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Уважаемые читатели!

В России в соответствии с новой Конституцией РФ (статья 114, пункт 1, п. 5) государственные органы власти обязаны содействовать реализации права каждого гражданина на жилье и стимулировать его для самостоятельной организации своего проживания. Таким образом, отправной точкой решения жилищных проблем является справедливое и равноправное удовлетворение основных потребностей граждан.

В соответствии с основными задачами улучшения условий проживания российских граждан каждому проживающему в России физическому лицу предоставляется возможность получить приемлемое жилье на основе трех критериев:

1) каждая семья должна иметь квартиру, количество комнат и площадь которой соответствуют размеру семьи и индивидуальным потребностям ее членов;

2) по своим составу, конструкции и оснащению квартира должна быть целесообразной, соответствовать нормативным экологическим требованиям и функциональности, а жилые дома должны вписываться в окружающую среду;

3) расходы на жилье являются приемлемыми и пропорциональны количеству членов семьи и используемым помещениям, а также объему дополнительных расходов.

Социальные дотации предназначены, в первую очередь, для таких семей, которые при отсутствии средств не имеют возможности достичь приемлемого уровня проживания. Это означает, что первоочередная ответственность за оплату организации жилья и расходов на него лежит на самих гражданах.

Помимо социального и коммерческого найма жилья, в некоторых регионах России в качестве эксперимента становится популярной особая форма корпоративного жилья — квартира с правом проживания и постепенного выкупа. Такая форма существует во многих странах уже давно, а в северных странах Европы и Канаде образует значительную часть жилого фонда — 12…17 %. Указанные формы жилья объединяет то, что гражданин, нуждающийся в жилье, может получить его, имея небольшие собственные средства, путем внесения взноса за право проживания, который составляет не менее 5 % стоимости квартиры.

Такую квартиру нельзя произвольно продать, поскольку она представляет собой нечто среднее между частной и арендной квартирой.

Подобная форма жилья становится популярной по той причине, что гарантия проживания в ней является надежной с точки зрения права граждан на жилье. Данная инициатива сейчас обсуждается в Государственной Думе РФ. Эти и другие жилищные проблемы, а также механизмы их решения представлены в данном выпуске журнала.

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Thus, the repair of thermal insulation of external walls of buildings is a problem and becomes of paramount importance and necessity for all residential buildings in Vietnam, and especially in large cities (for example, Hanoi, Ho Chi Minh city, da Nang).

Власов Д.Н., Вакуленко С.П., Роменский Д.Ю.

The choice of routing the only monorail line was due to several factors: Moscow's struggle for the right to host the prestigious EXPO-2010 exhibition (which was later held in Shanghai), the presence of a finished alignment in urban development, left by the General Plan of Moscow for the development of the road network and other factors.

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Volkov R.V.

Principles of corporate governance as the basis for the formation of the strategic advantage of enterprises in the construction industry

Volkov Roman Vyacheslavovich,
Candidate of Economic Sciences, Vice-rector; Russian University of Transport (RUT); bldg. 9, 9 Obraztsova St., GSP-4, Moscow, 127994, Russian Federation; ID RISC: 872062; volkov-su4@mail.ru

The classical interpretation of the principles of corporate governance in terms of effectiveness is important for understanding the economic essence of the management system and its evaluation. Constantly changing socio-economic, epidemiological and geopolitical conditions make the problem of updating the principles of corporate governance important for the clarification of the requirements to be met to ensure a strategic advantage in the construction industry and to maintain competitiveness in the course of the life cycle of an investment construction project and in the process of the long-term construction facility operation. This statement is quite logical, because the focus of the economic science on understanding the principles of corporate governance is especially strengthened during periods of interphase cyclical transitions, triggered by the activation of an economic reform, accompanied by an increase in the uncertainty of business conditions.

The project format of modern investment and construction activities becomes the dominant form of its implementation due to the high potential of integration with targeted federal and regional programs and as a result of the adequacy of the task of resource management at each stage of the project life cycle, which in turn allows to effectively allocate resources in time and space.

Keywords: *corporate governance, strategic advantage, management principles, economic efficiency, life cycle, competitiveness, structure-behavior-result*

I. INTRODUCTION

Back in the 19th century, the fundamental and up-to-date theses were formulated by M.M. Speransky (Table 1) [1], which predetermined the content characteristics of modern ideas about the principles of corporate governance. These management principles were the basis for the reforms carried out in Russia at the end of the 19th century [1]. The analysis of their content showed that in addition to the priority of the object over the subject of management, consistency and planning, management should change under the influence of the "spirit of change". According to the author of the pre-revolutionary reforms, the requirements applied to management should be clarified and brought to some "perfect" format. The Soviet period clearly shows how the principles of governance changed under the influence of altering development challenges. Such principles as the principles of partisanship, scientific character, democratic centralism, mass involvement in government, discipline, planning and accounting, party leadership, legality, and internationalism were not merely considered, but also contributed to legislative and regulatory legal acts. With the emergence of new economic relations and business conditions, especially in the course of transition to the market economy, the basic concepts of the management process, its goals and mechanisms changed. New business entities, or business communities emerged, which could not but lead to a revision of the general principles of management and the formation of their new contexts. The views of M.M. Speransky were contributed to the present-day principles of corporate governance, which, in fact, adapted to changes in the external and internal environment, and to a greater or lesser extent "were aligned with the spirit of the times".

II. STRUCTURING CORPORATE GOVERNANCE PRINCIPLES

Understanding the essence of the principles of corporate governance in a highly dynamic environment of corporate functioning is impossible, if the features of their application in modern conditions is disregarded [2]. In addition, placing too much importance on a particular requirement is always accompanied by risks. Table 2 shows the risks of excessive distribution and prevalence of certain requirements. This indicates that the use of principles, as well as management measures, is systematic and balanced.

Consistency and mutual compliance of all horizontal and hierarchical components of the corporate governance system is not only a consequence of the continuous process of coordinating the economic interests of divisions, services and employees, but also the result of the implementation of the principles listed in Table 2.

In the current environment of accelerating transformation processes, organizational harmony should not only be achieved, but also supported by managerial efforts exerted in accordance with the requirements arising from the essence and features of application of management principles, provided that the risks of each of them are minimized.

It is necessary to define the principle of efficiency and competitiveness as the essence of the target criterion. Thus, the internal hierarchy of the principles listed in the Table 2 can be summarized in Fig. 2.

Following the scheme of subordination of principles, we note that the principles of integrity and reasonableness, loyalty, efficiency and competitiveness undergo significant changes in accordance with changes in the values of society and the business environment.

Table 1. Governance principles of Count M.M. Speransky

No.	Principle title	Principle content
1	Governance instability	" … Lack of solid basis was the reason for our governance hitherto lacked any defined mode and many institutions, being perfect per se, decayed as swiftly, as they arose"
2	Consistency	" … Theories are seldom of any use to practice. They comprise only one part and take no consideration to the system friction, later lamenting over the human race"
3	Planning	" … Why all human regulations are so imperfect? Besides many other reasons, due to the fact that they are mainly accomplished fragmentary without general pattern"
4	Ideology commitment	"Correspondence of system of management to the spirit of time"
5	Priority of the Object over the Subject of management	"The Subject should always take into account features of the Object"
6	Self-governance	"Decision-making discretion — not benefit, but conditio sine qua non"

Table 2. The essence, features и risks of application of corporate governance principles

No.	Principle	Essence, features and risks
1	Organizational harmony (Taylor)	Congruency and compliance of hierarchal and functional levels of a corporate governance system. Feature: organizational harmony as a consequence of coordination of interests of corporate divisions, services and employees. Risks: development pace reduction, conflicts of interests as the source and driving force of development
2	Principle of legality	All decisions taken in the course of corporate governance should comply with the current legislation. Feature: legality should be applied to the whole corporation, it also protects the rights of corporation participants. Risks: the waste of time for validation of actions (licensed product manufacturing, etc.)
3	Principle of management centralization	Main strategic decisions and responsibility for their implementation are focused in one hand. Practical implementation feature: professional expertise in finance, IT, production and HR should be the basis for individual or collective decisions to ensure a common policy. Main risks: incompetence and lack of perception of the overall pattern of development
4	Principle of delegation of authority	Delegating authority to subordinate governance bodies, structural divisionы, employees. Feature: update due to the increasing scale and complexity of production, narrower management specialization. Risks: disintegration and separatism of divisions and services
5	Principle of activity coordination	Coordination of management impact on the objects of corporate governance in order to achieve a single corporate goal. Feature: decline of direct managing influence on the objects of governance that disregards the consequences for all objects. Risks: slowdown, loss of development sustainability and efficiency due to the lack of system information for everyone about everyone
6	Adaptivity principle	Bringing the corporate governance system into a state of maximum efficient use of all development resources. Features: the key importance of the time factor and feedback in respect of the elements and the entire corporate governance system exposed to changes in the external and internal environment. Risks: conservatism leads to partial realization of the company's strategic advantage and loss of its competitiveness
7	Principle of corporation participants involvement in the work of management bodies	It applies, first of all, to participation in the work of the assembly, public, scientific and discussion platforms. Features: the possibility of participation in other corporate management bodies in the manner determined by both the law and the constituent documents of the corporation. Risks: procrastination in finding consensus
8	Information support of corporate governance principle	Functioning of the integrated information support system. Features: sufficient information must be provided for informed decision making at all levels. Risks: waste of time and money on collecting excessive information
9	Good faith and reasonableness principle	The activities of the management bodies of the corporation in the interests of the legal entity represented by it. Features: participation in the management of non-equity capital, the duty of the manager to show in the conduct of the company's affairs an interest similar to that of an entrepreneur in similar circumstances. Risks: incomplete realization of the property interest of the owner of the capital

End of Table 2

No.	Principle	Essence, features and risks
10	Loyalty principle	The corporation's activities must be in the public interest. Features: the principle applies to both the internal and external environment. Risks: conflict of interests, development slowdown
11	Efficiency and competitiveness principle	The state of the corporate governance system, that is ahead of the entire competitive environment, is outlined according to the criterion of integrated efficiency. Features: additional requirements for capitalization, benchmarking, strategic priority, balance, redundancy, standardization, interchangeability, effective restructuring, budgeting, etc. Risks: loss of competitive advantages, bankruptcy

This hierarchy takes account of the development pace of external and internal factors of influence, as well as the continuous growth and change in the structure of consumer sentiment, the emergence of environmental and social filters, new communication technologies, the formation of public opinion, stable perception stereotypes, etc. In the context of division of management functions and ownership functions associated with the growth and increase in the scale of corporate activities, the requirement to ensure systematic actions for the benefit of a corporation is updated. It is implemented in practice according to the principle of good faith and reasonableness, which implies responsibility not only for one's own actions, but also for evaluating the actions of other persons in terms of compliance with corporate interests. In this regard, it is important, on the one hand, to identify corporate interests, on the other hand, to establish the degree of freedom of corporate divisions, services and employees in their activities.

It is obvious that the totality of all corporate interests cannot be reduced to the interests of the founders and owners [3]. They also do not always coincide with the those of the state. In this respect, it is no coincidence that the concept of "interests of a legal entity" (article 53 of the Civil Code of the Russian Federation) is fixed by the law and allows the autonomy and partial isolation from the state interests of a business entity, having the status of a legal entity.

The application of legality, loyalty, integrity and reasonableness principles in the corporate management of a construction company is the requirement established by the legislation of the Russian Federation in terms of pricing and estimated rationing in the field of urban planning, rules of land use and development, organization of design and construction works, as well as related mandatory measures aimed at obtaining approvals, permits and other documents issued by authorized bodies [4]. In such a case, depending on the situation, the company focuses on one of the principles in its activities, for example: if the activities of a construction company are more dependent on budgetary funding, then the principle of legality is taken as the basis; in case of extra-budgetary funds, the principle of good faith and reasonableness prevails.

At the same time, the effectiveness of management of a large construction corporation depends on the joint application of several principles, such as the principle of management centralization, delegation of authority, coordination of activities and information support. For example, strategic decisions are made by the head office (the meeting of founders), while local issues are resolved by subsidiaries in interaction with the head office of a large corporation engaged in the construction and sale of residential and commercial real estate in different regions of the country. At the same time, the information necessary for decision making is timely communicated both to the head office and the subsidiaries.

Corporate business stereotypes, that are currently being formed, are largely determined by loyalty requirements, but the content of principles of efficiency and competitiveness remains perhaps the most susceptible to dynamic changes in the environment, given the impossibility of ensuring competitiveness outside the modern understanding of efficiency underlying the sustainable development of a construction corporation.

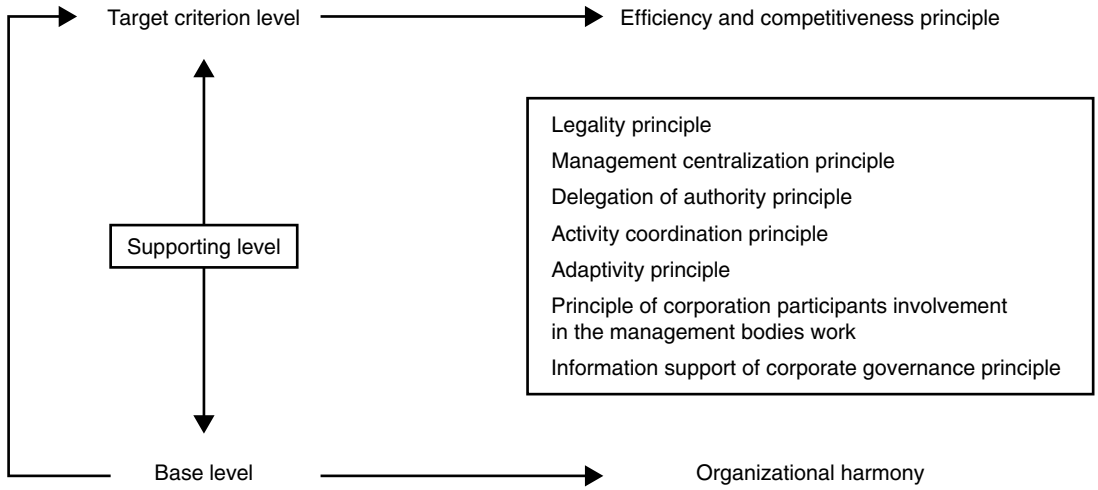

Fig. 1. Hierarchy of corporate governance principles in the construction sector

The focus of the principle of competitiveness and efficient implementation is placed on economic efficiency, while social and environmental efficiencies are fixed within acceptable limits (restrictions) and considered in the process of corporate activities as social and environmental filters [5, 6].

Fig. 2 shows that the focus is placed on the target efficiency. The determination of the concept of target efficiency of corporate activity, which objectively follows from the need to implement the principles of efficiency and competitiveness, within the framework of the fundamentals of the management theory, involves the decomposition into goal setting and executive efficiency [7].

The first component focuses on the degree of validity of corporate goals, including their selection and quantitative measurement. Performance efficiency reflects both the degree and quality of achievement of the set goals, which in turn is the basis for the competitiveness of a corporation.

All these types of economic efficiency are interrelated and come as a result of the certainty of values of functional and process efficiencies, set by the level of the target efficiency. In such a case, target effectiveness is a direct consequence of the strategic focus of activities. In the internal contour of Fig. 2, feedbacks show the need to organize a continuous process of targeted focus of corporate development with regard for the economic efficiency deviations of actual indicators in resource, functional and process sections [8].

Structuring the above types of economic efficiency of corporate governance requires their consideration not only depending on the types of resource provision or hierarchical levels, but also by project types and stages of project cycles. Accordingly, the target indicators of economic efficiency determined at each stage of corporate development are conventionally final, since they accumulate the previous effects and costs that date back to the previous stages of the life cycle of a real estate facility.

Thus, it is the target efficiency that is a decisive factor in relation to the resource, functional, process and project efficiency. The overall economic efficiency is ultimately determined by the degree of achievement of the pre-set final goals of the corporate activity.

III. THE MAIN TRENDS OF CHANGES IN THE PARAMETERS OF THE LIFE CYCLE OF COMMERCIAL REAL ESTATE PROJECTS

The project format of modern investment and construction activities becomes the dominant form of its implementation not only due to the high potential of integration with federal and regional target-oriented programs, including national projects, but also as a result of the adequacy of the task of managing the supply of resources at each stage of the project life cycle, which in turn allows project developers to effectively allocate resources in time and space. The framework of the concept of "structure-behavior-result" (SPR) assumes that the systemic characteristics of the external environment in relation to corporate activities directly determine the type of behavior of a corporation and, accordingly, the effectiveness of its activities [9]. In fact, in relation to the subject area under consideration, the industry-specific features of corporate activities determine the inter-corporate, inter-project and inter-phase distribution of resources. This means that as a result of competition for resources, a certain "rational system of corporate governance" (RSCI) is eventually developed [10]. Its distinctive features relate to the goal of accelerating the initial stages of project cycles in terms of rational resource consumption, included in the complex portfolio of real estate projects with regard for the factors of price and non-price competition

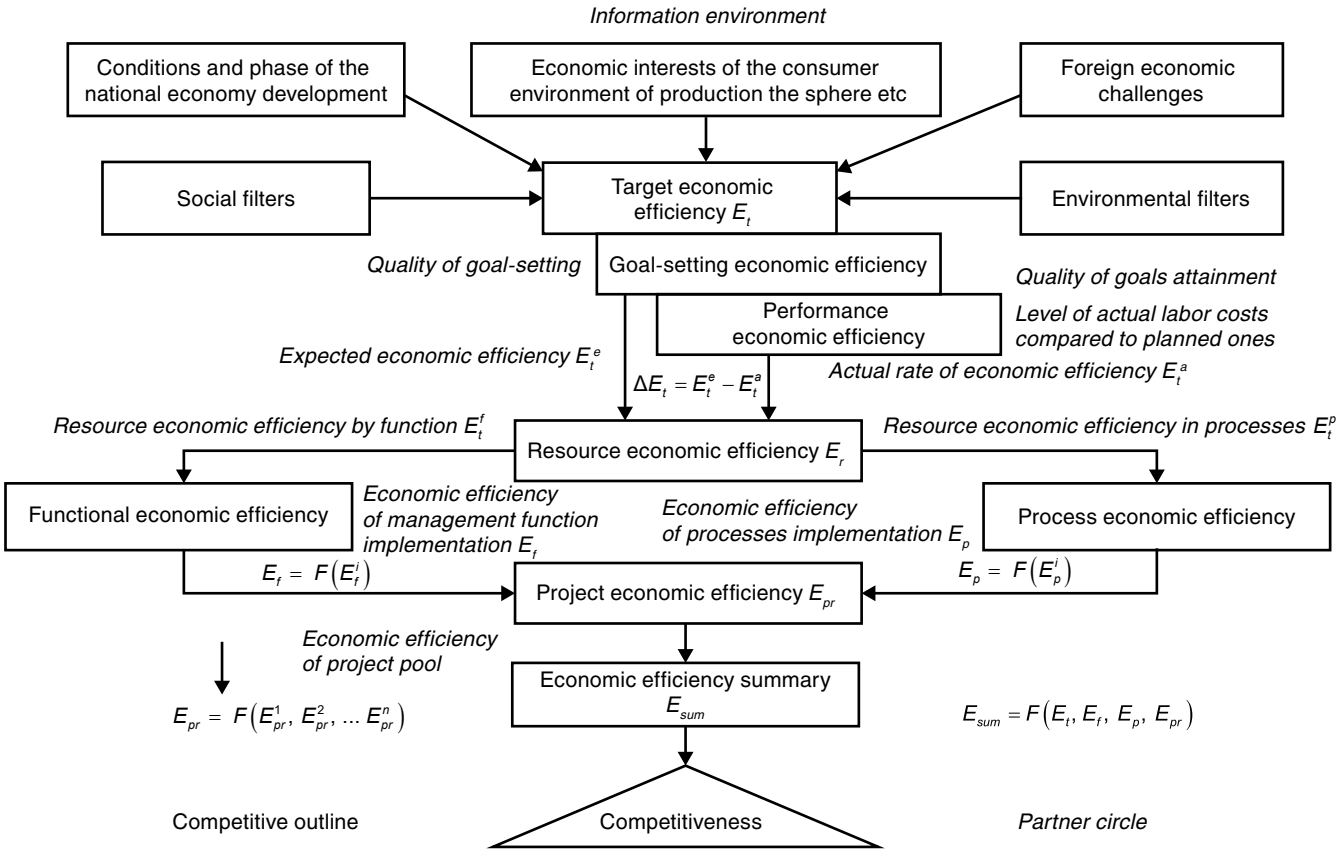

Fig. 2. Types of economic efficiencies of corporate activities in managing the life cycle of a real estate facility

that minimize the cost of producing finished construction products (Fig. 3). Rational resource consumption differs from minimalistic approaches in terms of its principal position in relation to the thesis of "obtaining corporate profit at any cost". The inadmissibility of deterioration of the project social and environmental parameters currently fully complements the technical and technological requirements [11].

Rationality as a concept that combines the goals of the "Nature – Society – Man" system and cuts off the goals of obtaining super-profits by the business environment reflects the desire of the elements of the system to reach a consensus of interests. By projecting corporate interests to the management system, we will be able to take account of the results of many years of researches focused on the essence of industry-specific corporate governance.

The meaning of this concept is reduced to the need for continuous development of the resource base needed for the implementation of project cycles. At the same time, it is quite obvious that each stage of the project implementation requires a special resource, and the polycentric format of corporate activities boosts the relevance of the problem of developing the construction resource base due to the the need for long-term partnerships, given the complexity of construction projects [12]. As for construction within the framework of a nation-wide project in a certain territory (for example, a special economic zone, a territory of advanced socio-economic development), resource provision should encompass not only the construction stage of the project cycle, but also the construction facility operation. The latter is also divided into characteristic stages.

The analysis of the activities, performed by construction corporations, shows that the creation of construction products is not the only stage where construction services are in demand [13]. The implementation of current and major repairs, reconstruction of real estate facilities in operation requires the involvement of professional construction organizations and the experience has proven that the best results are achieved by general contractors involved in the initial phases of project implementation [14]. As an example, Fig. 4 shows the life cycle of a conventional commercial real estate project divided into consolidated stages (the construction of an oil pipeline with a diameter of 780 mm in the context of non-decreasing demand and stable operation within the coming 35–40 years).

Given the fact that this is a highly risky project, stages of its implementation should entail tightened safety measures. They include:

1) periods of continuous diagnostics of the system condition T_i^d. They are carried out on an ongoing basis and interrupted to perform light and major repairs, as well as renovation;

2) periods of preventive measures and routine repairs T_j^{tr}, which include not only the planned replacement of certain components of fixed assets. We assume that preventive measures are carried out in a planned manner, that they do not significantly affect the resource consumption and do not require the involvement of independent contractors. Hence, we will only indicate periods of current repairs on the chart. The cost of current repairs should correspond to the task of restoring and capitalizing the original cost of a construction facility;

3) periods of major repairs T_n^{kr}. In practice, such periods may differ from the projected ones in terms of the start time, amount of work performed, and costs. It is important to understand that the

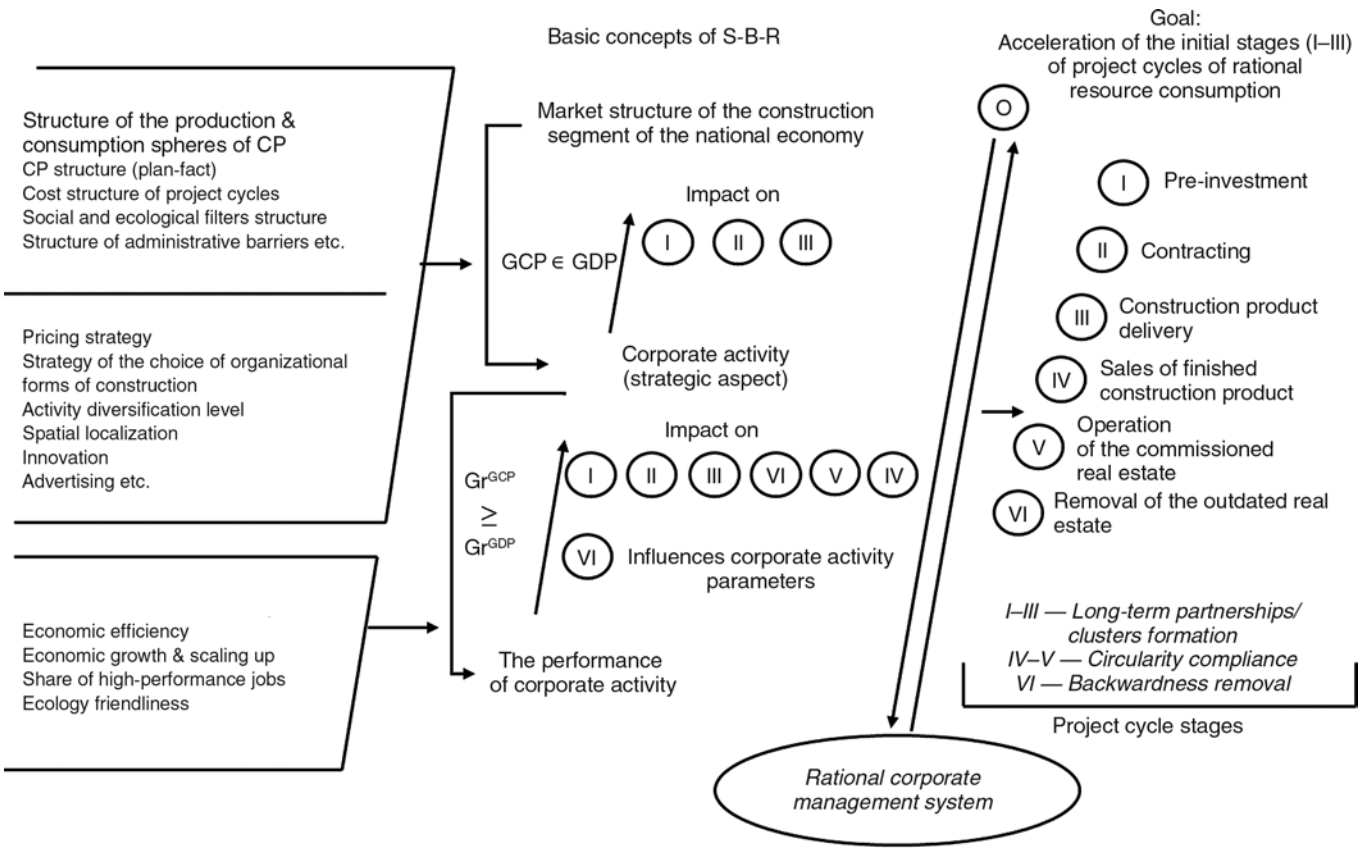

Fig. 3. Basic concepts of "structure-behavior-result" broken down by stages of the life cycle of commercial real estate: CP — construction product; GCP — gross corporate product; GDP — gross domestic product; Gr^{GCP}, Gr^{GCP} — growth of GCP and GDP accordingly

cost of major repairs must correlate with the prospects for the development of this property with regard for the alternative modes of its operation, as well as the technical and technological potential for the facility improvement;

4) renovation periods T_m^p, involving the renewal of linear and ground-based constructions. The capital intensity of the renovation is a consequence of the scale of renovation, that may involve the change in its functional purpose, capacity and significant correction of the level of operating costs.

We study the cost characteristics of the project cycle from the point of view of the potential and structure of emerging management problems and visualize them on the life cycle graph of a conventional commercial real estate project (Fig. 4). The main methodological assumption of the project cycle is the concept of total cost of ownership (TCO). In the international practice, it is used as an established concept of the "Total Cost of Ownership (TCO)" and is applied to the valuation of goods and wares, products or systems. Its essence is a comprehensive assessment of the total costs born throughout the entire life cycle of the project, including the pre-investment stage, iissuance of initial permits, making contracts and selecting contractors for investment and construction activities, construction, operation of the facility through its liquidation at the end of the project lifecycle. Thus, along with market indicators, investment, collateral, and liquidation values, it is advisable to monitor the pace of the total cost of ownership of real estate within the framework of the TCO concept. This indicator becomes the main indicator for a developer or an investor.

Plummeting values ($C^H(t)$), namely $C^{p1} > C^{p2} > C^{p3} > C^{p4}$ and C^{p5}, are the consequence of the accumulation of depreciation of the linear property and growing operating costs, which naturally increase the TCO and encourage the owner to take measures to reduce the cost characteristics of the life cycle of the property.

The decision on the scope of repair and reconstruction of pipelines is influenced by the following circumstances:

- firstly, the pace of production and the demand for transported raw materials;
- secondly, the projected parameters of the design cycle with regard for the wear resistance of materials, the geophysical conditions of the pipeline, as well as the operating mode set by the design characteristics;
- thirdly, the degree of compliance with the design requirements in terms of the operation of the pipeline;
- fourthly, the nature of the environmental impact on the technical condition of the pipeline (the influence of overpasses close to each other, natural factors, including groundwaters, earth movement, etc.);
- fifth, the potential of innovative preventive maintenance technologies;
- sixth, the level of decapitalization of the project broken down by the periods and phases of the project cycle, etc.

The latter circumstance is of fundamental importance: the larger the decapitalization value, that is, Δ_i, the larger the amount of the planned work to be carried out. In practice, this means that these

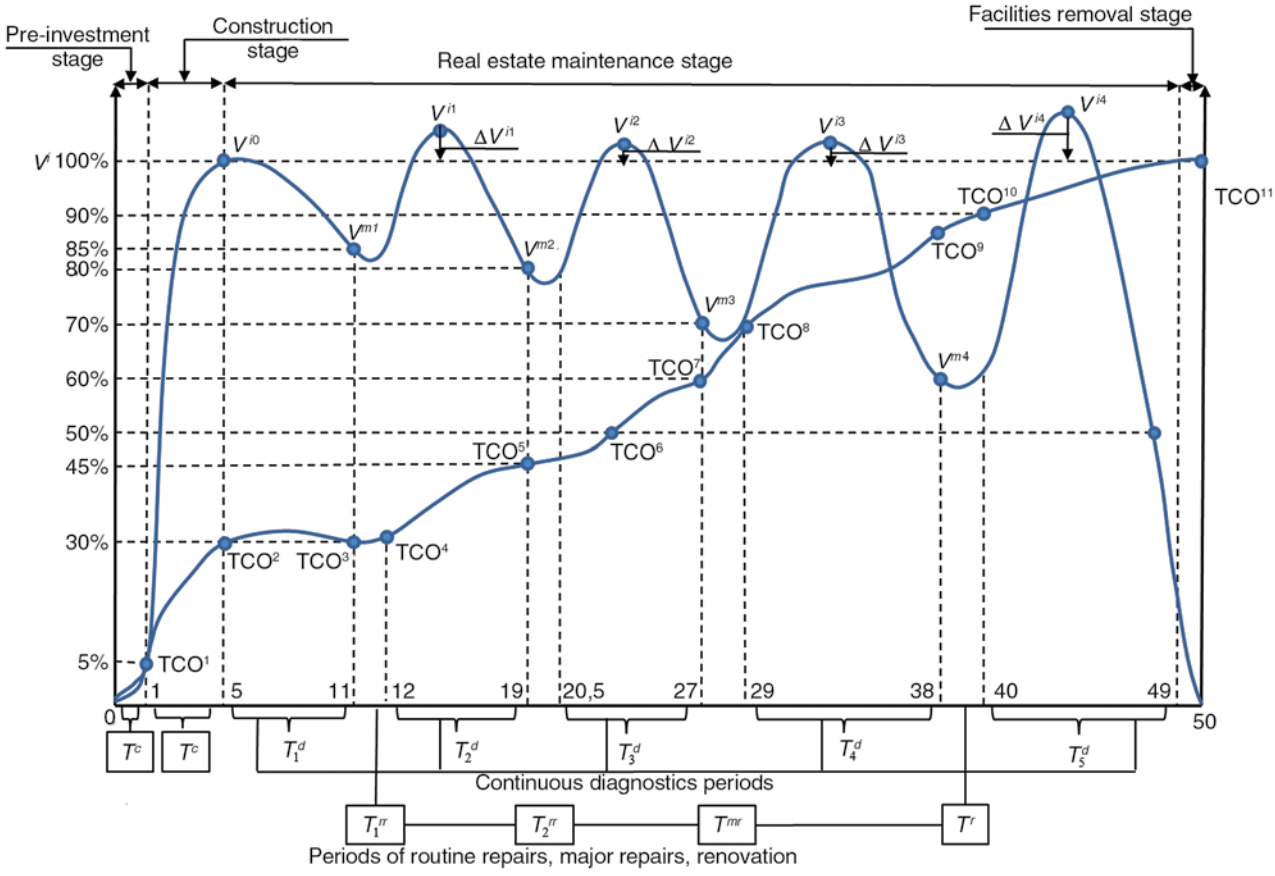

Fig. 4 The life cycle of a commercial real estate project (exemplified by the construction of a pipeline facility divided into consolidated stages): V^m — market value of the commercial real estate; V^i — investment value at the delivery stage; T^c, T^c, T_1^{rr}, T_2^{rr}, T^{mr}, T^r — corporations' interests zones; TCO — total cost of ownership of real estate object; T_i^j — life cycle stages duration

amount of work are of economic interest to construction corporations, forcing them to participate in competitive placement of contracts.

The decision of the owner to hire a contractor is influenced by the following factors:

- firstly, contractual terms and obligations of the Customer (the owner) and the Contractor involved in the first and second stages of the project;
- secondly, the balance sheet holder has its own production facilities for the repair and reconstruction of pipelines;
- thirdly, local contractors can minimize the costs of expedition and shift modes;
- fourthly, the state of the competitive environment and potential opportunities can reduce the cost of repairs and reconstruction of the pipeline, etc.

The studies show that construction contracts of the extended type are usually not concluded, and the choice of the Contractor is influenced exclusively by the cost characteristics, therefore, the Project is deprived of capitalization [15]. This approach reduces the wear, but, as a rule, performance characteristics do not change. It is quite obvious that the Project developer and the General Contractor, who are aware of all the technical, technological and geophysical details of the properties, are able to really assess not only the scope of work, including the entire pipeline length, but also to have the highest quality work done. At the same time, we will mind that projects that have long life cycles are implemented by the teams whose composition may change in the process, but if BIM technologies are applied, the accuracy and consistency of information available at all stages of the project implementation allows to solve the problems of maintenance and growth of the market value of the Project without prejudice to the comprehensive assessment of operational issues. The need for BIM technologies is determined by the market nature of the corporate activities performed by the Contractor and the Customer, who also needs to increase the value of the business enterprise [8].

Starting from the end of 2020 o information, documents, materials concerning the operation of a building and a structure, including the maintenance of a building or a structure, current repairs of a building or a structure, and operational control are subject to inclusion in the information model[1].

The information model of a capital construction facility, including processes of collecting, processing, classifying, recording and electronic storing of interrelated information, documents and materials about a construction facility and (or) the demolition of a construction facility;

The development and maintenance of an information model of a construction facility are performed by the developer, the customer, the person who provides or prepares the investment due diligence, and (or) the person responsible for the operation of a construction facility.

IV. Conclusion

Thus, understanding and clarifying the history of a construction facility allows the owner to minimize the total costs, since it enables him to realize that in most cases they depend on the quality of pre-investment and construction stages, that's when the efficiency of the facility's service life and its phases are specified. The frequency and duration of ongoing repairs, the need for major repairs and the lack of alternatives to renovation in all cases are specified in the project documentation and, in accordance with the concept of "structure-behavior-result", the pace of structural factors of the external environment is considered.

Changes in the parameters and objectives of consolidated project stages are effectively evaluated using the tools of the concept of "the total cost of ownership". The comparative analysis of predictive methods of strategic focus confirms the advantage of foresight methods, allows not only to identify "the breaking points" in the life cycle of a commercial real estate facility, but also to identify the potential for the parallel development of events.

1 Resolution of the Government of the Russian Federation, September 15, 2020 No. 1431 "On Approval of the Rules for the Formation and Maintenance of the Information Model of the Capital Construction Object, the Composition of Information, Documents and Materials Included in the Information Model of the Capital Construction Object and Submitted in the Form of Electronic Documents, and the requirements for the formats of these electronic documents, as well as on amendments to paragraph 6 of the Regulations on Performing Engineering Surveys for the Preparation of Project Documentation, Construction, Reconstruction of Capital Construction Objects".

