. 2022; 3(27):24-28. DOI: 10.18454/mca.2022.27.3 (rus.).

10. Schumpeter J.A. A theorist's comment on the current business cycle. Journal of the American Statistical Association. 1935; 30(189).
11. Khrustalev B.B., Moiseeva A. Main features of the scientific organization of the construction of low-rise residential real estate. Real Estate: Economics, Management. 2018; 3:74-80. (rus.). EDN YMBLHN.
12. Berezka V.V., Roehrl A. Features of project management and contractor risks in construction in foreign countries. Real Estate: Economics and Management. 2019; 1:13-18. EDN HABBVF. (rus.).
13. Grabovyy P.G., Yankovsky A.V. Evaluation of factors influencing the choice of developer strategy in the implementation of urban spatial-territorial redevelopment projects. Real estate: economics and management. 2024; 1:14-20. DOI: 10.22337/2073-8412-2024-1-14-20 (rus.).
14. Khrabrov A.P. Features of the development of multifunctional commercial real estate, Actual problems of science and practice in various sectors of the national economy : collection of reports of the VII National scientific and practical conference. Section 2, socio-economic sciences. Penza, PSUAS, 2024; 63-68. (rus.).

Особенности возведения крупных объектов коммерческой недвижимости на этапах жизненного цикла в условиях риска

В статье рассматриваются вопросы выявления основных особенностей возведения объектов коммерческой недвижимости и деятельности строительных предприятий. Выявлены основные тенденции и подходы, которые необходимо использовать при возведении многофункциональных крупных объектов недвижимости (торговых центров) на рынке жилья. При проведении исследования были использованы следующие основные научные методы: «диалектический», «системный», «динамический», «вариантный», «балансовый», «моделирование». Информационной базой для анализа данной проблемы являются литературные источники по вопросам деятельности строительных организаций, научные статьи, монографии. Методологической основной при написании статьи послужили такие научные методы, как описание, классификация. Для эффективной работы предприятий при строительстве таких объектов на рынке жилья необходимо создание комплекса законодательных, правовых и экономических нормативов, проведение различных мероприятий на производственных процессах, которые направлены на возведение сложных и крупных однородных объектов в виде региональных групп в регионах, что наиболее полно учитывают интересы каждого участника процесса и позволяют влиять на все производственные процессы в условиях поточных форм организации и управления материальным производством на всех этапах жизненного цикла объекта недвижимости с целью его сокращения.

Ключевые слова: *особенности строительства, объекты коммерческой недвижимости, виды производственного процесса, риски, жизненный цикл, участники возведения объектов коммерческой недвижимости*

СПИСОК ИСТОЧНИКОВ

1. Волгин В.В. Моделирование локально-интегрального управления в системе пространственно-территориального девелопмента индустриальных парков типа «гринфилд» // Недвижимость: экономика, управление. 2022. № 4. С. 18–26.
2. Волгин В.В., Баронин С.А., Моделирование жизненных циклов ускоренного развития воспроизводства промышленной недвижимости в индустриальных парках на основе моделей экодевелопмента // Недвижимость: экономика, управление. 2022. № 1. С. 23–31. DOI: 10.22337/2073-8412-2022-1-23-31
3. Грабовый П.Г. Организация строительства и девелопмент недвижимости. Часть I: Девелопмент недвижимости. 4-е изд., перераб. и доп. М. : Издательский дом АСВ, ИИА «Просветитель», 2018. 608 с.
4. Гусакова Е.А., Павлов А.С. Основы организации и управления в строительстве : учебник и практикум для вузов. 2-е изд., перераб. и доп. М. : Юрайт, 2022. 648 с.
5. Лапидус А.А., Сафарян Г.Б. Организационно-технологическая надежность производственно-логистических процессов // Наука и бизнес: пути развития. 2019. № 3 (93). С. 148–152. EDN XWSYGA.
6. Мищенко В.Я., Емельянов Д.И., Тихоненко А.А. Обоснование целесообразности использования генетических алгоритмов при оптимизации распределения ресурсов в календарном планировании строительства // Промышленное и гражданское строительство. 2013. № 10. С. 69–71. EDN RIUMXT.
7. Олейник П.П. Организация, планирование и управление в строительстве : учебник. Изд. 2-е, перераб. М. : Изд-во АСВ, 2017. 242 с.
8. Осташко В.Я. Управление жизненным циклом предприятий инвестиционно-строительного комплекса: теория и практика : монография. М. : АСВ, 2003. 285 с.
9. Ушакова Е.А. Анализ продолжительности выполнения строительных процессов с учетом показателей ОТН строительного производства // Современное строительство и архитектура. 2022. № 3 (27). С. 24–28. DOI: =10.18454/mca.2022.27.3
10. Schumpeter J.A. A theorist's comment on the current business cycle // Journal of the American Statistical Association. 1935. Vol. 30 (189).
11. Хрусталев Б.Б., Моисеева А.А. Основные особенности научной организации строительства малоэтажных объектов жилой недвижимости // Недвижимость: экономика, управление. 2018. № 3. С. 74–80. EDN YMBLHN.
12. Березка В.В., Роерль А. Особенности управления проектами и рисками подрядчика при осуществлении строительства в зарубежных странах // Недвижимость: экономика и управление. 2019. № 1. С. 13–18. EDN HABBVF.
13. Грабовый П.Г., Янковский А.В. Оценка факторов, воздействующих на выбор стратегии застройщика при реализации проектов городского пространственно-территориального редевелопмента // Недвижимость: экономика и управление. 2024. № 1. С. 14–20. DOI: 10.22337/2073-8412-2024-1-14-20
14. Храбров А.П. Особенности развития многофункциональной коммерческой недвижимости. Актуальные проблемы науки и практики в различных отраслях народного хозяйства : сб. докладов VII Национальной науч.-практ. конф. Секция 2, социально-экономические науки. Пенза : ПГУАС, 2024. С. 63–68.

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, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@gic.mgsu.ru;

Храбров Антон Павлович — аспирант кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; 5067844@gmail.com.

For citation: Grabovyy P.G., Khrabrov A.P. Construction of large commercial real estate objects at life cycle stages under risk conditions. *Real Estate: Economics, Management*. 2024; 3:65-68.

Для цитирования: *Грабовый П.Г., Храбров А.П.* Construction of large commercial real estate objects at life cycle stages under risk conditions // Недвижимость: экономика, управление. 2024. № 3. С. 65–68.

UDC 69.05

Shuoting X.
Fomin N.I.
Chong L.

Bibliometric Analysis of Structures and Connection Types Widely Used in Prefabricated Construction in China

Modern construction is increasingly turning to prefabricated technologies to enhance the efficiency and environmental sustainability of projects. This trend is particularly evident in China, where prefabricated construction is becoming a key element of the sustainable urban infrastructure development strategy, showcasing impressive growth rates. This study aims to analyze the types of building structures and connections widely used in prefabricated construction in China, focusing on their efficiency, cost, environmental impact, and sustainability. The methodology includes a bibliometric analysis of scientific literature and statistical data from recent years to identify key trends and development directions in this field. The main findings indicate that China leads in the research and application of prefabricated technologies, particularly in reinforced concrete and steel structures. Various types of prefabricated structures and connection methods are analyzed in terms of their application and effectiveness. Based on the analysis, the study identifies major challenges and prospects for the further development of prefabricated construction, including the need for standardization and improvement in the quality of connection elements. The research underscores the significant potential of prefabricated construction to promote sustainable development and the efficient use of resources in the construction industry.
Keywords: *prefabricated construction, China, building structures, connections, sustainable development, prefabricated connections, building technology*



Xiao Shuoting,
Graduate student Institute of Civil Engineering and Architecture; Ural Federal University named after the first President of Russia B.N. Yeltsin (UrFU); 19 Mira Street, Ekaterinburg, 620002, Russian Federation; RISC ID: 1225248, Scopus AuthorID: 58847090400, WoS ResearcherID: HCH-4506-2022, ORCID: 0009-0002-6552-0093, Google Scholar: 3k16g04AAAAJ&hl; Shawn.st@foxmail.com



Fomin Nikita Igorevich,
Candidate of Technical Sciences, Associate Professor, Head of the Department of Industrial, Civil Engineering and Real Estate, Director of the Institute of Civil Engineering and Architecture; Ural Federal University named after the first President of Russia B.N. Yeltsin (UrFU); 19 Mira Street, Ekaterinburg, 620002, Russian Federation; RISC ID: 241981, Scopus AuthorID: 56028009000, ORCID: 0000-0002-7095-7161; ni.fomin@urfu.ru



Liu Chong,
Graduate student; Institute of Civil Engineering and Architecture, Ural Federal University named after the first President of Russia B.N. Yeltsin (UrFU); 19 Mira Street, Ekaterinburg, 620002, Russian Federation; WoS ResearcherID: IYS-7482-2023, ORCID: 0009-0008-8279-0355; lc996463232@163.com

INTRODUCTION

In the current state and trends of the global construction market, traditional construction methods face numerous challenges such as inefficiency, irrational use of resources, and long construction timelines. As a significant development trend in the global construction industry, prefabricated construction is actively studied and researched by various countries to address the current issues facing the construction sector [1, 2]. Research has shown that building with prefabricated structures can significantly improve resource efficiency, reduce carbon emissions, and effectively decrease construction waste, thereby ensuring ecological efficiency and supporting the principles of sustainable development [3–5]. Moreover, studies also indicate that compared to traditional monolithic construction, prefabricated structures offer the advantage of higher construction speed [6, 7]. This significantly reduces project construction time, lowering overall costs. Due to these advantages, prefabricated construction becomes a preferred option for projects with tight deadlines or in regions experiencing significant climate changes. Prefabricated construction technology plays an increasingly important role in improving the efficiency, quality, and eco-friendliness of buildings, and its development and application provide new ideas and solutions for addressing some problems associated with traditional construction methods.

The durability of fully prefabricated buildings largely depends on the quality of embedded parts and connections between them [8]. The specificity (seismic rating) affecting the structural connections of building frames is one of the main factors determining the development of structural and technological solutions for prefabricated construction in East Asian countries [9]. Many existing prefabricated construction projects still demonstrate a high degree of vulnerability to seismic impacts, so the seismic characteristics of prefabricated structures remain a key research priority [10]. As a unique feature of prefabricated construction, the design of connections significantly determines the structural strength and seismic characteristics of prefabricated buildings [11]. Therefore, analyzing the existing widely used types of prefabricated construction and connection designs is of great importance.

MATERIALS AND METHODS

According to the statistical data from the CEPII-BACI database, the total global export volume of prefabricated structures amounted to USD 12.2 billion in 2022. The largest exporters were China, the Czech Republic, Estonia, the USA, and the Netherlands, with Europe being the continent with the highest share of exports (Fig. 1)[1]. Currently, Russia holds a small share of this market.

As shown in Fig. 2, we conducted a comparative analysis of the export shares of several countries with the highest indicators starting from 2000. Since 2004, China's share of prefabricated building exports in the global volume began to grow rapidly and maintained a leading position for many subsequent years. Meanwhile, the export share from the USA

1 CEPII-BACI. URL: http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37 (access data: 20.03.2024).

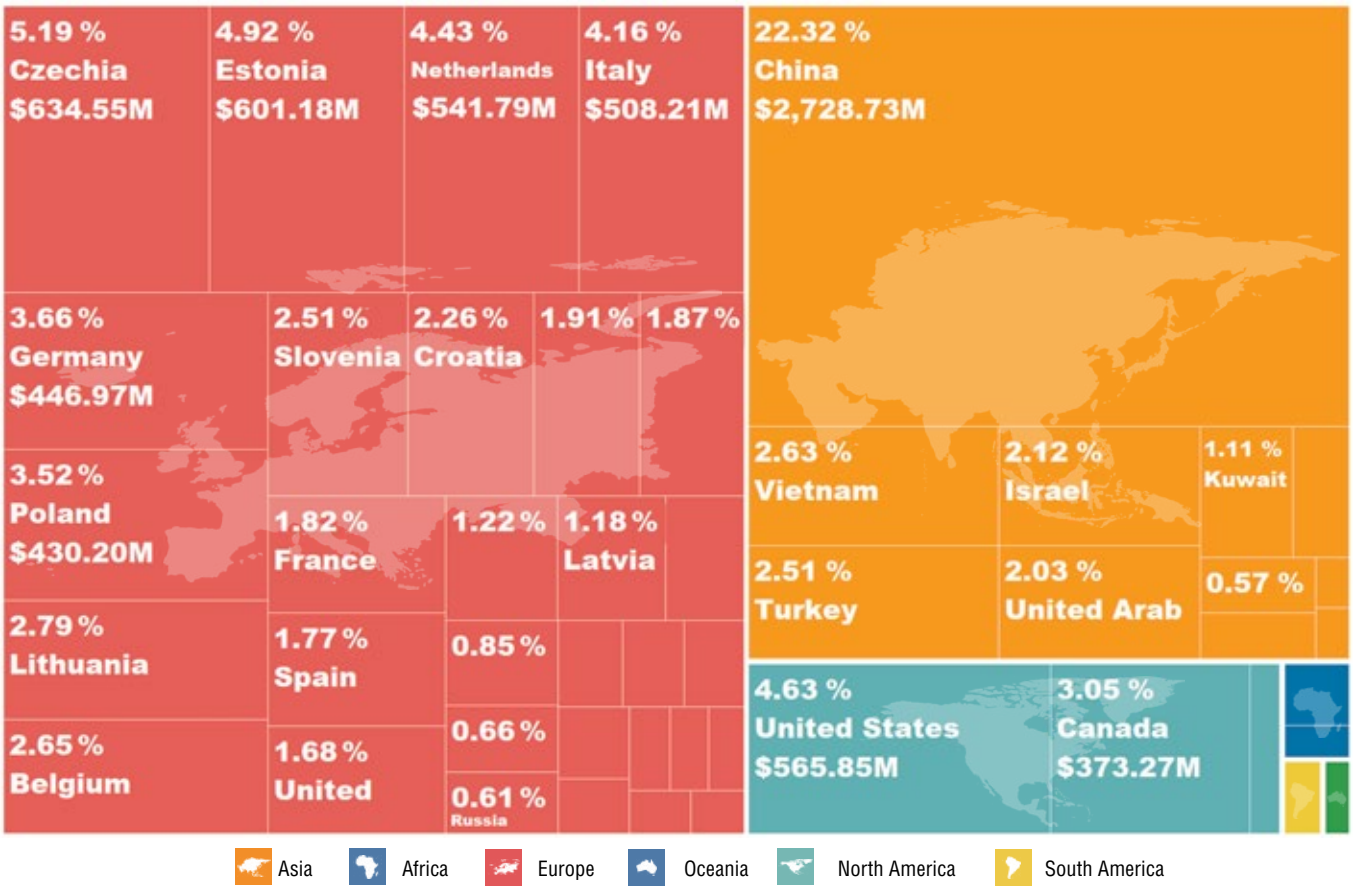


Fig. 1. Analysis of prefabricated structures export volume in the world in 2022

and Canada gradually decreased, while in European countries such as the Czech Republic, Estonia, the Netherlands, Italy, and Germany, the export share remained relatively stable.

Using the search formula "TI=(Prefabricated building) OR TI=(Prefabricated structure) OR TI=(Precast building) OR TI=(Precast structure) OR TI=(Prefabricated construction) OR TI=(Precast Construction)" in the Web of Science core collection database and filtering for materials published since 2015, we obtained 1505 search results. Of these, 76.54 % were journal papers and 17.41 % were conference materials. As shown in Fig. 3, the analysis of the results indicates that since 2015, China has been the country associated with the highest number of research outcomes and the highest level of cooperation between research organizations across different countries, with 827 publications. Australia ranks second in terms of cooperation with 105 works, while the USA ranks third both in terms of cooperation and the number of publications.

It is undeniable that against the backdrop of the global development of prefabricated construction, China stands out as one of the countries with the fastest-growing prefabricated construction industry. In recent years, the country has accumulated an extensive research base, and its practical experience and technological solutions in the field of prefabricated construction deserve detailed study. The analysis of widely used types of prefabricated buildings and connection structures in China can serve as a valuable source of experience and recommendations for practical engineering and future research.

RESULTS

Prefabricated structural systems in China are categorized by materials into steel, concrete, wood, and mixed structures. According to the Ministry of Housing and Urban-Rural Development of the People's Republic of China, reinforced concrete prefabricated structures remain the leading choice in the country's construction industry, accounting for approximately 66.22 %, while steel structures constitute 28.38 %[2].

Construction elements are primarily divided into two types: horizontally positioned elements and vertically positioned elements. Horizontally positioned elements include beams, slabs, etc., while vertically positioned elements comprise columns, diaphragms, prefabricated supports, etc. These primary elements, through the use of various materials, cross-sectional shapes, positioning methods, and construction techniques, can form different structural solutions that meet diverse usage and performance requirements. For instance, depending on the material, beams can be made of reinforced concrete, steel, mixed reinforced concrete, or a combination of steel and reinforced concrete. Various combinations and shapes provide a rich selection of design solutions and flexibility in prefabricated construction.

All types of building systems are also formed by combining various primary elements. Prefabricated building structural systems

2 Special topic on affordable housing: The core of new housing reform. URL: https://pdf.dfcfw.com/pdf/H301_AP202401161617522492_1.pdf (access data: 20.03.2024).