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Принципы корпоративного управления как основа формирования стратегического преимущества предприятий строительной сферы

Классическая трактовка принципов корпоративного управления как основных требований обеспечения его эффективности важна, в первую очередь, для понимания экономической сущности системы управления, а также выработки критериев ее оценки. Общеизвестно, что принципы определяют подходы к организационной реструктуризации, а также выявлению характера деятельности субъектов управления и механизмов их взаимодействия с объектами управления. В настоящее время, в связи с постоянно меняющимися социально-экономическими, эпидемиологическими и геополитическими условиями, проблема актуализации принципов корпоративного управления важна в целях уточнения требований обеспечения стратегического преимущества в строительной сфере как достижения устойчивого состояния конкурентоспособности не только в жизненном цикле инвестиционного строительного проекта, но и в перспективном эксплуатационном цикле. Это вполне логично, так как внимание экономической науки к пониманию принципов корпоративного управления особенно усиливается в периоды межфазовых циклических переходов, обеспечиваемых активизацией реформирования экономики, сопровождаемой ростом неопределенности условий хозяйствования.

Проектный формат современной инвестиционно-строительной деятельности становится доминирующей формой ее реализации не только вследствие высокого потенциала сопряжения с федеральными адресными и региональными программами, а также национальными проектами, но и в результате адекватного соответствия задаче управления ресурсным обеспечением стадий проектного жизненного цикла, что, в свою очередь, позволяет эффективно размещать ресурсы во времени и в пространстве.

Ключевые слова: *корпоративное управление, стратегическое преимущество, принципы управления, экономическая эффективность, жизненный цикл, конкурентоспособность, структура-поведение-результат*

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Об авторе: **Волков Роман Вячеславович** — кандидат экономических наук, проректор; **Российский университет транспорта (РУТ (МИИТ))**; 127994, ГСП-4, г. Москва, ул. Образцова, д. 9, стр. 9; РИНЦ ID: 872062; volkov-su4@mail.ru.

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

Transforming housing construction: project cost management challenges

Problems related to the transformation of housing construction based on the transition from shared-equity construction to project financing are being investigated. Along with the socio-economic benefits for consumers and an increase in the stability of the housing market, there are phenomena that negatively affect developers. The changes that affected the legislation governing the relationship between equity holders and developers affected not only the introduction of escrow accounts, but also amended the requirements for the contract of shared-equity construction, the composition of the rights and obligations of the parties to the contract, the methods of securing activities, and increased liability for violation of the terms of the agreement of shared participation. This creates new economic conditions for the activities of developers. The analysis of the changes established by the law by the analysis of differences in legal regulation of activity of builders in two periods became a research objective: when obtaining the construction license before and after the date of introduction of new norm. As a result of the analysis, contradictions are revealed and assessment of their consequences is made for activity of builders. The basic principles for successful transformation are justified: stage, awareness and system, feedback. The conclusions were drawn and concrete proposals were made to amend the legislation, including elimination of contradictions in the dual legal regulation of the activities of developers using various project financing schemes, in agreement with banks for the phased disclosure of escrow accounts, the introduction of costs for transport and engineering infrastructure into the project budget, as well as interest on loans for its creation and others. These measures will preserve the effectiveness of housing construction and the sustainable activities of developers as a result of the transformation of the industry.

Keywords: *shared-equity construction, transformation, construction industry, developers, escrow accounts, legislation*

Vladimirova Irina Lvovna,
Doctor of Economics, Professor of the Academic Department of Management of Projects and Programs of "Capital Group"; 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

Tsygankova Anna Aristokesovna,
Candidate of Economics, Docent of the Academic Department of Management of Projects and Programs of "Capital Group"; 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

Kosareva Yulia Yurevna,
Postgraduate student of Project and Program Management Joint Department With Capital Group; Plekhanov Russian University of Economics (PRUE); 36 Stremyanny Lane, Moscow, 117997, Russian Federation; kaf-stroy@yandex.ru

INTRODUCTION

Housing sector still remains problematic in Russian Federation: not enough new square meters are being introduced, decrepit and dilapidated housing stock is being slowly liquidated, low availability and high housing prices are being observed, mortgages are expensive, rental housing market is poorly developed, etc. Government makes considerable efforts to create conditions by providing citizens with housing, whose strategic goals are achieved in the framework of the national project called "Housing and urban environment"[1]. Housing for 5 million families are required yearly, where one needs to provide 120 million m^2 of ready-made housing. Significant role here is assigned to building owners, especially to systemically important ones, who build about a quarter of housing put into operation. However, the transition of industry to new business conditions has created difficulties in its functioning due to changes in the system of funding and contractual obligations[2].

Currently, the legislation in the field of shared-equity construction in the housing sector is undergoing drastic changes. Along with the visible and undeniable social positive effects, the implementation of these changes creates issues the building owner faces. Researches have been theoretically and practically carried out in the field of methodology and forecast results of innovations in cost and funding management while the life cycle of the project and a capital construction facility [1, 2]. Related consequences have been analyzed for participants in the investment and construction process, the real estate market as a whole, as well as for consumers of ready-made housing [3–6]. Meanwhile the entire business environment, the system of contractual relations, the size and types of economic interests of their participants are being significantly changed, new risks are being redistributed and appeared, including for building owners [7]. Detailed study of the economic instruments of the current transformation of housing construction will allow to formulate approaches to reduce the negative impact of factors being particularly strong while the transition period.

Shared-equity construction is a form of investment activity where the construction or investment entity (building owner) attracts monetary funds from participants in shared-equity construction (shareholders) — namely citizens or legal entities — for the construction of real estate facilities[3]. Considering the ongoing transformation of economic relations in this area, it can be stated that shared-equity construction practically ceases to exist. Investments in the construction are made in the form of project funding with the participation of the bank, which becomes an intermediary between individuals and legal entities and the building owner. Monetary funds of the shareholders remain their property, thus they are put on the

1 Passport of the national project "Housing and urban environment". URL: http://government.ru/info/35560/ (accessed 08.01.2021).

2 List of system-forming organizations of the Russian economy in the field of construction and housing and communal services. URL: https://minstroyrf.gov.ru/docs/61367/ (accessed 06.01.2021).

3 Federal Law of December 30, 2004 No. 214-FZ "On participation in the shared construction of apartment buildings and other real estate objects and on amending certain legislative acts of the Russian Federation". URL: https://www.consultant.ru/document/cons_doc_LAW_51038 (accessed 08.01.2021).

escrow accounts and are a source of lending to building owners at an optimized interest rate within the framework of project funding[4].

According to the authors, the transition to the new funding procedure cannot be one-time, thus the mandatory period is needed where the construction of facilities subject to the previous legislation shall be completed, as well as all contradictions and conflicts between the old and new legal regimes shall be resolved.

Along with the funding procedure change the requirements for the contract of shared-equity construction, the composition of the rights and obligations of the parties to the contract, as well as ways of making activities have been amended. Liability for breach of equity investment contract deadlines has been tightened.

MATERIALS AND METHODS

Purpose of this study was to analyze changes in legislation for participants in shared-equity construction that had a significant impact on the cost of projects and the financial stability of building owners, as well as to identify issues and develop proposals for the solution.

Changes related to the legislative introduction of new rules for shared-equity construction have been identified as the analysis subject matter. Let us consider the differences in the legal regulation of the two types of building owner activities:

1) construction of facilities under the permit for construction (hereinafter — PfC), received prior to July 1, 2018;

2) construction of facilities under PfC received following July 1, 2018.

About half of all shared-equity construction projects (about 50 million m^2) are currently being carried out under PfC received prior to July 1, 2018. This is due to the following two factors:

1) 2.5 to 3 years are required for the construction of a typical multi-entrance multicompartment building (MCB) (with an area of about 25 to 35 thousand m2), along with all the procedures for commissioning and delivery to regulatory authorities. Accordingly, unless PfC have been received shortly prior to July 1, 2018, then the construction continues;

2) majority of major building owners have received a large number of PfC "forward" shortly before the changes in the legislation announced. Some of them have become unnecessary and related costs unjustified — those ones being under a "junk" design. Paying change to permitted use (PU) of the land plots and formal PfC have become direct damages to building owners, since, contrary to expectations, changes in legislation have not allowed to continue to sell such facilities under the same equity funding pattern where the construction fails to comply the criteria. But majority of these facilities have been able to confirm the compliance with the criteria and retained the equity funding pattern.

Key issue of regulating the economic indicators of building owners is the list of expenses being carried out at the cost of shareholders. Thus according to PfC received prior to July 1, 2018, it is a short and exhaustive list of articles. According to PfC received following July 1, 2018, the funding streams have been expanded, but more restrictions involved.

It should be noted that the transformation of construction industry in terms of changes in the legislation on shared-equity construction with the introduction of new rules and restrictions, according to the authors, is not a systematic one. Lots of issues are being resolved by "point" method, as well as there is no built phased logic transition to the new regulation of activities of building owners.

Research method was to compare the permitted cost items for the two funding patterns, depending on the date of receipt of PfC.

Thus according to shared-equity construction pattern the following funding streams are allowed, including for: costs of the actual construction of a residential facility; purchase of a lease or ownership of the land plot and payment of rent for the shared-equity construction; payment for the development of design documentation, engineering surveys and follow-up examination; construction of engineering networks within the land plot; payment for connecting the networks to engineering and technical support; reimbursement of costs under the contract on the development of the territory and implementing functions of building owner when the construction of economy-class housing; reimbursement of costs under contracts for the development of built-up areas, integrated development of the territory and the complex development of the territory and the fulfillment of contractual obligations of building owner; payment for the documents registration on the territory planning, as well as for the construction of infrastructure facilities; payment of interest on the trust loans; costs of state registration of the co-investment contracts.

All the above-mentioned costs are also provided for by the new provisions, however the related list has been significantly expanded. Thus under the project funding pattern the payment of interest and repayment of principal trust loans are possible; placing temporarily available funds on deposit are permitted, as well as payment of services of the bank, transfer funds to the account in another authorized bank, pay the taxes, revenues, mandatory contributions to the compensation fund; returning the funds and interest for their use to shareholder; pay salary along with related taxes, contributions to insurance, pension, and LPA fund, as well as guarantees and compensation; pay for services of commercial executive body of building owner; implement the costs of premises keeping and utilities from the date of entry into operation of the facility up to the registration of ownership rights.

RESULTS

Thus, the building owners who received PfC prior to July 1, 2018, cannot implement a number of important current operations of shareholders' money compared to building owners who received PfC following the introduction of new provisions and are forced to use other sources of funding, such as to reimburse the major amount of debts for the targeted loans and payment of interest and reimburse of the major amount of debt of the specific borrowings.

It is necessary to pay special attention to the fact that the exclusion of the opportunity to attract new non-targeted borrowings and loans since December 25, 2018 jeopardized the funding of the current activities of the building owners with PfC received prior to July 1, 2018, since all the costs not provided in the list are prohibited to fund from the money of shareholders, and the building owner has no other sources in the absence of profit.

At the same time, in contrast to PfC received following July 1, 2018, more "early" ones also have a number of advantages, namely:

1) simplified control over transactions on the building owner's settlement accounts (hereinafter — special accounts), including the prohibition of costs not related to the project: for instance, purchase of shares, as well as issuance of new borrowings. According to PfC received following July 1, 2018, the bank analyzes such indicators as the share of advances under the general contractor and the

4 Federal Law of December 25, 2018 No. 478-FZ "On Amending the Federal Law" On Participation in the Shared Construction of Apartment Buildings and Other Real Estate Objects and on Amending Certain Legislative Acts of the Russian Federation. URL: https://www.garant.ru/products/ipo/prime/doc/72036930/ (accessed 10.01.2021).

share of operating costs in the project budget, which is indicated in the project declaration, and requests documents confirming the intended purpose of the payment;

2) possibility of further performance of obligations, including the payment of interest, receiving new tranches of non-targeted credit contracts and targeted loan agreements, as well as the execution of the surety agreements, which have been made prior to December 25, 2018 before No. 478-FL entered into force, according to which all building owners since December 25, 2018 are prohibited to attract new non-targeted loans;

3) possibility to reimburse the previously incurred costs through receiving the targeted loans and borrowings;

4) in addition, the new restrictions, according to which one building owner can have only one construction permit, do not apply to PfC received prior to July 1, 2018. Building owner should not have obligations under the loans and borrowings not related to the construction. Securities are also forbidden for issuance. Also, the amount of the building owner's obligations not related to the attraction of monetary funds from the participants of shared-equity construction and construction should not exceed one percent of the project cost of construction. Property owned by the building owner should not be used to ensure the performance of the obligations of third parties;

5) analysis showed that the building owner who received PfC in the interim period between July 1, 2018 and July 1, 2019 suffered additional restrictions that oblige to restructure the business and conduct part of the operating activities in a different legal field. Parallel operation of different norms indicates the absence of a developed mechanism for the phased transformation of legislation in shared-equity construction.

As the effort to consolidate control of the activities of building owners, since September 1, 2018, the duty of opening bank accounts of building owners (hereinafter — special accounts) for all building owners, regardless of the date of receipt of PfC (as amended by 175 FL dated July 1, 2018). But the control of transactions under these special accounts, as mentioned above, differs from PfC received at different times. According to amendments made to 214-FL (as amended by 175-FL dated July 1, 2018), the next step was the mandatory transition to a new funding procedure using escrow accounts since July 1, 2019. Starting from 2023, the use of escrow accounts in order to avoid direct attraction of shareholders' funds shall become the only way to purchase an apartment under the co-investment contract.

Funding pattern using the shareholders' funds within the transition period could be retained only by those projects that have received a Criteria compliance statement (CCS) when performance of mandatory requirements in terms of co-investment contracts amounts under PfC of at least 10 % of the total area sold, and not less than 30 % of the facility construction readiness. For systemically important building owners, as well as for those who have been involved in the construction of social facilities, these indicators were reduced to 6 and 15 %, respectively. As a result, a number of building owners are completing the construction under to the previous funding pattern along with the attracting money of shareholders to special accounts.

DISCUSSION

Under current situation, when there are several types of legal regulation of the same activity in parallel, major building owners face significant difficulties. Thus, unless the building owner implements a large project for the construction of residential and commercial real estate with a single engineering and social infrastructure, have already received PfC for the land plots and performs building activity, and other plots are for prospective — this building owner falls within double (or maybe even triple) legal regulation. For the facilities with PfC with a date prior to July 1, 2018 and from July 1, 2018 to July 1, 2019 (subject to receipt of CCS) — this is bank control of transactions on special accounts plus special restrictions on activities not related to the target one, and for the facilities attracting funds from shareholders to escrow accounts — cooperation with banks on project funding and other requirements for the building owner in terms of its compliance with the activities performed. At the same time, the building owner provides reports on its activities to the supervisory authority as a single legal entity, which entails a contradiction in the assessment of compliance with the requirements on behalf of the supervisory authority.

Another important issue is that the building owner who is forced to attract project funding faces strict requirements of banks for subordination of the target project loan related to other loans and borrowings the building owner has at the date of applying for project funding. Unless at the moment the building owner has outstanding obligations on old non-targeted loans and borrowings, or other targeted loans from other banks — this makes project funding greatly complicated, and sometimes impossible to do.

It should be noted that the building owner is not always able to transfer existing new projects to separate legal entities — namely specialized building owners — without significant losses in order to avoid this barrier. This is due to the terms of land lease contracts, developed technical and economic indicators, as well as with a single social and engineering load for the entire development, etc.

Thus, the transition period in the ways of control and implementation of project funding requires substantial and detailed elaboration and changes in a number of related legislative norms to simplify and accelerate this transition. In other words, it is necessary to quickly develop and implement a mechanism for regulating this transformation, namely:

- collect data and analyze the current status of existing building owners in terms of legal regulation of their projects;
- consolidate and systematize the positions of regulatory authorities regarding each project, especially in regions where there are significant subjective differences in the regulation of building owners' activities;
- eliminate contradictions between the existing regulations, as well as amend the enactments.
- projects that attract shareholders' funds through escrow accounts, should be provided with a single mechanism for the building owner's interaction with banking institutions, registry of Russian Federation, Cadastral Chamber, supervisory authorities, as well as establish communications, build an electronic document flow, including with the participation of shareholders.

Since the further activity of building owners is possible only through escrow accounts and project funding, the development of such a mechanism with the creation of a single digital information platform shall become an important step for the planned implementation of the national project called “Housing and urban environment”.

As noted, approaches to managing the project cost of construction in the context of the new funding pattern using escrow accounts are fully and widely described and analyzed [8–14]. However, the subsequent changes in the legislation in shared-equity construction are already aimed at regulating this mechanism for implementing the

building owners' activities. Thus for instance, No. 841216-7 law draft (Adopted by the State Duma of the Russian Federation in the third reading dated July 7, 2020, published on July 13, 2020) introduces the following amendments: to disclose funds in escrow accounts following the completion of construction, the building owner shall only provide the bank with a permit to put the facility into operation. Previously, it was required to additionally provide an extract from the USRN confirming the registration of ownership rights in respect of one shared-equity construction facility. This regulation reduces the period for receiving funds from escrow accounts by at least 1 month, which reduces the building owner's costs for servicing the loan and releases funds for other projects.

Building owners are currently widely discussing the possibility of phased disclosure of escrow accounts during the construction of the facility. Banks are not yet ready for this step due to the lack of a mechanism to ensure funding of the facility construction in the event of the building owner's insolvency, since the funds from the escrow accounts shall be returned to the shareholders by banks in full. Alternative option is the disclosure of escrow accounts exclusively for the reimbursement of part of the bank's loan [15].

In addition, one should note a single significant change in the tax legislation, which is directly related to the building owner's activities. Federal Law No. 210-FL dated July 27, 2019 amended the Tax Code of the Russian Federation, according to which building owners dated January 1, 2020 received the opportunity to include in the costs for profit taxation purposes the expenses incurred for the creation of social infrastructure facilities that are transferred to state or municipal ownership unpaid. This much-needed regulation shall allow building owners to partially compensate their expenses in the amount of income tax on the value of the property transferred[5].

In terms of finalizing this regulation, the following should be amended:

1) Law No. 210-FL, by adding the list of facilities, the costs of creation of which can be considered by the building owner for the purposes of profit taxation, transport and engineering infrastructure facilities;

2) Tax Code of the Russian Federation, which shall allow one to consider the costs of the building owner in the form of interest on loans received for the construction of social facilities, as well as transport and engineering infrastructure facilities;

3) Tax Code of the Russian Federation, which shall allow one to consider the costs of the building owner for the maintaining built social facilities, as well as transport and engineering infrastructure facilities since commissioning up to the transfer into state or municipal property.

Analysis of the current status of the regulatory framework, considering recent amendments, has shown that the large-scale legislative reforms affecting all participants in the investment and construction process, especially in such strategic areas as housing construction and its cost management, should be based on the following principles:

First principle is phasing, providing the legal transition from one legal field to another without presence of conflicting regulations, leading to the complications of operating real estate by the building owners, along with a clear definition of terms and explanation of transition.

Second principle is awareness and consistency required for the rapid and successful transition to the new legal regulation and ensuring readiness for the transition of all participants of process with the amendments to the regulations of each agency and business areas: Ministry of construction the Russian Federation, Cadastral Chamber, Registry of the Russian Federation, State Construction Supervision and Inspection Service, Bank sector, FTA of the Russian Federation, insurance sector, shared-equity construction supervisory authorities, etc.

Third principle is feedback, implying a prompt response to the signals of the participants in the process on the emerging issues in the new legal regulation along with the development of a solution to each issue. It is necessary to define a single responsibility center, which shall accumulate questions and proposals, as well as have the powers to organize the process of solving.

CONCLUSIONS

In conclusion, let us formulate proposals for improving the regulation of building owners' activities in the context of economic transformation. To do this, one should base on the principles provided by existing enactments amended, namely:

1. In terms of regulating the activities of building owners who attract money of shareholders to special accounts, one should remove contradictions in the legal field, as well as eliminate gaps in the legislation under double legal regulation.

2. In terms of regulating the activities of building owners who attract money of shareholders to escrow accounts, and coordinate with banks and to amend the legislation under the phased disclosure of the escrow accounts, approve the maximum allowable requirements of banks over the level of the own funds, the interest rate, the terms of consideration of applications for project funding, as well as for requirements to the financial status of the building owner.

3. Tax regulation should be amended by the allocation of costs for transport and engineering infrastructure, interest on loans for the construction of this infrastructure to the project costs, as well as retain VAT and property tax benefits.

4. To organize registration activities, one should amend and approve the terms of consideration of applications for registration of co-investment contracts, property rights, mortgage agreements, leases, as well as develop action plans for all known cases of delays and refusals in registration.

5. In terms of conducting scheduled and unscheduled inspections, one should specify the final list of grounds and terms of inspections made by State Construction Supervision and Inspection Service, regulatory authorities to verify the performance of obligations to shareholders, Registry of the Russian Federation, etc.

6. When providing preferential interest rates on loans, along with one-time measures to subsidize the interest rate, one should consider subsidizing the interest rate on loans to finance the operating activities of the building owner and its capital investments aimed at improving business efficiency, including the purchase of software, licenses and patents for the purpose of digitalization of activities.

All these measures shall improve the efficiency and transparency of housing construction cost management, accelerate the commissioning of houses, make the economic situation of building owners reliable, as well as reduce the risks of the population when providing housing.

5 Federal Law of July 26, 2019 No. 210-FZ "On Amendments to Part Two of the Tax Code of the Russian Federation and Certain Legislative Acts of the Russian Federation". URL: base.garant.ru/72332744 (accessed 08.01.2021).

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Трансформация жилищного строительства: проблемы управления стоимостью проектов

Исследуются проблемы, связанные с трансформацией жилищного строительства, базирующейся на переходе от долевого строительства к проектному финансированию. Наряду с социально-экономическими выгодами для потребителей и повышением стабильности рынка жилья, наблюдаются явления, негативно воздействующие на застройщиков. Изменения, затронувшие законодательство, регулирующее взаимоотношения дольщиков и застройщиков, коснулись не только введения эскроу-счетов, также внесены поправки в требования к договору долевого строительства, состав прав и обязанностей сторон договора, способы обеспечения деятельности. Ужесточилась ответственность за нарушение сроков исполнения договора долевого участия. Это создает новые экономические условия для деятельности застройщиков. Целью исследования стал анализ изменений, установленных законом, путем анализа различий в правовом регулировании деятельности застройщиков в двух периодах: при получении разрешения на строительство до и после даты введения новой нормы. В результате анализа выявлены противоречия и произведена оценка их последствий для деятельности застройщиков. Обоснованы основные принципы для успешной трансформации: этапность, осознанность и системность, обратная связь. Сформулированы выводы и даны конкретные предложения по изменению законодательства, в том числе по устранению противоречий при двойном правовом регулировании деятельности застройщиков, использующих различные схемы финансирования проектов, по согласованию с банками поэтапного раскрытия эскроу-счетов, внесению в бюджет проекта затрат на транспортную и инженерную инфраструктуру, а также процентов по кредитам на ее создание и др. Эти меры позволят сохранить эффективность жилищного строительства и устойчивую деятельность застройщиков в результате трансформации отрасли.

Ключевые слова: *долевое жилищное строительство, трансформация, строительная отрасль, застройщики, эскроу-счета, законодательство*

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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;

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;

Косарева Юлия Юрьевна — аспирант базовой кафедры управления проектами и программами Capital Group; **Российский экономический университет им. Г.В. Плеханова (РЭУ им. Г.В. Плеханова)**; Россия, 117997, г. Москва, Стремянный пер., д. 36; kaf-stroy@yandex.ru.

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Komar I.A.

Features of determining the market value of retail real estate and individual trade related properties during pre-trial evaluation and forensic examination

Komar Irina Alekseevna,
Ph.D. in Economics, Deputy General Director, member of the RICS Management Board in Russia and the CIS, member of the Valuation Council under the Ministry of Economic Development of Russia; Professional Group of Appraisal LLC; Office 4, 12 Presnenskaya Emb., Moscow, 123112, Russian Federation; i.komar@pgo.ru

The present article deals with the specifics of valuation of retail property and individual trade related properties on the basis of the international experience and as recommended by International Valuation Standards and RICS (The Royal Institution of Chartered Surveyors (Great Britain)) valuation standards (Red Book). The present article is justified as currently Russia lacks a standard, uniform for the valuers or legal experts, to be used for the purposes of valuation of similar subjects. At the same time, methodical literature is insufficient while there are numerous property disputes that call for pre-court valuations and expert evidence of valuation of such subjects, including numerous litigations arising out of bankruptcy or establishing cadaster value to the amount of market value.

The author reviews the existing approaches to valuation of real estate in accordance with both the international and national standards and awards professional recommendations pertaining to the use of the income approach to value retail real properties and individual trade related properties. The definitions and metrics of the above real properties' groups are described separately. Also, the author provides guidelines for inquiry of the documents and information necessary for the acquisition of the data to be used in the course of valuation and expert evidence. All pricing factors are described in detail in the present article against the examples of retail real properties and individual trade related properties (say, hotel) and explanation of their effect on the market value in case the income approach is applied is provided.

Keywords: *valuation, valuation report, real estate, valuation approaches, market value, cadastral value, state cadastral valuation, property tax, bankruptcy, retail properties, individual trade related properties, forensic examination, expert opinion*

Application of three methods to measure value, i.e., the cost approach, market approach and income approach, is generally accepted in the valuation methods. The economic essence of the approaches is elaborated in the International Valuation Standards (IVS) [1].

In accordance with IVS, "The goal in selecting valuation approaches and methods for an asset is to find the most appropriate method under the particular circumstances. No one method is suitable in every possible situation. The selection process should consider, at a minimum:

- the appropriate basis(es) of value and premise(s) of value, determined by the terms and purpose of the valuation assignment;
- the respective strengths and weaknesses of the possible valuation approaches and methods;
- the appropriateness of each method in view of the nature of the asset, and the approaches or methods used by participants in the relevant market;
- the availability of reliable information needed to apply the method(s)" [1].

The International Valuation Standards also set, that Valuers "are not required to use more than one method for the valuation of an asset, particularly when the valuer has a high degree of confidence in the accuracy and reliability of a single method, given the facts and circumstances of the valuation engagement".

In the Russian Federation the Federal Valuation Standards (FVS) statutorily prescribe the scope of application of the valuation approaches:

- in Section III, "Valuation Approaches", Federal Valuation Standard, "General concepts of valuation, approaches and requirements to valuation (FVS No. 1)", as approved by the Ministry of Economic Development and Trade of Russia through its Order No. 297, dated 20.05. 2015 [2].
- for the real properties — in Section VII, "Valuation Approaches", Federal Valuation Standard, "Real properties valuation (FVS No. 7)", as approved by the Ministry of Economic Development and Trade of Russia through its Order No. 611, dated 25.09.2014 [3].

In accordance with FVS No. 7, "the key approaches used in the course of valuation are the market approach, income approach and cost approach. Where approaches are selected for the purpose of valuation, one should consider not only each approach possible application but also the purposes and tasks of valuation, the valuation results' intended use, assumptions, completeness and reliability of source information. Valuers substantiate the selected approaches on the basis of the above factors' analysis" [3].

The retail real estate's market value is generally measured using the market approach and the income approach in the Russian practice of valuation.

However, in the international practice target subjects, for which only the income approach is the most appropriate one as it gives the most reliable result, are separated into an individual block. Retail estate objects may be classified as such target subjects (shopping and shopping and entertainment malls),

excluding properties of the street-retail format and the so-called individual trade related properties/ITRP).

In accordance with RICS valuation practice guidance — applications (VPGAs), "certain properties are normally bought and sold on the basis of their trading potential. Examples include hotels, pubs and bars, restaurants, night clubs, casinos, cinemas and theatres, and various other forms of leisure property. The essential characteristics of this type of property is that it has been designed or adapted for a specific use, and the resulting lack of flexibility usually means that the value of the property interest is intrinsically linked to the returns that the owner can generate from that use" [4].

In other words, the value of such properties reflects their trading potential. This contrasts with generic properties which may be occupied in different purposes, for example as office premises, industrial, warehouse or street retail properties [5].

Such properties often display unique architectural and space-planning characteristics which can be hardly taken into account when the cost approach is applied, and the transactions with such properties are rare and do not have an open nature (such properties are often sold and bought in the business composition rather than as a separate and free of encumbrances asset), thus implementation of the market approach raises certain difficulties. The market approach may identify a market range within which the market value may vary but does not allow to conclude about the particular value. At the same time using the income approach brings complete and reliable information about all pricing factors which have effect on the market value of similar properties.

Currently in Russia there is no separate and uniform for all valuers or forensic experts standard of valuation of such properties and methodical literature is scarce. At the same time property disputes are numerous which call for pre-court valuation and forensic examination of the value of such properties, including numerous litigations pertaining to bankruptcy or establishing cadastral value to the amount of the market value.

For the purpose of measuring the market value of such properties it is necessary to obtain from the client (and in case of court expert examination, file a petition for request) the documents, which contain the qualitative and quantitative metrics of the target properties which will be used in the course of computations within the income approach (developing the cash flows).

For example, where the shopping centre or shopping and entertainment mall is valued, the following documents need to be analyzed:

1) extract from Unified State Register of Taxpayers (EGRN) issued with respect to the building;

2) extract from EGRN issued with respect to the land plot within which the building is located (if the land plot is leased in, the lease contract);

3) building technical certificate issued by Technical Inventory Bureau (BTI), including an extract from the technical certificate, floor plan, breakdown of premises;

4) building cadastral certificate (where available);

5) information about the general technical condition of the properties, including information about all performed and scheduled repair works, about the dates of the recent major repairs and running repairs;

6) building operating costs broken down by months for the recent calendar year, including expenses reported in items as follows:

- property tax;
- land tax or land lease rent;
- insurance;
- security services;
- utility fees;
- cleaning services;
- other (if any);

7) lease contracts if the building or a part thereof is leased out (with the structure identified: VAT accounting/not accounting, maintenance and operating expenses, accounting within the marginal rate).

Information contained in the above documents is required for the valuer and the forensic expert to perform computations within the income approach (Table 1).

To value market value of the individual trade relate properties, for example, of the hotel, other pricing factors, such as stars rate existing and their number (from 1 to 5), the number and type[1] of the rooms, rates, income structure[2], hotel occupancy (it may vary depending on the season), operating and maintenance expenses, etc., must be considered.

1 No uniform classification of the room type exists, the most known types are as follows: standard, de lux, suite, de lux suite, presidential suite, etc.

2 In addition to room inventory, hotels may obtain additional income from other departments: room service, restaurants, bars, conference halls, dry-cleaner/laundry services, etc.

Table 1

No.	Document title	Information contained in the document which must be noted and considered in the course of valuation or forensic examination
1	Extract from EGRN issued with respect to the building	The document is composed of several parts: 1. Part which contains information about technical characteristics. This part includes such information as the year built, walling material, number of stores, basement store, if any, functional purpose, total area. 2. Part which contains information about the registered titles. In addition to information about the owner of the subject, this part provides information about the registered encumbrances which must be recorded in the course of valuation or forensic examination. For example, the subject may be leased out for a long term. In such case information about such lease encumbrance will be cited in an extract since the lease with the term exceeding 11 months is subject to statutory registration. Where the subject is leased out, either in part or as a whole, at the uncommon rental rate, this fact needs to be taken into consideration to measure the actual value of gross income
2	Land extract from EGRN issued with respect to the plot within which the building is located (if the land plot is leased in, the lease contract)	Similar to Clause 1

End of Table 1

No.	Document title	Information contained in the document which must be noted and considered in the course of valuation or forensic examination
3	BTI technical certificate issued with respect to the building, including an extract from the technical certificate, floor plate, breakdown of premises	The document contains information about the total area of the subject, footprint area. Using the floor plan, breakdown of premises and the data acquired in the course of surveillance (object's surveillance), gross leasable area, or GLA, may be measured. Meanwhile to forecast cash flows from lease rents pertaining to shopping centres and shopping and entertainment malls, it should be remembered that not the gross area of the building or GBA is the income source. The building has common premises (for example, atrium, entry elements), and also vertically arranged communications (for example, elevators, ventilation trunks), which are not included into the leasable area. The average indicator of the share occupied by GLA in GBA (excluding parking area) is less than 70 % in the shopping centres of A class
4	Building cadastral certificate (if any)	Similar to Clause 3
5	Information about the general technical condition of the real property, including information about all performed maintenance works, dates of the recently performed major and operating repairs	Where information is available that the building requires the repair works or that any defects must be eliminated, the respective expenses must be accounted for to forecast cash flow
6	Expenses from operation of the building, broken down by months, for the recent calendar year, including expenses as follows: • property tax; • land lease rent; • insurance; • security services; • utilities; • cleaning services; • other (if any)	These expenses must be analyzed and taken into account whilst making forecast of cash flow. Where single or abnormal items of expenses are identified, those need to be normalized. Where expenses differ from the average market values, a departure reason must be identified. Possibly this is due to objective reasons and will have effect on the subject's market value. For example, due to the building's design features winter supply of heating and summer conditioning consumes more power than is required for other buildings. In such case expenses will be higher and the building value, less
7	Lease contracts, if the building is leased out either as a whole or in part (with the structure to be specified: with/without VAT, maintenance costs and operating expenses — accounting using the marginal rate)	Where the shopping centres or shopping and entertainment malls are to be valued, a key role is played by the occupancy rate and the lessees' structure. The larger the subject is, the larger its lessees' pool and aggregate information which is contained in the rent roll with the lease conditions specified with respect to each lessee — the most important object for analysis when the valuation works are performed within the income approach. Whilst performing the analysis, the following matters as below must be in the focus, specifically: Building's occupancy by the lessees (where it is below the average market indicator, the reasons must be determined. For example, the reason may be that the subject has been recently commissioned and thus is not occupied by the lessees as a whole; also, the reason may be that the concept, or transport accessibility, or flow of visitors are poor); Amount of rent rates (if the rates do not correlate with the average market values, the reasons of such deviation must be analyzed). Here one should take into account that in the modern shopping centres the rate is determined by many factors: the lessee's type, area leased in, location in the building, etc. The real property market's analysts currently observe the average lease rates (for the shopping centres and shopping and entertainment malls in Moscow)[3] (Table 2). Lease terms (short-term/long-term, accounting of VAT in the rate, utilities included in the rate, accounting of additional interest from the turnover, and etc.)

Table 2

Nature of the occupancy	Range of basic rent rates, RUB/m²/year*	Percent of SC
Hypermarket (> 7,000 m²)	0…8,000	1.5…4
DIY (> 5,000 m²)	0…6,000	4…6
Supermarket (1,000…2,000 m²)	8,000…18,000	4…6
Supermarket (450…900 m²)	18,000…35,000	6…6
Household product (< 1,500 m²)	0…10,000	6…10
Household appliances and electronics (1,200…1,800 m²)	6,000…15,000	2.5…5
Sporting goods (1,200…1,800 m²)	6,000…12,000	6…8

3 Retail.ru. URL: https://www.retail.ru/articles/knight-frank-itogi-2020-goda-na-rynke-torgovoy-nedvizhimosti-moskvy/

End of Table 2

Nature of the occupancy	Range of basic rent rates, RUB/m²/year*	Percent of SC
Baby stuff (1,200…2,000 m²)	6,000…12,000	7…9
Operators of the shopping mall		
Anchors in excess of 1,000 m²	0…12,000	4…12
Mini-anchors 700…1,000 m²	0…14,000	6…12
Mini-anchors 500…700 m²	0…16,000	6…12
300…500 m²	0…25,000	5…12
150…300 m²	8,000…18,000	6…14
100–150 m²	16,000…36,000	10…14
50–100 m²	25,000…80,000	12…14
0–50 m²	45,000…100,000	12…14
Leisure concepts		
Leisure centres (2,000–4,000 m²)	4,000…8,000	10…14
Cinema (2,500–5,000 m²)	0…6,000	8…12
Food service		
Food-court	45,000…120,000	12…15
Cafe	15,000…90,000	12…14
Restaurants	0…25,000	10…12

* Commercial terms are negotiable. Rent rates are specified without VAT and operating expenses[4].