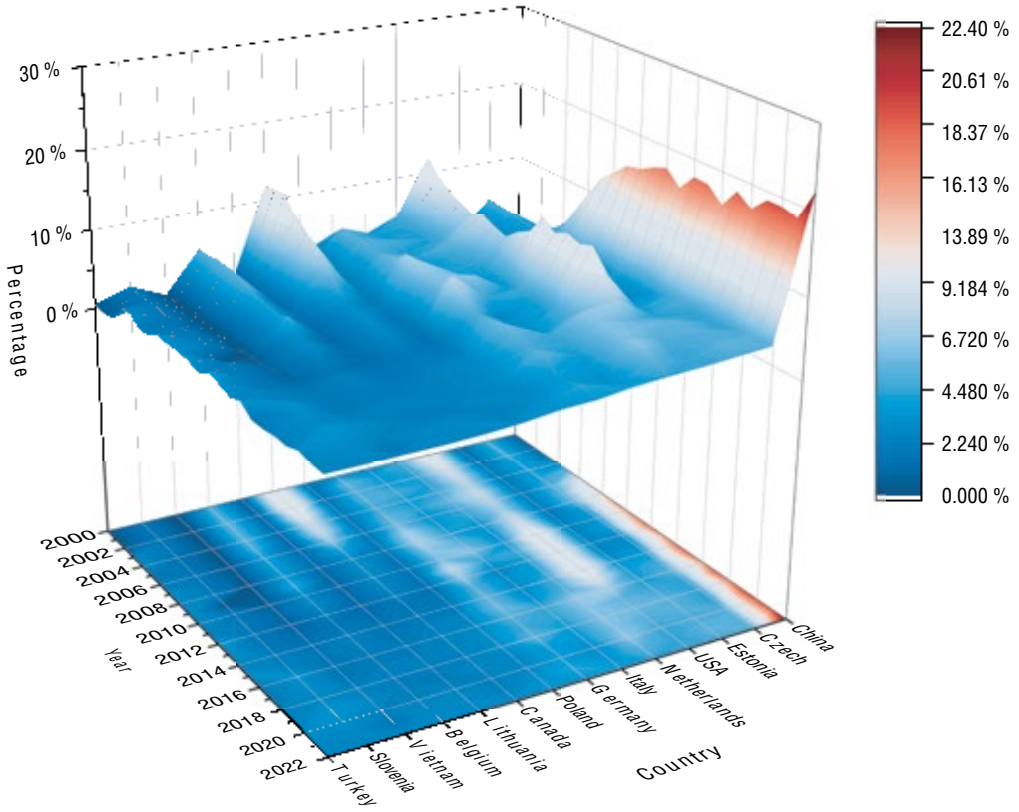


Fig. 2. Analysis of exports of prefabricated structures of countries of volume change from 2000 to 2022

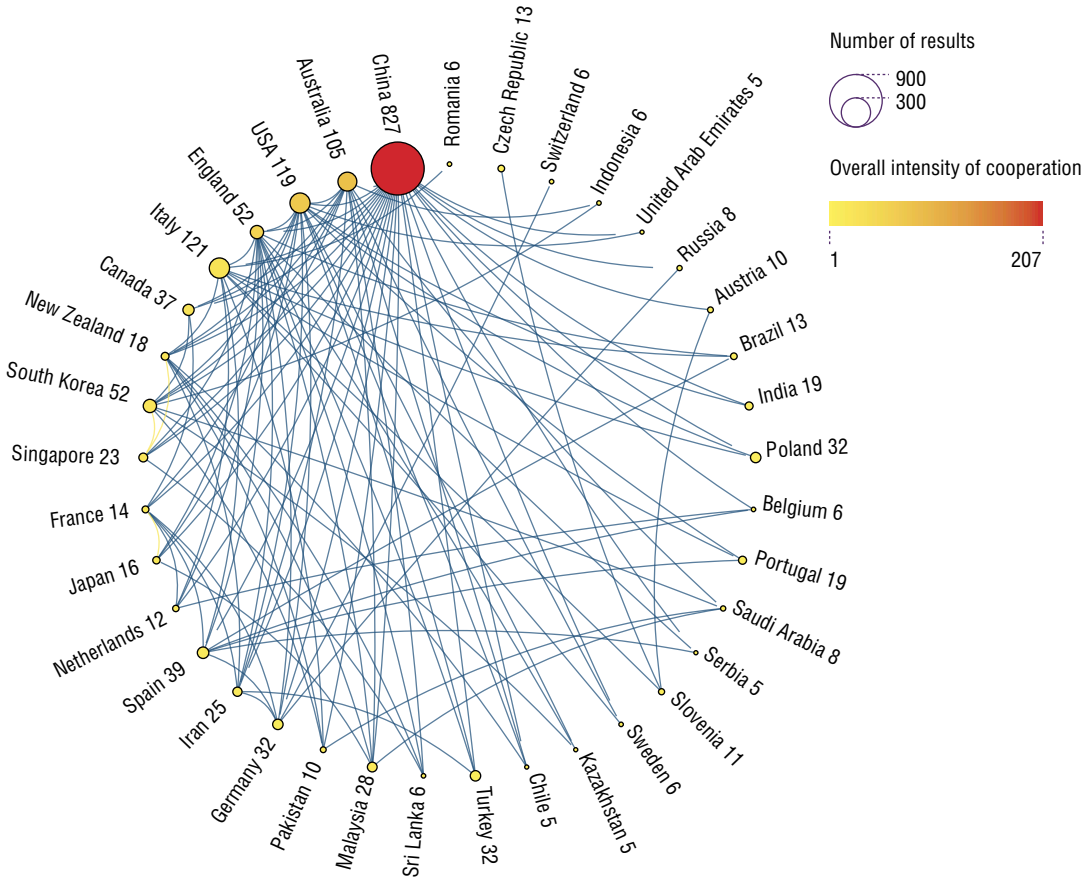


Fig. 3. Analysis of the number of results and the level of cooperation between research organizations in different countries

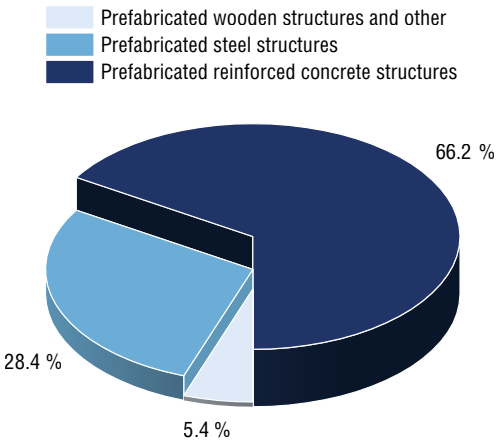


Fig. 4. Proportion of material types for prefabricated structures in China

currently used in China include frame structures, wall structures, frame-wall structures, frame-support structures, girderless slab systems, and so on (Fig. 4). Different structures have different ranges of applicable buildings and geographic regions. Through interviews and surveys of 10 engineers holding various positions in design and construction in the Chinese construction industry, the corresponding ranges of application for these different types of structures in the construction industry in China were identified (Table 1).

By conducting a search in the China National Knowledge Infrastructure (CNKI) using relevant keywords for various structural systems, we obtained a diverse number of results, including patents, dissertations, journal papers, and conference materials (Fig. 5). This allows us to understand the current research trends in prefabricated construction types. It is evident that prefabricated wall structures are the most popular among the research topics, followed by prefabricated frame-wall structures and prefabricated frame structures. Since 2015, with changes in government policy

Table 1. Types of prefabricated structures widely used in China

Number	Type of Structure	Main Load-Bearing Elements	Application Area	Applicable Geographic Region	Schematics
1	Prefabricated frame structures	Columns, beams, floor slabs	Widely used in multi-story and high-rise buildings such as residential, office, and educational buildings	Central and eastern provinces such as Henan, Shandong, Jiangsu, and regions with moderate seismic activity	
2	Prefabricated wall structures	Wall panels, floor slabsя	Suitable for high-rise residential buildings, hotels, office buildings, and other buildings with modest design requirements	Southwestern provinces such as Sichuan, Yunnan, and coastal areas prone to typhoons, such as Guangdong, Fujian. For high-rise residential and public buildings in seismic zones and areas prone to strong winds	
3	Prefabricated frame-wall structures	Columns, beams, wall panels, floor slabs	Suitable for multi-story and high-rise buildings, especially those requiring good seismic performance, such as residential buildings, offices, and hospitals	Northern and northeastern provinces such as Heilongjiang, Jilin, Liaoning, and regions with cold climates and high wind loads. For multi-story residential and public buildings in cold regions requiring good insulation and wind resistance	
4	Prefabricated frame support structures	Columns, beams, supports, floor slabs	Suitable for high-rise buildings and buildings requiring large open spaces such as sports halls, exhibition centers, etc.	Major cities across China such as Beijing, Shanghai, Guangzhou, and regions with high population density and limited construction space. For buildings located in areas with high wind or seismic loads	
5	Prefabricated girderless slabs structures	Prefabricated columns, prefabricated floor slabs	Suitable for rapidly constructed and long-span buildings such as multi-story factories, warehouses, public buildings, halls; can also be used in office and residential buildings for more flexible interior space planning	Coastal areas of southern China such as Guangdong, Hainan, and islands in the South China Sea. For resort buildings requiring maximum openness and natural ventilation	