This information may be obtained after the analysis of the legal person's financial statements, where the respective asset is reported in the balance sheet, and requesting the financial results statement with the detailed breakdown of the data of all income and expenses, or the management statements of a legal person which manages the respective asset (for example, an international operator).

In accordance with RICS valuation practice guidance — applications (VPGAs), individual trade related properties are usually valued based on their potential earnings before interest, taxes, depreciation and amortization (EBITDA) using the cash flow discount method or capitalization rate applied to such EBITDA [4].

Where the computations are performed within the income approach the valuer or expert need to consider that the resultant market value includes not only the value of the building and land titles but also of plant and equipment, furniture and fixtures of the target hotel and also intangible assets, including the value of goodwill transferred. Value of the target property is obtained when value of other components is deducted from the total value.

Given examples and analysis of the specifics of the methods used to determine market value of the trade properties and trade related properties (real properties used in the entertainment and leisure activities) based on the international experience and valuation standards will improve quality of the valuation reports and expert's opinions used for the purposes of forensic studies.

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Особенности определения рыночной стоимости торговой недвижимости и недвижимости, связанной с торговлей, при предварительной оценке и судебной экспертизе

В настоящей статье автор разбирает особенности оценки торговой недвижимости и недвижимости, связанной с торговлей и используемой в сфере досуга и развлечений, опираясь на международный опыт и рекомендации международных стандартов оценки и стандартов оценки RICS (The Royal Institution of Chartered Surveyors/Королевское общество сертифицированных экспертов в области недвижимости (Великобритания)) — Красная Книга (Red Book). Актуальность статьи обусловлена тем, что в настоящий момент в России нет отдельного единого для всех оценщиков или судебных экспертов стандарта по оценке подобных объектов, а методической литературы крайне мало, при этом широко распространены имущественные споры, требующие проведения досудебных оце-

4 Knight Frank Research, 2020. URL: https://content.knightfrank.com/research/598/documents/en/moscow-retail-market-q1-2020-7127.pdf

нок и судебных экспертиз стоимости таких объектов, в том числе многочисленные судебные споры, связанные с банкротством или установлением кадастровой стоимости в размере рыночной.

В статье автор проводит обзор существующих подходов при оценке недвижимости как по международным, так и по национальным стандартам, и дает профессиональные рекомендации по применению доходного подхода при оценке торговой недвижимости и недвижимости, связанной с торговлей. Отдельно даны определения и проанализированы особенности этих групп недвижимости. Автором также даны рекомендации по запросу документов и информации, которые требуются для сбора данных, необходимых при проведении оценки и судебной экспертизы. На основе примеров с торговой недвижимостью и недвижимостью, связанной с торговлей (на примере гостиницы), в статье детально разобраны все ценообразующие факторы, и объяснено их влияние на рыночную стоимость при реализации доходного подхода.

Ключевые слова: *оценка, отчет об оценке, объект недвижимости, подходы к оценке, рыночная стоимость, кадастровая стоимость, государственная кадастровая оценка, налог на имущество, банкротство, торговая недвижимость, связанная с торговлей недвижимость, судебная экспертиза, заключение эксперта*

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Об авторе: **Комар Ирина Алексеевна** — кандидат экономических наук, заместитель генерального директора; **ООО «Профессиональная Группа Оценки»**; 123112, Москва, Пресненская набережная, д. 12, эт. 31, пом. 4; i.komar@pgo.ru.

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Development of a digital service for real estate transactions

Sternik S.G.
Gareev I.F.
Akhmetgaliev T.A.

The majority of present-day aggregators of the Russian real estate market fail to meet modern requirements and trends. Currently, the information support of real estate valuation activities is generally assigned to individual valuers, rather than the valuation community as a whole. The absence, insufficiency, unreliability of the market information makes it difficult to determine the cadastral value of the properties as well fulfill the requirements prescribed by the existing methodological recommendations. The main problem in developing digital platforms is that the value of the digital platform proposition can only be adequately assessed by the platform developer, while the complexity of creating a quality digital platform may exceed the benefits for the developer. In this regard, we set a goal to analyze the aggregators of the real estate market in terms of the shortcomings, whose systematization is to lay the basis for a consolidated real estate market database of Russian Federation. In this article, selected digital platforms were analyzed with regards to meeting specified criteria using a multi-criterial rating system. The results of the study represent the necessary criteria, conclusions concerning compliance with certain criteria based on the analysis of classifieds, as well as recommendations for the use of innovative technologies to ensure the most advanced operation of real estate market aggregators. In addition, several forms of information exchange between market players and viable solutions to common problems are suggested. A method of developing a consolidated real estate market database was developed. It is based on innovative information technologies and the actionable way of implementing software solutions designated for automation and structuring of real estate data.

Keywords: *information systems, geographic information systems, digital platforms, open data, data aggregators, housing construction, housing market, cadastral valuation, real estate valuation*

Research relevance

The real estate market is often considered as a specific area of innovative economics [1]. Information opacity has existed in the recent history of the Russian real estate market, and it may cause analysts to use indirect and not always reliable information, develop and apply indirect sophisticated methods of data collection, processing, analysis and forecasting. For example, G.M. Sternik developed a schematic model of an information system. The model has the following components: “Information space” (databases and data processing blocks), “Consumers” (functional divisions, which may require the following information: Analytical Center — AC, Marketing Division — MD, Financial-economic Division — FED) [2].

Since the enactment of Federal law of the Russian Federation No. 221-FZ of 24.07.2007 “On the state of cadaster of real estate” owners hurried to have their property duly registered, since the unavailability of a cadastral passport made it impossible to perform any actions involving real property (registration of rights and encumbrances, sale, consolidation, transfer, etc.) [3]. Mandatory cadastral registration as one of the stages of accounting and registration of real estate will help to get the necessary information about the right holder and other equally important information about real estate facilities [4].

Currently, the information support of evaluation activities is actually delegated to each subject of evaluation activities, but not to the evaluation community as a whole. Everyone generates his/her own set of information available to a limited number of people, but there is no consolidated information platform [5]. The collection and comprehensive presentation of cadastral, urban planning, topographic, and thematic information using geoportal technologies is relevant for the development of the digital economy of the Russian Federation. At the same time, the main task is to provide individuals and legal entities with information about spatial structures and facilities. Therefore, the best solution is the development and operation of the geoportal maintained by the Federal Service of State Registration, Land Register and Mapping (“Rosreestr geoportal”) [6].

As a result, the relevance of the study of aggregators (classifieds) of the real estate market, as innovative programs, is due to modern changing conditions. The prevalence of innovative products, such as real estate market aggregators, has almost completely replaced the printed advertisements; however, digital platforms are currently not used in full, although they can solve a large number of problems on the real estate market, as well as streamline the state regulation of the real estate market. For example, the absence, insufficiency, unreliability of information makes it difficult to determine the cadastral value of real estate facilities; these factors make it impossible to meet the requirements established by the current methodological guidelines for the state cadastral valuation [7].

The basis for the implementation of machine processing of information flows between the system elements is the development of a database for an information system. The most promising and technically convenient sources of information, designated for the database, are regional multi-listing systems (hereinafter referred to as MLSs) available in the Internet. Although they still have some shortcomings inherent in periodicals, as a rule, MLSs, contain more structured and “noise-free” information. The analysis

Sternik Sergey Gennadievich,
Doctor of Economic Sciences, Professor, Professor of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe Shosse, Moscow, 129337, Russian Federation;
ID RISC: 596056,
Scopus: 6507292791,
ResearcherID: 4093911,
ORCID: 0000-0003-1411-1011;
sergey-sternik@yandex.ru

Gareev Ilnur Failovitch,
Candidate of Economic Sciences, Associate Professor, Associate Professor of the Department of Expertise and Real Estate Management; Kazan State University of Architecture and Engineering (KSUAE); 1 Zelenaya St., Kazan, Republic of Tatarstan, 420043, Russian Federation;
SPIN-code: 9619-4284;
ResearcherID: L-4898-2018;
igareev@mail.ru

Akhmetgaliev Timur Aleksandrovitch,
Graduate student; Kazan State University of Architecture and Engineering (KSUAE); 1 Zelenaya St., Kazan, Republic of Tatarstan, 420043, Russian Federation;
timur280991@list.ru

of the number and the intensity of offers, the composition of market players, the terms of display of real estate facilities allows to exclude inefficient (abandoned, or "noisy") MLSs [8]. Information sources may include offers, deals, and auctions from relevant real estate market aggregators.

The acceleration of information processing at the recognition and identification stage allows to conduct revaluation of real estate facilities in the real time mode [9]. However, the main problem is that the value of a product or a service based on a digital platform is visible only to developers, and the complexity of creating and using the platform significantly exceeds its benefits. The development and application of digital platforms in the field of trade and information are more successful. Companies like Ulmart and Ozon have already announced the development of cross-border trading platforms, which indicates their readiness to compete on the global market. Major companies, using digital platforms, include Avito, Price.ru, Torg@mail.ru (the Russian Internet portal owned by Mail.Ru Group) [10].

Therefore, we can formulate the purpose of the study as follows: we are going to analyze the aggregators of the real estate market in terms of the shortcomings that prevent the generation of a consolidated database of real estate items in the Russian Federation. We will identify and analyze the main shortcomings of market aggregators by selecting information platforms that provide information on real estate facilities mainly on the Russian Federation market. When identifying the main shortcomings, it is necessary to propose effective solutions aimed at their elimination, as well as to develop a methodology for implementing a consolidated digital platform that has no shortcomings.

The object of the study is real estate market data aggregators. The subject of the study is the shortcomings of existing real estate market data aggregators.

It is necessary to formulate the main criteria for the analysis of aggregators, analyze the classification data in terms of its compliance with the selected criteria, and develop recommendations for the use of innovative technologies to assure the most advanced operation of real estate market aggregators.

Research methods

The study was conducted on the basis of personal experience and professional opinions, the experience of performers in this field since the early 2000s.

The research methodology consists in the identification, analysis and comparison of certain shortcomings in order to provide full-fledged information on real estate facilities by selected aggregators on the real estate market.

In this study, the following market aggregators were analyzed:

- Bulletin Board "AVITO" (https://www.avito.ru/).
- Database of real estate "CIAN" (https://cian.ru/).
- Database of real estate "Domofond" (https://www.domofond.ru/).
- Database of real estate "MIRKVARTIR" (https://www.mirkvartir.ru/).
- Information portal "MOVE" (https://move.ru/).
- Database of Sberbank real estate "DOMCLICK" (https:// domclick.ru/).
- Real estate database "MLSN" (https://mlsn.ru/).
- Real estate database "TATRE" (https://www.tatre.ru/).
- Website "ONREALT" (https://onrealt.ru/).
- Bulletin Board "From hand to hand" (https://irr.ru/).
- American real estate database "ZILLOW" (https://www.zillow.com/).

The analysis of aggregators was carried out according to certain criteria. Selected platforms were ranked according to the ranking system. The information about the ranking system is provided below.

The co-authors have defined 7 evaluation criteria (see results and discussions); each criterion has a certain number of points from 1 to 10, where 10 is the maximum value, depending on its compliance with the selected criterion, since compliance is possible in the range of 0 to 100 %. Points were awarded in accordance with the objective opinion of researchers, based on the analysis of information about the market aggregators listed above.

Further, the percentage of compliance with the selected criteria was determined for each facility under research using the following formula:

$$CCP = TN/70 \cdot 100\ \%,$$

where CCP is the criteria compliance percentage, %; TN is total number of points according to the selected criteria; 70 is the maximum score.

Based on the results of the study, we can formulate the shortcomings of aggregators (classifieds) on the real estate market.

Study findings

We present the analysis of the aforementioned digital platforms in terms of information provision using the following criteria developed by the co-authors based on their professional opinion:

1. Correct classification of real estate. The lack of correct classification of real estate facilities is a consequence of the lack of the real estate market awareness, as well as the presence of various classifications, which may be misleading.

For example, if we address the website at https://www.avito.ru/ to search for a land plot for commercial and office purposes, we should choose "industrial land" in the item "category of land", after that we choose "settlement lands (private housing projects)", then the search engine shows land plots for individual housing construction, which makes it misleading and difficult to work with. The real estate database https://cian.ru/ has a separate filter for commercial land plots; however, commercial land plots differ in the type of permitted use. The concept of a "commercial land plot" can include both land plots for multi-store residential development, as well as land plots designated for the construction of a railway station.

Based on the analysis of literature, various Russian and international valuation standards, as well as the practice of real estate valuation, real estate facilities can be roughly classified in accordance with the following independent criteria [11]:

- nature;
- types of main element;
- presence or the absence of the main elements and their improvements;
- composition of the main elements;
- functionality;
- housing construction type;
- commercial construction type;
- specialization;
- profitability.

The aforementioned classification is correct; however, it can be used for the benefit of the real estate aggregator rather than the

main search engine. Based on the existing classification analysis performed by the co-authors, a simplified real estate filter can be as follows (Fig. 1) [12, 13]:

In the above classification, it is important to note that real estate facilities are divided by the type of functional purpose: residential and commercial real estate; types of permitted use, and the above list is not exhaustive. The following Fig. 2 also shows a variant of the extended search for land plots.

The search menu has:

1. Types of permitted use:
- individual housing construction;
- gardening;
- retail-office, near-road service;
- industrial (warehousing, bases etc.);
- low-, mid-rise housing;
- garage and parking;
- recreational facilities;
- agricultural use;
- other use.

2. Location relative to the road: 1st line, inside the block, near the road (but not on the first line), away from the road.

3. Utilities: on the site, on the border of the site, removed from the site (in this case, it displays the most complete information, so, for example, when the "gas" check mark is pressed, you can display more correct information about the presence of communications, which is important for users and analysts of the real estate market).

Also, this search is not limited to the criteria above, one can add such criteria as:
- the type of legal title: i.e. ownership, leasehold for 49 years, leasehold for up to 10 years (not shown in Fig. 2).

2. Identification of property by its cadastral number. Absence or partial absence of the cadastral number of the property.

If the property has a cadastral number, one can check it using the following parameters:
- information about encumbrances freely accessible on the Rosreestr website [14];
- the option to order an extract from the Unified State Register of Taxpayers to clarify the information about the owner (through the service of the personal account on the website of Rosreestr);
- check the location information on the cadastral map;
- find out information about the cadastral value and the property tax;
- analyze the history of the price of the real estate for a certain period of time.

The presence of a cadastral number of a real estate facility builds confidence and make a real estate item more popular on the

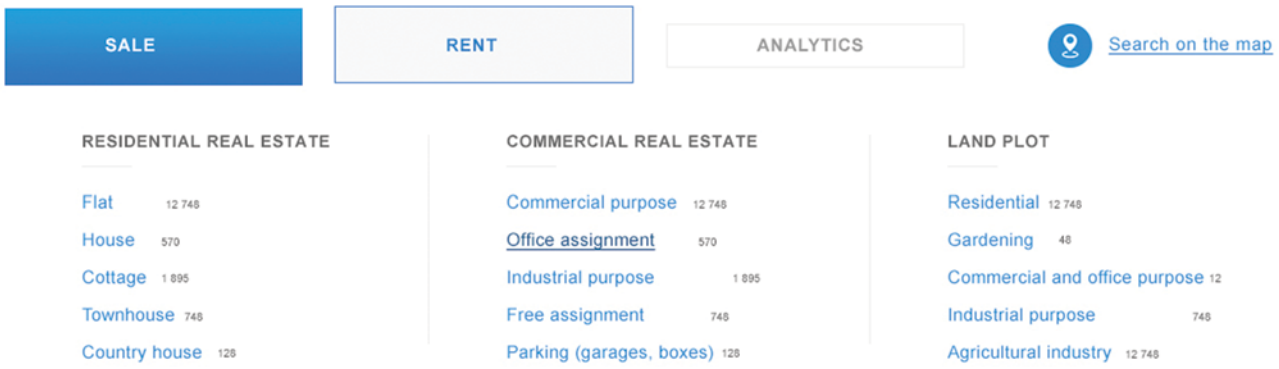

Fig. 1. The screenshot of a filter to be used by real estate aggregators. Source: the portal developed by the co-authors

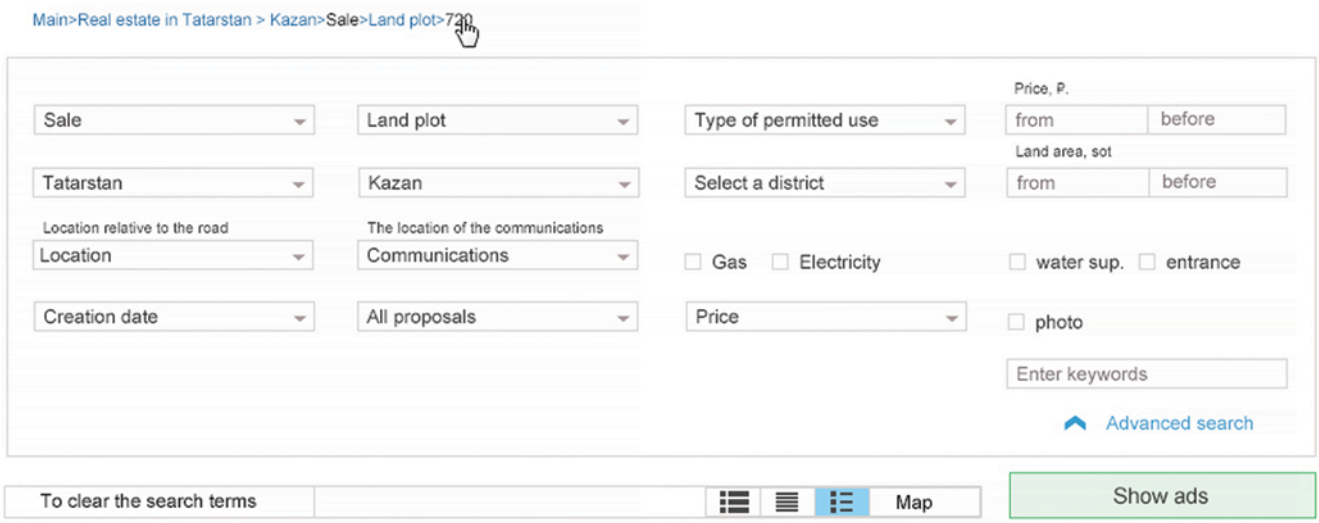

Fig. 2. A screenshot of an advanced land plot search option. Source: the portal developed by the co-authors

market, it can also be a tool regulating the relations between the owner and the state.

In this case, it is most optimal to consider attaching the advertisement to the cadastral number, and to permit automated data submission/update from the Rosreestr website to the aggregator's website.

Thus, it is possible to implement the relationship between the players that regulate property relations and ensure the presence of the most recent information about a particular facility, forming a property data entry.

3. Availability of geospatial modelling. Linking the location of a facility on the map with full information about the property, including the presence of the following layers on the map:

- town-planning regulations;
- satellite imagery;
- protective zones;
- construction facilities;
- boundaries and shapes of land plots;
- heat maps of supply and demand availability;
- spread of prices for real estate facilities;
- retrospective data layer;
- colored layer of data completeness;
- the map of traffic flows, pedestrian traffic, etc.

For example, the main function of GIS-based systems is the ability to use economic and cadastral information in coordination with other elements, such as physical factors, social factors, taxation, infrastructure, pollution and noise, economic and legal factors. Together, this can make it easier to assess the value of real estate [15].

GIS projects, can take advantage of map data from various WEB sources. For example, you can add Open Street Map base maps, National Geographic maps, etc. to an ArcGIS project[1]. The disadvantage of the current stage of development of multi-scale mapping is the lack of a unified methodology for creating a multi-scale cartographic framework, in most cases it is developed in accordance with the production requirements of individual enterprises [16].

Greek researchers used GIS toolkit to study the level of relationship between urban integration processes and housing market prices [17]. The researchers addressed the findings to the city authorities for the further adjustment of the municipal urban policy.

Finnish researchers, in our opinion, are the leaders in the study of cadastral information; they consider it as a sociotechnical system [18]. As part of the study, they divide it into urban and rural areas, predict integration with other information platforms, and forecast the development of cadastral information through 2035.

The platforms that have this parameter analyzed are limited, and there is practically no information about layers [19]. For some facilities, location does not correspond to reality, in particular, land plots without a cadastral number, as well as “garbage” information about the items that cannot be identified by their location.

An important area of application of geoinformation systems is the use of spatial data, primarily information about the value of the territory to assess real estate facilities (for taxation purposes) [20]. Researchers from Nizhnevartovsk have proposed their own approach to the use of geoinformation methods in real estate valuation. For the taxation system, the co-authors made maps of the city with the display of areas within walking distance of social facilities [21].

1 Rosreestr — Federal service for state registration, cadastre and cartography. State cadastral assessment data Fund. URL: https://rosreestr.ru/wps/portal/online_request/ (accessed: November 10, 2021).

Some researchers believe that the next stage in the development of GIS technologies is forecasting the cost of residential real estate and modeling the development of the market as a whole. Artificial intelligence, machine learning and augmented reality technologies will be involved. GIS, for example, will help to identify profitable segments of the residential real estate market that have been inadvertently overlooked in the past. Markets and locations where investments in residential real estate and infrastructure are relevant will be identified [22].

Romania is also working on a consolidated GIS that can collect all the data necessary for the assessment of a particular land plot, as well as correlate the characteristics of the plot with market prices and transfer them to the map [23].

Adding the selected layers, as well as developing and implementing new ones, can affect both the user's choice of property, as well as fill in the missing data in accordance with the selected goals. Also, this information will be relevant when a high-quality automated real estate monitoring system is developed.

4. Data availability. This criterion is highlighted separately, since according to the analysis of the selected aggregators, the free period of advertisements placement is limited to an average of 30 days (depending on the aggregator) [13]. However, for example, in the case of the implementation of a production facility and a warehouse, the dosplay period, which can last from 9 to 25 months, is not limited to 30 days, which means that the advertisement may be closed, but the property remains on display. It is also possible to change the offer price over time for a certain period.

According to the results of the study, it was revealed that although the majority of transactions in Russia get closed, the information about them is not published in open sources and is confidential [24].

In the co-authors’ opinion, it is necessary to add information about the exposure time of the property (when the property was offered for sale, the price change pattern, and other retrospective information that allows the user to be filled in to make a more educated decision).

The experience of Finnish researchers who studied the consequences of data disclosure in Helsinki is noteworthy [25]. In particular, a website with detailed information on individual housing transactions was launched in the country in 2007. In particular, the study allowed us to obtain the following main results:

- data openness has increased public awareness of property prices and real housing affordability (ultimately, this has affected acceleration of home purchase decisions);
- the impact of open-access information about transactions and real estate prices on the operation of the residential real estate market is also strong. For example, the appearance of open information was more valuable for sellers who underestimated the value of their property than sellers who overestimated the value of their property. Because of this asymmetry, information about housing prices boosted prices. In other words, open-access information affected different sellers in different ways [26];
- the results of the analysis of the price dynamics indicate that the increase in the amount of information about past transactions led not only to an increase in prices.

5. The availability of high-quality market monitoring information means the availability of high-quality market monitoring information in contrast to the correct classification of real estate facilities, including the analysis of the real estate market for a certain period,

the presence of links between markets, the dynamics of supply and demand, market capacity, information about the timing of exposure of similar real estate facilities.

This issue is most relevant during submission of advertisements and evaluation of real estate on inactive or closed markets, where there is almost no information and rare offers are available [27]. This problem is typical for scarcely populated communities.

Retrospective information, including the identification of a real estate facility, the availability of geospatial modeling and open-access data allow to solve the above-mentioned problem in an automated mode.

For example, this function is implemented in one of the software products developed by SRG group of companies (Fig. 3, 4) [13].

As you can see in the Fig. 3, 4, the number of advertisements submitted since 2015 is much higher than in 2019 (the search is shown for residential real estate). By using this function, you can monitor the market in the corresponding market segment, not only for a past date, but also in the real time, in conditions of limited sampling.

6. Using innovative platform technologies to present information in a comfortable way. This function of the aggregator is an opportunity to use innovative technologies to present the property to users, in particular the following services:

- the ability to publish real estate advertisements on multiple digital platforms by filling a single form (duplication of advertisements);
- conducting real estate auctions;
- property inspection online or using virtual reality glasses;
- use of software products to visit the property without a real estate agent;
- the relationship of banking institutions with the platform in order to use credit funds for transactions involving real estate facilities;
- automated property valuation;
- electronic registration of the title (use of electronic signature for online registration of ownership to real estate through the Rosreestr website);
- implementation of real estate transactions without intermediaries;
- artificial intelligence used to calculate the economic and technical parameters of a real estate facility to be constructed in a specific location;
- traffic analysis of retail, office premises, as well as premises related to the provision of services.

7. Interconnected "universe" of properties means lack of interconnection between digital platforms, real estate market participants, banking structures and property regulators.

In practice, the cadastral value of real estate may be overestimated, and it affects the interests of owners and tenants. However, sometimes the cadastral value is attached to a past date and the tax is calculated on the basis of the "outdated" estimate. For example, according to Report No. 2 (Rosreestr) dated 10.10.2014 on determining the cadastral value of capital construction facilities in the Republic of Tatarstan, the assessment was carried out as of January 1, 2014 (Rosreestr, 2014), and the amount of property tax was calculated based on the results of the above assessment. By the time of drafting this article (2020), 6 years had passed since then, and prices for capital construction projects had increased [28].

The data are submitted to digital platforms; however, tax authorities have no access to the results of assessments and credit

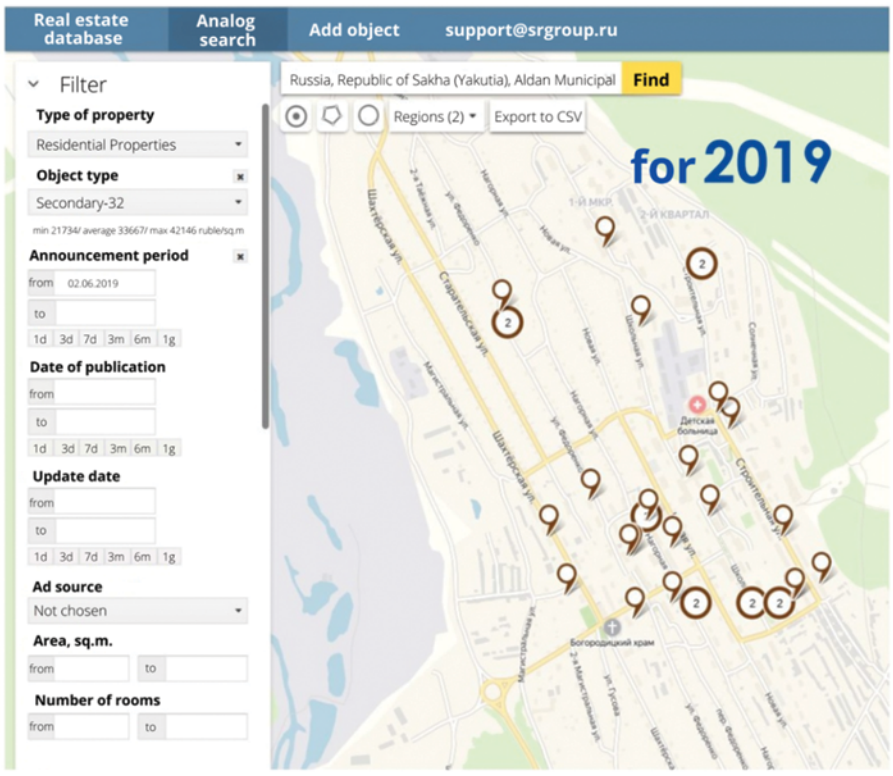

Fig. 3. Making a sample using historical data. Source: the co-authors [8]

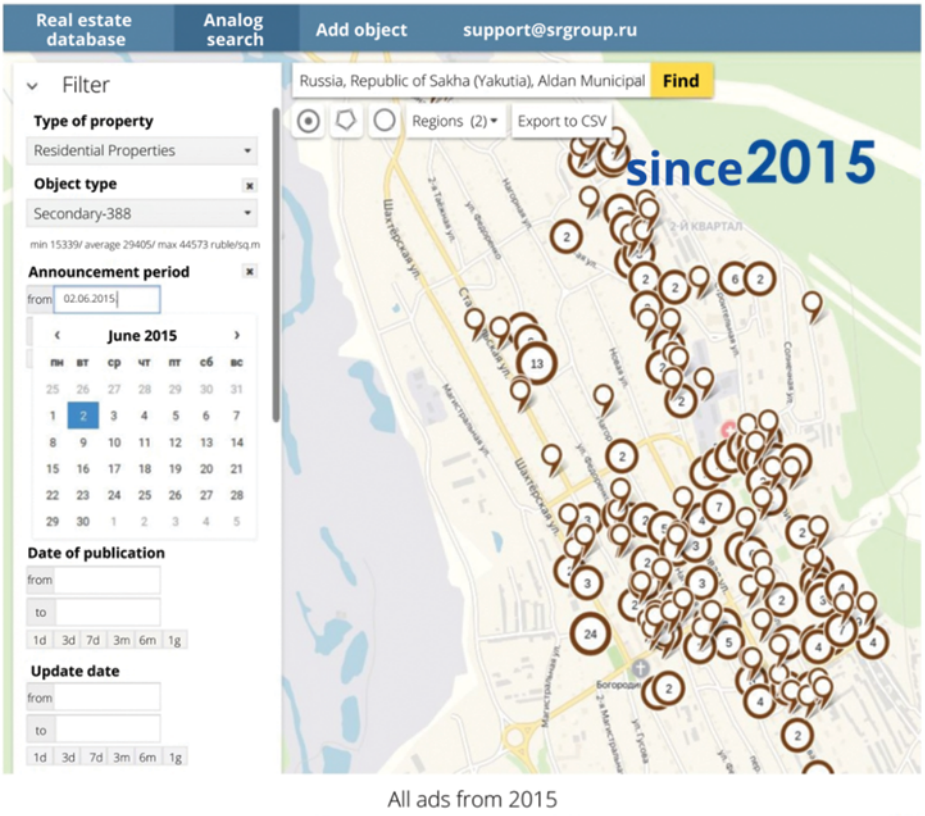

Fig. 4. Making a sample using historical data. Source: the co-authors [13]

obligations discharged by the customers. There are no data entries containing information about the offer price, transaction results over a selected period.

If we consider the international practice, in the USA, after the decision is made to value the property, the further work is done using the following sequence of actions:

1) planning, or staging of the project;

2) data collection (general as well as specific property-related data);

3) data assembly into the property database entry, which features property photos, its transaction history, including the prices, for which it was sold historically. Sketches of the property foundation are also placed into data entry. As a result, all changes that the property has undergone can be tracked and analyzed [29].

Tax assessors (further — assessors) are required by the law to undertake property valuation by its full and fair value as of the 1st of January of each year. As a result, assessors (the valuation division) analyze and confirm each sale-purchase transaction in order to determine whether it reflects the market value, which is done annually for residential, commercial or industrial real estate. For example, in the city of Boston there are roughly 11,000 land plots used for commercial / industrial purposes and 120,000 land plots used as residential real estate. Accounting and update of property information for the purposes of assessing its tax valuation are undertaken annually, which allows for the timely reflection of changes throughout the year, which may result from new construction, damages to properties caused by fires, other types of destruction and damages to properties and/or reconstruction efforts.

The interaction and direct relationships between real estate market institutions may lead to better cadastral value calculation, and boost the real estate market transparency in terms of the property information on the different stages of its lifecycle, which in turn may affect interests of all real estate market players.

Further we analyze real estate market aggregators using the aforementioned criteria. Due to large datasets involved, comparison between market data aggregators was done in terms of the presence or absence of the aforementioned parameters. The results, obtained in accordance with the method described above, are listed in the table below.

Discussion

As a result of the study, it was revealed that American portal ZILLOW most fully meets the identified market criteria. The major feature of this digital platform is the availability of the history of transactions related to the properties within this database. A user can find out the price at what the facility was sold for the first time, the buyer and the next transaction, the rent, as well as the tax rate.

Among domestic platforms, the platform developed by Sberbank PJSC is particularly noteworthy, it is available at https://kazan.domclick.ru/, which is a service designated for buying real property online, and this features makes this platform different from those launched by its competitors.

Other aggregators are seemingly mediocre in terms of the services that they provide, and they are focused on making revenues, although there is a market monitoring option present exclusively for residential real estate [11]. Innovative solutions and/or technologies are barely implemented [30].

Shortcomings of the majority of aggregators are firstly explained by the lack of the necessary level of information technologies, considerable costs of their implementation and the lack of market data.

Results of study of the real estate market aggregators

Item number	The main aggregators/criteria (number of criteria)	Correct classification of real estate objects	Identification of a real estate object by cadastral number	Availability of geospatial modeling	Data availability	Availability of high-quality market monitoring	Using innovative platform technologies to present information in a comfortable way	An interconnected "universe" of objects	Percentage of compliance with the criteria (CCP)	Percentage of compliance with the criteria Pcr, %
1	https://www.avito.ru/	4	2	2	0	0	1	0	9	12.86
2	https://cian.ru/	5	2	2	1	1	1	0	12	17.14
3	https://www.domofond.ru/	4	2	2	1	1	2	0	12	17.14
4	https://www.mirkvartir.ru/	4	2	1	0	1	1	0	9	12.86
5	https://move.ru/	5	2	0	0	0	0	0	7	10.00
6	https://kazan.domclick.ru/	5	2	2	1	1	4	1	16	22.86
7	https://mlsn.ru/	3	2	2	0	0	0	0	7	10.00
8	https://www.tatre.ru/	4	2	0	0	1	0	0	7	10.00
9	https://onrealt.ru/	4	2	2	0	0	0	0	8	11.43
10	https://irr.ru/	4	2	0	0	0	0	0	6	8.57
11	https://www.zillow.com/	5	10	2	10	10	3	10	50	71.43

Note. Source: the authors' analysis.

Secondly, one of significant factors affecting the level of services provided by the aggregators consists in the information interaction and exchange between market players and institutions, which also affect the pricing on the real estate market.

The application of innovative technologies to problems and shortcomings of real estate market data aggregators may affect not only the Russian real estate market, but also the economy of certain regions of Russia. Currently, the Russian digital economy is at the very beginning of its development, while in real estate data innovations may improve the overall system, make it more transparent and open for all real estate market players [31].

This study allows to demonstrate the opportunities of innovative technologies and software solutions for real estate market players, as most of the real estate market data aggregators cannot use them effectively. Their phased implementation in a digital environment, usage and correction of classifieds in accordance with the analyzed criteria will undoubtedly create a considerable competitive advantage for data providers, while the application of this tool as a cadastral value calculator may increase tax collection in the Russian Federation and its regions [10].

Therefore, we continue to develop a digital service for real estate transactions entitled KVADU.RU. This service represents a digital platform for real estate transactions, which has eliminated the prior shortcomings. It has integrated innovative technological solutions allowing its users to work with the real estate used as a collateral. In this project, new technologies will be implemented in terms of banking services and tools to assure better interaction between real estate market players (automatic verification and "express" valuation of real estate, a valuation database and a data processing toolkit).

This service is aimed at addressing the shortcomings of real estate market data aggregators (avito.ru, cian.ru and others); it entails the implementation and saturation of the real estate database with relevant property data entries, and it represents a systemic solution for providing easily accessible real estate market data and transactions. Also, this product facilitates the correct calculation of the cadastral value, facilitation of high quality real estate market monitoring, improving data "legitimacy" and reliability, increasing tax collection, reducing the number of disputed properties.

The digital platform has several blocks:

Block 1: visual representation of information in the form of a bulletin board:

- correct information and properties identification;
- presence of GIS with layer maps and filters;
- data availability;
- presence of real estate market monitoring in respective market segments and periods of time;
- use of innovative technologies to presents the information in a user-friendly format and a comfortable mode;
- an interconnected "universe" of properties (interaction between digital platforms, real estate market players, banking institutions and property relations regulators).