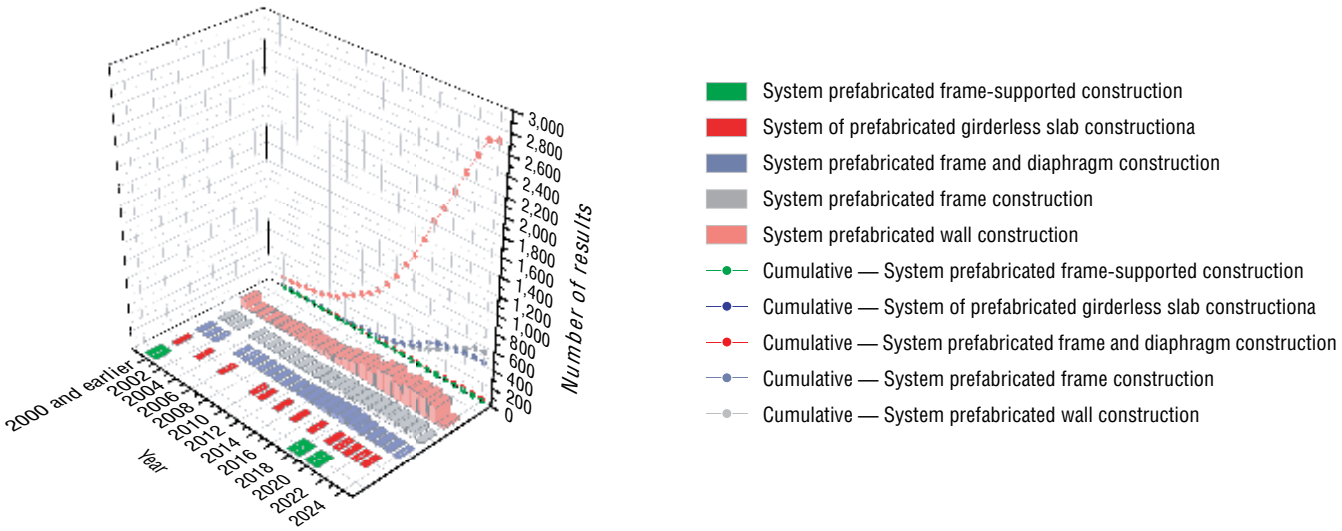


Fig. 5. Analyzing the number of results with different types of designs in search results

Table 2. Connection types for prefabricated structures

Number	Application Area	Connection Method	Types	Applied Elements
1	Frame structures where the building height does not exceed three stories or 12 meters [13]	Rebar lapping in grout-filled hole, Fig. 6	Rigid	Columns, walls, floor slabs, beams
2		Rebar lapping in grout-filledhole formed with metal bellow, Fig. 7	Rigid	
3	Stairs suitable for high-rise buildings of all structural systems. Structural elements for low-rise frame or wall structures	Bolt connection	Hinged	Stairs, wall panels, beams, columns
4		Element welding	Rigid	
5	High-rise buildings of various structural systems	Grout sleeve splicing of rebars	Rigid	Columns, walls
6		Threaded couplers	Rigid	Beams, floor slabs
7		Rebar lap-spliced connections	Hinged	Wall panels, beams, floor slabs, etc.
8		Welded reinforcement connections	Rigid	Beams, floor slabs
9		Connection of section steel	Hinged	Column
10	Frame apartments, office buildings	Modular joint	Rigid	Frame beams, columns
11	For masonry, wall structures, or frame-wall structures	HALFEN HBT Rebend Connection	Rigid	Block wall connection with structure

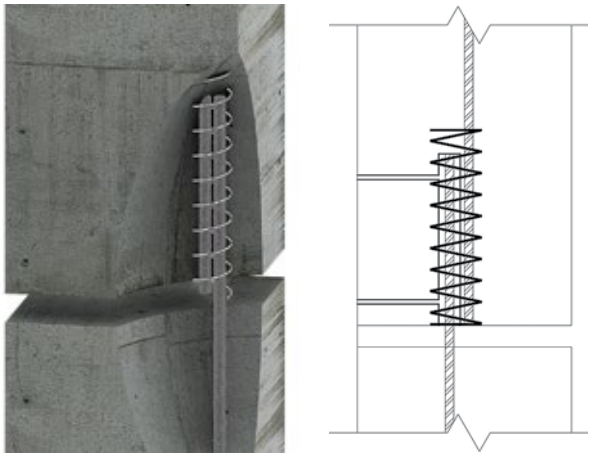


Fig. 6. Rebar lapping in grout-filled hole

and technological advancements, research on these three types of structures has entered a phase of active growth.

This trend indicates the increasing focus on and development of prefabricated construction methods in China, aligning with broader goals of efficiency and sustainability in the construction industry. The active growth in research also suggests a robust and ongoing effort to innovate and optimize prefabricated construction technologies, which will likely continue to influence the field significantly in the coming years.

Connections between prefabricated elements play a crucial role in ensuring the structural integrity and efficiency of the prefabricated construction system. They also enhance the multifunctionality and speed of the construction process [12]. As shown in Table 2, various types of connections are used in prefabricated constructions depending on the design of the structure and the materials used. Connection types can be classified according to the behavior of the connecting structure, mechanical properties, types of connected

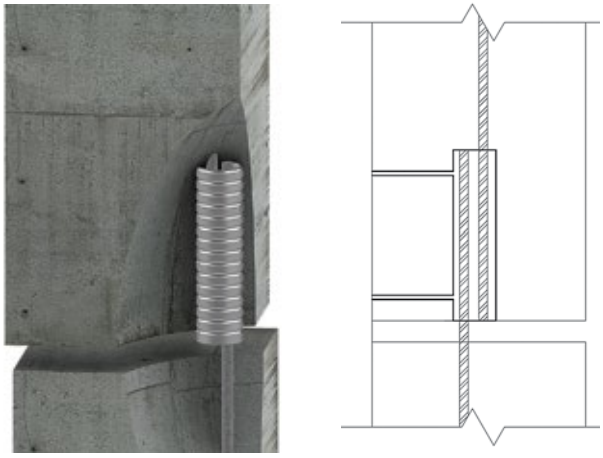


Fig. 7. Rebar lapping in grout-filled hole formed with metal bellow

elements, joint requirements, and the load-bearing capacity of components. Different types of connections are suitable for various types of buildings or structures.

Additionally, a search in the China National Knowledge Infrastructure (CNKI) using keywords related to various types of connections yielded a diverse number of results, including patents, dissertations, journal papers, conference materials, etc. (Fig. 8).

It can be noted that currently, the greatest interest among researchers is in grout sleeve splicing of rebars, followed by rebar lapping in grout-filled holes and bolt connections. Research on grout sleeve splicing of rebars began relatively late, but since 2014, the number of studies in this area has grown rapidly. Bolt connections had a certain research base and interest in the early stages, whereas interest in studies on rebar connections using grout-filled holes began to exceed interest in bolt connections from 2017 onwards.

DISCUSSION

Examining the current state of the prefabricated construction industry in China reveals its significance and enduring role in the global market for prefabricated structures. As the country with the largest export volume, China's systems of construction and connection design in the field of prefabricated construction undoubtedly deserve attention and study.

It is worth noting that Chinese research in the area of prefabricated structural systems began relatively early. By 2000, China had already accumulated a substantial body of research results related to prefabricated structures. These early studies laid a solid foundation for subsequent technological advancements and innovations. Research on types of connections between various prefabricated elements began relatively late, attracting significant attention from researchers and engineers starting in 2005. The study of connections between prefabricated elements, both traditional and innovative, gradually became a relevant topic. In particular, researchers focused on connection technologies that enhance structural safety, reliability, and construction efficiency.

In the context of structural systems in prefabricated construction, reinforced concrete structures predominate. In the area of connections, grout sleeve splicing of rebars has become the most actively researched area in China, demonstrating the fastest development rates. Bolt connections attracted research interest early on, which continues to this day. Additionally, rebar lapping in grout-filled holes remains an active area of current research.

CONCLUSION

With the deepening of research into connection technologies for prefabricated elements, various new connection methods have been proposed and optimized to overcome the limitations inherent in traditional connection methods. The application of prefabricated

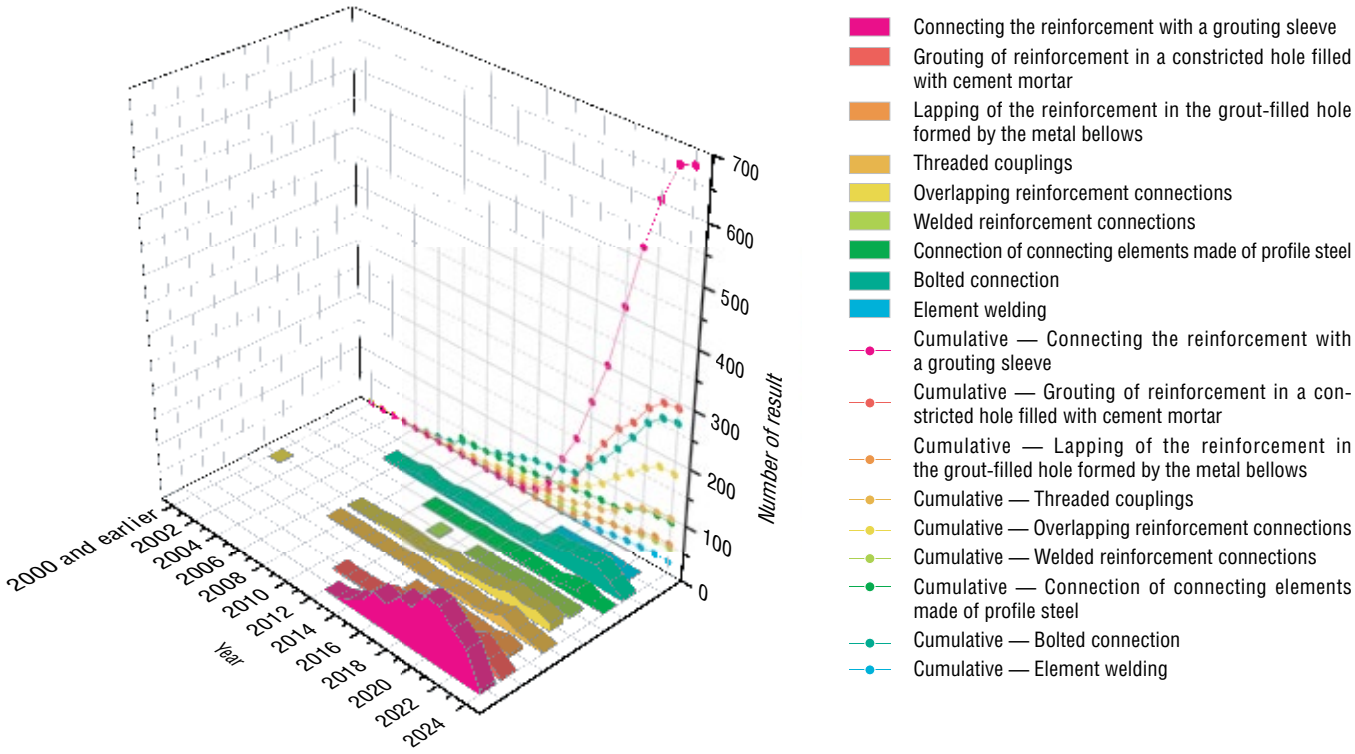


Fig. 8. Analyze the number of results related to different types of connections in search results

construction technologies in practical projects has shown good results and received positive feedback, which, in turn, has stimulated the development and application of these technologies. The development and improvement of these technologies have offered new approaches and solutions to the problems of traditional construction, increasing construction efficiency, reducing project timelines, and lowering construction costs.

However, despite significant achievements in the systems of construction and connection design in prefabricated construction, many challenges remain for scientists to address. For example, issues of seismic resilience in prefabricated structures remain a critically important research direction, requiring the development and study of structures and connections with high levels of seismic resistance.

REFERENCES

1. Hong J. et al. Energy use embodied in China's construction industry: A multi-regional input–output analysis. Renewable and Sustainable Energy Reviews. 2016; 53:1303-1312. DOI: 10.1016/j.rser.2015.09.068
2. Manoj Philip A., Ramesh Kannan M. Constructability assessment of cast in-situ, precast and modular reinforced concrete structures. Materials Today: Proceedings. 2021; 45:6011-6015. DOI: 10.1016/j.matpr.2020.09.528
3. Cao X. et al. A comparative study of environmental performance between prefabricated and traditional residential buildings in China. Journal of Cleaner Production. 2015; 109:131-143. DOI: 10.1016/j.jclepro.2015.04.120
4. Liu S. et al. A dynamic simulation study on the sustainability of prefabricated buildings, Sustainable Cities and Society. 2022; 77:103551. DOI: 10.1016/j.scs.2021.103551
5. Jiang Y. et al. Sustainable Performance of Buildings through Modular Prefabrication in the Construction Phase: A Comparative Study. Sustainability. Multidisciplinary Digital Publishing Institute. 2019; 11(20):5658. DOI: 10.3390/su11205658
6. Wang S., Sinha R. Life Cycle Assessment of Different Prefabricated Rates for Building Construction. Buildings. Multidisciplinary Digital Publishing Institute. 2021; 11(11):552. DOI: 10.3390/buildings11110552
7. Chen Y. et al. Factors influencing construction time performance of prefabricated house building: A multi-case study. Habitat International. 2023; 131:102731. DOI: 10.1016/j.habitatint.2022.102731
8. Ershov M.N., Lapidus A.A., Telichenko V.I. Technological processes in construction. Book 6. Installation of building structures: Textbook. Moscow, Publisher ASV, 2019. ISBN 978-5-4323-0134-5. (rus.).
9. Lysova Y.D. et al. Structural and technological solutions of prefabricated-monolithic systems in East Asian countries. Engineering Bulletin of the Don. 2022; 10(94):283-300.
10. Guaygua B., Sánchez-Garrido A.J., Yepes V. A systematic review of seismic-resistant precast concrete buildings. Structures. 2023; 58:105598. DOI: 10.1016/j.istruc.2023.105598
11. Xiao S. Research on the joints of prefabricated structures based on Chinese and Russian industry experience : dissertation of candidate of technical sciences. Ekaterinburg, 2023. (rus.).
12. Sychyov S.A. et al. Active elements of passive and energy-efficient methods of mounting reinforced concrete elements. Engineering Bulletin of the Don. 2022; 4(88):475-486. (rus.).
13. Ministry of Housing and Urban-Rural Development of the People's Republic of China. Technical Regulations for Prefabricated Concrete Structures: JGJ 1-2014. Beijing, China Architecture & Building Press, 2014. ISBN 9781511223881.

Библиометрический анализ конструкций и типов соединений, широко используемых в сборном строительстве Китая

Современное строительство все чаще обращается к сборным технологиям, стремясь повысить эффективность и экологическую устойчивость проектов. Особенно в Китае, где данное направление показывает впечатляющие темпы развития, сборное строительство становится ключевым элементом стратегии устойчивого развития городской инфраструктуры. Цель данного исследования заключается в анализе типов строительных конструкций и соединений, широко используемых в сборном строительстве в Китае, с акцентом на их эффективность, стоимость, влияние на окружающую среду и устойчивость. Методология включает в себя библиометрический анализ научной литературы и статистических данных, охватывающих последние годы, для выявления ключевых трендов и направлений развития в данной области. Основные результаты показывают, что Китай занимает лидирующие позиции в исследованиях и применении сборных технологий, особенно в области железобетонных и стальных конструкций. Различные типы сборных конструкций и методы соединений анализируются с точки зрения их применения и эффективности. На основе анализа определены основные проблемы и перспективы дальнейшего развития сборного строительства, включая необходимость стандартизации и улучшения качества соединительных элементов. Исследование подчеркивает значительный потенциал сборного строительства для содействия устойчивому развитию и эффективному использованию ресурсов в строительной отрасли.

Ключевые слова: *сборное строительство, Китай, строительные конструкции, соединения, устойчивое развитие, сборные соединения, строительная технология*

СПИСОК ИСТОЧНИКОВ

1. Hong J. et al. Energy use embodied in China's construction industry: A multi-regional input–output analysis // Renewable and Sustainable Energy Reviews. 2016. Vol. 53. Pp. 1303–1312. DOI: 10.1016/j.rser.2015.09.068
2. Manoj Philip A., Ramesh Kannan M. Constructability assessment of cast in-situ, precast and modular reinforced concrete structures // Materials Today: Proceedings. 2021. Vol. 45. Pp. 6011–6015. DOI: 10.1016/j.matpr.2020.09.528
3. Cao X. et al. A comparative study of environmental performance between prefabricated and traditional residential buildings in China // Journal of Cleaner Production. 2015. Vol. 109. Pp. 131–143. DOI: 10.1016/j.jclepro.2015.04.120
4. Liu S. et al. A dynamic simulation study on the sustainability of prefabricated buildings // Sustainable Cities and Society. 2022. Vol. 77. P. 103551. DOI: 10.1016/j.scs.2021.103551
5. Jiang Y. et al. Sustainable Performance of Buildings through Modular Prefabrication in the Construction Phase: A Comparative Study // Sustainability. Multidisciplinary Digital Publishing Institute. 2019. Vol. 11. No 20. P. 5658. DOI: 10.3390/su11205658
6. Wang S., Sinha R. Life Cycle Assessment of Different Prefabricated Rates for Building Construction // Buildings. Multidisciplinary Digital Publishing Institute. 2021. Vol. 11. No. 11. P. 552. DOI: 10.3390/buildings11110552
7. Chen Y. et al. Factors influencing construction time performance of prefabricated house building: A multi-case study // Habitat International. 2023. Vol. 131. P. 102731. DOI: 10.1016/j.habitatint.2022.102731
8. Ершов М.Н., Лапидус А.А., Теличенко В.И. Технологические процессы в строительстве. Кн. 6. Монтаж строительных конструкций : учебник. М. : Изд-во АСВ, 2016.
9. Лысова Ю.Д. и др. Конструктивно-технологические решения сборно-монолитных систем в странах Восточной Азии // Инженерный вестник Дона. 2022. № 10 (94). С. 283–300.
10. Guaygua B., Sánchez-Garrido A.J., Yepes V. A systematic review of seismic-resistant precast concrete buildings // Structures. 2023. Vol. 58 (4). P. 105598. DOI: 10.1016/j.istruc.2023.105598

11. Сяо Ш. Исследование узлов соединения сборных конструкций на основе китайского и российского отраслевого опыта : дис. … канд. техн. наук. Екатеринбург, 2023.
12. Сычёв С.А. и др. Активные элементы пассивных и энергоэффективных методов монтажа железобетонных элементов // Инженерный вестник Дона. 2022. № 4 (88). С. 475–486.
13. Ministry of Housing and Urban-Rural Development of the People's Republic of China. Technical Regulations for Prefabricated Concrete Structures: JGJ 1-2014. Beijing, China Architecture & Building Press, 2014. ISBN 9781511223881.