Block 2: the database (that contains automatically and manually collected information):

- database of offers (collection of information from various sources, parsing, real estate agencies, printed sources, etc.);
- database of transactions (rosreestr.ru, databases maintained by real estate agencies, fedresurs.ru, etc.);
- data about tenders and auctions (torgi.gov.ru, regional and municipal tenders);
- generation of the "property card", i.e. data entry (cadastral number, photo, technical data, GIS data, changes, data archive);

- database of printed classifieds in the electronic format.

Block 3: the implementation of research works using the collected data (computation and methodological part):

- data structuring (classification, price zoning using GIS, zoning in the time dimension);
- development of a calculation methodology and a mathematical model;
- presence and utilization of government standards, educational materials and publications, special requirements;
- database mergers, development of database, mathematical models, real estate valuation;
- open-access computational methodology, data verification;
- development of technical specifications and software solutions for focused tasks.

Block 4: a solution for data automation and structuring on the real estate market (a software product for the automation of operations):

- real estate valuation automatization;
- real estate transaction data synchronization;
- implementation of the system "bank-valuer-Rosreestr";
- online formation of property valuation reports;
- other services, related to property data provision and analysis (for example, analysis of pedestrian flows in terms of retail trade, office space, supply and demand for real estate, etc.).

Authors analyzed the following potential customers for the digital platform:

- banking sector;
- real estate valuers and experts;
- real estate agencies;
- users (both individual and corporate);
- business communities (builders, real estate developers etc.);
- municipal bodies;
- Rosreestr (Federal Service for State Registration, Cadastre and Cartography);
- scientific and research community.

Conclusions

The innovative nature of our proposal is manifested as follows:

1. Information interaction between various market players within the consolidation data sharing system is proposed;

2. A method for compiling a consolidated real estate market database using innovative information technologies is developed;

3. Actionable methods of problem resolution in the real estate market are proposed;

4. Opportunities of using innovative technologies for information provision to different customer segments are explored;

5. An advanced approach to the calculation of the cadastral value is proposed;

6. An actionable method for implementing software solutions aimed at automated structuring of the real estate information is developed.

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Разработка цифрового сервиса для проведения операций с объектами недвижимости

Современные агрегаторы рынка недвижимости Российской Федерации по большей степени не отвечают современным требованиям и тенденциям. Информационное обеспечение оценочной деятельности фактически возложено на каждого субъекта оценочной деятельности, но не на оценочное сообщество в целом. Отсутствие, недостаточность и недостоверность информации затрудняют определение кадастровой стоимости объектов недвижимости, а также не позволяют выполнить требования, которые установлены действующими методическими указаниями. Основная проблема состоит в том, что ценность продукта или услуги на базе цифровой платформы видна только разработчикам, а сложность создания и использования платформы существенно превышает выгоды от ее использования. В связи с этим нами поставлена цель по исследованию агрегаторов рынка недвижимости на предмет наличия недостатков, систематизация которых ляжет в основу разработки единой базы объектов недвижимости на рынке Российской Федерации. В данной статье были проанализированы выбранные цифровые платформы на предмет соответствия предъявляемым критериям с использованием многокритериальной рейтинговой системы. Результатами исследования являются формулировка необходимых критериев путем исследования и сравнения, выводы на предмет соответствия определенных критериев на базе анализа классифайдов, а также рекомендации по использованию инновационных технологий для наиболее расширенного функционирования агрегаторов рынка недвижимости. Предложены формы информационного взаимодействия участков рынка недвижимости и действенные методы для решения общих проблем. Разработаны методика реализации единой базы объектов недвижимости на базе инновационных технологий и действенный способ реализации программных продуктов для автоматизации и структурирования информации объектов недвижимости.

Ключевые слова: *информационные системы, геоинформационные системы, цифровые платформы, открытые данные, агрегаторы данных, жилищное строительство, рынок жилья, кадастровая оценка, оценка недвижимости*

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Об авторах: **Стерник Сергей Геннадьевич** — 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; SPIN-код: 2930-4020; Scopus: 6507292791; ResearcherID: 4093911; ORCID: 0000-0003-1411-1011; sterniksg@mgsu.ru;

Гареев Ильнур Фаилович — кандидат экономических наук, доцент, доцент кафедры экспертизы и управления недвижимостью; **Казанский государственный архитектурно-строительный университет (КГАСУ)**; 420043, Республика Татарстан, г. Казань, ул. Зеленая, д. 1; SPIN-код: 9619-4284; ResearcherID: L-4898-2018; ORCID: 0000-0002-7993-9111; igareev@mail.ru;

Ахметгалиев Тимур Александрович — аспирант; **Казанский государственный архитектурно-строительный университет (КГАСУ)**; 420043, Республика Татарстан, г. Казань, ул. Зеленая, д. 1; timur280991@list.ru.

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Sinyak N.G.
Tajinder S.
Madhu K.J.
Kozlovskiy V.V.

Predicting real estate market trends and value using pre-processing and sentiment text mining analysis

Ubiquitous growth in the text mining field is unprecedented, where social media mining is playing a significant role. Gigantic growth of text mining is becoming a potential source of crowd wisdom extraction and analysis especially in terms of text pre-processing and sentiment analysis. The analysis of a potential influence of sentiment on real estate markets controversially discussed by scholars of finance, valuation and market efficiency supporters. Therefore, it's a significant task of current research purview which not only provide an appropriate platform for the contributors but also for active real estate market information seekers. Text mining has gained the widespread attention of real estate market information users which is almost on explosion level. Accessibility of data on such behemoth scale mandates regular and critical analysis of this information for various perspectives' plausibility. Rich patterns of online social text can be exploited to extract the relevant real estate information effectively. As text mining plays a significant and crucial role in discovery of these insights therefore its challenges and contribution in social media analysis must be explored extensively. In this paper, we provide a brief about the current summary of the modern state of text mining in pre-processing and sentiment for the real estate market analysis. Emphasis is placed on the resources and learning mechanism available to real estate researchers and practitioners, as well as the major text mining tasks of interest to the community. Thus, the main aim of this chapter is to expound and intellectualize the domains of social media which are accessible on an extraordinary range in the field of text mining real estate for predicting real estate market trends and value.

Keywords: *housing, real estate, sentiment analysis, social media, text mining, spam, CRF, n-gram, entropy*

Sinyak Nikolay Georgievich,
PhD in Economics, Professor of the Department of Management and Economics, Private Institute of Management and Business; bldg. 3, 1 Slavinsky St., Minsk, 220086, Belarus;
SPIN-code: 4400-2224,
Scopus: 55952470200,
ResearcherID: K-4838-2015;
ORCID: 0000-0002-1688-9268,
Google Scholar: 9wEDUrMAAAAJ;
siniakn@gmail.com

Tajinder Singh,
Assistant Professor of Computer Science and Engineering Department; Sant Longowal Institute of Engineering and Technology; SLIET Administration Block, SLIET Rd, Sangrur, Punjab, 148106, India;
Google Scholar: nn4t8UMAAAAJ&hl;
nith2k14@gmail.com

Madhu Kumari Jaglan,
Assistant Professor of Computer Science & Engineering Department, National Institute of Technology Hamirpur; Himachal Pradesh, Hamirpur, 177005, India;
ORCID: 0000-0003-3203-2579;
Madhu.jaglan@gmail.com

Kozlovskiy Vitaliy Vladimirovich,
Professor, Chief Researcher; Research Economic Institute of the Ministry of Economy of the Republic of Belarus; bldg. 1, 1 Slavinsky St., Minsk, 220086, Belarus; SPIN-code: 4354-7264,
ResearcherID: ABI-8122-2020,
ORCID: 000-0002-9194-6170;
vital_kozlovsky@mail.ru

1. INTRODUCTION

Nowadays, the Web is unique a foremost assets for text corpora because of the enormous extent of HTML documentations containing text of all manners. Thus, text mining is gaining a great attention in recent years due to huge amount of text which is posted in a number of social media, networks, blogs and forums. It is a knowledge intensive manner in which user of social media deals with text collected over time with the help of analysis tools. As data mining, similarly text mining seeks to extract suitable information from text sources through the identification and exploration of fascinating patterns. However, the text sources are text collections in text mining and useful, valuable patterns are found not among formalized database records but in the unstructured textual data whereas, data mining assumes that data have already been stored in a structured format, much of its preprocessing focus falls on two critical tasks: scrubbing and normalizing data and creating extensive numbers of table joins. Online social media has generated innovative pattern of information sharing which not solitary offers platform for the contributors but also for dynamic, active information seekers. Numerous types of social media have gained the extensive attention internet users' almost on explosion level. Availability of data on such behemoth scale mandates regular and critical analysis of this information for various perspectives' plausibility. In past few years, number of mechanism and training procedures is presented which are used to share and communicate with other users in the form of text only and such systems also handles the recurrence of text [1]. Such mechanisms are providing a conducive milieu for all social users to generate and diffuse information with which the intensification of usage of social media is rapidly growing.

With the unexpected evolution of information in the World Wide Web, with the growth of online user's, online text increasingly turns into the foremost source for creating eminence corpus of huge size. From WWW, Leipzig Corpora Collection [2] helps to combines various schemes for assembling textual data. This collected text is used for preprocessing [3] from which a valuable, knowledgeable, feature based textual information is extracted which are used for further processing such as sentiment analysis [4, 5], sentiment polarity disambiguation [6], event detection [7, 8] and classification [9], trend prediction [10], topic tracking [11], Recommendation system [12], etc. Furthermore, various levels of text representation are also illustrated in which text can be simply be represent as bag-of-words, string of words or it can be signified semantically so that further expressive, evocative analysis and mining can be done. Name entity recognition is a good example of information extraction [13]. Thus, the main aim behind text mining is to convert large corpus of text into numbers by applying influential mining technique to extract meaningful knowledge patterns [14]. With this to bring clarity in the field of text mining, seven foremost areas within text mining are playing significant role which are:

1. *Search and information retrieval (IR):* it helps to search and retrieve documents from huge corpus according to keyword queries, covers indexing [14, 15].

2. *Document clustering:* it helps to collect related documents into clusters in text mining with the help of algorithm [15–17].

3. *Document classification:* it is the supreme prominent method used in text mining which uses a model of text learned from documents with well-known labels to untagged documents [15, 18].

4. *Web mining:* due to distinctive structure and huge availability of text on web typically in the form of tags, hyperlinks within document (usually in structured manner), used to extract knowledgeable patterns i.e. web content, web structure, and web usage data [15, 19].

5. *Information extraction (IE):* structured text is to be created from collected unstructured or semi structured text [13, 15].

6. *Natural language processing (NLP):* it is an influential tool and in text mining it provides valuable information such as part of speech tags, phrase boundaries etc. [15, 20].

7. *Concept extraction:* it is to detecting relationship between texts in the text based on a lexical database. It matches the words which generate closely matched conceptual [15, 21].

Furthermore, such deep-learning classifiers as artificial neural networks have the prospective to extract a much richer information structure from textual documents. They provide more data available for training with a better scalability and are predetermined for real time analytics and big data applications, which further estimates them superior to traditional indicators.

In spite of these advantages, the potential of textual sentiment indicators in real estate has not been enough theoretically explored. With respect to traditional data and value analysis in real estate, textual sentiment, machine- and-deep-learning classifiers have been absolutely ignored.

1.1. Activities of text mining process (Fig. 1)

Activity 1. Establish the Corpus. In text mining quality and quantity of text are supreme elements. The main aim of this activity is to bring together all the documents that are appropriate to the research problem being addressed. Occasionally, collected documents in the text mining are readily obtainable which can be used by the research depiction (e.g., conducting sentiment analysis on customer reviews of a precise product/service).

Activity 2. Preprocess the Data. This phase helps to generate structured representation of collected corpus of text. It plays an important role in text mining as its aim is to tame text in terms of noise [1, 22] is emoticons, misspelled or incorrect.

Activity 3. Extract the Knowledge. Innovative, knowledgeable, patterns are take out from the processed text in the milieu of precise problem being addressed using the structured text. Predictions (e.g., classification, regression, and time-series exploration), Clustering (e.g., segmentation and outlier analysis), Association (e.g., affinity analysis, link analysis, and sequence analysis), trend analysis are the core classifications of information extraction techniques in text mining.

2. MOTIVATION

As text mining is becoming popular and advanced in current era thus, in this way it has become integral part of human lives. Text in the social media is usually huge in size, with multi-modality capabilities which allows them to collect actual feature of text from raw text. The features are deployed according to the need or thousand leading towards efficient monitoring at higher granularity as compared to traditional text mining. Due to intelligent and cooperating behavior of pre-processing task it is easier to perform complex task in unlabeled, raw and from dynamic text efficiently. Usually in text mining contextual information is not clear as ambiguities exist between textual words which lead users to take wrong decision. Thus in text mining to capture domain knowledge, learning techniques should be efficient which cope up with missing, noisy and dynamic nature of textual data. In this way it leads to more accurate

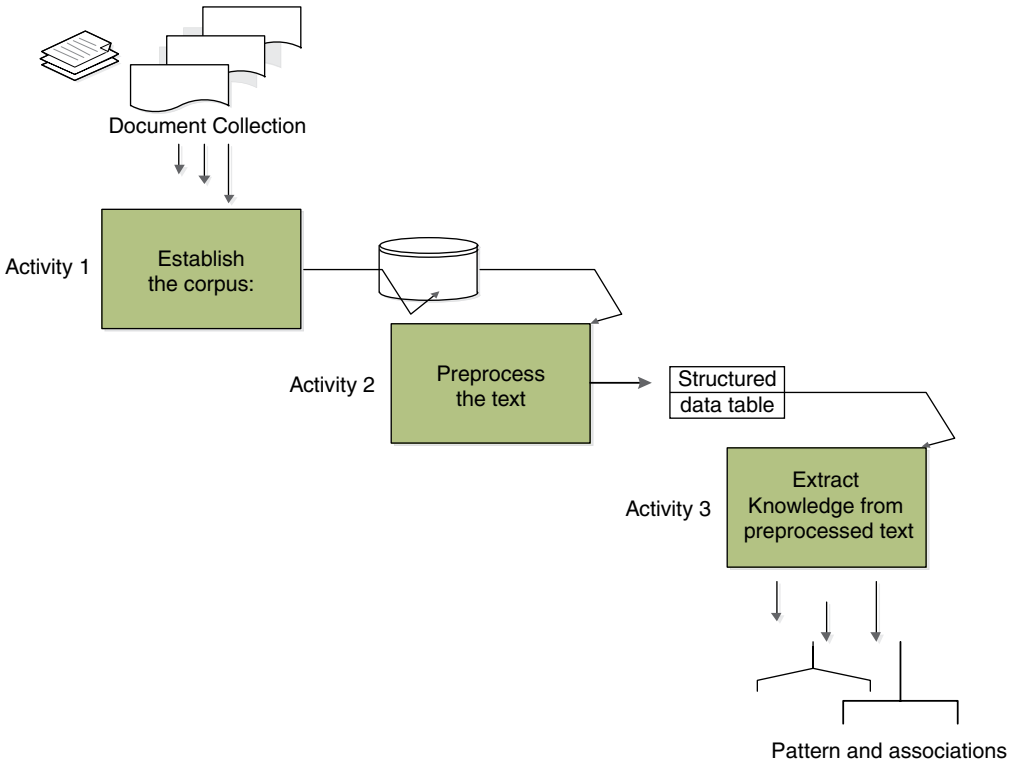

Fig. 1. A detailed view of the context diagram for text mining

tools for extracting semantic as well as contextual information which provides empirical properties of social text and social interactions of users. With advancements of text mining, the applications are no longer limited to just corpus monitoring rather extends towards event detection, classification, trend prediction and estimation using text streams also. Another certain innovative and exciting applications in text mining are also present such as Semantic Mapping and Web search enhancement, which promise have progressively essential effects of the depth of analysis and quality of text mining results.

2.1. Applications of text mining

Text mining is used for a wide array of applications spanning multiple domains. Broadly applications can be classified according to the goals that are tough to define in general terms. Compared to other approaches and established methods, text mining is advance and unstandardized analytical technique for knowledge discovery. Therefore variety of methods, procedures, techniques and tools are used to extract knowledge from textual data. Text mining is well established in Semantic Mapping, sentiment analysis and opinion mining, Mining Bibliographic Data, Enhancing Web Search, trend detection, event detection and classification, recommendation system and many more. These ever increasing applications of text mining can be explained in detailed way as given below:

Open ended survey. In marketing it's an integral part of mining and analyzing the customer's attitude and behavior using open ended questions refers to the theme under exploration. Main aim is to permit respondents to express their interpretations or sentiments without obliging them to specific format or extents.

Involuntary processing of posts, messages, emails, etc. Automatic classification of text is a common application of text mining in which most undesirable "junk email" is possible to filter out. Similarly, messages, posts can automatically be discarded.

Application in evaluating warranty, insurance entitlements and analytical interviews. In various business domains vast amount of information is collected using open ended textual form. Thus in estimating warranties entitlement and medical insurance, brief interviews can be summarized which is collected electronically. Then such kind of narratives is read by text mining approaches for further processing and in this way they play a vast role in text mining applications.

Exploring challengers/competitors by crawling web sites. In a specific domain, automatically processing of web contents of web pages is an emerging application. It helps to derive list of terms and documents available at sites and supports to determine useful, knowledgeable features that are described.

Semantic mapping. Dimensions between word illustrations allow the mapping of indirect relationships between words that appear in related contexts. Semantic mapping is not a new concept in text mining. Latent semantic indexing (LSI) is playing significance role to correlate semantically related terms that are latent in a collection of text documents and latent semantic analysis (LSA) feats the co-occurrence of words in text segments respectively.

Enhancing web explorations. In modern development, meta search engines are gaining great momentum in web searches. These search engines enhance the web exploration where one search engine sends out search request to other search engine and displays all of the return. It offers an opportunity to browse web specifically to enhance the consequences of browsing session.

Sentiment classification. The arena of sentiment analysis deals with the analysis of opinions found in text documents. In this case text is sorted into positive, negative and neutral classes. Polarity disambiguation at sentence and document level is an emerging area of research in which contextual polarity at document and as well as sentence level is to be analyzed to find the actual score of sentiment. Various shopping and survey sites use the scale rating in the form of (★★★★★) or (1 to 10) to collect the customer's sentiments but sentiments in the form of text conveys actual experience of the customers.

Mining Bibliographic Data. It is based on to extract text, related to bibliographic and distinguishes duplicate references. It helps to arrange and establish co-authors relationships and can further be used for analysis by visualizing the functionalities of extracted bibliographic text.

Text mining in detecting Antagonistic, Heated Language in Mails and Cybercrime. In text mining few researchers are dealing with the design of precise application which detects antagonistic from group chat or blog. Use of a bag of words and a statistical classification approaches are playing a key role in text mining to deal with heated languages and to collect chat text from the chat rooms to prevent the cybercrime.

Detecting Popular Events and Trend Prediction. Social media platform offers abundant chance to post on social media, to participate in social forums, events and blogs. Thus its great opportunity for researchers to analyze the event on social media as well as to find the impact of event on trend can also be evaluated. Novelty of event detection and classification is a hot application in text mining which captures the newly arrived with other people on single platform about famous events and trends.

Profile Spams Detection (Fig. 2). In text mining spams profile detection is an emerging application where a blacklist of URLs, DNS, IP address etc. is to be generated and if fake profile match with this database then it will be blocked automatically. Classification approaches are used to classify the spam profiles, links, URLs etc. which blocks the spammers to distribute spam messages, promoting personal blogs, advertisements, pages etc. Fig. 2. is demonstrating the framework of spam detection.

2.2. Design issues in text mining

In text mining majority of text is in unstructured form and it is most common type of text which appears in emails, web pages, blogs, etc. thus this unstructured data demands to be processed for further decision making and then pre-processing come into real picture. Generally a computer cannot understand about the text being communicated, simply structure and syntax of the text is defined. Syntax refers to the organization of language and how distinct words are collected to create well rounded sentences. Whereas semantic define the importance of specific words within the neighboring context. Thus, in text mining it's important to understand the contextual information to analyze the actual meaning of various keywords in the given sentence and document. Following are few of the important issues that must be taken care while designing and studying the text mining:

2.2.1. *Multi-Modality*

Usually, text in the social media contains information which is not required for processing. As it may contains text, images, tags, URLs and hyperlinks. Most of the text mining approaches deal with text only. Thus, it is essential to eliminate undesirable additional information from the collected data [3] otherwise it leads to social text noisy and ambiguous. This is a big challenge in text mining to access

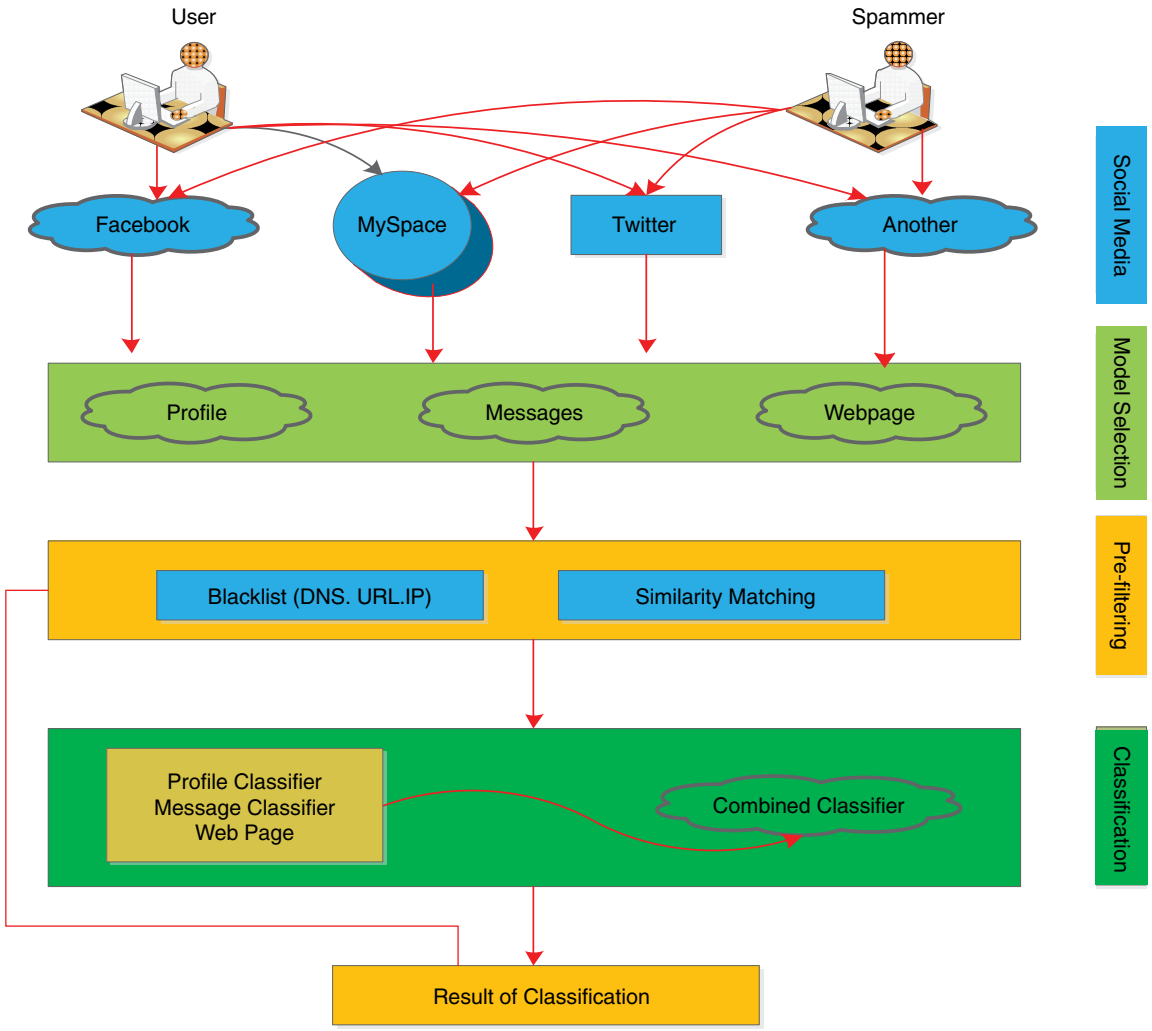

Fig. 2. Framework for Spam Detection Source

useful information buried in collected corpus of text which is stored in different forms (text + image + tags + hyperlinks). Information extraction and information retrieval are used to access information from a sequence of documents whose aim is to collect information which can be used further for sentiment analysis [4, 23], event detection [7] and classification, trend measurement [10], etc.

2.2.2. *Rich social context*

Text mining is rich of social context which is also known as social environment where the online social users interact with each other's in groups, chat rooms, blogs etc. This rich nature of social text generates number of textual connection, graphs and tree structures from root word to the stem word. From the social graph and tree structure of text features of text can be obtained but it is a major issue in text mining to classify text on the basis of features and context. Thus number of parsing mechanism (dependency parsing) is used to find the actual structure of collected text.

2.2.3. *Inconsistent quality*

Usually, user produced information on social media is categorized by noise because users use number of slangs, abbreviations, emoticons, short form of words etc. which acts as a noise in text mining. Social media is occupied with spam messages, frauds, as well as internet viruses. Thus textual information in social media is very limited and the available textual information usually noisy which needs to be processed before further processing. Thus needs a text mining pre-processing schemes to handle such noisy textual information in social media.

2.2.4. *Huge volume and multi-source*

Text in the social media may be generated by various applications, blogs and users' communities which is produced tremendously and spread over social media. It may take less time to diffuse over media or may take long time which depends on the active participation of users. Collected text will be in un-structured form and it can be in the form of corpus or from stream with huge volume based on predefined query or keyword. Thus it's a big issue in text mining to handle text generated from numerous sources which is huge in capacity.

2.2.5. *Dynamic nature of social text*

Due to dynamic nature of social media in real time scenario users post in very less span of time which needs online fast clustering to target fast updates and to cluster together all upcoming text in less amount of time and accurately. Thus, to maintain quality/correctness of collected data and to prevent resources from wastage because of fast updates, the text should be identified and handled timely in the real time situation.

2.2.6. *Slangs and folksonomies*

Generally, in text mining different people have dissimilar symbolization/notations for information sharing. Number of slangs and folksonomies are used in text mining which is corrected by WordNet dictionary for matching process to get the actual meaning of the

particular word and in which context it is represented. Therefore, in order to sustain the correctness of the words and to provide desired meaning within the text, the timely identification of word sense and their recovery is necessary. Due to isolated conditions, the text process should have capabilities to cope up with such correctness without any human intervention.

3. GENERAL OUTLINE OF TEXT PRE-PROCESSING

Text pre-processing (Fig. 3) contains number of steps in a sequence designed at converting noisy text into an appropriate form for input to an algorithm. Fig. 3 illustrate the distinctive operations of text pre-processing for sentiment analysis. Tokenization is most important step in sentiment analysis because it represents sentiment information sparsely and unusually. In tokenization the input text is divided into its small units and the subsequent tokens are tagged with their respective POS and sentiment scores are extracted from SentiWordNet.in the next phase, tokens are transformed to a reliable case using lemmatization and finally, filtering of stop word is typically implemented.

3.1. Main Challenges related to Social Media Text

Social media is ambiguous notion which refers to websites and applications that facilitate consumers

to generate and share text or contribute in social networking [24]. In modern era, social media also refers to social networking sites such as Facebook, G+, and LinkedIn [25]. Website and applications of social media comprise delicate blogs, micro-blogs, web forums, community question-answering, mailing lists, and numerous websites through social networking facilities [25, 26]. Broadly social media is defined which include extensively accessible electronic tools that allow everyone to distribute, access, and broadcast information. Social networking is an essential feature of social media. In [27], authors divide social media into eight types such as: blogs, micro-blogs, e-commerce portals, multimedia sharing, social networks, review platforms, social gaming, and virtual worlds. Documents of social media contain exclusive features in numerous aspects such as:

1. **Shortness.** With the comparison of traditional media, social media documents usually shorter. Consider an example of twitter then, there is a 140-character limit to the length of a tweet [28]. Thus, it's very challenging to extract important features from the short length of tweet.

2. **Multi-linguality.** In social media, users use different languages to participate in various communities, blogs, and groups in the identical communication platform. Due to this multi-linguality nature of social media, usually it becomes difficult to analyze the text message as it will be out of vocabulary. E.g. in FIFA WorldCup 2014, people deliberate the identical match in several languages on Twitter [25].

3. **Opinions.** Numerous documents in social media hold opinions. An opinion is a quintuple (o_j, f_{jk}, so_{ijkl}, h_i, t_l), where, o_j is a target object, f_{jk} is a feature of the object o_j, so_{ijkl} is the sentiment value of the opinion of the opinion holder h_i on feature f_{jk} of object o_j at time t_l. so_{ijkl} is positive, negative or neutral, or a more granular score, h_i is an opinion holder, t_l is the time when the opinion is expressed [29].

4. **Timeliness**. Social media is dynamic in nature and documents are posted with precise timestamps. Thus, the text over social media changes over time in social text streams. Event detection, classification and trend prediction in text stream is quite challenging.

Table 1. Social text quality challenges

Challenge	Description
Stop list	Common words frequency of occurrence
Lemmatization	Similarity detection of text/words
Text cleaning	Removal of unwanted from the data
Clarity of words	To clear the meaning in text
Tagging	Predicting data annotation and its characteristics
Syntax /Grammar	Scope of ambiguity, data dependency
Tokenization	Various methods to tokenize words or phrases
Automatic learning	Similarity measures and use of characterization

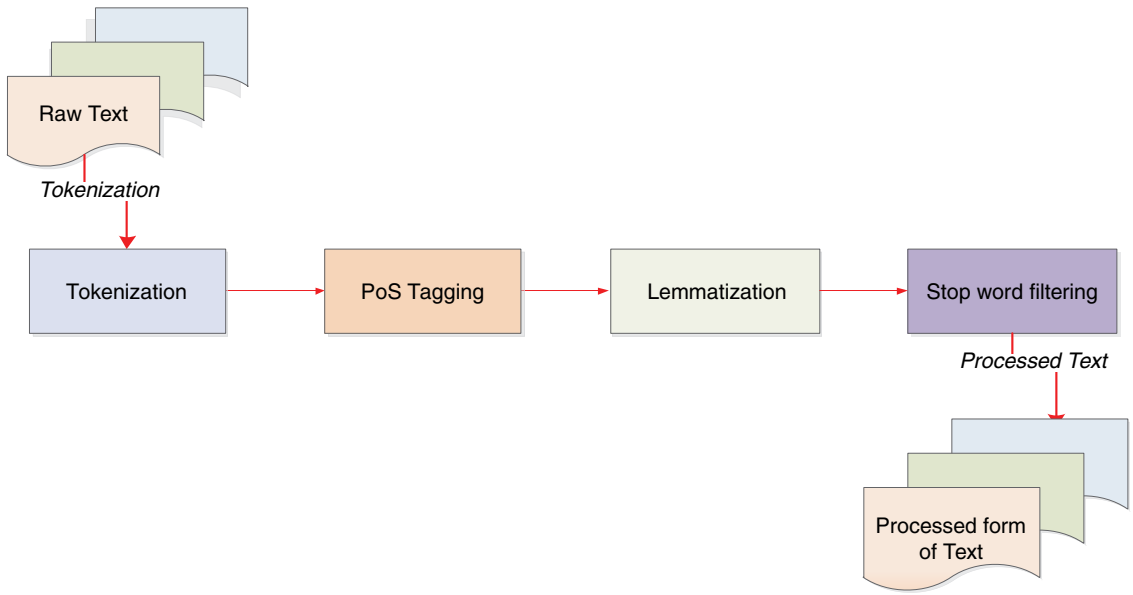

Fig. 3. General outline of text pre-processing

4. TEXT PRE-PROCESSING

In social media, non-standard words show their negative impact, thus normalization methods are persistently emerging. For instance, an ISBN is generally used to represent "*International Standard Book Number*" [30]. Mobile phone SMS messages often hold non-standard words like *hru*/how are you, *ttyl*/talk to you later, *cu*\see you [26] and many more. Thus with the growth of social media, twitter contains a huge non-standard words, including *mistakes/typos* (e.g. *helo*/hello", *stndrd*/standard"), phonetic approximations (e.g., *w8*\wait", *f9*/fine"), words with repetitions (e.g. *hiiiiiiii*/hi", *helloooooooo*/hello"), informal abbreviations (e.g., *awsummmmmm*/awesome", *gr888888888*/great"). Such non-standard words act as noise in social media text mining and it is hard and challenging task to compute all possible factors underlying the formation of non-standard words.

4.1. Analysis of text pre-processing (The n-gram model and assumptions)

The *n*-gram model is a language model that allocates probabilities to series of words. It is a sequence of n words, whereas a 3-gram (trigram) contains three-word sequence like "with humble submission", or "humble submission and" and a 2-gram (bigram) contains two-word sequence like "with humble" or "humble submission". Now, we will understand the use of *n*-gram model to evaluate the probability of the preceding word of an *N*-gram specified the prior words, and furthermore to allocate probabilities to whole word sequences. In estimating the probabilities of the next words or the while word sequence, *n*-gram model is the greatest model in language processing. With *n*-gram probability of entire sequence like $P(t_1, t_2, \ldots, t_n)$ is computed as:

$$P(X_1 \ldots X_n) = P(X_1)P(X_2|X_1)P(X_3|X_1^2)\ldots P(X_n|X_1^{n-1}) = \prod_{k=1}^{n} P(X_k|X_1^{k-1}). \quad (1)$$

Thus, after applying chain rule it will be computed as:

$$P(t_1^n) = P(t_1)P(t_2|t_1)P(t_3|t_1^2)\ldots P(t_n|t_1^{n-1}) = \prod_{k=1}^{n} P(t_k|t_1^{k-1}). \quad (2)$$

The above equation (1) shows the connection between joint probability of a word sequence and calculating the conditional probability of a word specified prior words whereas, from the equation (2), joint probability of complete word sequence can be estimated by multiplying together a number of conditional probabilities.

On the other hand, if we consider 2-gram (bigram) language model and want to estimates the probability of a word given all the previous words $P(t_n|t_1^{n-1})$, with the help of conditional probability of the previous words $P(t_n|t_{n-1})$. With the use of 2-gram (bigram), conditional probability of the next word is calculated by using the following calculation:

$$P(t_n|t_1^{n-1}) \approx P(t_n|t_{n-1}). \quad (3)$$

Markov assumption. It states that the probability of a word based solely on the previous word is known as Markov assumption. It is supposed that, the probability of future words can be presume without recognizing too deep into the past. Thus, we can simplify the 2-gram, which inspect one word into the prior, whereas the 3-gram, inspect two word into the prior and as a result to the *n*-gram, which inspect $n - 1$ word into the prior. Therefore, the probability of the consequent word in a word sequence in *n*-gram to the conditional probability is described as:

$$P(t_n|t_1^{n-1}) \approx P(t_n|t_{n-N+1}^{n-1}). \quad (4)$$

In case of 2-gram, from probability of a specific word probability of a whole word sequence can be computed by replacing eq. (3) into eq. (2) as:

$$P(t_1^n) \approx \prod_{k=1}^{n} P(t_k|t_{k-1}). \quad (5)$$

4.2. Conditional random fields (CRF) and assumptions

The philosophy of conditional random fields is too profound to be explained. These are used in number of applications where to calculate several variables that be influenced on each other. Conditional random fields (CRFs) are a structured forecast framework which is widely used for name entity recognition (NER). These are the probalistic framework, which are used for labeling and segmenting organized well-structured text, such as classification, sequences and trees. The fundamental task is that of describing a conditional probability dispensation over train text given a particular consideration train, comparatively a combined distribution over both train and consideration train. Moreover, CRFs are undirected graphical models much flexible than hidden Markov models as they abstain label bias issue. They perform better in both MEMMs and HMMs including many real world efforts in various fields such as bioinformatics, linguistics etc. in text classification and sequence labeling, CRFs provides much flexibility to define the feature vector.

Definition. Consider $G = (V, E)$ be a graph so that $Y = (Y_v)_{v \in V}$, thus, Y is ordered by the vertices of G. Therefore, (X, Y) are the CRFs in case, when trained on X, the random variables Y_v follow the estate of Markov w.r.t. the graph which is given below (eq. 8) in which, $w \sim v$ indicates that in G, w and v are neighbor:

$$p(Y_v|X, Y_w, w \neq v) = p(Y_v|X, Y_w, w \sim v). \quad (6)$$

According to the essential proposition of random arenas, joint distribution over the label order sequence Y given X is described as eq. 9, in which, x and y are the data sequence and label sequence respectively:

$$p_\theta(y|x) \propto \exp\left(\sum_{e \in E,k} \lambda_k f_k(e, y|_e, x) + \sum_{v \in V,k} \mu_k g_k(v, y|_v, x)\right). \quad (7)$$

Moreover, in defining the features function, a set of real value feature is created by which some features and characteristics of the training data set are described which is defined as (eq. (8)):

$$W(x,i) = \begin{cases} 1 & \textit{when the observation is at the position } i; \\ 0 & \textit{otherwise.} \end{cases} \quad (8)$$

Fig. 4 defines the depiction of functional model called conditional random field and the eq. (9) elaborate the CRFs as a functional unit:

$$p(y|x) = \frac{\exp\left\{\sum_{m=1}^{M} \lambda_m f_m(y_n, y_{n-1}, x_n)\right\}}{\sum_{y'} \exp\left\{\sum_{m=1}^{M} \lambda_m f_m(y'_n, x_n)\right\}}. \quad (9)$$

Thus, in general, a linear condition random field (CRF) is defined as a distribution of $p(Y|X)$ that takes the form as in eq. (10), in which $Z(X)$ is known as instance specific normalization function:

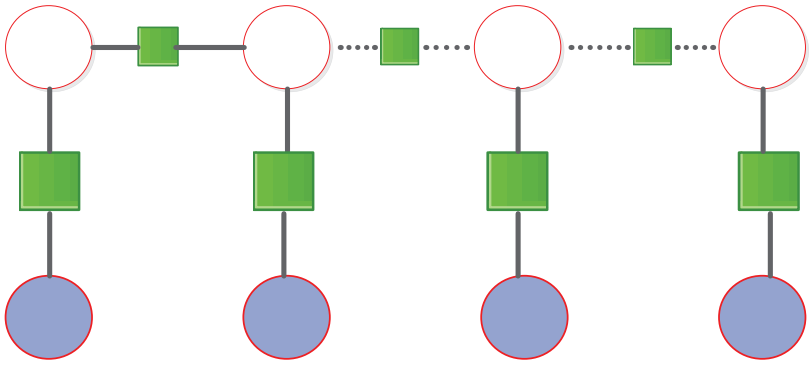

Fig. 4. Functional model of conditional random fields (CRFs)

$$p(Y|X) = \frac{1}{Z(X)} \exp\left\{\sum_{m=1}^{M} \lambda_m f_m(y_n, y_{n-1}, x_n)\right\}; \quad (10)$$

$$Z(X) = \sum_{y} \exp\left\{\sum_{m=1}^{M} \lambda_m f_m(y_n, y_{n-1}, x_n)\right\}. \quad (11)$$

Furthermore, conditional random fields (CRFs) have many applications and they are used to a number of fields. In text mining, CRFs are used for named entity recognition (NER). These are commonly accepted by many researches because they represent entities graphically and their dependencies are also characterized including their rich features. In this dissertation, we used conditional random fields (CRFs) for named entity recognition in tweets for the purposed of text normalization.

5. CONCLUSIONS

This article is an endeavor to elucidate text analytics bent of social media with current updates and text mining method. As social media has progressed in exceptional mode, it led to numerous motivating and exciting research direction particularly in the arena of text mining. Looking at the interestingness of the text mining area, it is full of information. Thus, the main impact of this paper is to expand and conceptualize the areas of social media which are available and can be accessible on an astonished variety. Social media text is full of noise, abbreviations, special symbols, emoticons out of vocabulary words and folksonomy. Therefore, rich patterns of text stream or corpus, can be exploited to generate relevant and required information. Number of techniques are present for text mining which can't be ignored and helps to measure the impact on text pre-processing and sentiment analysis. This article explains the various tasks along with real estate market application areas. It also discusses the various methodologies available for text pre-processing as well as for the sentiment analysis in text corpus and text stream. As a discovery, these techniques can be used for real estate market analysis and valuation and text mining can be applied for prolific research domain such as: event detection and classification, sentiment polarity disambiguation, trend prediction, semantic hashing, crowd sourcing etc. Yet, it is to be evolve few multilingual model which are capable to handle multilingual eccentricities in text stream and text corpus to facilitate the better classification in text mining. For the first time, the capabilities of a machine- and a deep-learning classifier for predicting real estate market trends are assessed. Real estate market updates and news analytics by means of textual sentiment classifiers in general and machine- and deep-learning algorithms in particular can be perceived as a valuable and innovative source of market sentiment and is able to provide real estate researchers and valuers with a reliable leading market indicators.

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Прогнозирование тенденций развития и цен на рынке недвижимости с помощью предварительной обработки и анализа тональности текста

Повсеместный рост в области интеллектуального анализа текста, где интеллектуальный анализ социальных сетей играет значительную роль, является беспрецедентным. Это становится потенциальным источником изучения и анализа познаний людей, особенно с помощью предварительной обработки анализа тональности и текста. Анализ потенциального влияния настроений на реальные рынки недвижимости вызывает дискуссии ученых из области финансов, оценки и рыночной эффективности. Следовательно, это является весьма важной задачей для нашего исследования, которое не только обеспечивает подходящую платформу для подобных обсуждений, но и для всех, активно ищущих информацию о рынке недвижимости. Интеллектуальный анализ текста привлек внимание пользователей информации о рынке недвижимости, который находится на грани серьезных трансформаций. Доступность данных в таком гигантском объеме требует регулярного и критического анализа всей этой информации на предмет правдоподобия различных точек зрения. Огромные объемы текстов в социальных сетях онлайн можно использовать для эффективного извлечения релевантной информации о недвижимости. Поскольку интеллектуальный анализ текста играет важную и решающую роль в раскрытии этой идеи, необходимо тщательно изучить данные проблемы и их вклад в развитие анализа социальных сетей. В этой статье кратко рассмотрено текущее состояние предварительной обработки и анализа тональности текста для анализа рынка недвижимости. Особое внимание уделяется источникам и механизму изучения, доступным для исследователей и практиков в сфере недвижимости, также обсуждаются основные задачи интеллектуального анализа текста, представляющие интерес для широкого круга потребителей результатов исследования. Таким образом, основная цель этой статьи состоит в том, чтобы разъяснить и исследовать те области социальных сетей, которые широко доступны для предварительной обработки и анализа тональности текста о недвижимости для прогнозирования тенденций и цен на рынке недвижимости.

***Ключевые слова**: недвижимость, анализ тональности, социальные сети, интеллектуальный анализ текста, спам, CRF, n-грамм, энтропия*

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Об авторах: **Синяк Николай Георгиевич** — кандидат экономических наук, профессор кафедры менеджмента и экономики; **Частный институт управления и предпринимательства**; Беларусь, 220086, г. Минск, ул. Славинского, д. 1, корп. 3; SPIN-код: 4400-2224; Scopus: 55952470200; ResearcherID: K-4838-2015; ORCID: 0000-0002-1688-9268; Google Scholar: 9wEDUrMAAAAJ; siniakn@gmail.com;

Тажиндер Сингх — доцент кафедры компьютерных наук и инженерии, **Институт инженерии и технологий Сант Лонговал**; Индия, 148106, г. Пенджаб, Сангрур, Административный блок SLIET, SLIET Rd; Google Scholar: nn4t8UMAAAAJ&hl; nith2k14@gmail.com;

Мадху Кумари Джаглан — кандидат наук, доцент, доцент кафедры компьютерных наук и информационных технологий; **Национальный технологический институт Хамирпура**; Индия, 177005, Химачал-Прадеш, г. Хамирпура; ORCID: 0000-0003-3203-2579; Madhu.jaglan@gmail.com;

Козловский Виталий Владимирович — доктор экономических наук, главный научный сотрудник; **Научно-исследовательский экономический институт Министерства экономики Республики Беларусь (НИЭИ Минэкономики)**; Беларусь, 220086, г. Минск, ул. Славинского, д. 1, корп. 1; SPIN-код: 4354-7264, ResearcherID: ABI-8122-2020, ORCID: 000-0002-9194-6170; Vital_kozlovsky@mail.ru.

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Mishchenko V.Ya.
Gorbaneva E.P.
Ovchinnikova E.V.

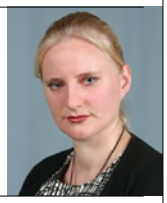
The “rebound effect” of energy efficient actions to be performed as part of a major renovation of apartment buildings

Environmental safety and the rational use of natural resources are among pressing present-day problems. Energy efficiency improvement is an important constituent of energy policies in many countries. This article examines the impact of the “rebound effect” on improving the energy efficiency of environmental safety programs implemented at federal and municipal levels. There is still no consensus on how to take the “rebound effect” into account and whether it should be considered at all. Paradoxically, the “rebound effect” is the unintended side effect of energy efficiency activities. In this paper, different types of this effect are considered. The “direct assessment” method, based on the non-linear relationship between energy consumption and efficiency, is used to assess the “rebound effect” produced on individual household appliances. The factors hindering the implementation of energy efficiency activities are also identified. Having analyzed the impact of the effect on different sectors of economy, we can conclude that the most pronounced “rebound effect” is observed in the housing sector. Consequently, if we consider a major energy efficient renovation, we have to take account of the “rebound effect” caused by new energy saving activities.

Keywords: *major renovation, housing stock, apartment buildings, energy efficiency, energy saving technologies, rebound effect*

Mishchenko Valeriy Yakovlevich,
Doctor of Technical Sciences, Professor, Head of the Department of Technology, Organization of Construction, Expertise and Property Management, Advisor to RAACS, Member of the Russian Ecological Academy; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya St., Voronezh, 394006, Russian Federation; ID RISC: 717804, ORCID: 0000-0003-2385-5426; oseun@yandex.ru

Gorbaneva Elena Petrovna,
Candidate of Technical Sciences, Associate Professor of the Department of Technology, Organization of Construction, Expertise and Property Management; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya St., Voronezh, 394006, Russian Federation; ID RISC: 386458, Scopus: 57196442554, ORCID: 0000-0002-4105-350X; egorbaneva@vgasu.vrn.ru



Ovchinnikova Elena Viktorovna,
Postgraduate Student of the Department of Technology, Organization of Construction, Expertise and Property Management; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya St., Voronezh, 394006, Russian Federation; ID RISC: 1001649, ORCID: 0000-0002-7795-8132; eovchinnikova0803@gmail.com

INTRODUCTION

The purpose of major renovations is to improve the quality and comfort of an apartment building, but only an energy efficient renovation allows to recoup the work performed and the services provided during a major renovation, since it saves energy costs [1–3].

Let's address the advantages of an energy efficient renovation. It encompasses the modernization of in-house engineering systems, improves the level of comfort in apartment buildings, reduces the consumption of energy resources, cuts per-apartment utility bills; raises the market value of premises.

Federal Law 185-FZ of July 21, 2007 “About the housing and utilities reform fund”, and Decree No. 183 issued by the Government of the Voronezh Region on March 6, 2014 “On the approval of the regional program for the major renovation of common property in apartment buildings in the Voronezh region for 2014–2044”, the subprogram “Major renovation of common property in apartment buildings” were enacted to bring multi-family housing into proper technical and operational condition. The priority areas, covered by this municipal program, are provided in Fig. 1[1].

A major renovation cannot be done in all apartment buildings at the same time for objective reasons. The main criteria for the selection of apartment buildings to be renovated include the number of

1 On approval of the regional program for the overhaul of common property in apartment buildings in the Voronezh Region for 2014–2044 (as amended on February 7, 2019) : Decree of the Government of the Voronezh Region dated March 6, 2014 No. 183. URL: http://docs.cntd.ru/document/430639697

Fig. 1. Implementation priorities of municipal policies set in subprogram “Major renovation of common property in apartment buildings”[1]

years in operation, the physical deterioration of building elements, and the dates of the most recent major renovation [2, 3].

Despite the advantages of a major renovation, the so-called "rebound effect" may occur due to the irrational implementation of energy efficient activities in the process of renovation.

"The rebound effect" is the rise in consumption of energy and/or materials after the implementation of energy efficiency activities [4, 5].

MATERIALS AND METHODS

Energy efficiency policies, adopted by many countries as a way to reduce energy consumption and related negative effects, are aimed at avoiding or reducing the consumption of non-renewable energy sources.

The "rebound effect" paradox, resulting from the introduction of new energy-efficient technologies, reduces the cost of energy services, thereby increasing the demand for these services or goods (whose production is accompanied by energy consumption).

"The rebound effect" is a side effect of technologies aimed at increasing energy efficiency. It was first described in 1865 by William Stanley Jevons (the Jevons paradox). William Stanley Jevons has identified that the technological progress boosts the efficient use of a resource, thereby increasing its consumption (Fig. 2) [6, 7].

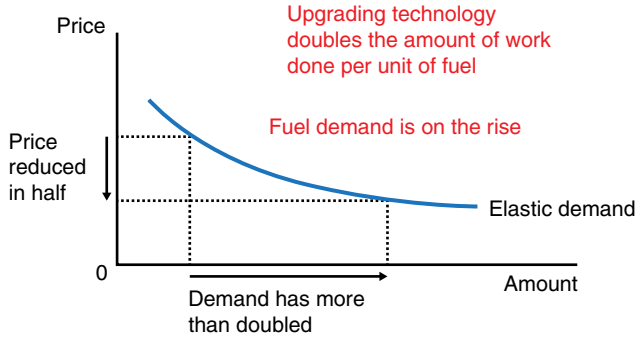


Fig. 2. The Jevons paradox [7]

Let's address the dispute on the importance of considering or ignoring the "rebound effect" when implementing energy efficiency programs. Firstly, let's identify the types of effects to be subdivided. In general, "the rebound effect" is divided into a direct rebound effect, an indirect effect, and a macroeconomic effect. The structure of the rebound effect is shown in Fig. 3 [8–10].

The "rebound effect" is determined by the formula [9]:

$$R = 1 - \left(\frac{\Delta E_a}{\Delta E_e} \right),$$

where ΔE_a is the actual change in the energy resource consumption after the implementation of energy efficiency improvements; ΔE_e is the estimated change in the energy resource consumption after the implementation of energy efficiency improvements.

The following conditions determine the "rebound effect":

- if $\Delta E_a = \Delta E_e \rightarrow R = 0$, then there is no rebound effect, as the actual result coincides with the anticipated one;
- if $\Delta E_a < \Delta E_e \rightarrow R > 0$, the rebound effect manifests itself;
- if $\Delta E_a < \Delta E_e \rightarrow R < 0$, the actual effect exceeds the anticipated one;
- if $\Delta E_a < \Delta E_e \rightarrow R \geq 0$, the rebound effect emerges.

The intensity of the "rebound effect" depends on many factors. For example, it ranges from 0 % to 60 % for the residential housing sector. This effect is triggered by various energy-related services (residential lighting, space heating, air conditioning, dishwashers and washing machines, refrigerators) [6, 7, 11].

RESULTS

The "direct estimate" method can be used to evaluate the rebound effect of individual appliances. This method employs the non-linear relationship between the energy used and the resulting efficiency. In the linear relationship, energy consumption is usually assumed to be negligible and the efficiency of a household appliance is high. However, in reality, the relationship is non-linear. Consequently, the gap between linear and non-linear relationships represents the rebound effect. It can be concluded that the concavity in the nonlinear relationship is the value of the rebound effect (Fig. 4) [7].

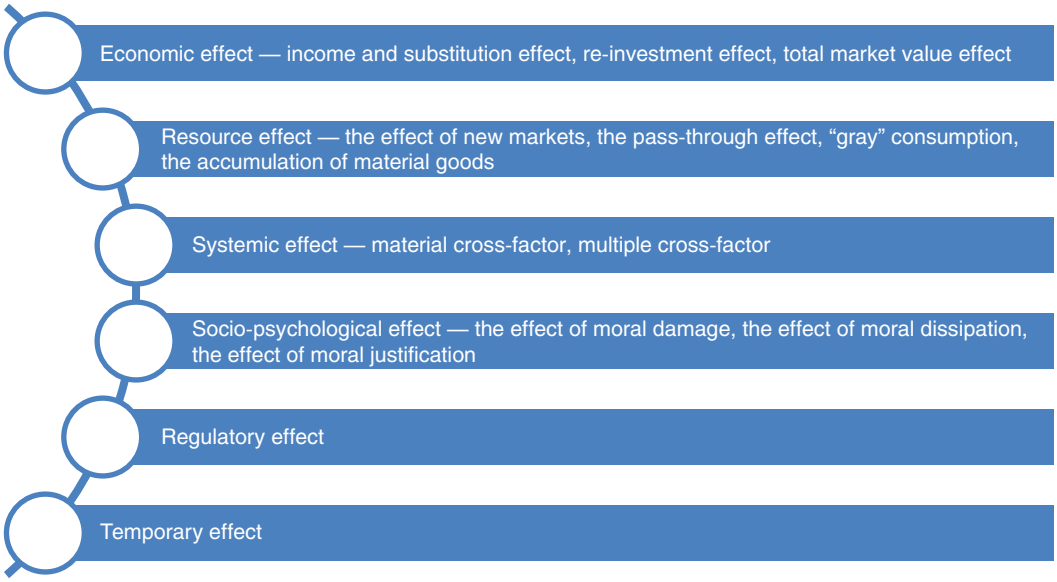


Fig. 3. The structure of the rebound effect

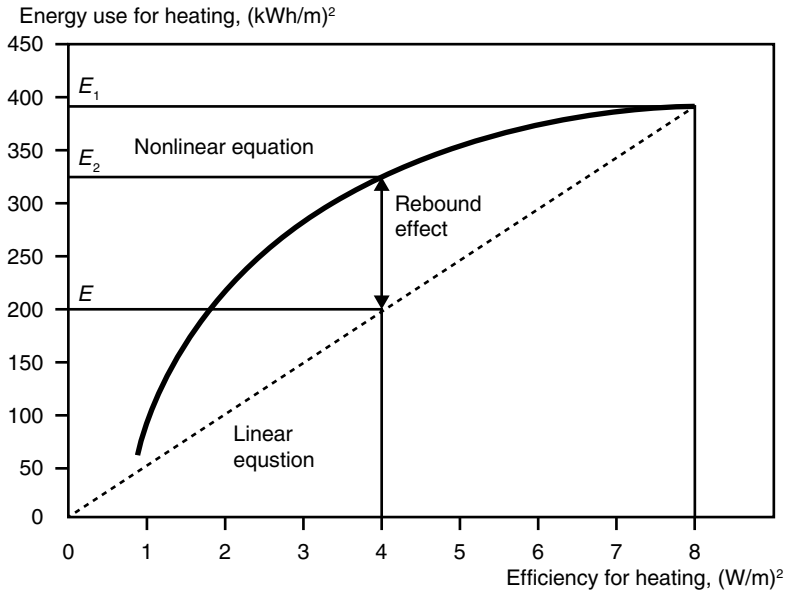


Fig. 4. The rebound effect in the non-linear relationship between the energy used for heating and the heating efficiency [8]: E_1 — actual energy consumption before efficiency improvements; E_2 — actual energy consumption after efficiency improvements; E — anticipated energy consumption after efficiency improvements

The table shows the approximate intensity of direct effects for different residential energy services [12, 13].

The intensity range of the direct rebound effect, %

Types of energy services	The intensity range
Lighting	5...12
Heating	2...60
Air conditioning	0...50
Other energy services	0...49

The table shows that lighting has the smallest "rebound effect", while heating and air conditioning show higher "rebound effect" values.

The author [8] proposed to divide the main methods, used to reduce the impact of the rebound effect, into six groups. The author consolidated information campaigns, educational activities, and changes in consumer habits into the first group (26 %). The second group encompasses the impact on program design (23 %); the third group has fiscal activities (19 %); the fourth group contains stimulation (13 %), the fifth group has standardization (8 %); and the sixth group sets consumption limits and rationalizes consumption (8 %). This breakdown encompasses 97 % of activities, thus, minimizing "the rebound effect". The remaining three per cent are insignificant.

DISCUSSION

The analysis of "the rebound effect" performed for different industries in several countries generated different results. The comparison was made for several categories: the economy as a whole, the housing sector, and the industry. As for the economy as a whole, the rebound effect in the energy sector of China was 53.2 %, in the UK — 37.0 %; as for the housing sector, in China the rebound effect reached 71.5 %, in the UK — 34.0 %; as for the industry, China — 39.0 %, India — 80.0 %, USA — 24.0 %. It is noteworthy that the rebound effect depends on the national economy [14, 15]. Energy efficiency strategies do not always lead to energy savings. The cost and the return on investments are the obstacles. When starting energy efficient activities, a consumer expects that the investment in their launch will recoup in 2–3 years; however, this is not always feasible. Moreover, "the invisibility" of energy consumption is an obstacle. In most cases, it is difficult to determine how much energy each device consumes in a house. We get to know the ultimate power consumption figures for all electrical devices every month. Consequently, consumers do not care about electricity costs.

CONCLUSIONS

"The rebound effect" manifests itself in such spheres of economy as household power consumption, the residential sector, the construction and maintenance of buildings and structures, transport, industrial production, and the IT infrastructure.

The number of studies focused on this topic grows every year. It is noteworthy that the international community has developed an understanding of the need to consider the "rebound effect" when implementing energy efficient activities. Energy efficiency strategies need to consider lifestyles and changes in consumer behavior patterns as a matter of priority.

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«Эффект отскока» при внедрении энергоэффективных мероприятий при капитальном ремонте многоквартирных домов

Одной из актуальных проблем является экологическая безопасность и рациональное расходование природных ресурсов. Повышение энергоэффективности является важной частью энергетической политики многих стран. В данной статье рассматривается влияние «эффекта отскока» на реализацию программ по повышению энергоэффективности. По-прежнему нет единого мнения как учитывать «эффект отскока» и нужно ли вообще учитывать его. Как не парадоксально, «эффект отскока» является непреднамеренным побочным эффектом при внедрении энергоэффективных мероприятий. В данной работе рассмотрены виды эффекта. Для оценки «эффекта отскока» для отдельных бытовых приборов рассмотрен метод — «прямой оценки», который основывается на нелинейной зависимости между используемой энергией и эффективностью. Также были обозначены факторы, препятствующие внедрению энергоэффективных мероприятий. Анализируя влияние эффекта в разных сферах экономики, можно сделать вывод, что больше всего «эффект отскока» наблюдается в жилищном секторе. Следовательно, если рассматривать проведение энергоэффективного капитального ремонта, то перед нами стоит задача учитывать «эффект отскока» при внедрении энергосберегающих мероприятий при проведении энергоэффективного капитального ремонта.

Ключевые слова: *капитальный ремонт, жилищный фонд, многоквартирные дома, энергоэффективность, энергосберегающие технологии, эффект отскока*

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Об авторах: **Мищенко Валерий Яковлевич** — доктор технических наук, профессор, заведующий кафедрой технологии, организации строительства, экспертизы и управления недвижимостью, советник РААСН, член Российской Экологической Академии; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; РИНЦ ID: 717804, ORCID: 0000-0003-2385-5426; oseun@yandex.ru;

Горбанева Елена Петровна — кандидат технических наук, доцент кафедры технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; РИНЦ ID: 386458, Scopus: 57196442554, ORCID: 0000-0002-4105-350X; egorbaneva@vgasu.vrn.ru;

Овчинникова Елена Викторовна — аспирант кафедры технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет (ВГТУ);** 394006, г. Воронеж, ул. 20-летия Октября, д. 84; РИНЦ ID: 1001649, ORCID: 0000-0002-7795-8132; eovchinnikova0803@gmail.com.

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Павлова Л.И. Каунас. Площадь венчаний. Офорт

UDC 721:502.12.911.8

Benuzh A.A.
Sukhinina E.A.
Eames G.A.

Development stages of ecological architectural and construction design in Russia

The history of environmental standards, the emergence of environmental architectural and construction design in Russia and the forerunners of environmental certification systems in construction are studied. Historical material is analysed and data is systematised chronologically.

Development stages of ecological architectural and construction design in our country are highlighted, their main features are given: Stage 1 (late 17th – mid 20th centuries) — the history of the formation of environmental requirements for the conservation of natural resources and the creation of a comfortable environment for life in urban areas; Stage 2 (mid XXth – early XXIth centuries) — the formation of environmental legislation, the opening of the first Russian Green Building councils, the adaptation of international environmental standards in construction to Russian realities; Stage 3 (the beginning of the XXIth century – the present) — the creation of sustainable requirements in the Russian Federation, increasing the viability of the architectural and construction environment, the introduction of a number of Russian environmental standards in construction, the formation of a national Technical Committee 366 to develop national standards to GOST R series on green construction and promoting green standardization at the national and international levels with the introduction of new green technologies, materials and products for a comfortable living environment.

Today in Russia, a new architectural and construction environment is emerging, aimed at saving resources, preserving health, energy conservation, reducing waste, safety, comfort, preserving biodiversity and creating holistic conditions. To intensify the development of this area, it is necessary to introduce new environmental standards for the design of sustainable space in Russian cities, using best world practice.

Keywords: *ecological construction, Green Standards, environmental standards, architectural and construction design, sustainable living environment*

In the Russian Federation, environmental regulations for the protection of natural resources began to be adopted to a greater extent in the mid-to-late 20th century, however, the stage of the formation of an ecological approach in architectural and construction design has a long history with the identification of prerequisites for its emergence [1]. The subject of study in this article is the forerunners of environmental standards and environmental standards in construction, as well as the formation of environmental-aspects of design in Russia.

People have since ancient times intuitively adapted to natural conditions, carefully selecting sites, using materials at hand for construction, and making their homes compact. In those distant times, there was almost no harm from such human activity to nature [1].

With the development of settlements and the strengthening of the city walls, the built-up areas moved increasingly away from nature, the first environmental problems appeared related to unsanitary conditions, over-density of urban development and the lack of open green areas, Fig. 1.

The rudiments of the first norms on the conservation of natural resources appeared in the territory of Ancient Rus'[1]. Pressure on natural ecosystems was not felt in the XI–XVI centuries, accordingly there were no special state measures for nature's protection at that time [1].

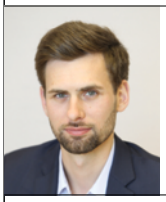
A common type of dwelling in Russia was a wooden hut with a transitional buffer space in the form of a canopy, which was originally placed on a "stage" for warmth. A person could assemble a hut without a single nail, disassemble it and transport it to another place. The structure was always scaled to the size of the human body. Consistency with natural phenomena was at the heart of everyday issues and construction processes of that time [2].

The characteristic features of the design of ancient Russian cities include: the choice of a secure site for construction; picturesque territory; fortifications around the city; lack of a clearly defined regular building structure; use of the landscape within the buildings' hierarchy; complex versatility of the urban silhouette; wooden planks used for paving paths, riverbanks and bridges [3].

The first significant measures for the rational use of natural resources were carried out by Peter the Great[2]. He adopted many decrees for the protection of natural resources, evolving towards the all-Russian standards for the protection of nature [4]. Subsequently, the number of legislative acts in this area increased — in 1725–1801, over 140 laws were issued, and during the 60 years of the 19th century – about 300 [5, p. 196]. At the beginning of the 19th century, under Alexander I, the Forest Code (1802) was introduced, Nicholas I finalized the Forest Code by adopting new resolutions. In the second half of the 19th century, under Alexander II, the section on City Status (1870) provides for a number of requirements for creating favourable urban conditions.

1 The collection "Russkaya Pravda", introduced in the 11th century by the Kyivian prince Yaroslav the Wise, established the rules to regulate hunting and foraging.

2 Under Peter Great, over 60 decrees were adopted regulating the use of natural resources in the country.



Benuzh Andrey Alexandrovich,
Candidate of Science, Associate Professor of the Department of Design of Buildings and Structures; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation;
ID RISC: 767166,
Scopus: 55924719500,
ResearcherID: N-7098-2016;
abenuzh@gmail.com

Sukhinina Elena Aleksandrovna,
Candidate of Architecture, Associate Professor of the Department of Architecture; Yuri Gagarin State Technical University of Saratov (SSTU); 77 Polytechnicheskaya St., Saratov, 410054, Russian Federation;
ID RISC: 701984;
arx-art-lena@yandex.ru

Eames Guy Alexander,
MSc, Chair; Association "Green Building council" (Association "RuGBC"); 5 Pokrovka St., Moscow, 101000, Russian Federation;
guy.eames@gmail.com

Fig. 1. First Eco Problems of Architectural Design

At the beginning of the 20th century, a number of projects were completed that reflected the environmental problems of cities at that time. Especially significant are the projects of the green cities of Ladovsky N., Barshch M., Ginzburg M. The increasing rates of urbanization and industrial production contributed to the development of a deteriorating architectural and construction environment. Since the 1920s, urban growth and the formation of industrial centers became the main socio-economic priority. Soviet cities were not balanced in terms of ecological balance, there was an increased rate of urbanization, typification of architectural solutions, geometric plans.

Researchers during the period 1917–1950 determined the traditional attitude to protect natural resources by creating natural parks and complexes in the USSR, the science of nature conservation begins to emerge, supported by legislative acts. In the 1960s and 1980s, the Soviet Union adopted a number of forest, land and water codes, which contributed to the development and formation of environmental legislation[3].

Since 1990, there has been a special awareness of the importance and scale of many environmental problems and the global goals of sustainable development [6–9].

Evidence of environmental friendliness and energy efficiency of buildings are witnessed at the turn of the XXI century, as the first Green Building standards in construction are developed [10–13].

In Russia, the architectural space began to change since 2008 — as environmentally certified construction projects appear using the British BREEAM standard [14, 15], Fig. 2.

3 History of environmental regulation. URL: http://otherreferats.allbest.ru/ecology/00040234_1.html

International obligations determined the choice of sustainable construction requirements and environmental solutions for sports facilities of the Olympic Games in Sochi 2014.

The first documentation was produced by (the Olympic delivery body) State Company “Olympstroy” called “Additional environmental requirements and recommendations, DETiR”, for the construction of large-scale Olympic facilities [16, p. 61].

In 2009, the Russian Green Building Council — RuGBC was created, adapting English BREEAM and American LEED to Russian realities. In 2010, by the initiative of the Union of Architects of Russia, the “Council for Green Construction – NP SPSS” was formed.

In 2011, NP SPZS, taking as a basis the requirements of the German standard DGNB, introduces an eco-standard for low-rise buildings NP-SPZS 1.1.M–2011.

At the same time, in 2011, NP ABOK, NP NOSTROY, OJSC TsNIIPromzdaniy and LLC NPO TERMEK developed STO NOSTROY 2.35.4–2011 “Green Construction”. Residential and public buildings. The rating system for assessing the sustainability of the built environment.

In 2014, the Russian guild of managers and developers becomes the main initiator of the creation of the GREEN ZOOM system “Practical recommendations for reducing energy consumption and improving the environmental friendliness of civil and industrial construction projects”.

In 2016, The Technical Committee 366 Green technologies of the living environment and “green” innovative products (TC 366) was formed under Rosstandart to create a system of standards that introduce green technologies into the living environment [17, p. 369].

a *b*

Fig. 2. The first BREEAM eco-certified buildings in Russia: a — Business center “Japanese House”; b — Ducat Place III office building

As a result of long-term work, the employees of NRU MGSU developed the first national Green Standards, approved by the Orders of Rosstandart on January 15, 2019:

- Green Standards. Green technologies of the living environment and "green" innovative products. Terms and Definitions;
- Green Standards. Green technologies of the living environment. Classification;
- Green Standards. Green technologies of the living environment. Assignment criteria;
- Green Standards. Green technologies of the living environment. Assessment of compliance with the requirements of green standards. General provisions.

SUMMARY

Analysis of ecological architectural and construction design in Russia in the late 17th – early 21st centuries. Allowed us to distinguish three stages:

Stage 1 (late 17th – mid 20th centuries): the history of the emergence of environmental law is characterized by the formation, in human understanding, of the need to protect natural resources and the inclusion of green spaces in urbanized structures of the city to protect against adverse factors.

Stage 2 (mid XX – early XXI centuries): the formation of environmental legislation and the creation of the first Russian Green Building councils, the adaptation of foreign environmental standards in construction is characterized by the most intense environmental pollution, an active policy in the field of energy conservation and the introduction of eco-methodologies.

Stage 3 (the beginning of the XXI century – the present): the creation of sustainability requirements in the Russian Federation that raise the environmental friendliness of buildings and urban spaces, the introduction of Russian environmental standards, the creation of a national TC 366 for the development of (state standards) GOSTs for green construction.

Throughout the history of the formation of ecological architectural and urban planning, the foundations were born for creating comfortable living conditions. Even in the methods of organizing the first settlements, some eco-aspects of design can be distinguished. In the 21st century, the rapid development of technologies and information processes should not ignore environmentally friendly methods of architectural and construction design, laid down in ancient times. Therefore, the national standards developed in TC 366 are expected to be in high demand.

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Этапы развития экологического архитектурно-строительного проектирования в России

Рассмотрены история экологических нормативов, зарождение экологического архитектурно-строительного проектирования в России и предтечей систем экологической сертификации в строительстве. Проведен анализ исторического материала, в хронологической последовательности систематизированы данные об особенностях взаимоотношения человека и природы, ограничения использования природных ресурсов и проектирования зданий и городов в гармонии с окружающей средой.

Выделены этапы развития экологического архитектурно-строительного проектирования в нашей стране, приведены их основные характеристики: 1 этап (конец XVII – середина XX в.) — история формирования экологических требований относительно сбережения природных ресурсов и создания комфортной среды для жизни в городских кварталах; 2 этап (середина XX – начало XXI в.) — становление экологического законодательства, открытие первых российских экологических советов, адаптация международных экологических стан-

дартов в строительстве к российским реалиям; 3 этап (начало XXI в. – настоящее время) — создание в Российской Федерации устойчивых требований, повышающих жизнеспособность архитектурно-строительной среды, введение ряда российских экологических стандартов в строительстве, формирование национального Технического комитета 366 для разработки национальных стандартов серии ГОСТ Р по экологическому строительству и продвижению «зеленой» стандартизации на национальном и международном уровнях с использованием новых зеленых технологий, материалов и продукции для комфортной среды жизнедеятельности.

Сегодня в России происходит зарождение новой архитектурно-строительной среды, направленной на экономию ресурсов, сбережение здоровья граждан страны, энергосбережение, безотходность, безопасность, комфорт, сохранение биоразнообразия и формирование гармоничных условий. Для повышения интенсивности развития данного направления необходимо внедрение новых экологических нормативов для проектирования устойчивого пространства в российских городах с учетом лучшей мировой практики.

Ключевые слова: *экологическое строительство, зеленые стандарты, экологические нормативы, архитектурно-строительное проектирование, устойчивая среда жизнедеятельности*

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Об авторах: **Бенуж Андрей Александрович** — кандидат технических наук, доцент, доцент кафедры проектирования зданий и сооружений; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 767166, Scopus: 55924719500, ResearcherID: N-7098-2016; abenuzh@gmail.com;

Сухинина Елена Александровна — кандидат архитектуры, доцент кафедры архитектуры; **Саратовский государственный технический университет имени Гагарина Ю.А. (СГТУ имени Гагарина Ю.А.)**; 410054, г. Саратов, ул. Политехническая, д. 77; РИНЦ ID: 701984; arx-art-lena@yandex.ru;

Имз Гай Александр — магистр, президент; **Ассоциация содействия созданию норм и правил «Экологического строительства» (Ассоциация «ЭкоСтрой»)**; 101000, г. Москва, ул. Покровка, д. 5; guy.eames@gmail.com.

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Green Building in Russia as well as its problems and solutions

Tuzov N.Ye.