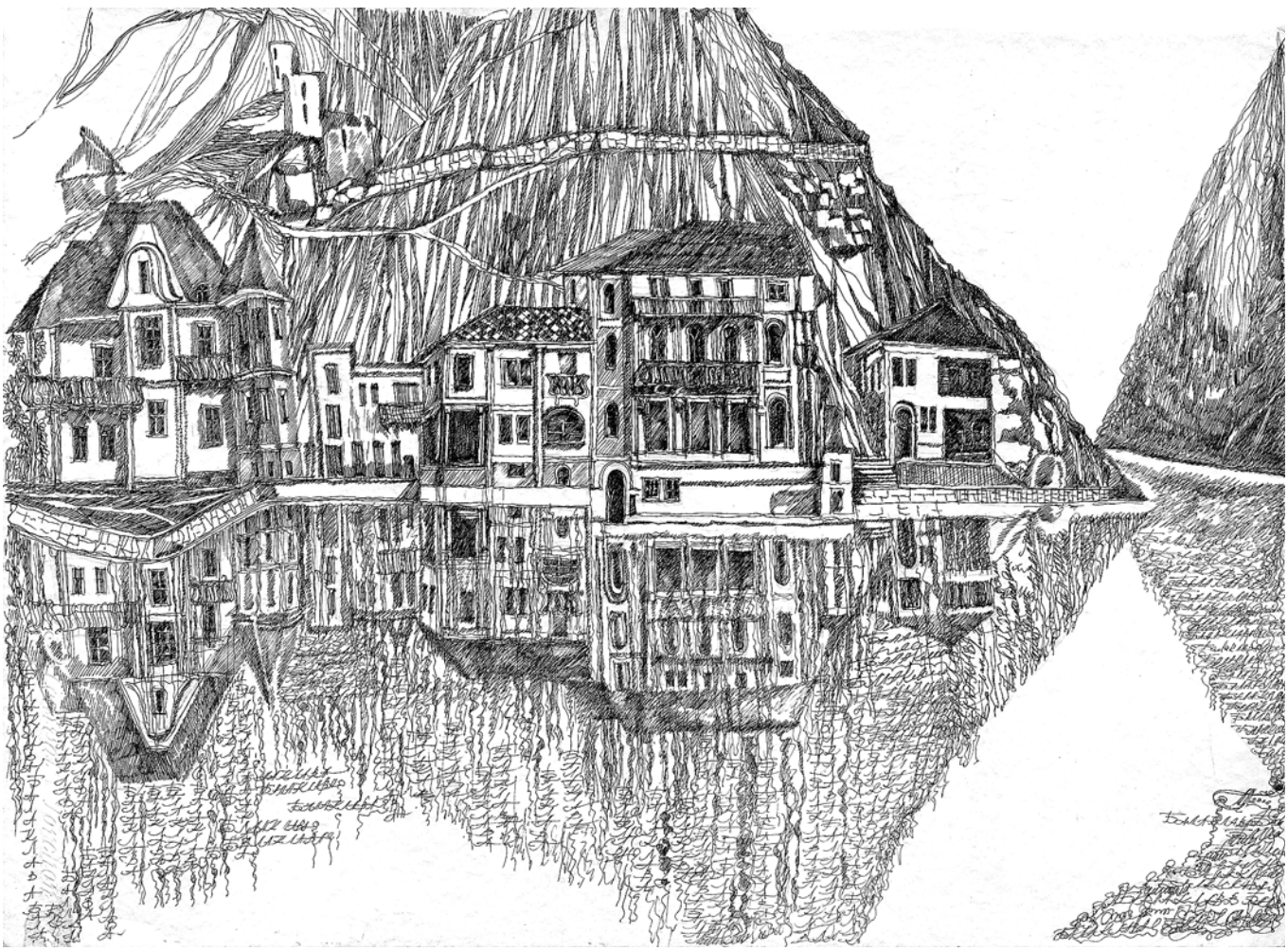
Об авторах: **Сяо Шотин** — аспирант Института строительства и архитектуры; **Уральский федеральный университет имени первого Президента России Б.Н. Ельцина**; 620002, г. Екатеринбург, ул. Мира, д. 19; RISC ID: 1225248, Scopus AuthorID: 58847090400, WoS ResearcherID: HCH-4506-2022, ORCID: 0009-0002-6552-0093, Google Scholar: 3k16g04AAAAJ&hl; Shawn.st@foxmail.com;

Фомин Никита Игоревич — кандидат технических наук, доцент, заведующий кафедрой промышленного, гражданского строительства и экспертизы недвижимости, директор Института строительства и архитектуры; **Уральский федеральный университет имени первого Президента России Б.Н. Ельцина**; 620002, г. Екатеринбург, ул. Мира, д. 19; RISC ID: 241981, Scopus AuthorID: 56028009000, ORCID: 0000-0002-7095-7161; ni.fomin@urfu.ru;

Лю Чун — аспирант Института строительства и архитектуры; **Уральский федеральный университет имени первого Президента России Б.Н. Ельцина**; 620002, г. Екатеринбург, ул. Мира, д. 19; WoS ResearcherID: IYS-7482-2023, ORCID: 0009-0008-8279-0355; lc996463232@163.com.

For citation: Shuoting X., Fomin N.I., Chong L. Bibliometric Analysis of Structures and Connection Types Widely Used in Prefabricated Construction in China. *Real Estate: Economics, Management*. 2024; 3:69-76.

Для цитирования: *Шотин С., Фомин Н.И., Чун Л.* Bibliometric Analysis of Structures and Connection Types Widely Used in Prefabricated Construction in China // Недвижимость: экономика, управление. 2024. № 3. С. 69–76.



Л.И. Павлова. Балаклава. Рисунок, тушь, перо.

UDC 338.2:332.145

Ershova S.A.
Chernyshova A.S.

Methodological approaches to establishing areas of responsibility of authorities during preparation and implementation of integrated development programmes

A study of methodological approaches to the formation of integrated development programmes is presented. Monitoring of the provisions of regulatory legal acts on the development and approval of comprehensive development programmes was carried out. The features of regulatory requirements for the formation of comprehensive development programmes of various industry orientations are identified, and a conclusion is drawn about the priority of the industry approach. The main shortcomings of the current system for developing integrated development programmes and the need to take into account the components of economic and spatial planning are noted. Based on the proposed integrated approach for St. Petersburg, areas of responsibility of executive bodies of state power for the preparation and implementation of integrated development programmes have been identified, and proposals have been made to legislatively consolidate the proposed delimitation of powers of government bodies in terms of the preparation and approval of integrated development programmes.
The developments presented in the paper will make it possible to solve in practice the problem of establishing the order of interaction between executive bodies of state power in the formation of comprehensive development programmes, i.e. solve a problem that has important socio-economic significance for Russia.
Keywords: *Integrated development programmes, methodological approaches, formation of integrated development programmes, areas of responsibility of the authorities of St. Petersburg in the preparation of integrated development programmes*



Ershova Svetlana Anatolyevna,
Doctor of Economical Sciences, Professor, 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 RISC: 319827, Scopus: 56478980400, ORCID: 0000-0001-6100-6404; evshova-2024@ yandex.ru



Chernyshova Angelina Stanislavovna,
4th year student of the Bachelor's degree programme, 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; Ast.chernyshova@yandex.ru

INTRODUCTION

Currently, there are essential changes in the target settings of strategies for the socio-economic and spatial development of Russian megacities, when setting targets, priorities are given to the quality of the urban environment, which is directly related to changes in methodological approaches to the formation of integrated development programmes (IDP), focused not so much on the advantages of the urbanized environment as on the level of development infrastructure [1–7]. The need for an integrated approach to the formation of a living environment that directly affects the quality of life is noted in the works of Russian scientists [4, 6]. The shift in emphasis in the development of spatial development strategies is confirmed by the trends noted by scientists in the harmonization of the urbanized environment, on the one hand, meeting residents' ideas of living comfort, on the other — provided by guarantees from public authorities to ensure standards of quality of life adopted for a particular territory [1, 4, 7–15]. Achieving strategic targets that ensure balanced and sustainable development of territories through the development of measures for the design and construction of social, transport and engineering infrastructure facilities is possible only with the competent solution of a number of organizational issues to establish authorized authorities for the preparation of IDP. At the same time, the most important task of the mechanism for implementing strategies for socio-economic and spatial development of regions and municipalities is to identify strategic planning documents and investment programmes and agreements providing for the formation of IDP and identifying authorities responsible for the preparation and implementation of IDP.

The information presented above confirms the relevance of the study of the delimitation of powers of public authorities in the preparation and implementation of IDP of the relevant infrastructure.