Tuzov Nikolai Yevgenievitch,
Candidate of Economic Sciences, director; LLC "Production and Construction company «HERCULES LTD»"; 43-21, Polyanka, Lesnye Polyany, 141212, Russian Federation; sweethomes@bk.ru

The article deals with the issues of environmental ("green") construction in Russia in relation to the tasks of low-rise and individual development. The article describes the history of the formation of the ecological construction market in Russia and abroad, gives a general classification and the main directions of its development. The advantages of green construction, the problems that hinder the rapid development of ecological construction and the stimulating factors of such development are described. The applicable standards of green construction are indicated, both established by the state in the form of normative legal acts, and voluntary, and the advantages of following environmental standards are shown. Practical examples of ecological construction and problems faced by developers in practice are given. The concepts of Passive House, energy-efficient house and non-volatile house are considered in detail, indicating the ways to use the elements of such concepts in the implementation of real construction at the moment, including some practical examples of technical and technological solutions, as well as ways to further improve them. Examples of low-rise buildings currently under construction using standards and principles of ecological construction are given. The Russian standards of green construction are considered in detail, with references to specific regulations and other sources regulating the issues of ecological construction, and the ways of their further development and improvement are indicated. A mathematical model of the order of construction of eco-mobility facilities is proposed, where the capital return indicator is selected as an important criterion, which is determined taking into account the different times of costs for the objects being introduced. Its maximization leads to the choice of such an option, which will be characterized by the largest intermediate volume of input objects, as well as the smallest amount of reduced capital investments, i.e. their more rational dynamics. Thus, this indicator characterizes the efficiency of using capital investments, as well as their return as a result of reducing construction in progress.

Keywords: *ecological construction, passive house, standards of green construction, energy-efficient house, non-volatile house, life cycle cost, practical solutions in green construction, eco-village "Svetlaya Polyana", mathematical model of the priority of ecological construction*

The level and quality of life largely depend on the sustainable development of housing construction utilizing modern resource-efficient technologies that ensure not only cost reduction, but also the eco-efficiency of construction. While ensuring the satisfaction of the needs of citizens in inexpensive, but high-quality and environmentally friendly housing, the construction complex is at the same time one of the most important points of growth of the country s economy, providing a large share of demand in the real estate market all on itself.

The theory of managing the innovative development of housing construction at the regional level today poses the problem of an economic system organization, that would base off of the commensuration of anthropogenic impact on nature and its resistance to these influences.

1. Development of the eco-building market

The task of gradual transition to the so-called "Green Building", e.g. construction of energy-efficient and environmentally friendly buildings, is becoming urgent. These buildings are to follow several guidelines:

- ensure comfortable living conditions;
- rational use of renewable resources;
- minimization of the negative impact of the facility on the environment during the construction, usage and deconstruction of the building.

State policy pays special attention to increasing certified construction volumes in accordance with the Green Standards requirements. We already have experience in certification according to LEED and BREEAM standards, namely — several unique buildings of Olympic Sochi, a complex of buildings in the Skolkovo innovation center, and etc.

The analysis of the life cycle of buildings made it possible to establish the ratio of the cost of construction and the costs associated with the operation of buildings as 20 to 80 % accordingly. Thus, the reduction of operating costs plays a huge role and the assessment of such costs is one of the base principles of Green Building [1].

Green Building is, first of all, houses aimed at energy efficiency, buildings from natural materials, self-contained energy-independent houses and even houses that generate energy by themselves. They can be classified as follows:

1. Mainstream. The buildings are focused on saving heat and water — they are well insulated, use systems for recovery, collection and use of rainwater and melted snow.

2. Eco High-Tech. These are usually office buildings used by large corporations that use complex waste recycle systems.

3. Autonomous eco-houses — housing focused on complete energy independence achieved through the use of solar and wind energy.

4. Eco-futurism — a trend that is prominently represented by the American architect William McDonough. His ideas imply reuse in the production of buildings that have exhausted their resource, as well as construction from materials that involve

partial or complete dissolution in the soil without causing any damage to nature.

It is obvious that the construction of eco-buildings is more expensive than traditional ones, but in the end, they cut on operational costs. Moreover, the development of technologies, the improvement of architectural and engineering solutions, the appearance on the market of new economical and efficient engineering systems are constantly narrowing this gap. In addition, the use of renewable energy sources is often more profitable already during the construction phase at sites remote from gas and electricity networks. houses built using local building materials are of particular interest. Lastly, taking into account the constant rise in prices for electricity and gas in Russia, "green construction" in the future has no alternative against the background of constantly improving resource saving technologies and the emergence of new engineering solutions that allow more efficient and less expensive use of renewable energy sources.

2. Passive House concept. Solution of practical problems

The concept of Passive House is of great interest, the main feature of which is the next to complete absence of a heating system and extremely low energy consumption. The architectural concept of a passive house is based on the principles of compactness, high-quality and most effective insulation, correct building geometry, zoning, orientation to the cardinal points and the use of recuperation in the ventilation system. A passive house does not require any expenses for maintaining a comfortable temperature at all. Heating is carried out using the energy released by household appliances and people living in the house. In practice, such a system will still need minimal heating, which should be carried out using alternative energy sources, which will also be objectively needed for hot water supply through systems of heat pumps and solar water heaters. Due to them, the issue of air conditioning in the hot season is solved.

The passive house technology provides for a very effective multilayer thermal insulation of all enclosing surfaces, including the floor and ceiling, exclusion of cold bridges, window openings are minimized in area and are manufactured using technological solutions that reduce heat loss — a wide profile, vacuumization of glass units and an increase in their thickness, pasting with special energy-saving films. In addition, to reduce the cost of air cooling, external blinds are used, dissipating the heat of the sun and not letting it inside the house.

The use of energy efficient home technologies paves the way for a non-volatile home — a home that does not need to be connected to external electricity and gas networks. The energy efficiency of the house is such that all of its needs can be met by alternative energy sources. The advantages of such a house can hardly be overestimated:

- the owners of such a house do not depend on changes in gas and electricity prices;
- house upkeep costs cut;
- main power grid independency — fear no blackouts;
- the house selling price is favorably competitive;
- long service life of photovoltaic cells guarantees low system maintenance costs.

The combination of the principle of energy efficient, non-volatile and "smart" home gives its owners undeniable advantages for many years.

The cost of building an energy efficient house is on average 10…15 % higher than the average of an ordinary building, but the recoupment of additional costs, depending on the area of the building, can be from 5 to 10 years. In addition, such a house does not require a boiler room and the organization of water or air heating systems in volume, as is usually done in traditional construction, which means there will be no costs for their operation and repair [2].

In practical terms, the construction of an ideal passive house is constrained by both imperfect technologies and the backwardness of the regulatory framework. Moreover, the construction of partially passive houses seems to be relevant for the near future, using both alternative energy sources, in particular, geothermal energy, and connection to central power supply networks as backup or additional in case of emergencies or abnormal cold weather [3, 4].

An important aspect is the constant improvement of standards, where the main trends should be noted:

- expansion of the categories of objects for which compliance with the standards of green construction and operation will be mandatory;
- development of tools and methodological base for determining indicators previously not used in construction;
- constant tightening of environmental requirements and stimulation of innovations in the field of ecology of construction and operation of buildings;
- involvement of a wide range of scientists, specialists and builders in the formation of standards for Green Building.

The goal of Green Building is to make housing technologies less punishing for the environment, reduce energy consumption, minimize waste and, ultimately, have a beneficial effect on human health, creating a comfortable, safe and environmentally friendly living environment. The technologies used in "green construction" can significantly reduce operating costs, which in itself makes such houses attractive for their future owners, and in addition, it has a beneficial effect on the image of developer companies, allowing them to count not only on the growth of the client base, but also on priority support from public authorities and municipalities [5, 6].

3. Russian system of environmental construction standards

Construction is one of the most conservative industries in the economy. Innovation enters the market and takes hold gradually until it becomes the accepted norm. Environmental certification in construction aims to modernize the construction industry and that is why it sets requirements significantly higher than the current building codes and regulations. The basis for the formation of certification criteria is the principle that about 2 % of buildings on the existing market will be able to reach the highest level, and the main part of certified buildings will make up no more than 25 % of the total construction market. Building performance standards establish targets and objectives to be achieved, and describe methods that can confirm the achievement of targets. The establishment of the Russian system of environmental standards in construction began with the development of criteria for voluntary environmental certification and the creation of a non-profit partnership "Center for Environmental Certification – Green Standards". The certification system is registered in Rosstandart, reg. No. 8470; ROSS RU.I630.04AAD0. The copyright holder is NP "Center for Environmental Certification – Green Standards", the certification body is EcoStandard group. Green Standards is a rating system in which points are awarded for achieving certain levels of compliance. The main goal is to stimulate developers, architects and designers, builders and tenants to introduce resource-saving, energy-efficient technologies, use environmentally friendly building materials that reduce the negative impact of real estate on human health and the world around them. It is

possible to certify a projected, constructed and reconstructed building for any purpose, as well as a part of a building.

Today, Russian environmental legislation does not yet fully meet the real needs of economic life. The specifics of the Russian economy, the conditions for the activities of business entities and the lack of legal culture in the field of ecology require certain steps to deepen and clarify the norms that are being formed[1].

The Green Building development movement in Russia is just gaining ground and already has prerequisites for successful promotion:

1) the economic crisis requires the introduction of modern ecotechnologies as an important factor in obtaining competitive advantages in the real estate market;

2) Russia declared energy efficiency in construction as the main instrument as part of fulfilling its obligations under the Kyoto Protocol;

3) the growth of economic, social and environmental problems in the country is largely caused by inefficient use of resources and outdated technologies.

The requirements of the Green Standards system are aimed at reducing the consumption of energy resources, using renewable and secondary energy resources, rational water use, and reducing harmful environmental impacts during the construction, operation and disposal of buildings, provided that a comfortable human environment is provided. Using the system, GOST R 54964–2012[2] "Environmental requirements for real estate objects" was developed and approved. The standard can be applied at the stages of design, construction, operation and disposal of real estate objects. The standard recommends assessing the sustainability of the habitat and the effectiveness of the implementation of environmental requirements for real estate in accordance with the Green Standards system and the STO NOSTROY standard of Green Construction. Residential and public buildings. The rating system for assessing the sustainability of the habitat". Environmental requirements for real estate objects are defined by a combination of the following categories:

- eco-management;
- infrastructure and quality of the external environment;
- quality of architecture and layout of the facility;
- comfort and ecology of the internal environment;
- quality of sanitary protection and waste disposal;
- rational water use and regulation of storm water;
- energy saving and energy efficiency;
- environmental protection during the construction, operation and disposal of facilities;
- life safety.

Each basic category is represented by a separate group of criteria that define it. Methods for assessing the degree of ensuring environmental requirements for real estate objects, providing for the achievement of recommended indicators and minimum environmental requirements, are carried out in accordance with the rules and procedures established by the Green Standards certification system.

The main obstacles hindering the development of Green Building in Russia are as follows:

- 80 % of respondents consider the increase in costs for the construction of Green Building as excessive and unreasonable;
- differences in the interests of developers, builders, users and building owners;
- lack of public awareness of the benefits of Green Building;
- lack of qualified specialists in the field of Green Building;
- undeveloped market for environmentally friendly materials, lack of suppliers of such materials;
- lack of government support;
- outdated regulatory and legal framework [7, 8].

Despite the above-mentioned constraining factors for the development of green construction in Russia, elements of environmentally efficient residential development are increasingly being used in the practice of creating new housing, especially individual and low-rise housing. As an example of such development, we can consider the eco-village "Svetlaya Polyana" located in the urban district of Domodedovo, Moscow region (Fig. 1). More than two hundred individual residential buildings ranging from 100 to 130 m^2. are located on land plots with an average of 750 m^2. The adjacent territory is represented by forest, the Severka River and agricultural

1 Federal Law No. 7-FZ of January 10, 2002 "On Environmental Protection".

2 GOST R 54964–2012. Environmental requirements for real estate objects.

Fig. 1. Eco-village "Svetlaya Polyana"

land — there are no sources of water or air pollution and do not have a negative impact. There are also no noise sources. The water supply of the village is organized through a common water intake unit supplying the village with water from artesian wells, and household water disposal through individual septic tanks for each household. Storm runoffs are not used in the village.

The houses of the village achieve high energy efficiency due to good insulation of all enclosing structures, including floors and roofs. The wall of the house is built from a 250 mm thick aerated concrete block, glued on the outside with PSB-S-35 foam plastic 100 mm thick, on which the facade plaster is applied. The projects of the houses provide for a relatively small glazing area, and the window blocks themselves are an energy-efficient double-glazed unit. The houses are oriented in such a way that most of the window openings are oriented towards the south. The ventilation system provides air recuperation.

Low heat losses of houses made it possible to abandon the installation of gas or boiler rooms on other types of fuel and use electric convectors to heat the house. Thus, the houses of the village do not pollute the atmosphere with the products of combustion of certain types of fuel.

The development of the village is carried out by eight types of house projects and due to the standardization of each model, where each structural element is calculated in advance and unchanged from house to house, it was possible to avoid the formation of a large amount of waste, which usually accompanies individual residential development.

From the very beginning, the developer chose such a strategy for the development of the village, in which the start of sales of houses does not begin until the completion of the construction of the neighborhoods, including landscaping, which provides an opportunity for comfortable living immediately after purchasing a home and again reduces the harmful impact on the environment.

Widely accessible and usually locally produced environmentally friendly building materials are used in construction.

4. Mathematical model of eco-construction priority

An important factor in increasing the efficiency of capital investments is the establishment of economically feasible terms for the construction of eco-real estate. When choosing the order of construction of buildings and structures of eco-real estate, it is necessary to consider not only the time aspect, but also economic factors, which include, first of all, the efficiency of using capital investments.

The model criterion for determining the timing and priority of the construction of buildings should be the ratio of the total volumes of construction in progress to the total capital investments calculated for all quarters of the construction period of the property. Suppose that the zoned large-scale flow consists of three real estate objects, erected in sequence, as shown in the graph in Fig. 2.

The segments of straight lines represent the construction process of each property, the numbers above these segments are the quarterly volumes of capital investments, and the numbers under the segments are the same volumes reduced to the start date of the construction of the facility. OAB is an integrated schedule of capital investments development, brought to the moment of construction start, and polygon CDEFHB is an integrated schedule of commissioned objects. Let us denote the area of the OAB by F_1, and the area of the polygon CDEFHB by F_2, then the above criterion can be represented as:

$$Z = (F_1 - F_2)/F_1. \quad (1)$$

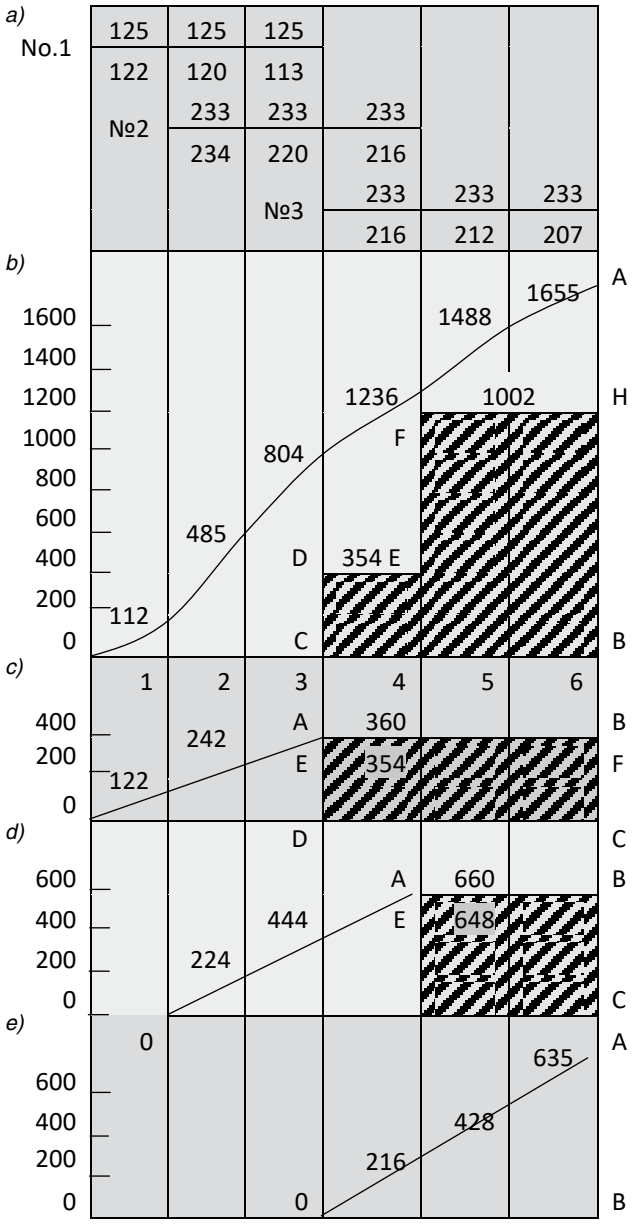

Fig. 2. Graphical interpretation of the model of the construction order of objects included in the zoned consolidated flow

The difference between the areas of $F_1 - F_2$ characterizes the total volume of unfinished construction and it cannot be equal to zero, since the unfinished construction in the form of eco-real estate objects at various stages of construction should be permanent, ensuring the continuous nature of the release of finished products and maintaining a constant front of work. Minimizing the exponent Z in (1) is equivalent to maximizing the simpler exponent Z_k:

$$Z_k = F_2/F_1 \rightarrow \max. \quad (2)$$

The Z_k indicator is the ratio of fixed assets and infrastructure facilities used during construction to the total amount of capital investments used during the construction period. This indicator denotes the share of capital investments utilized during construction, which provides intermediate inputs of funds and capacities and characterizes the return on capital investments diverted for construction.

In Fig. 2, "*c*", "*d*", and "*e*" are given for each object included in the zoned consolidated flow, integral schedules for the development and commissioning of funds. The addition of these schedules results in integral schedules for the development of capital investments and the introduction of funds for development in general — "*b*". Therefore, the capital return indicator can reflect the timing of the start and completion of the construction of eco-real estate, as well as the dynamics of the development of capital investments for each of them.

Let us introduce the following designations: Z_k is capital return indicator; T is the duration of the planning period, quarters ($t = 1, 2 \ldots$); N is the required amount of resource when performing work (i–j); Φ_i is the cost of funds, thousand rubles, introduced when the i-th object is put into operation; t_i^n and t_i^0 are the start and end dates of its construction; t_i is duration of construction of the i-th structure in blocks; E_o is the nominal rate of return; T^o is the total term for the completion of eco-development; S_i is the estimated cost of the i-th object, thousand rubles; x_i^τ is the volume of capital investments planned for the i-th facility in the quarter τ, with the serial number of the beginning of the i-th construction. t_i refers to the standard duration of the construction of a property.

To determine F_2 and F_1, it is necessary to analyze all quarters of the planning period and all objects of eco-real estate and infrastructure included in the plan, and for each of them summarize the funds entered at the beginning of the period and quarterly volumes of capital investments starting from the quarter in which the construction of the facility is planned, i.e. from the quarter t, for which $y_i^t = 1$, then (2) takes the form:

$$Z_k = \frac{\sum_{t=1}^{T}\sum_{i=1}^{N} y_i^t \Phi_1 (1+E_o)^{-\left(t_i^n + t_i\right)} \left(T^0 - t_i^0\right) S_i}{\sum_{t=1}^{T}\sum_{i=1}^{N}\sum_{t=1}^{1} y_i^t x_i^\tau (1+E_0)^{-\left(t_i^n + t_i\right)} \left(T^0 - t_i^n - \tau\right)} \to \max. \qquad (3)$$

The resulting expression meets the requirements for the optimality criterion. The capital return indicator is associated with the total duration of the construction of eco-facilities, with the timing of the start and completion of the construction of individual buildings, as well as with the quarterly volumes of capital investments and commissioned funds of each facility; thus, it considers the volume of the planned construction. If it is calculated for different time intervals, then it will express the degree of construction readiness for a particular moment in time. The capital return indicator is determined considering the difference in timing of costs and for the facilities being commissioned. Its maximization will lead to the choice of such an option, which will be characterized by the largest intermediate volume of commissioned objects, as well as the smallest value of the reduced capital investments, i.e. their more rational dynamics. Thus, this indicator characterizes the efficiency of the use of capital investments, as well as their return as a result of the reduction of unfinished construction.

5. Summary

The development pace of Green Building in Russia is constrained by the increased cost of such construction, low awareness of consumers about the benefits in the process of using construction products manufactured in accordance with Green Standards and the backwardness of the regulatory framework [9].

At the same time, progress in the field of new technologies is constantly reducing the difference between the cost of traditional and "green construction", and the development of modern information technologies, coupled with a constant increase in the level of environmental awareness of the population, makes progress in this area inevitable.

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Экологическое строительство в России. Проблемы и решения

В статье рассматриваются вопросы экологического («зеленого») строительства в России применительно к задачам малоэтажной и индивидуальной застройки. Описана история становления рынка экологического строительства в России и за рубежом, дана общая классификация и основные направления его развития. Описываются преимущества зеленого строительства, проблемы, препятствующие быстрому развитию экологического строительства, и стимулирующие факторы такого развития. Указаны применяемые стандарты зеленого строительства как установленные государством в виде нормативно-правовых актов, так и добровольные, показаны преимущества следованию экологическим стандартам. Приводятся практические примеры экологического строительства и проблемы, с которыми сталкиваются застройщики на практике. Подробно рассматриваются концепции пассивного дома, энергоэффективного дома и энергонезависимого дома с указанием путей использования элементов таких концепций в реализации реального строительства на настоящий момент, в том числе даются некоторые практические примеры технических и технологических решений, а также пути их дальнейшего совершенствования. Приводятся примеры ведущейся в настоящее время малоэтажной застройки с использованием стандартов и принципов экологического строительства. Подробно рас-

смотрены российские стандарты зеленого строительства со ссылками на конкретные нормативные акты и иные источники, регулирующие вопросы экологического строительства, указываются пути их дальнейшего развития и совершенствования. Предложена математическая модель очередности строительства объектов эконедвижимости, где в качестве важного критерия выбран показатель капиталоотдачи, определяемый с учетом разновременности затрат по вводимым объектам. Его максимизация приводит к выбору такого варианта, который будет характеризоваться наибольшим промежуточным объемом вводимых объектов, а также наименьшей величиной приведенных капитальных вложений, т.е. их более рациональной динамикой. Тем самым этот показатель характеризует эффективность использования капитальных вложений, а также их отдачу в результате сокращения незавершенного строительства.

Ключевые слова: *экологическое строительство, пассивный дом, стандарты зеленого строительства, энергоэффективный дом, энергонезависимый дом, стоимость жизненного цикла, практические решения в «зеленом строительстве», экопоселок «Светлая Поляна», математическая модель очередности экологического строительства*

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Об авторе: **Тузов Николай Евгеньевич** — кандидат экономических наук, директор; **ООО «Производственно-строительная компания “Геркулес”»**; 141212, п. Лесные Поляны, мкрн. Полянка, д. 43, оф. 21; sweethomes@bk.ru.

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Graboviy P.G.
Berezka V.V.

Risk modeling at the pre-investment phase of nuclear powerplant construction on the international market

Involvement in the construction of nuclear power plants worldwide is a promising direction for developing the research and technological potential of engineering and general contracting companies in Russia. Nevertheless, Russian companies, involved in the construction of nuclear power plants (NPPs) abroad, need to adapt to foreign jurisdictions, their requirements and rules applied to the construction of hazardous industrial facilities, as well as unique social, economic and physical environments. In this regard, international activities, performed by Russian companies, are associated with uncertainty and risks that require the study and systematization of risk factors and development of risk management models.

The statistical data, covering the recent ten-year period, illustrates the level of uncertainty and problems arising in this area. Over 60 % of nuclear reactors worldwide are built with a delay in construction. The consequences of such delays boost project costs. Major international corporations, implementing nuclear power plant construction projects abroad, consider the insufficient pre-project study of project organization and management issues at the stage of entering into an EPC (M) contract to be the risk factors arising in the pre-investment phase.

Risk management modeling is considered as the main element of the system designated for managing the organizational and economic reliability of the pre-investment phase of NPP construction in the international market. It includes: (a) structuring a multiparametric risk factor space based on four sources, including, on the part of the customer, the EPC (M) contractor, the contract and the external environment; (b) a pre-investment risk management model, applicable to NPP construction abroad, to be based on the overall project risk $P(r_{f1})$; (c) a mathematical model for selecting a project implementation option based on the multi-criterial optimization of the future-oriented project plan-schedule.

Keywords: *management and analysis of risks, construction of nuclear power plants abroad, pre-investment phase, life cycle of nuclear power plants*

Graboviy Petr Grigorievich,
Doctor of Economics, Professor, Head of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 302471; onib@mail.ru

Berezka Vitaly Viktorovich,
Lecturer of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Enigineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; Scopus: 57205214283; v.berezka@hotmail.com

1. INTRODUCTION. PROBLEMS OF DEVELOPMENT OF THE INTERNATIONAL MARKET OF NPP CONSTRUCTION AND RELEVANCE OF MINIMIZATION OF RISKS IN THE PRE-INVESTMENT PHASE

According to the 2020 results, the value of Russia's portfolio of international NPP construction projects ranks first, since it has exceeded 130 billion USD for the ten-year period [1]. At the same time, an increase in the share of NPP construction in international markets is one of critical strategic directions of State Atomic Energy Corporation Rosatom. The compliance with deadlines and construction budgets, as well as the use of the Russian technology is a prerequisite for the Russian engineering companies acting as NPP suppliers. Actions, aimed at the continuous improvement of project management and operational processes, advanced information technologies and solutions, applied throughout the project life cycle, starting from the pre-contract efforts and ending with NPP commissioning, are taken to tackle these goals.

The participation of Russian companies in a large-scale international NPP construction project has several constituents, such as engineering services, construction and installation works, supply of materials and equipment, project design and management, as well as fundraising services[1].

As of 2020, Russian engineering companies construct nuclear power plants in Europe, Middle East, and North Africa, as well as in the Asia-Pacific region (Table 1)[2].

The strength of Russia's approach is the "turnkey" construction of a nuclear power plant. A Russian NPP supplier acts as an EPC (M) company responsible for supplying and integrating the technology, the final investment amount, and the contract implementation term. In addition, the Russian EPC (M) company fully designs, plans, builds and puts projects into operation, as well as manages NPPs in furtherance of the instructions issued by the owner [2].

Several studies, carried out by foreign and Russian researchers [3–5], have identified problems in NPP construction, such as regular failures to meet deadlines and project cost overruns that may reach up to several dozens or even hundreds of percent (Fig. 1)[3].

One of the problems that accompanies the construction of a nuclear power facility is the assessment and sufficiently accurate projection of the overall project cost and timing, which implies that decision-makers obtain answers to such questions as "what is the probability of compliance with the project implementation schedule?", "how can possible risks be

1 Official website of the State Corporation "Rosatom". URL: https://rosatom.ru/production/design/stroyashchiesya-aes/ (accessed: January 1, 2021).

2 Official website of the ASE Engineering Division of the Rosatom State Corporation. URL: https://www.ase-ec.ru/ (accessed: January 1, 2021).

3 World Nuclear Industry Status Report, report on the current status of the nuclear industry in the world for 2020. URL: https://www.worldnuclearreport.org/IMG/pdf/wnisr2019-v2-hr.pdf http://www.rusatom-overseas.com/ (accessed: January 1, 2021).

Table 1. Ongoing international NPP construction projects using the Russian technology (as of December 31, 2020)

Project country	Project name	Type of reactor	Main construction period	Investment amount, USD billion
Belarus	Belarusian NPP	VVER-1200	2011–2020	11.0
Finland	Hanhikivi 1	VVER-1200	2016–2028	7.0–7.7
Hungary	Paks II	VVER-1200	2019–2031	14.0
Turkey	Akkuyu	VVER-1200	2010–2023	22.0
Iran	Bushehr — 2.3	VVER-1000	2016–2026	11.0
China	Tianwan — 7.8 Xudapu	VVER-1000 and VVER -1200	2011–2020	10.4 (6.1 and 4.3)
India	Kudankulam — 3.4 Kudankulam — 5.6	VVER-1000	2002–2025	9.5
Egypt	Dabaa	VVER-1200	2015–2026	30
Bangladesh	Rooppur	VVER-1200	2015–2024	13
TOTAL:				128.6

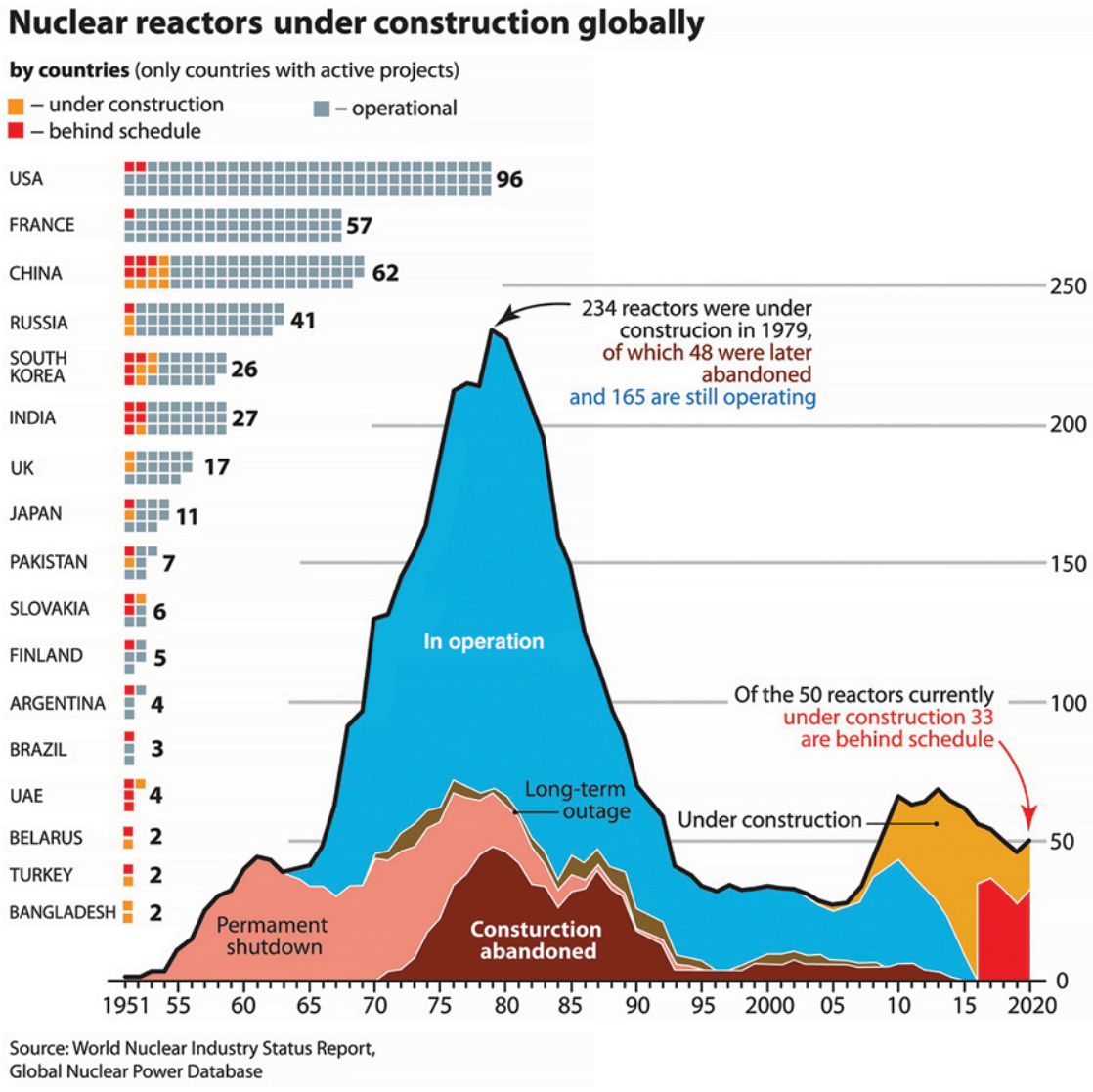

Fig. 1. The analysis of the international NPP construction market broken down by stages of construction and operation, including project delays (as of 31.01.2021)

minimized?", and "how will possible deviations affect the total cost of the project?".

Moreover, a substantial investment amount contributed to nuclear power plants, if compared to other types of power plants[4], makes them more sensitive to risks. Any delays and cost overruns have an immediate negative impact on economic performance and, as a result, on the ability to raise funding.

In this regard, a relevant task is to study management system elements in the pre-investment phase and to examine a methodological approach to assessing and reducing risks to ensure the timely completion of construction within initial budget limits to ensure the organizational and economic sustainability of NPP construction projects implemented worldwide.

2. MATERIALS. MODELING THE STRUCTURE OF THE NPP CONSTRUCTION LIFE CYCLE BROKEN DOWN BY STAGES, COSTS, DEADLINES, AND MANAGEMENT FEATURES

2.1. Structuring the life cycle of construction of a nuclear power plant abroad

An NPP construction project belongs to the category of large complex investment and construction projects (following the UNIDO rules), which are characterized by[5] [6]:

- large-scale investments (up to 30 billion USD);
- long implementation periods (10–15 years to be spent to design, construct, and start up an NPP, that has a 60-year service life term);
- special attention to security issues throughout the entire life cycle.

An NPP construction project, implemented abroad, has several stages, clustered into the concepts of "a life cycle" and "an investment cycle" [7]:

- the life cycle (Fig. 2) includes the period from an investment project concept formulation to the decommissioning of a nuclear power plant;
- the investment cycle is an economic concept that covers the NPP lifecycle during which initial investments are made. It lasts 8–12 years on average.

4 International Energy Agency, Nuclear Power in a Clean Energy System, report — May 2019. URL: https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system (accessed: January 1, 2021).

5 Information on the status of the nuclear industry from the International Atomic Energy Agency (IAEA). URL: https://www.iaea.org/topics/nuclear-power-plant-life-cycle (accessed: January 1, 2021).

It is noteworthy that in the Russian practice, the area of the general contractor's responsibility for the construction of a nuclear power plant differs from the area of responsibility of an EPCM company worldwide. Russian engineering companies can enter into contracts at various stages of a project, and the scope of services and supplies within the framework of an NPP construction project may also vary[1].

2.2. Modeling the cost structure of NPP construction projects

The construction costs of nuclear power facilities are the key indicators, and the consequences of the schedule overruns affect the following two aspects[6]:

1. **Project financing**. Additional costs, representing the interest amount, accumulated during the schedule overrun increases the overall financial burden, and boosts the risk assumed by the investors. Besides, cash inflows generated by the sale of electricity are delayed due to the construction schedule overrun.
2. **Construction costs**. The major portion of construction work is carried out on the construction site of the future nuclear power plant, and it requires the mobilization of a significant amount of labor resources, including the engineering personnel, and the availability of specialized construction and installation equipment. This leads to low adaptability to the changing design and, consequently, reduced productivity due to less rational use of the personnel and the idle time of equipment. Furthermore, delays rise the overall cost of the power plant construction [8].

The consequences of overruns can seriously affect the profitability of an NPP construction project. For example, in case of a three-year delay, the breakeven point is reached in about ten years [5, 9]. Since capital expenditures are primarily reflected in the final cost of electricity generation by new nuclear power plants, timely completion of construction is an effective means of limiting rising costs and risks in the course of constructing new nuclear facilities.

The 2016 report of the World Nuclear Association[7] on the global nuclear supply chain provided a consolidated structure of capital expenditures (Fig. 3) that also included labor, equipment and raw material expenses (Fig. 4).

6 Unlocking Reductions in the Costs of Nuclear Construction — A Practical Guide for Stakeholders, the report of the nuclear energy Agency of the Organization for economic cooperation and development, 2020. URL: https://www.oecd-nea.org/jcms/pl_30653/unlocking-reductions-in-the-construction-costs-of-nuclear (accessed: January 1, 2021).

7 Economics of Nuclear Power (updated in March 2020). URL: https://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx (accessed: January 1, 2021).