METHODS

The purpose of the presented article is to identify and establish the areas of responsibility of the executive authorities in the preparation and implementation of IDP.

Methods of logical and comparative analysis and expert assessment were used to identify areas of responsibility of authorities. Logical conclusions are drawn based on the knowledge and personal experience of experts.

When formulating the problem, the experts consistently carried out the following analytical activities:

- monitoring the provisions of strategic planning documents, investment programmes and contracts in order to determine the strategic directions of IDP preparation, areas of application and objects included in IDP, affecting the creation of objects of social, communal and transport infrastructure systems, as well as their updating;
- a logical and comparative analysis of the regulations on the authorities of St. Petersburg, which allows to identify the areas of responsibility of executive bodies of state power for the preparation and implementation of IDP of various sectoral orientation;
- research of IDP areas to identify responsible

performers for the development and implementation of programmes.

Currently, in practice, the development and approval of the IDP is carried out in accordance with the procedure approved by Art. 26 of the Civil Code of the Russian Federation[1], according to which the IDP develops the provisions of approved territorial planning documents. The requirements for the composition and content of the IDP, approved by the Government of the Russian Federation, are guided by an industry approach and vary depending on the type of IDP:

1) for social infrastructure, according to the Decree of the Government of the Russian Federation dated 01.10.2015 No. 1050[2], IDP are developed only in relation to facilities in the fields of education, healthcare, culture, physical culture and sports;

2) requirements for transport infrastructure are established by Decree of the Government of the Russian Federation No. 1440 dated 12/25/2015[3];

3) for public infrastructure systems, the requirements are established by Decree of the Government of the Russian Federation No. 502 dated 06/14/2013[4].

However, these documents do not contain the procedure for interaction of authorized public authorities involved in the preparation of IDP, and the rules for delineating the areas of responsibility of authorities for the preparation of IDP are not established. In addition, these documents do not show the correlation of the IDP and other documents formed and implemented by public authorities within the framework of the implementation of territorial planning documents.

The authors of the paper propose a new methodological approach to establishing the procedure for delineating the areas of responsibility of public authorities in the preparation of IDP, filling a gap in the organizational, economic and legal field and ensuring the introduction of effective tools for the implementation of plans and measures for the integrated development of the city.

The use of the proposed methodological approach, primarily for cities of federal significance, will allow in practice to streamline the interaction of authorities on the formation of a comfortable urban environment, ensure transparency of IDP creation process, interconnection of documents of various levels and decisions taken to create appropriate infrastructure facilities.

The presented information confirms the novelty in comparison with the industry approach, which is the basis of the current regulations.

RESULTS

The monitoring of normative acts carried out by the authors of the article showed differences in the requirements for documents providing for the formation of IDPs of various directions (Table 1).

Table 1. The main documents are the grounds for the formation of IDPs of various industry orientation

Name of the document to generate the IDP	Integrated development programmes *		
	Transport infrastructure	Social infrastructure	Communal infrastructure
The strategy of socio-economic development of the municipality and its implementation plan	+	+	+
State and municipal programmes	+	+	+
The plan and programme of integrated socio-economic development of the municipality and its implementation plan	+	+	+
Investment programmes of subjects of natural monopolies	+	+	–
An agreement on the integrated development of territories or on the development of built-up areas	+	+	–
Other investment programmes and agreements providing for the obligations of developers for the design, construction, and reconstruction of facilities	–	+	–
Schemes and programmes for the development of a unified national (all-Russian) electric grid for a long-term period	–	–	+
General layout of electric power facilities	–	–	+
Federal Gasification Programme	–	–	+
Interregional and regional gasification programmes	–	–	+
Heat supply scheme	–	–	+
Water supply and sanitation scheme	–	–	+
Waste management programmes	–	–	+

Note: * — (+) — documents that are the basis for the development of IDP; (–) — documents that are not intended to be used in the development of IDP.

1 Urban Planning Code of the Russian Federation dated December 29, 2004 No. 190-FZ. URL: http://pravo.gov.ru/proxy/ips/?docbody=&nd=102090643 (access date: 06.09.2024) (rus.).

2 Approval of requirements for programmes for the integrated development of social infrastructure in settlements, municipal districts, and urban districts : Resolution of the Government of the Russian Federation dated October 01.2015 No. 1050. URL: http://pravo.gov.ru/proxy/ips/?docbody=&nd=102379324&intelsearch=01.10.2015+%B9+1050 (access date: 06.09.2024) (rus.).

3 Approval of requirements for programmes for the integrated development of transport infrastructure in settlements, municipal districts, and urban districts : Resolution of the Government of the Russian Federation dated December 25, 2015 No. 1440. URL: http://pravo.gov.ru/proxy/ips/?docbody=&intelsearch=%EF%EE%F1%F2%E0%ED%EE%E2%EB%E5%ED%E8%E5%20%EE%F2%2025.12.2015%20%B91440&nd=102387795 (access date: 06.09.2024) (rus.).

4 Approval of requirements for programmes for the Integrated development of communal infrastructure systems in settlements, municipal districts, and urban districts : Resolution of the Government of the Russian Federation dated June 14, 2013 No. 502. URL: http://pravo.gov.ru/proxy/ips/?docbody=&link_id=6&nd=102166023&bpa=cd00000&bpas=cd00000&intelsearch=%C1%FE%E4%E6%E5%F2%ED%FB%E9+%EA%EE%E4%E5%EA%F1++ (access date: 06.09.2024) (rus.).

The analysis of normative documents[1, 2, 3, 4, 5] carried out by the authors of the paper, in accordance with which the development of IDP is envisaged, and the provisions of the authorities of St. Petersburg, made it possible to identify the areas of responsibility of executive bodies of state power in the preparation and implementation of IDP (Table 2).

The proposed assignment of authority for the formation of IDP to a specific authority is based on the principles of territorial and sectoral planning, which allows taking into account not only the industries directly established for the development of IDP, but also the need to involve authorities in the development of a socio-economic strategy of a city or region and a spatial development strategy.

The delineation of the areas of responsibility of the authorities of St. Petersburg in the preparation of IDP should be legally fixed. It is proposed to amend the Law of St. Petersburg dated 10/28/2009 No. 508-100 "Urban Development in St. Petersburg"[5], ensuring the separation of powers between legislative and executive authorities in terms of preparation and approval of IDP. Also, a necessary step is the development and approval of the decree of the Government of St. Petersburg, which establishes the procedure for interaction of executive bodies of state power in the development and approval of IDP.

CONCLUSIONS

1. Based on the methods of logical and comparative analysis, expert assessment, a new methodological approach to establishing the procedure for delineating the areas of responsibility of public authorities in the preparation of IDP is proposed, which allows filling a gap in the organizational, economic and legal field and ensuring the introduction of effective tools for the implementation of plans and measures for the integrated development of the city, taking into account economic and spatial components.

2. Based on the conducted research for St. Petersburg, a city of federal significance, the areas of responsibility of executive bodies of state power for the preparation and implementation of IDP are

Table 2. Areas of responsibility of executive bodies of state power in the preparation and implementation of IDP (on the example of St. Petersburg)

IDP area	Committee	Authority
Communal infrastructure	Committee on Energy and Engineering	1. Development of IDP systems of municipal infrastructure of St. Petersburg, as well as sections of IDP systems of municipal infrastructure of St. Petersburg concerning heat, water supply, sanitation and wastewater treatment. 2. Preparation of draft federal laws, legal acts of federal executive authorities, laws of St. Petersburg, resolutions and orders of the Governor of St. Petersburg, including resolutions of the Governor of St. Petersburg on approval of the scheme and programme for the development of the electric power industry of St. Petersburg. 3. Approval of the regional gasification programme for housing and communal services, industrial and other organizations. 4. Approval of the resolutions of the Government of St. Petersburg on the approval of the scheme of water supply and sanitation of St. Petersburg, the regional programme of St. Petersburg in the field of energy conservation and energy efficiency improvement
Transport infrastructure	Committee for the Development of Transport Infrastructure	Development and implementation of programmes and measures for the development of transport infrastructure facilities, improvement of the transport and operational condition of roads and road structures
	Transport Committee	1. Analysis, forecasting and planning of the development of the transport complex of St. Petersburg. 2. Participation in the implementation of strategic planning
Social infrastructure	Health Committee	1. Development and implementation of a healthcare development programme. 2. Ensuring the implementation of state programmes of St. Petersburg and other plans and programmes approved by the Government of St. Petersburg
	Education Committee	1. Development and implementation of measures for the implementation of management in the field of education. 2. Coordination of activities in the field of education of the executive bodies of state power of St. Petersburg
	Committee on Physical Culture and Sports	Development and organization of the implementation of programmes and plans, as well as long-term target programmes and departmental target programmes of St. Petersburg
Economic planning	Committee on Economic Policy and Strategic Planning	1. Determining the necessary financial resources for the implementation of IDP and clarifying the compliance of the needs and budget opportunities of the city. 2. Coordination of the preparation of the procedure for interaction between the committees of St. Petersburg in the preparation of IDP of social infrastructure, taking into account the interdepartmental nature of the project (objects of education, health, physical culture and sports and culture)
Territorial planning	Committee on Urban Planning and Architecture	Verification of the developed IDPs for compliance with the General Plan of St. Petersburg

5 Urban development in St. Petersburg : The Law of St. Petersburg dated October 28, 2009 No. 508-10. URL: https://docs.cntd.ru/document/891821322 (access date: 06.09.2024) (rus.).

identified, further necessary measures for regulatory support of the developed procedure are proposed.