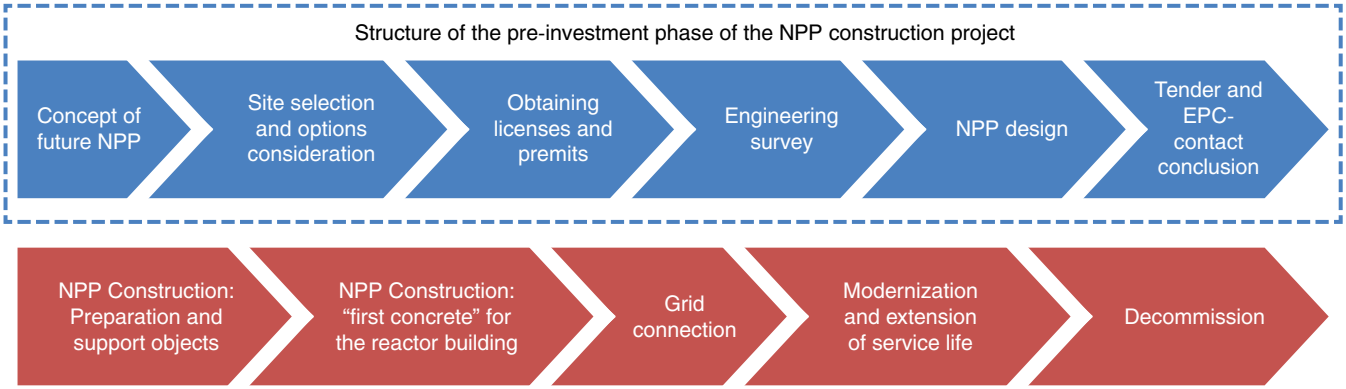

Fig. 2. Model of the life cycle of a nuclear power plant

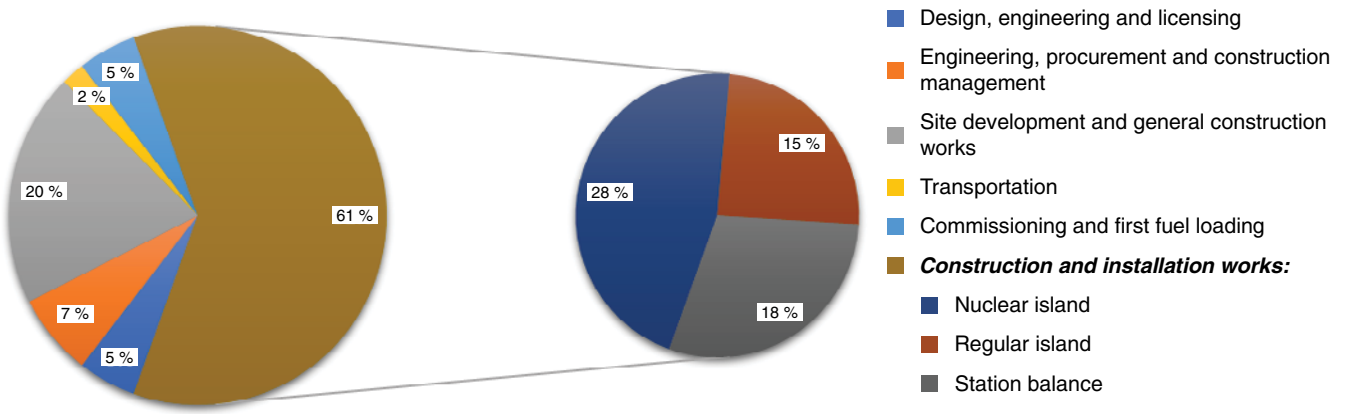

Fig. 3. Consolidated structure of capital expenditures for the construction of nuclear power plants

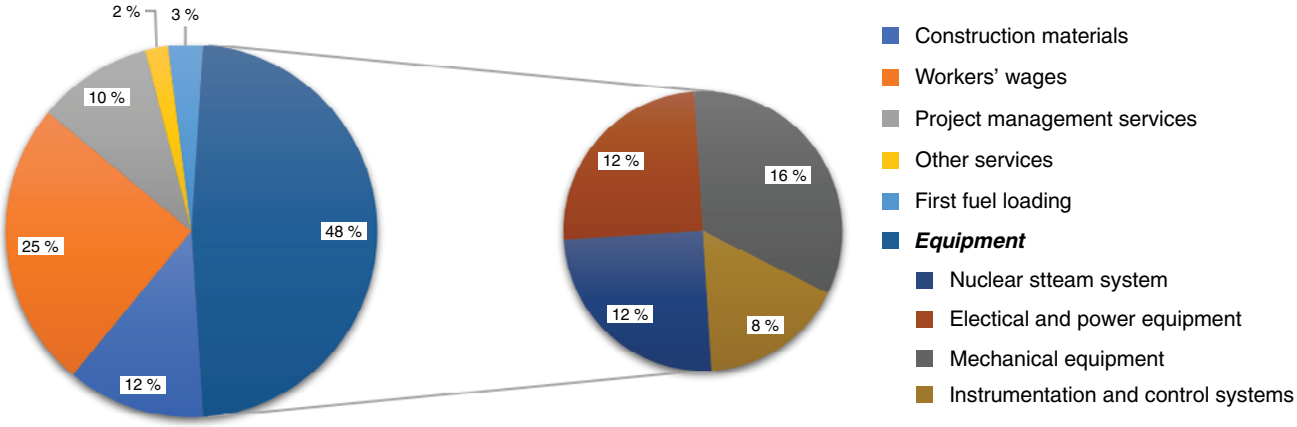

Fig. 4. Breakdown of the cost of construction of nuclear power plants in the context of labor remuneration, cost of equipment and materials

2.3. The analysis of terms of NPP construction projects

It should be noted that, according to the Russian technology (the "NPP-2006" project), the main target period of construction of each power unit is set by State Atomic Energy Corporation Rosatom for a maximum of 4.5 years (or 54 months)[1].

The actual NPP project execution time includes construction work and lengthy licensing procedures, complex financial negotiations, site preparation, and infrastructure development. As the British Hinkley Point C project shows, a substantial share of investments had been made and a large amount of work had been completed long before the official construction phase began.

According to the IAEA statistics[5, 8], the average construction period of 63 units in nine countries (37 of them in China), launched in 2009–2019, reached 10 years. The analysis of the timelines of NPP construction projects, initiated between 2010 and 2019, illustrates the level of uncertainty and challenges associated with many of these projects, especially given that most of them were to have a five-year construction period (Table 2).

As of July 1, 2020, the average construction time was 7.3 years, exceeding the mid-2019 average by more than six months in terms of 52 reactors under construction.

In addition, all nuclear power plant units under construction in at least 10 out of 17 countries experienced an average delay of one year, and the completion dates for 33 (64 %) construction projects were postponed. Most of the NPP units, conventionally constructed on time, were started within the last three years or they have not yet reached the planned start-up dates, making it difficult to assess their compliance with the project schedule. There is still no certainty about the construction projects in the UK, Bangladesh, China and Russia.

According to IAEA, in most cases, additional licensing requirements, interference of the general public, problems with suppliers and financing, and improper construction management were the reasons for schedule overruns and rising costs[8, 9] [10].

2.4. Features of NPP construction project management outside of Russia

An NPP construction project, that employs the Russian technology, is a set of interrelated actions aimed at achieving the pre-set goals in a given time frame within a given budget. A set of interrelated elements and links between them, representing a "tree" of product-oriented components represented by equipment, work, services, and information, determines the project structure [11].

8 IAEA s NUCLEUS information resource, International Atomic Energy Agency. International Atomic Energy Agency, Project Management in Nuclear Power Plant Construction: Guidelines and Experience, Nuclear Energy Series No. NP-T-2.7, IAEA, Vienna, 2012. URL: https://www.iaea.org (accessed: January 1, 2021)

9 International Atomic Energy Agency, Project Management in Nuclear Power Plant Construction: Guidelines and Experience, Nuclear Energy Series. No. NP-T-2.7, IAEA, Vienna, 2012.

Table 2. 2010–2019 global nuclear reactor construction timelines

Country	Total number of reactors	Construction period of 63 projects, years		
		Average	Min	Max
China	37	6.0	4.1	11.2
Russia	10	20.3	8.1	35.1
South Korea	6	6.0	4.1	9.6
India	4	10.4	7.2	14.2
Pakistan	3	5.4	5.2	5.6
Argentina	1	33.0	33.0	
Iran	1	36.3	36.3	
USA World	1	43.5	43.5	
China	63	10.0	4.1	43.5

Pursuant to the IAEA recommendations, in addition to ensuring the high quality of construction work according to the construction schedule, the project requirements, and the budget, the contractor (EPCM) responsible for the NPP construction outside of Russia, must prioritize the project work, ensure the availability of material resources and workforce, analyze and define risk management programs and solve any problems that delay the project implementation or threaten the quality of work performed.

NPP project management is the art of managing and coordinating human, financial, and material resources using modern management methods and techniques, organizational forms of production and construction to achieve the pre-set results in terms of the composition and scope of work, costs, timing, and quality to meet the goals pursued by the project participants.

NPP project functions are divided into project goal management (the subject area), time management, cost management, quality management, risk management, contract management, participant and personnel management, relationship management, and information flow management.

The management model of an investment project that entails the construction of a nuclear power plant on a foreign market involves planning a set of measures that ensure the project funding and management, the supply of technologies and engineering services, as well as construction, installation, and commissioning works. The development of project schedule options and the evaluation of investment performance are the strategic issues considered by decision makers at the pre-investment stage.

When choosing an organizational model for the implementation of an international project, it is recommended to take account of the following features of entry of foreign engineering and construction companies (of any level) to the market in the project implementation country [6]:

- a multi-stage system of obtaining licenses for the construction of particularly hazardous and technically complex facilities (for example, nuclear power facilities);
- tightened control and supervision over the project development by local self-government bodies;
- granting preferences to local service and equipment suppliers;
- the obligation to comply with the recommendations made by international organizations (for example, IAEA);
- immigration restrictions, including those issued due to the epidemiological situation in the country and difficulties with the employment of foreign engineering and technical personnel;
- conditions of certification and customs clearance for the import/export of materials or equipment.

3. METHODS. STRUCTURING THE FACTOR SPACE OF PRE-INVESTMENT RISKS THAT ACCOMPANY NPP CONSTRUCTION OUTSIDE OF RUSSIA

3.1. Risk assessment of NPP construction abroad in the pre-investment phase

The mission of construction project risk management (according to the PMBOK® Knowledge Sets) is to increase the likelihood and impact of positive events or opportunities while reducing the likelihood and impact of negative events or threats that occur during the design and construction process. It includes risk management planning, identification, analysis, response planning, and project control applied throughout the project lifecycle.

The management of NPP construction projects, implemented outside of Russia, also means the identification, control, and management of characteristic risk factors [12, 13]. To solve this problem, the analysis of the main features of NPP construction projects, implemented outside of Russia, including the analysis of international experience, was carried out. As a result, an approach to assessing the organizational and economic sustainability of the pre-investment phase of NPP construction outside of Russia was formulated with account for the risk factors.

The study [14] examines the classification of risks and the management model applied to unique large-scale investment and construction projects (ISPs) outside of Russia. The cumulative risk of implementing a large complex ISP abroad is a set of causes of uncertainty as a result of the occurrence of random adverse events, the possibility of significant revenue shortfalls, and the loss of some resources by economic entities.

Largest international investment and construction groups (for example, VINCI, BOUYGUES, France[10]) list the main risk factors that need to be taken into account in the pre-investment phase of an

10 Annual report of the VINCI Group for 2019. URL: https://www.vinci.com/publi/vinci/2019-vinci-annual-report.pdf (accessed: January 1, 2021).

international project, such as: (a) difficulties in the facility design and analysis caused by the underestimation of the amount of work or the overestimation of the expected profitability; (b) errors in the analysis of the terms of the tender documentation and the contract proposed by the customer, or (c) errors in the analysis of technical and legal norms of the country of the project implementation. In addition, the following specific factors are identified [15] in relation to the construction of nuclear power plants abroad:

- **Insufficient qualification** of local subcontractors due to the lack of experience in the implementation of technologically complex large-scale projects, such as the construction of nuclear power plants;
- **Supply delays** due to the global shortage of skilled manufacturers of special equipment for nuclear power plants and its late delivery to construction sites for installation. In addition, there may arise problems with the purchase of bulk materials (concrete, rebar, crushed stone, metal, etc.) due to large amounts of purchases and their unavailability on local or global markets;
- **Lack of qualified labor resources.** Delayed construction, installation and commissioning due to the lack of experienced technical specialists and/or the need to do the work once again due to quality control errors in the course of production and construction.

The disputes, broken down by their cause (which can be associated with the Owner, the Contractor, the Contract, and External Factors) are provided in Table 5 [15–17].

Each type of risk corresponds to unique factors (causes of occurrence), which can be used to simulate the probability of a risk and the degree of its impact on the course of construction of nuclear power plants, thereby providing information for decision makers.

Thus, the overall risk of implementing a nuclear power plant construction project abroad $P(r_{t1})$ can be defined as the sum of the probabilities of occurrence of negative events P, given the account is taken of their significance w:

$$P(r_{t1}) = \sum_{j=1}^{q1} P(r_{1j} x w_{qi}), \quad (1)$$

where $q1$ — events; r_{1j} — factors (causes).

Table 5. Multiparametric factor space of risks in the pre-investment phase of an NPP construction project outside of Russia

Risk Type *x*	Code	Negative risk factor or event *R*	*W*eight *w*	Probability *P*
Project Owner (O)	O_1	Late payment	w_{o1}	P_{o1}
	O_2	Schedule overrun caused by the Owner	w_{o2}	P_{o2}
	O_3	A change in the value of SMR during construction	w_{o3}	P_{o3}
	O_4	Design errors or low quality POI	w_{o4}	P_{o4}
	O_5	Provision of incorrect/incomplete information	w_{o5}	P_{o5}
	O_6	Late access to the construction site	w_{o6}	P_{o6}
	O_7	Unilateral refusal to accept the completed CMP	w_{o7}	P_{o7}
EPCM-contractor (E)	E_1	Unawareness of the geographical conditions of the project	w_{e1}	P_{e1}
	E_2	Work quality assurance problem	w_{e2}	P_{e2}
	E_3	Delays in the progress of construction and installation works	w_{e3}	P_{e3}
	E_4	Contractor s financial problems	w_{e4}	P_{e4}
	E_5	Absence of written instructions from the customer	w_{e5}	P_{e5}
	E_6	Unclear local tender laws and regulations	w_{e6}	P_{e6}
	E_7	Different interpretations of the contract terms	w_{e7}	P_{e7}
	E_8	Unclear contract terms regarding the change of the contract price in relation to the preliminary amounts	w_{e8}	P_{e8}
	E_9	Unclear contract terms regarding the adjustment of approximate quantities	w_{e9}	P_{e9}
	E_{10}	Unclear terms of refunding withheld cash amounts	w_{e10}	P_{e10}
	E_{11}	An unclear way of reducing the damage caused by delays	w_{e11}	P_{e11}
	E_{12}	Unclear definition and types of defects	w_{e12}	P_{e12}
	E_{13}	Ungrounded distribution of risks in the contract	w_{e13}	P_{e13}
	E_{14}	Failure to account for or accurately calculate the additional cost of actual work at the time of the tender and the evaluation process	w_{e14}	P_{e14}
	E_{15}	Failure to examine the terms of the contract during the tender	w_{e15}	P_{e15}
	E_{16}	Ambiguous limit of liability for the use or storage of materials and equipment provided by the employer	w_{e16}	P_{e16}
	E_{17}	Disagreements over the amount of compensation for construction costs and time, in case a claim is filed	w_{e17}	P_{e17}
	E_{18}	Disagreements about the payment method caused by a change in the quantity	w_{e18}	P_{e18}

End of Table 5

Risk Type *x*	Code	Negative risk factor or event *R*	Weight *w*	Probability *P*
Contract (C)	C_1	Different interpretations of the contract terms	w_{c1}	P_{c1}
	C_2	Unclear contract terms concerning approximate calculations	w_{c2}	P_{c2}
	C_3	Unclear definition of defects	w_{c3}	P_{c3}
	C_4	Ungrounded distribution of risks in the contract	w_{c4}	P_{c4}
	C_5	Ambiguous limit of liability for the use or storage of materials and equipment provided by the employer	w_{c5}	P_{c5}
	C_6	Disagreements over the amount of compensation of costs in the event of a claim and the method of payment for changes in amounts	w_{c6}	P_{c6}
	C_7	Differences in construction standards and methods of organization and production of works	w_{c7}	P_{c7}
External factors (X)	X_1	Currency exchange rate fluctuations	w_{x1}	P_{x1}
	X_2	Economic fluctuations and changes in tax rates	w_{x2}	P_{x2}
	X_3	Changes in laws and regulations	w_{x3}	P_{x3}
	X_4	Language barriers, different cultural and religious traditions	w_{x4}	P_{x4}
	X_5	Force majeure, such as weather disasters, war, revolution, and civil unrest	w_{x5}	P_{x5}
	X_6	Differences in construction standards and methods of organization and production of works	w_{x6}	P_{x6}
	X_7	Tougher immigration rules governing the stay of SMEs	w_{x7}	P_{x7}

In addition, a similar method describes the risk of delayed construction of NPPs abroad $P(r_{d1})$, for example, a failure and/or a delay on the part of the Customer (O) (an energy company) to accept the work performed (events O_7) due to its incompliance with the local building codes (E_2), inconsistencies between the executive documentation and the Owner's requirements and regulations issued by local regulatory agencies and (E_6), the availability of growing amounts of work and rising costs (C_2).

In this case, the cumulative risk that affects the t_{fdi} parameter, or "the forecasted duration of the project implementation option", is determined as follows:

$$P(r_{fd1}) = P(O_7 x w_{o7} + E_2 x w_{e2} + E_6 x w_{e6} + C_2 x w_{c2}). \quad (2)$$

4. RESULTS. PROPOSALS CONCERNING MODELING THE MANAGEMENT OF PRE-INVESTMENT RISKS OF NPP CONSTRUCTION PROJECTS BASED ON MULTI-CRITERIAL OPTIMIZATION OF FUTURE-ORIENTED SCHEDULES

Basic principles of multi-criterial optimization subsystems applicable to future-oriented project implementation plans at the pre-investment phase of NPP construction projects are formulated on the basis of the research works of Russian and foreign scientists and decision making frameworks. A mathematical model of multi-criterial optimization is one of basic components of this system [18].

The issue of multi-criterial formulation of the task of developing future-oriented project implementation plans is particularly relevant for large-scale investment and construction projects due to the large number of project participants (stakeholders) and differences in their interests and motivation [19]. For example, the criteria of optimality of future-oriented project implementation plans in the pre-investment phase of an NPP construction project can include:

1. On the side of the project initiator (an energy company) in the country of construction:

- **assurance of the proper level of safety** and compliance with all international and local requirements applicable to the construction of nuclear energy facilities;
- **minimization of the construction period.** In the case of a grave problem of electricity shortage in the region, this criterion may prevail over others;
- **completion of construction and installation works by a certain date.** This criterion may be imposed by political factors (for example, it may be attached to the date of elections to government authorities).

2. On the side of the contractor, or the Russian EPC (M) company:

- **profit maximization;**
- **assurance of high quality design, construction, installation and commissioning** of unique NPP equipment in discharge of further operation obligations;
- **setting the stage for the regular and timely use of financing.** The disbursement of funds designated for the design, construction and installation work may be limited to certain time periods (for example, years);
- **minimization of construction costs.** This criterion can serve as the main one in the case of an EPC contract having a fixed amount specified;
- **setting the stage for the regular and timely use of resources,** including highly skilled labor resources, special machinery and equipment. This issue may be relevant due to the contractor's involvement in several projects at the same time.

The multi-criterial decision-making model can be formally presented as follows [20]:

$$G(T, K, X, S, F, P, R), \quad (3)$$

where T is the problem formulation; K — the set of criteria; X — the set of scales; S — the set of alternatives; F — the mapping of a set of alternatives onto the set of assessments; P — the system of preferences of a decision-maker; R — the decision rule.

Scientists and specialists offer different types of criteria depending on problem solving conditions. For example, the main (most significant) criteria include the net present value (NPV), the profitability index (PI), the internal rate of return (IRR) [21], income maximization, expected risk minimization [22], project implementation time (P), social effect, etc.

The choice of the optimality criterion of future-oriented schedules in the pre-investment phase depends on specific conditions of the construction process and activities of the organization, the interests of the investor and the contractor. It is proposed to optimize the project implementation schedule according to the most significant criterion, the is, the identification of the optimal solution. In particular, the most significant criterion is the efficiency of the dynamics of capital investments, proposed by V.A. Afanasyev [23], who analyzed the market aspects of construction activities as early as in the days of the USSR. The efficiency coefficient of the dynamics of capital investments can be represented as follows:

$$K_{IO} = \frac{K\left(\alpha^T - I\right) + \sum_{i=1}^{n} K_{t_i}\left(2 - \beta^{t_i}\right) - \alpha^{T-t_i}}{K\left(\alpha^T - \beta^T\right)}, \quad (4)$$

where K is the total amount of capital investments (the estimated cost of building a facility or a group of facilities); K_{ti} is the i-th capital investment at time t_i; T is the duration of the entire set of works; α is the coefficient of reduction of the i-th capital investment to term $t_i + 1$, equal to $1 + E_n$; β is the coefficient of reduction of the i-th capital investment to term $t_i - 1$, equal to $1/(1 + E_n)$; E_n is the standard efficiency factor.

These principles serve as the basis for the developed set of **formal heuristic algorithms designated for finding the optimal option of future-oriented project implementation schedules in the pre-investment phase.** Methods of sequential analysis of options [24] and direct search [25] were used to develop formal heuristic algorithms.

The optimization algorithm, based on the most significant criterion, can be specified as follows: there is an ordered set of $S = \{S_n\}$ options for making a future-oriented project implementation schedule that meets regulatory requirements ($S \subset D$); $P = \{P_k\}$ is a set of alternative future-oriented schedules taking account of a specific facility, material, technical, human and financial resources.

For each P_k option, the set of outcomes $J = \{J_m\}$ and the transition vector on set S are defined: $R_n[a_{1k-1}e_1, a_{2k-1}e_2, a_{3k-1}e_3]$, where e_i (i = 1, 2, 3) is the unit transition vector parallel to the axis.

$$e_i = \begin{cases} 1 \text{ — } during\ transition\ to\ S_k : a_{ik}a_{ik} - 1; \\ 0 \text{ — } during\ \ transition\ to\ S_k : a_{ik} = a_{ik} - 1; \\ -1 \text{ — } during\ \ transition\ to\ S_k : a_{ik}\ \ a_{ik} - 1. \end{cases} \quad (5)$$

Limiting operator $O(J_l)$ of search domain D is defined for set J. It corresponds to each outcome with subset $S_{k+1} = O(J_k)S_k = S_k \backslash C$, containing the optimal version of the future-oriented schedule at $D \neq 0$.

The sampling space may, for example, contain the following mutually exclusive outcomes:

- the time limit for the future-oriented schedule is not met (J_k = 1);
- the construction and installation work funding limit is not met (J_k = 2);
- the material supply limit is not met (J_k = 3);
- the human resources use limit is not met (J_k = 4);
- the technical support limit is not met (J_k = 5);
- the option led to an improvement in the target function (J_k = 6);
- the option led to the deterioration of the target function (J_k = 7).

The transition to experience is characterized by the following operations:

- when $J_k - 1 = 1$:

$e_{ik} = -1$, where i is the number of any options;
$e_{lk} = 0$ for $l \neq i$;
$\nabla S_n[\Sigma a_{in} \geq \Sigma a_{ik-1} \rightarrow S_n \subset C]$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 2$:

$e_{3k} = 1$; $e_{2k} = e_{1k} = 0$;
$\nabla S_n[a_{3n} \leq a_{3k-1}; a_{1n} = a_{1k-1}; a_{2n} = a_{1k-1} \rightarrow S_n \subset C]$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 3$:

$e_{ik} = 1$, where i is the number of the option, for which this limit is not met;
$e_{lk} = 0$ for $l \neq i$;
$\nabla S_n[a_{3n} \leq a_{3k-1}; a_{1n} = a_{1k-1}; a_{2n} = a_{1k-1} \rightarrow S_n \subset C]$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 4$:

$e_{ik} = 1$, where i is the number of the option, for which this limit is not met;
$a_{ln} = 0$ for $l \neq i$;
$\nabla S_n[a_{in} \leq a_{ik-1} \rightarrow S_n \subset C]$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 5$:

$e_{ik} = -1$, where i is the number of the option, for which this limit is not met;
$e_{lk} = 0$ for $l \neq i$;
$\nabla S_n[a_{in} \geq a_{ik-1} \rightarrow S_n \subset C]$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 6$:

$R_n = R_n$;
$\nabla S_n[a_{in} \leq a_{ik-1}; e_{ik-1} = 1; J_{k-2} = 6 \cup J_{k-2} = 7 \rightarrow S_n \subset C]$;
$(\nabla S_n[a_{in} \geq a_{ik-1}; e_{ik-1} = -1; J_{k-2} = 6 \cup J_{k-2} = 7 \rightarrow S_n \subset C])$;
$S_k = S_{k-1} \backslash C$;

- when $J_{k-1} = 7$:

$R_n = R_{k-1}e$, where $[-1, -1, -1]$ — unit vector;
$\nabla S_n[a_{in} \geq a_{ik-1}; e_{ik-1} = 1; J_{k-2} = 6 \cup J_{k-2} = 7 \rightarrow S_n \subset C]$;
$(\nabla S_n[a_{in} \geq a_{ik-1}; e_{ik-1} = -1; J_{k-2} = 6 \cup J_{k-2} = 7 \rightarrow S_n \subset C])$;
$S_k = S_{k-1} \backslash C$.

The research continues as long as set $S \neq 0$.

Formal heuristic algorithms allow to reduce the time of the optimization process by 2.5–3 times compared to the iteration of future-oriented schedule options and guarantee to find the extremum of the target function at $D \neq 0$.

The decision making process in the multi-criterial conditions is reduced to finding such an alternative option from the set of acceptable ones, which may not be optimal for any of the criteria q_i, but which turns out to be acceptable for the entire vector of criteria $Q = \{q_1, q_2, q_3, \ldots, q_n\}$, i.e. finding a compromise alternative [24]. The real facility will always represent some compromise combination of required qualities. This problem can be solved by introducing an additive criterion, for example, reduced costs.

Thus, it is possible to obtain an option of the future-oriented schedule applicable to the implementation of an NPP project, for which the relative level of all particular criteria is not worse than a certain limit value of $q_i^* + \Delta q_i$ with the value of the additive criterion Q_Σ sufficiently close to optimal Q_Σ^*. In addition, this approach allows

us to take account of a number of factors that are non-deterministic or not reflected in the selection of particular criteria by using informal decision making procedures [26].

As a result, one or more options of the future-oriented project implementation schedule of an NPP project, selected by decision makers, are, if necessary, handed over to an expert group for the detailed analysis, elaboration and further processing of results using the Fuzzy Logic approach [27].

5. CONCLUSIONS AND DISCUSSION

The international NPP construction market has a strong potential for Russian engineering (EPCM) suppliers whose objective is to increase the export potential of nuclear energy, with regard for the global situation, national competitiveness and the market positions.

As the practice and research show, NPP construction organization and management outside of Russia represent more challenging tasks than projects implemented on the local market. The organizational and economic reliability in this environment implies special investment and construction project management processes and approaches to risk identification and management by the parties to the project.

Given the international and domestic research works, recommendations and practical experience, we propose to develop a model for managing the organizational and economic reliability of NPP construction outside of Russia as a combination of the following components:

1. **The organizational and legal model of an NPP project** with account for the features of the legal regulation of construction of nuclear power facilities in the country of project implementation, the available licenses authorizing the construction of nuclear power plants, and the recommendations of international organizations (IAEA).

2. **The strategy for managing pre-investment risks based on the structured risk factor space for the construction of NPPs abroad.** Provision of decision makers with data on the quantitative and qualitative analysis of project implementation risks, including possible deviations from the project schedules and costs, as well as mechanisms and/or recommendations aimed at their minimization.

3. **Multi-criterial analysis and optimization of options of future-oriented project implementation schedules**, including financing schedules and resource-focused requirements, using modern information technologies in project management.

The factor space of pre-investment risks that accompany the construction of NPPs abroad was structured and the mechanism of finding the optimal future-oriented schedule was modeled on the basis of multi-criterial optimization performed within the framework of an integrated organizational/economic reliability management system. The described formal algorithm allows us to take account of a number of factors that are non-deterministic or not specified in the process of selecting partial criteria of optimality.

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Моделирование управления рисками предынвестиционной фазы сооружения объектов атомной энергии на международном рынке строительства АЭС

Участие в зарубежных проектах атомного энергетического строительства является перспективным направлением развития научно-технического потенциала инжиниринговых и генподрядных компаний России. В то же время российским компаниям-участникам сооружения атомных электростанций (АЭС) за рубежом необходимо адаптироваться к иностранной юрисдикции, с присущим ей набором требований и правил строительства опасных промышленных объектов, а также к уникальной социальной, экономической и физической среде. В связи с этим зарубежная деятельность российских компаний сопряжена с неопределенностью и рисками, которые требуют изучения и систематизации факторов риска и разработки модели управления ими.

Статистика последних 10 лет иллюстрирует уровень неопределенности и проблем в этой области — более 60 % атомных реакторов в мире сооружаются с задержкой сроков строительства, последствия которых приводят к увеличению затрат проекта. Крупнейшие международные корпорации, реализующие проекты строительства АЭС за рубежом, к факторам риска на предынвестиционной фазе относят недостаточную предпроектную проработку вопросов организации и управления проектом на этапе заключения EPC(M)-контракта (engineering, procurement, construction, management — управление проектированием, поставками и строительством).

Моделирование управления рисками рассматривается в качестве основного элемента системы управления организационно-экономической надежностью предынвестиционной фазы сооружения АЭС на зарубежном рынке и включает в себя: a — структуризацию многопараметрического факторного пространства рисков по четырем источникам: со стороны заказчика, EPC(M)-подрядчика, контракта и внешней среды; b — модель управления предынвестиционными рисками строительства АЭС за рубежом на основе совокупного риска проекта $P(r_{t1})$; c — математическую модель выбора варианта реализации проекта на основе многокритериальной оптимизации прогнозного плана-графика.

Ключевые слова: *управление рисками и анализ, сооружение АЭС за рубежом, предынвестиционная фаза, жизненный цикл АЭС*

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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; osun_kaf@mgsu.ru;

Березка Виталий Викторович — преподаватель кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; г. Москва, ул. Петровка; Scopus: 57205214283; v.berezka@hotmail.com.

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Hai Doan Duong
Duyen Dang Thi Hong
Hai Uyen Doan

The situation and solutions to develop Green Building in Vietnam

Housing in Vietnames megacities is quite expensive due to limited land availability. Besides, green housing investment requires higher implementation costs than non-green housing investments, plus a Green Building certification fee implemented by international organizations. Despite specific difficulties and problems, green real estate projects bring economic benefits to both investors and users in the long run.

Green building development is a trend that is particularly interested in by governments and real estate developers.

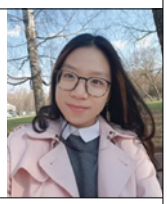
Through analyzing the current status of Green Building development in Vietnam, the authors have discovered barriers, limitations, and proposed solutions.

To develop green buildings effectively, investors need to operate a 5-step process throughout the project life cycle, including Green planning — Green design — Green construction — Green operation — Green lifestyle. Using environmentally friendly materials, energy-saving efficiency in green housing is no longer an unattainable dream for urban residents in Vietnam.

Keywords: *green construction, green building, real estate, green real estate*

Hai Doan Duong,
Head of the Department of Economics and Real Estate Management; National University of Civil Engineering; 55 Giai Phong Street, Hai Ba Trung District, Ha Noi, Viet Nam;
dduonghai2003@gmail.com

Duyen Dang Thi Hong,
Graduate student, teacher; National University of Civil Engineering; 55 Giai Phong Street, Hai Ba Trung District, Ha Noi, Viet Nam;
dduonghai2003@gmail.com



Hai Uyen Doan,
Student; Moscow State University of Civil Enigineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation;
dduonghai2003@gmail.com

INTRODUCTION

Integration with the world s development trend of using environmentally friendly materials, efficient energy use, and sustainable development, Vietnamese consumers are increasingly interested in a healthy and green lifestyle. Vietnam is an emerging and dynamically developing economy in the Asia-Indian Ocean, attracting intensely foreign investment sources.

Economic development and industrial production have undesirable consequences on living environment, especially environmental pollution in big cities where the population concentrates and high traffic density. The housing demand increases, while the ability to respond is limited. Although construction costs are high and the land is expensive and scarce, having a green place is always everyone's desire. Green Building investment costs are still required higher than non-green buildings. With these difficulties, so how is Green Building development in megacities feasible?

However, a rapidly growing young population and increasing people s incomes will have a positive impact on the development of the green real estate market in urban areas in Vietnam.

2. LITERATURE REVIEW

According to many experts, Green Building development in the world and Vietnam is massive. Despite facing many difficulties and challenges, Vietnamese developers have recently developed real estate projects with many green elements and energy efficiency. To minimize the impact of climate change and sustainable development, Vietnam received support from many international organizations such as UNDP, IFC, Organization for Development Cooperation of Germany (GIZ) on consultants using energy saving and efficiency, contributing to reducing greenhouse gas emissions.

IFC is a member of the World Bank Group forecast that in the near term, through 2025, Green Building has a $3.4 trillion investment potential. The investment opportunity summary for Vietnam $ 2.16 trillion for Commercial, $ 20.0 trillion for Residential, and 260,000 Residential Units [1].

IFC has a strategy to promote global green finance for the project, including a four-part process: 1) Investment & Advisory for Banks; 2) Investment & Advisory for Building Sector; 3) Green building Codes & Incentives; 4) EDGE Certification [1].

According to the Vietnam Green Building Council, by the second quarter of 2020, the total number of certified green buildings in Vietnam only stopped at 146 projects, with 3.2 million m^2, relatively low compared to the number of green buildings in Southeast Asian countries [2].

With many years of experience in green project development, Ecopark shows that there are four biggest challenges in Green Building implementation in Vietnam: 1) increasing investment costs; 2) the State has not had a specific support mechanism for real estate development under the green model; 3) there is a particular barrier to the creation of exterior architectural design; 4) the state regulations only have methods for assessing works (the September 2017 standard), there is no assessment method for green urban areas [3].

From the perspective of Green Building certifiers, difficulties in Green Building development in Vietnam include: 1) big developers are not ready; 2) design consultant, contractor has not paid due attention; 3) the additional cost of consulting and construction is not fully understood; 4) not yet drastic from the management agency [4].

Capital House said that Green Buildings' investment costs increase by 1 to 5 % depending on the type of building and EDGE or Lotus certification (Table 1) [5]. They believe that Green Building is suitable for all segments, especially the affordable segment,

Table 1. Increased investment costs in the green projects of Capital House [5]

No.	Project	Increased investment costs	Certificate
1	Ecolife Capitol	3 %	EDGE — home
2	EcoHome Phuc Loi	1…1.5 %	EDGE — home
3	EcoHome 3	1…1.5 %	EDGE — home
4	Ecolife Riverside	1…1.5 %	EDGE — home
5	EcoHome Nhon Binh	1…1.5 %	EDGE — home
6	Genesis School	5 %	LOTUS Non-Residential — GOLD
7	Capital House Office	5 %	LOTUS Interiors — Certified
8	Sales Center	5 %	LOTUS small Interiors — Certified

and needs to apply green solutions from the beginning and look at the whole project life cycle instead of look at the initial investment cost.

From the perspective of state management, experts of the Ministry of Construction stated that there are two reasons to promote Green Building development and efficient energy use: 1) Vietnam's demand for energy increases; 2) the development of construction science and technology. Accordingly, the tasks of factors to promote faster and more active Green Building development include: 1) government: international commitment to protect the environment, reduce emission and apply energy-efficient buildings and green buildings standards; 2) investors: competition in products and real estate rental price competition; 3) residents: higher requirements for living facilities, quality of housing and working environment [6].