REFERENCES

1. Gertsberg L.Ya. The Quality of the urban environment: issues of planning and implementation. City and Town Planning. 2013; 2(24): 29-33. EDN QCKDXF. (rus.).
2. Ershova S.A., Shishelova S.A., Orlovskaya T.N. Efficiency assessment of urban planning transformations: economic and legal aspects. Vestnik MGSU [Monthly Journal on Construction and Architecture]. 2020; 15(9):1308-1320. DOI: 10.22227/1997-0935.2020.9.1308-1320. EDN WWKFEY. (rus.).
3. Zotov V.B. Strategic planning in the system of local self-government (problem review and recommendations). Municipal Academy. 2018; 1:6-9. (rus.).
4. Sokolova S.V. Urban environment and its comfort in the cities of the Russian Federation. Municipal Academy. 2022; 3:173-179. DOI: 10.52176/2304831X_2022_03_173. EDN GOCOQR. (rus.).
5. Douglas O., Lennon M., Scott M. Green space benefits for health and well-being: A life-course approach for urban planning, design and management. Cities. 2017; 66:53-62. DOI: 10.1016/j.cities.2017.03.011
6. Kirillova A., Kostrikin P.N. Setting the urban development standards as the basis of ensuring eco-economic sustainability of construction. MATEC Web of Conferences. 2018; 193:05024. DOI: 10.1051/matecconf/201819305024. EDN HUXPHK.
7. Krugman P.R. Geography and Trade. Cambridge (Mass.). 1991; 156.
8. Clark D. Urban world, Global city. Taylor & Francis e-Library, 2004: 211.
9. Krätke S., Taylor P.J. A world geography of global media cities. European Planning Studies. 2004; 12(4):459-477. DOI: 10.1080/0965431042000212731
10. Sternik S.G. Integrated urban development and regional economies. Forecasting problems. 2023; 2(197):57-75. DOI: 10.47711/0868-6351-197-57-75. EDN LSMBKA. (rus.).
11. Grabovyy P.G., Samosudova N.V. Legislative framework, enforcement and prospects for the development of housing policy and housing relations. Realty: economy, management. 2020; 2:73-82. DOI: 10.22227/2073-8412.2020.2.73-82. EDN UCHKQC. (rus.).
12. Larionov A.N., Larionova Yu.V. Problems of increasing effectiveness of house building at macroregion level. Journal of Legal and Economic Studies. 2017; 1:167-171. (rus.).
13. Ershova S., Orlovskaya T., Shishelova S. Methodology of planning social infrastructure development to create a comfortable urban environment. MATEC Web of Conferences. 2018; 02018. DOI: 10.1051/matecconf/201817002018. EDN VBPTTQ.
14. Lukmanova I.G., Yaskova N.Yu. On investment and construction activity tasks in the context of Russian spatial development trends. Vestnik MGSU. 2019; 14(6):774-784. DOI: 10.22227/1997-0935.2019.6.774-784
15. Yaskova N.Yu., Sarchenko V.I., Khirichev S.A. Integrated approach to the formation of a high-quality, competitive urban environment. Realty: economy, management. 2020; 2:12-21. DOI: 10.22227/2073-8412.2020.2.12-21. EDN HDYWVW. (rus.).

Методические подходы к установлению зон ответственности органов власти при подготовке и реализации программ комплексного развития

Представлено исследование методических подходов к формированию программ комплексного развития. Проведен мониторинг положений нормативных правовых актов по разработке и утверждению программ комплексного развития. Выявлены особенности нормативных требований к формированию программ комплексного развития различной отраслевой направленности, сделан вывод о приоритете отраслевого подхода. Отмечены главные недостатки действующей системы формирования программ комплексного развития и необходимость учета компонентов экономического и пространственного планирования. На основе предложенного комплексного подхода для Санкт-Петербурга выявлены зоны ответственности исполнительных органов государственной власти по подготовке и реализации программ комплексного развития, сделаны предложения по законодательному закреплению предложенного разграничения полномочий органов власти в части подготовки и утверждения программ комплексного развития.

Представленные в статье разработки позволят на практике решать проблему по установлению порядка взаимодействия исполнительных органов государственной власти при формировании программ комплексного развития, т.е. решать проблему, имеющую важное социально-экономическое значение для России.

Ключевые слова: *программы комплексного развития, методические подходы, формирование программ комплексного развития, зоны ответственности органов власти Санкт-Петербурга при подготовке программ комплексного развития*

СПИСОК ИСТОЧНИКОВ

1. Герцберг Л.Я. Качество городской среды: проблемы проектирования и реализации // Градостроительство. 2013. № 2 (24). С. 29–33. EDN QCKDXF.
2. Ершова С.А., Шишелова С.А., Орловская Т.Н. Экономические и правовые аспекты оценки эффективности градостроительных преобразований территории // Вестник МГСУ. 2020. Т. 15. Вып. 9. С. 1308–1320. DOI: 10.22227/1997-0935.2020.9.1308-1320. EDN WWKFEY.
3. Зотов В.Б. Стратегическое планирование в системе местного самоуправления (проблемный обзор и рекомендации) // Муниципальная академия. 2018. № 1. С. 6–9.
4. Соколова С.В. Городская среда и ее комфортность в городах Российской Федерации // Муниципальная академия. 2022. № 3. С. 173–179. DOI: 10.52176/2304831X_2022_03_173. EDN GOCOQR.
5. Douglas O., Lennon M., Scott M. Green space benefits for health and well-being: A life-course approach for urban planning, design and management // Cities. 2017. Vol. 66. Pp. 53–62. DOI: 10.1016/j.cities.2017.03.011
6. Kirillova A., Kostrikin P.N. Setting the urban development standards as the basis of ensuring eco-economic sustainability of construction // MATEC Web of Conferences. 2018. Vol. 193. P. 05024. DOI: 10.1051/matecconf/201819305024. EDN HUXPHK.
7. Krugman P.R. Geography and Trade. Cambridge (Mass.). 1991. 156 p.
8. Clark D. Urban world, Global city // Taylor & Francis e-Library. 2004. 211 p.
9. Krätke S., Taylor P.J. A world geography of global media cities // European Planning Studies. 2004. Vol. 12. No. 4. Pp. 459–477. DOI: 10.1080/0965431042000212731
10. Стерник С.Г. Комплексное развитие территорий и экономика регионов // Проблемы прогнозирования. 2023. № 2 (197). С. 57–75. DOI: 10.47711/0868-6351-197-57-75. EDN LSMBKA.
11. Грабовый П.Г., Самосудова Н.В. Законодательная основа, правоприменение и перспективы развития жилищной политики и жилищных отношений // Недвижимость: экономика, управление. 2020. № 2. С. 73–82. DOI: 10.22227/2073-8412.2020.2.73-82. EDN UCHKQC.
12. Ларионов А.Н., Ларионова Ю.В. Проблемы повышения эффективности жилищного строительства на уровне макрорегиона // Журнал правовых и экономических исследований. 2017. № 1. С. 167–171.
13. Ershova S., Orlovskaya T., Shishelova S. Methodology of planning social infrastructure development to create a comfortable urban environment // MATEC Web of Conferences. 2018. P. 02018. DOI: 10.1051/matecconf/201817002018. EDN VBPTTQ.
14. Лукманова И.Г., Яськова Н.Ю. О новых задачах инвестиционно-строительной деятельности в контексте трендов про-

странственного развития России // Вестник МГСУ. 2019. Т. 14. Вып. 6 (129). С. 774–784. DOI: 10.22227/1997-0935.2019.6.774-784.
15. Яськова Н.Ю., Сарченко В.И., Хиревич С.А. Комплексный подход к формированию качественной городской среды // Недвижимость: экономика, управление. 2020. № 2. С. 12–21. DOI: 10.22227/2073-8412.2020.2.12-21. EDN HDYWVW.

Об авторах: **Ершова Светлана Анатольевна** — доктор экономических наук, профессор, профессор кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; ID RISC: 319827, Scopus: 56478980400, ORCID: 0000-0001-6100-6404; ershova-2024@yandex.ru;

Чернышова Ангелина Станиславовна — студент 4 курса бакалавриата, кафедра организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; Ast.chernyshova@yandex.ru.

For citation: Ershova S.A., Chernyshova A.S. Methodological approaches to establishing areas of responsibility of authorities during preparation and implementation of integrated development programmes. *Real Estate: Economics, Management.* 2024; 3:77-81.

Для цитирования: *Ершова С.А., Чернышова А.С.* Methodological approaches to establishing areas of responsibility of authorities during preparation and implementation of integrated development programmes // Недвижимость: экономика, управление. 2024. № 3. С. 77–81.



Л.И. Павлова. Москва. Церковь Антипия на Колымажном дворе. Рисунок, тушь перо.