Besides, the mobilization of investment capital for Green Building development is still tricky because credit institutions' mobilized capital is mainly short-term with commercial loan interest rates on the market. While investing in green fields (renewable energy, green buildings) has a long payback period, enormous investment costs, and many risks. Since then, banking experts propose to the Government the following solutions: 1) early issue guidelines on the list and criteria for identifying green projects suitable for Vietnam; 2) develop a comprehensive roadmap, policy mechanism (taxes, fees, capital, engineering, market, planning, development strategy) of each sector/field; 3) there is a mechanism to encourage all economic sectors (including credit institutions) to participate in Green Building development [7].

Compared with other countries in the world, investment costs for Green Buildings in Vietnam are higher [8].

Table 2. Cost of Green Buildings in Vietnam (Source: VGBC, 2017)

Other coutries	Certification level	Vietnam
< 1 %	Certify	1.2… 2 %
0.8…2 %	Silver	1.2…2 %
1…3,5 %	Gold	1.8…5 %
2…10 %	Platinum	> 10 %

For various reasons, the number of Green Building certified projects in Vietnam compared to other countries in the region and worldwide is still relatively low [9].

When evaluating the efficiency that a Green Building brings, it is necessary to assess the efficiency in its entire life cycle. A Life Cycle Assessment (LCA) is the systematic analysis of products or services' potential environmental impacts during their whole life cycle [10].

The benefits, energy efficiency, environment, economics, and health that green buildings bring are evident and proven in Green Building certified projects.

3. MATERIALS AND METHODS

The policy of Green Building development is in line with the world trend of environmental protection, climate change response, and sustainable development, and the Vietnamese government has issued a system of legal documents, including:

- Law No. 55/2014/QH13 dated June 23, 2014, on environmental protection and Law on environmental protection (revised) 2020;
- Law No. 62/2020/QH14 dated June 17, 2020, on construction;
- Resolution No. 55-NQ/TW dated February 11, 2020, of the Politburo on "Vietnam s National Energy Development Strategy Orientation to 2030, Vision to 2045";
- Resolution No. 140/NQ-CP dated October 2, 2020, of the Government, promulgating the Government's Action Program to implement Resolution No. 55-NQ / TW dated February 11, 2020, of the Politburo on "direction of the National Energy Development Strategy of Vietnam to 2030, with a vision to 2045".

Table 3. Green Building certification systems in Vietnam [2]

Projects	EDGE	LEED	LOTUS	TOTAL
Number of certified projects	39	79	28	146
Gross Floor Area (GFA) of certified projects	1,995,439	878,002	331,161	3,206,603

In terms of local organizations, Vietnam Green Building Council (VGBC) is a member of the World Green Building Council Network launched LOTUS — the first local Green Building certification program for Vietnam in 2007 [11]. In particular, LOTUS certification has used some Vietnamese state standards instead of international standards.

Due to rising construction costs, many investors believe that green buildings are only for high-end housing when customers have

Table 4. Green Building Standards [2]

No.	LEED	LOTUS
1	ASHRAE 90.1 — Energy Standard for Buildings Except Low-Rise Residential Buildings	QCVN 09:2013 — National Technical Regulation on Energy Efficiency Buildings
2	ASHRAE 62.1 — Ventilation for Acceptable Indoor Air Quality	TCVN 5687:2010 — Ventilation-air conditioning Design standards
3	ASHRAE 55 — Thermal Comfort Conditions for Human Occupancy	TCXDVN 306:2004 — Dwelling and public buildings — Parametes for micro — Climates in the room
4	ASHRAE 189.1 — Standard for the Design of High-Performance Green Building	N/A

Table 5. The Ecohome three project gets the EDGE Green Certificate [5]

Project scale	Benefits	Increased investment costs
Location: Tu Liem, The west of Hanoi	Energy savings: 25 % (1.7 million MWh/year, 230,000 $/year) Water savings: 36 % (98,500 m^3/year, $ 30,000/year)	Total investment increased 1…1.5 %, equivalent to $ 830,000
Site area: 67,000 m^2		
Density of building: 30 %		
5 blocks, 31–35 floors		
3,744 apartments		
Area 39.9…76.7 m2		
Price: 700 $/$m^2$		
Procedure: Third quarter of 2020		

high affordability, but green housing development by many developers shows how more positive. Capital House recommends that Green buildings are very suitable for affordable housing with reasonable prices from implementing its green projects [5].

Through learning the experience of developing many green real estate projects, it is clearly seen that business efficiency is shown in many aspects as follows: 1) good price; 2) fast consumption time; 3) high brand value; 4) access to green finance. The survey at the HAUSNEO green housing project in District 9 Ho Chi Minh City (EDGE Certificate) also showed that the construction difference cost increased by 1 %, but the effect is enormous: fast sales, secondary market price increase by 25 % in 16 months.

At the Ecopark green project, after completing phase 1 (50 hectares), Ecopark starts phase 2 (West Bay Sky Residences), including

West Bay Sky Residences Apartment [12]

apartments of 45 m^2 or more, with $ 30,000 to 40,000 depending on the area (Fig.). Strategic orientation for green development, Ecopark continues to develop new projects such as SkyOasis, Solforest, international schools. To create green buildings effectively, investors need to operate a 5-step process throughout the project life cycle, including Green planning — Green design — Green construction — Green operation — Green lifestyle.

Vietnam s real estate market overview shows that green housing has brought sound effects, buyers are excited about new products, and investors are optimistic about business performance. However, there are many difficulties and obstacles in developing green real estate projects, mainly due to increased investment costs, not positive customer sentiment, and lack of supportive policies and mechanisms from the state:

- increased investment costs reduce price competitiveness. Meanwhile, although operating costs decrease, most customers do not pay attention to this when buying an apartment, only looking from the initial purchase price's perspective, utility works to decide.
- the financial support mechanism is not specific yet for green real estate developers. There is no support for customers of energy-efficient housing projects.
- green sector/sector classification criteria are not specific, and there are no particular regulations on green buildings, current technical standards on energy-efficient buildings;
- propaganda is not effective. Most customers are not aware of the benefits of economical housing, so there is not much demand for housing. Green real estate investment and development companies have not yet linked practical needs with the need to use energy efficiently in buildings, so customers are less interested.

- capital mobilization of credit institutions is mainly short-term according to the market's cost of commercial capital. Greenfield projects (renewable energy, green buildings) have long payback periods, enormous investment costs, and market risks.
- there is lack of large projects to implement. Most interested customers are in the high-end housing segment with limited numbers or customers who buy for speculation, and few people buy houses to live.

Research on international experience shows that governments play an important role in promoting green buildings, efficient use of energy, and sustainable development:

- the Thai government incentives floor area according to the degree certificate;
- Singapore is required to apply Green Building for construction permit;
- China obliges to apply Green Building for state budget projects in big cities;
- Malaysia refund for the cost increase due to Green Building;
- the US Green Building Council grants LEED certification for the first project in one country for free.

Analyzing Green Building implementation results in Vietnam leads to proposing solutions to remove difficulties and obstacles for Green Building development. The state, professional social organizations, and developers need to propagate and disseminate to customers to buy, rent, and rent and purchase houses about the importance of green housing and economic and effective energy use.

To stimulate demand for the housing market through specific projects and projects. Need to have a particular regulation on Energy Efficiency Buildings that meet the criteria and standards of national energy efficiency.

The state management agencies should issue Regulations and circulars to guide and manage Green Building certification activities in Vietnam, classify Green Building classes for financial incentives, and adequately recognize social responsibility.

It is necessary to have a broader propaganda form so that businesses and people are aware of the need for Green Building development. The expression of social responsibility is not a strong enough motivation to motivate companies to develop Green Buildings, so it is necessary to have more specific financial support mechanisms.

It is necessary to consider adjusting the design fees and adding the cost of consulting, evaluating, and certifying Green Buildings to the norm. The State should issue preferential policies (taxes, administrative procedures, construction density/floor area) for the Green Building construction actors.

The State should complete a legal system to guide, manage and evaluate a green development process from site selection, planning, design, construction, and operation, and issue guidelines and regulations for Green Building projects using public investment capital.

4. RESULTS

The potential for Green Building development in Vietnam and the world is enormous. Many international financial institutions and UN agencies are actively participating in policy support, make recommendations, and organizing training courses and seminars to raise awareness about sustainable Green Building development for Government, investors, consultants, and all people. Vietnam has used many international Green Certification standards.

The study has analyzed the current state of Green Building development in Vietnamese cities, the current state of the green certification system, the state management policy system, and international financial institutions' participation. Green real estate projects are deployed in different market segments, from low-end to high-end, and bring clear economic benefits to investors.

Real estate project implementation reveals difficulties and reasons for limited green building development, including increased investment costs, investor and user awareness, and saving solutions energy in design, construction, and materials and equipment used in Green Buildings.

The financial support and supporting mechanisms and policies from the authorities are not appropriate.

The study also proposes solutions to promote Green Building development for investors, consultants, residents, state management agencies, and credit institutions.

5. DISCUSSIONS, CONCLUSIONS

State management agencies role is vital for Green Building development, including policy-making, support and propaganda mechanisms, and public awareness. Green Building development should be carried out throughout the building's lifecycle, including 5 phases: Green planning — Green design — Green construction — Green operation — Green lifestyle.

It is essential to study the international system of Green Building certification standards. The state should also issue the Vietnamese standards for Green Building certification and the accompanying identification of technical standards.

The issuance of Green Building rating standards and Green Building certifications contributes significantly to environmentally friendly natural materials, efficient energy use, and overall sustainable development.

Initial results show that real estate developers and people are very interested in green housing products and a healthy living environment. This is an essential premise to continue developing green real estate projects in the future, especially in Vietnamese megacities.

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Состояние зеленого строительства и решения для его развития во Вьетнаме

Цены на жилье в мегаполисах Вьетнама довольно высокие из-за ограниченного количества земли. Кроме того, инвестиции в «зеленое» жилье требуют более высоких затрат на реализацию, чем инвестиции в обычные проекты, поскольку их удорожают расходы на сертификацию зеленого строительства, необходимую по международным стандартам. Несмотря на определенные трудности и проблемы, проекты «зеленой» недвижимости в долгосрочной перспективе приносят экономические выгоды как инвесторам, так и пользователям.

Развитие зеленого строительства — это тенденция, которая особенно интересует как государственные органы, так и частных девелоперов.

Анализируя текущее состояние развития зеленого строительства во Вьетнаме, авторы обнаружили препятствия, ограничения и предложили решения.

Для эффективного развития зеленого строительства инвесторам необходимо использовать пятиэтапный процесс на протяжении всего жизненного цикла проекта: «Зеленое планирование» — «Зеленый дизайн» — «Зеленое строительство» — «Зеленая эксплуатация» — «Зеленый образ жизни». Благодаря использованию экологически чистых материалов эффективность энергосбережения в зеленом жилье становится более доступной для городских жителей Вьетнама.

***Ключевые слова**: зеленое строительство, зеленое здание, недвижимость, зеленая недвижимость*

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Об авторах: **Доан Зыонг Хай** — заведующий кафедрой экономики и управления недвижимостью; **Ханойский строительный университет**; Вьетнам, Ханой, Хайбачынг, ул. Зиа Фонг, д. 55; dduonghai2003@gmail.com;

Данг Тхи Хонг Зуен — аспирант, преподаватель; **Ханойский строительный университет**; Вьетнам, Ханой, Хайбачынг, ул. Зиа Фонг, д. 55; dduonghai2003@gmail.com;

Доан Хай Уен — студентка; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; dduonghai2003@gmail.com.

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Tkachenko V.B.

Overview of changes in Russian legislation in the field of construction and real estate management in the first half of 2021

The review presents changes in Russian legislation in the field of construction, real estate management, and housing and communal complex management.

The overview reflects the normative legal regulation of public relations in the establishment and legal status of a single customer in the field of construction, the authority of local governments on attracting the management of the organization, creating a universal mechanism for integrated development of territories, the establishment of procedures to ensure housing rights of citizens in the implementation of the integrated development of residential areas, etc.

Keywords: *changes, additions, legislation, regulations, judicial practice, construction, urban planning, apartment building, housing and utilities.*

Tkachenko Vladimir Borisivich,
Candidate of Legal Sciences, Docent, Associate Professor of The Department of Organization Of Construction And Real Estate Management; Expert (Lawyer) on Property Disputes, Construction, Real Estate Management, Housing And Communal Regulation; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation;
ID RISC: 451978;
TkachenkoVB@mgsu.ru

Regulatory legal acts

Federal Law No. 435-FZ of December 22, 2020 "On the Public Law Company "Single customer in the field of construction" and on amendments to certain legislative acts of the Russian Federation" [1]

The law provides for the creation of a single customer in the field of construction of state-owned objects of the Russian Federation. This is a public law company that is formed as a result of the reorganization of federal state institutions determined by the Government of the Russian Federation.

The activities of a single customer will not affect the objects of transport infrastructure, law enforcement, defense, nuclear energy, and some others. A single customer will perform the functions of a state customer and a developer in relation to objects, types (categories) which will be established by the Government of the Russian Federation.

The structure of the company is defined, the order of its activity is prescribed.

The Law comes into force from the date of publication.

Federal law of December 22, 2020 No. 441-FZ "On amendments to article 161 of the Housing code of the Russian Federation" [2]

The law stipulates that in the absence of choice by the owners of apartment houses (AB) management method or the selected method is not implemented, and the management organization not specified, the AB is transmitted to the management of a local authority management organization.

The local self-government body within five working days from the date of making a decision on the determination of the management organization, notifies in writing all owners of premises in an apartment building of the adoption of this decision and the terms of the management agreement of the AB and the terms of termination of the management agreement with the management organization. The contract for the management of an apartment building between the management organization and the owners of the premises in the apartment building is considered concluded from the date of the decision of the local government body to determine the management organization.

Federal law of December 29, 2020 No. 468-FZ "On amendments to the town planning code of the Russian Federation and certain legislative acts of the Russian Federation" [3]

The law provides for the reduction of the timing of individual procedures related to amending the rules of land use and development, grant permission to the deviation from the limiting parameters permitted the construction and preparation of the documentation on the territory planning.

The Government has the authority to determine the services provided in the field of urban development exclusively in electronic form.

The terms of consideration by the federal and regional bodies for the protection of cultural heritage objects of the draft master plan prepared for the territories of historical settlements, as well as the draft rules for land use and development, have been clarified.

Until January 1, 2022, the provision of support to SRO members in the field of construction in connection with the pandemic in terms of providing them with loans at the expense of the compensation fund to ensure the contractual obligations of the SRO has been extended.

The Law comes into force from the date of publication.

Federal Law No. 494-FZ of December 30, 2020 "On Amendments to the Urban Planning Code of the Russian Federation and certain legislative acts of the Russian Federation in order to ensure the integrated development of territories" [4]

The law establishes a universal mechanism for the integrated development of territories.

The Urban Planning and Land Codes of the Russian Federation are being amended to improve the institution of integrated development of territories.

The definition of the concept of integrated development of territories is given as a set of measures carried out in accordance with the approved documentation on the planning of the territory and aimed at creating favorable living conditions for citizens, updating the living environment and common areas of settlements, urban districts.

The Urban Planning Code of the Russian Federation is supplemented by a new chapter 10, which establishes a single legal mechanism for regulating the integrated development of territories (the goals and types of integrated development of the territory, the procedure and cases for making decisions on the integrated development of the territory, the procedure for concluding agreements on the integrated development of the territory and the procedure for its implementation, the procedure for the withdrawal of land plots and other real estate objects for state and municipal needs for the purpose of integrated development of territories).

Decisions on the integrated development of the territory are made by the Government of the Russian Federation, the supreme executive body of state power of the subject of the Russian Federation, the head of the local administration and may provide for the need to build apartment buildings or houses of blocked development on the territory subject to integrated development, in which all residential premises or the minimum number of residential premises meet the conditions for classification as standard housing. It is established that the complex development of the territory of residential development is carried out in relation to the built-up territory of a settlement, urban district within one or more elements of the planning structure or their parts, within the boundaries of which there are apartment buildings recognized as emergency and subject to demolition or reconstruction, and apartment buildings that meet the criteria established by regulatory legal acts of the subjects of the Russian Federation, which include, in particular, indicators of excess physical wear of the main structural elements of houses, the presence of houses of the period of industrial housing construction according to standard projects, the limited-working technical condition of apartment buildings, as well as the lack of centralized systems of engineering and technical support in them.

Complex development of the territory of non-residential development is carried out in relation to the built-up territory, within the boundaries of which there are land plots on which capital construction objects are located, which are not apartment buildings and are recognized in accordance with the procedure established by the Government of the Russian Federation as emergency and subject to demolition or reconstruction, or the demolition or reconstruction of which is planned on the basis of targeted programs approved by the supreme executive authority of the subject of the Russian Federation, or recognized in accordance with civil legislation as unauthorized buildings, as well as not corresponding to the types of permitted use of land plots, land use and development rules, including the maximum parameters of construction and reconstruction of capital construction objects. When implementing the integrated development of the territory of non-residential development, the boundaries of such territory may not include apartment buildings, residential buildings of blocked development, objects of individual housing construction, garden houses, other objects of capital construction located on land plots intended for individual housing construction, personal subsidiary farming, gardening.

The Government of the Russian Federation, a regulatory legal act of a subject of the Russian Federation may define real estate objects that are not subject to withdrawal for state or municipal needs for the purpose of integrated development of the territory.

Draft decisions on the integrated development of residential development areas are subject to posting on the official websites of the supreme executive body of state power of the subject of the Russian Federation, the authorized local self-government body on the Internet or in the state or municipal information system that provides for public discussions, public hearings using the Internet, on the regional portal of state and municipal services, on information stands (information boards) equipped near the local administration building, in other places located on the territory in respect of which the draft decision on the integrated development of the territory has been prepared.

The integrated development of the territory is carried out independently by the Russian Federation, the subjects of the Russian Federation, municipalities, a legal entity defined by the Russian Federation, a legal entity defined by the subject of the Russian Federation, or persons with whom agreements on the integrated development of the territory have been concluded. The conclusion of an agreement on the integrated development of the territory is carried out based on the results of a tender, tender or auction (hereinafter referred to as the auction) and is concluded with the winner of the auction. The agreement on the integrated development of the territory should provide for the distribution of the obligations of its parties in the implementation of measures aimed at implementing the decision on the integrated development of the territory, as well as provide for benefits (if any) and measures of state support. The term of the agreement on the integrated development of the territory may not exceed the deadline for the implementation of the decision on the integrated development of the territory.

It is provided that the procedure for conducting auctions, the cases and the procedure for concluding the specified contract when conducting auctions in electronic form are established by the Government of the Russian Federation.

The Housing Code of the Russian Federation is being amended to establish the procedure for ensuring the housing rights of citizens in the implementation of the integrated development of the territory of residential development.

Owners of residential premises in apartment buildings located on the territory in respect of which a decision on its complex development has been made, in return for the vacated residential premises, are provided with compensation determined on the day preceding the day of making a decision on the complex development of the residential development territory (equivalent compensation). At the request of the owner of the residential premises, another residential premises must be provided in place of the vacated residential premises with its cost offset when determining the amount of compensation for the withdrawn residential premises.

If the owner of the residential premises does not own other residential premises, at his request, he retains the right to use the residential premises for a period of no more than six months after providing him with an equivalent compensation in cash.

The tenant of the residential premises in place of the vacated residential premises is provided with another residential premises under a social rental agreement, the total area, living area and number of rooms in which is not less than the total area, living area and number of rooms in the vacated residential premises, and in the presence of his written application, such residential premises can be provided to him on the right of ownership on the basis of a contract for the transfer of residential premises to ownership.

A regulatory legal act of a subject of the Russian Federation may provide for the right of owners of residential premises and tenants of residential premises to receive equivalent residential premises that

meet the established requirements (the living area of the premises and the number of rooms in the residential premises are not less than the living area and the number of rooms in the vacated residential premises; the total area of such residential premises exceeds the total area of the vacated residential premises; the residential premises meets the standards established by the regulatory legal act of the subject of the Russian Federation; residential premises are located in an apartment building located in the same settlement, city district, in which the apartment building is located, included in the boundaries of the territory of residential development, subject to complex development). The provision of equivalent compensation or residential premises with its cost offset, the provision of equivalent residential premises is carried out on the basis of an agreement concluded between the owner of the residential premises and an authorized state or local government body, a legal entity established by the Russian Federation or a subject of the Russian Federation, or a person with whom an agreement on the integrated development of the residential development territory has been concluded.

Owners of residential premises and tenants of residential premises who are registered as needing residential premises provided under social rental agreements, and who have been provided with other residential premises under social rental agreements or in ownership, retain the right to be registered as needing residential premises provided under social rental agreements.

Citizens in need of residential premises provided under social employment contracts, housing conditions are improved by providing residential premises at the rate of provision per person established by the subject of the Russian Federation, in an extraordinary manner, if this is provided for by a regulatory legal act of the subject of the Russian Federation.

Owners of residential premises have the right, upon written application, to purchase for an additional payment residential premises of a larger area and residential premises with a larger number of rooms than the residential premises provided to them, in accordance with the procedure established by a regulatory legal act of a subject of the Russian Federation, including at the expense of maternal (family) capital, housing subsidies and social payments, the right to receive which is also confirmed by state housing certificates.

This Federal Law comes into force from the date of its official publication.

Decree of the Government of the Russian Federation of December 31, 2020 No. 2395 "On public-law company «One customer in the construction industry»" [5]

In accordance with article 2 of the Federal law "On public-law company «One customer in the construction industry» and on amendments to certain legislative acts of the Russian Federation", the Russian Government has created a public-law company "One customer in the construction industry" (hereinafter – the company).

The company was created through the reorganization (with a simultaneous combination of transformation and merger) of the Federal state institution "Directorate of a single customer for Construction, Capital and Current Repairs of Educational and Scientific Facilities" of the Ministry of Construction and Housing and Communal Services of the Russian Federation, Moscow; Federal state institution "Joint Directorate of a Single Customer of the Ministry of Construction and Housing and Communal Services of the Russian Federation", Moscow; Federal State Institution "Directorate for the Construction, Reconstruction and Restoration of Cultural Objects" of the Ministry of Construction and Housing and Communal Services of the Russian Federation, Moscow; Federal State Institution "North-Western Directorate for the Construction of Cultural Objects" of the Ministry of Construction and Housing and Communal Services of the Russian Federation, St. Petersburg; Federal State institution "Directorate for the Development of Physical Culture and Sports", Moscow; Federal State Institution "Directorate of a single customer-developer of health facilities" of the Ministry of Construction and Housing and Communal Services of the Russian Federation, Moscow.

The functions and powers of the founder of the company on behalf of the Russian Federation are performed by the Ministry of Construction and Housing and Communal Services of the Russian Federation.

The subject of the company's activities is to ensure the implementation of engineering surveys, architectural and construction design, construction, reconstruction (including works on the preservation of cultural heritage), capital repairs, demolition of capital construction projects and other activities.

The company's charter, the rules for appointing the General director and the working procedure of the Supervisory Board were approved.

The subject of the company's activities is to ensure the implementation of engineering surveys, architectural and construction design, construction, reconstruction (including works on the preservation of cultural heritage objects (historical and cultural monuments) of the peoples of the Russian Federation), capital repairs, demolition (hereinafter referred to as construction) of capital construction objects and other activities in accordance with Russian legislation.

The company was established for the purpose of performing the functions of a state customer and developer in ensuring the construction of capital construction projects that are or will be in the state ownership of the Russian Federation (hereinafter referred to as the objects).

The Company performs the following functions: preparation of draft decisions on the implementation of state capital investments in objects included or subject to inclusion in the company's program of activities, as well as making decisions on the implementation of capital investments in accordance with the budget legislation of the Russian Federation; preparation of proposals for the inclusion of objects in the federal targeted investment program and making changes to it; ensuring the construction of objects included in the company's program of activities; implementation of organizational, expert-analytical, informational and legal support for the construction of objects included in the company's program of activities; organization of research, development and technological works in connection with the construction of objects included in the company's program of activities; implementation of other activities provided for by federal laws and regulatory legal acts of the Government of the Russian Federation.

In order to perform the functions and powers assigned to it, the company has the right to carry out the following activities: organization of construction of capital construction facilities, technical equipment of capital construction facilities, including the purchase and supply of material and technical resources, registration and (or) receipt of initial permits; organization of work on the development, approval, approval and issuance of a design assignment; organization of the survey of the technical condition of capital construction objects and monitoring of the technical condition of capital construction objects; organization and control of the terms of development of project documentation, its acceptance and transfer to the general

contractor; organization of obtaining the expert opinion of the project documentation and the results of engineering surveys, including in terms of verifying the accuracy of determining the estimated cost of construction, reconstruction, capital repairs of capital construction objects, works on the preservation of cultural heritage objects (historical and cultural monuments) of the peoples of the Russian Federation, the conclusion of the state environmental expertise of the project documentation, as well as the approval and storage of the project documentation in accordance with the legislation of the Russian Federation; organization of obtaining permits for the construction of capital construction objects, as well as documents necessary for obtaining such permits and performing construction works; organization of obtaining permits for the commissioning of capital construction objects in accordance with the established procedure; conducting construction control, concluding state contracts (contracts) for the provision of construction control services; performing design supervision at capital construction objects; organization of activities for obtaining technical conditions for connection (technological connection) of capital construction objects to the networks of engineering and technical support necessary for the organization and execution of construction and installation and other works in relation to capital construction objects; organization of registration of documents in accordance with the established procedure, allowing the cutting and replanting of trees, fruit and berry plantations, the transfer of engineering and technical support networks, the demolition of buildings and structures that prevent the implementation of construction and installation and other works in relation to capital construction projects, including the determination of the volume and places of export and import of soil and fertile soil layer to ensure the implementation of construction and installation and other works in relation to capital construction projects; ensuring the implementation of cadastral works and works on the technical inventory of capital construction objects and the preparation of documents necessary for securing the right of operational management or economic management of capital construction objects for state institutions and state unitary enterprises or making changes to the information about capital construction objects contained in the Unified State Register of Real Estate and Other State registers; formation of a library of standard design solutions used in the field of construction of capital construction objects; acquisition of property necessary for the construction of capital construction objects, including special equipment and equipment, ownership and disposal of this property, implementation of its operation; acquisition of land plots necessary for the construction of capital construction objects; participation, in accordance with the procedure established by the legislation of the Russian Federation, in the implementation of investment projects in the field of construction of capital construction facilities, including the development of design and estimate documentation and the execution of works on the construction of such facilities; interaction with federal state bodies, executive authorities of the subjects of the Russian Federation, local self-government bodies and organizations on issues within the competence of the company; within its competence, the implementation of international cooperation in the field of construction, including the conclusion of agreements with international organizations and other activities.

The Decree came into force from the moment of its publication.

Decree of the Government of the Russian Federation No. 2460 of December 31, 2020 "On Approval of the Rules for certification, re-certification for the right to prepare expert opinions on project documentation and (or) expert opinions on the results of engineering surveys, including the extension of the validity period of the qualification certificate for the right to prepare expert opinions on project documentation and (or) expert opinions on the results of engineering surveys" [6]

In accordance with Part 6 of Article 491 of the Urban Planning Code of the Russian Federation, the Rules establish the procedure for certification for the right to prepare conclusions of state and non-state expertise of project documentation and (or) examination of the results of engineering surveys (hereinafter-conclusions), re-certification for the right to prepare conclusions, including the procedure for extending the validity of the qualification certificate for the right to prepare conclusions. Certification is carried out by the Ministry of Construction and Housing and Communal Services of the Russian Federation in respect of individuals who intend to obtain the right to prepare opinions (hereinafter referred to as applicants).

The certification is conducted based on the results of the applicant s knowledge test in the form of a certification session, including testing, a written exam and an interview.

Re-certification is carried out in respect of individuals who were previously certified in the declared field of activity from among the areas of activity included in the list established by the Ministry of Construction and Housing and Communal Services of the Russian Federation for the right to prepare conclusions. The certificate is valid throughout the Russian Federation for 5 years.

Decree of the Government of the Russian Federation of January 16, 2021 No. 9 "On amendments to the regulations on the Federal State Information System «Unified Portal of State and Municipal Services (Functions)»" [7]

Meetings of homeowners can be held through the unified portal of state and municipal services (hereinafter – the portal). On the basis of the portal, a service has been created for holding meetings in absentia of homeowners in electronic form.

On the portal, it is possible to submit questions for voting by the owner of the premises, provided that they automatically confirm the information about the ownership of the premises in an apartment building in accordance with the data from the federal state information system for maintaining the Unified State Register of Real Estate or by the person who manages the apartment building (hereinafter referred to as — initiator), provided that the initiator is registered in the unified identification and authentication system in accordance with the procedure established by law by posting a message in electronic form on the unified portal; it is possible to inform the owners of premises in an apartment building about the general meeting of owners of premises in absentia using the unified portal, as well as about the results of the general meeting of owners of premises; the possibility of voting of owners of premises in an apartment building in absentia using a single portal and making decisions on issues put to the vote, provided that the information about the ownership of the owners of premises in an apartment building intending to take part in the vote is confirmed automatically in accordance with the data from the federal register management system and subject to the condition of registration in the unified identification and authentication system in accordance with the procedure established by the legislation of the Russian Federation; it is possible to form the minutes of the general meeting of owners of premises on the basis of decisions taken on issues put to the vote, in absentia, using a single portal; interaction with the state information system of housing and communal services, including for the purpose of placing in the specified system in automated mode messages about the general meeting of owners of premises, decisions taken by the general meeting of owners of premises, voting results, minutes of general meetings of owners of premises on the agenda of the general

meeting of owners of premises, decisions of owners of premises in an apartment building on issues put to the vote, the federal register management system and other state information systems that contain information necessary to ensure that the general meeting of owners of premises is held in absentia using a single portal.

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3. Federal law of December 29, 2020 No. 468-FZ "On amendments to the town planning code of the Russian Federation and certain legislative acts of the Russian Federation".
4. Federal Law No. 494-FZ of December 30, 2020 "On Amendments to the Urban Planning Code of the Russian Federation and certain legislative acts of the Russian Federation in order to ensure the integrated development of territories".
5. Decree of the Government of the Russian Federation of December 31, 2020 No. 2395 «On public-law company "One customer in the construction industry"».
6. Decree of the Government of the Russian Federation No. 2460 of December 31, 2020 "On Approval of the Rules for certification, re-certification for the right to prepare expert opinions on project documentation and (or) expert opinions on the results of engineering surveys, including the extension of the validity period of the qualification certificate for the right to prepare expert opinions on project documentation and (or) expert opinions on the results of engineering surveys".
7. Decree of the Government of the Russian Federation of January 16, 2021 No. 9 "On amendments to the regulations on the Federal State Information System "Unified Portal of State and Municipal Services (Functions)".

Note: when forming the review, information from open sources was used: the website of the State Duma of the Federation Council of the Russian Federation[1]; Internet portal of legal information[2]; Internet portal "Rossiyskaya Gazeta"[3]; Reference legal system "ConsultantPlus"[4]; Information and legal portal "Garant.ru"[5]; Information portal "RBC Real Estate"[6].

1 State Duma of the Federal Assembly of the Russian Federation. URL: http://duma.gov.ru/en/

2 Internet portal of legal information. URL: http//www.pravo.gov.ru

3 Rossiyskaya Gazeta. URL: http//rg.ru

4 ConsultantPlus. URL: http//www.consultant.ru

5 Garant.ru. URL: http://www.garant.ru

6 RBC Real Estate URL: http://realty.rbc.ru

Обзор изменений российского законодательства в сфере строительства и управления недвижимостью в первом полугодии 2021 г.

В обзоре представлены изменения российского законодательства в сфере строительства, управления недвижимостью и жилищно-коммунальным комплексом.

В обзоре отражено нормативное правовое регулирование общественных отношений по вопросам создания и правового положения единого заказчика в области строительства, полномочий органов местного самоуправления в области привлечения управляющей организации, создания универсального механизма комплексного развития территорий, установления порядка обеспечения жилищных прав граждан при осуществлении комплексного развития территории жилой застройки и т.п.

Ключевые слова: *изменения, дополнения, законодательство, нормативно-правовые акты, судебная практика, строительство, градостроительство, многоквартирный дом, ЖКХ*

ЛИТЕРАТУРА

1. О публично-правовой компании «Единый заказчик в сфере строительства» и о внесении изменений в отдельные законодательные акты Российской Федерации : Федеральный закон от 22 декабря 2020 г. № 435-ФЗ.
2. О внесении изменения в статью 161 Жилищного кодекса Российской Федерации : Федеральный закон от 22 декабря 2020 г. № 441-ФЗ.
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6. Об утверждении Правил аттестации, переаттестации на право подготовки заключений экспертизы проектной документации и (или) экспертизы результатов инженерных изысканий, в том числе продления срока действия квалификационного аттестата на право подготовки заключений экспертизы проектной документации и (или) экспертизы результатов инженерных изысканий : Постановление Правительства РФ от 31 декабря 2020 г. № 2460.
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Об авторе: **Ткаченко Владимир Борисович** — кандидат юридических наук, доцент, доцент кафедры организации строительства и управления недвижимостью; эксперт (адвокат) по вопросам имущественных споров, строительства, управления недвижимостью, вопросам жилищно-коммунального регулирования; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 451978; TkachenkoVB@mgsu.ru.

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Vlasov D.N.
Vakulenko S.P.
Romenskii D.Yu.

Redevelopment of the Moscow monorail

In the world practice of recent decades, monorail transport systems have been actively developing as an element of the mass passenger transport system. There is a monorail line in Moscow, which has exhausted its operational reserves and needs reconstruction. The article discusses the possible directions of development of the monorail in Moscow. Five possible directions of development have been identified, including the transformation of the line into other modes of transport (tram), the construction of an extension of the monorail line in various directions, the arrangement of urban public spaces and the renewal of rolling stock. Construction of an extension of the existing monorail line, rebuilding the system into a tramway, arrangement of a linear fleet — these are very costly options that require a significant amount of time to discuss projects. The most promising direction in the development of the system is the renewal of the rolling stock or its complete replacement while preserving the linear part of the monorail.

Keywords: *mass passenger transport, General plan of Moscow, monorail, linear parks, tram*

Vlasov Denis Nikolaevich,
Doctor of Technical Sciences, Deputy Head of the Transport and Engineering Center, RAACS advisor; State Autonomous Institution "Research and Project Institute of General Planning for the city of Moscow"; 2/14, 2nd Brestskaya St., Moscow, 125047, Russian Federation; ID RISC: 289259, Scopus: 57193410512, ResearcherID: A-6226-2017, ORCID: 0000-0001-8765-4485; vlasych@mail.ru

Vakulenko Sergey Petrovich,
Candidate of Technical Sciences, Professor; Director of the Institute of Management and Digital Technologies; Russian University of Transport (RUT); bldg. 9, 9, Obraztsova St., Moscow, 127055, Russian Federation; ID RISC: 289259, ORCID: 0000-0002-6471-8690; post-iuit@bk.ru

Romenskii Dmitry Yur'evich,
Senior Lecturer of Department of Transport Business Management and Intelligent Systems; Russian University of Transport (RUT); bldg. 9, 9, Obraztsova St., Moscow, 127055, Russian Federation; ID RISC: 748301, ORCID: 0000-0002-3693-5508; romensky@miit.ru

Currently, monorail high-speed off-street transport is actively developing in large cities and megalopolises of the world. There has been a significant increase in the length of fully automated monorail lines in China, Japan, USA, South Korea and other countries. Over the past 30 years, leading manufacturers have come a long way in improving the technical and economic parameters of their products. Monorail systems of different generations differ significantly in their efficiency and operational reliability.

The average haul length in modern monorail systems is 500…800 m with communication speeds of 30…36 km/h, with accelerations and decelerations the same as on subway cars [1–6]. For example, a monorail system built in 2015 in the city of Daegu (South Korea) with a length of 24 km (average run length 800 m) worth $333 million (970 million rubles/km) provides a communication speed of 36 km/h (on the Moscow metro — 42 km/h). The system is characterized by high carrying capacity and is part of the Daegu subway as the 3rd subway line.

The Moscow Monorail Transport System (MMTS) is the only monorail transport line that is part of the high-speed off-street transport system in Moscow. Built in the period 2001–2004, the line runs through the territory of the North-Eastern and Northern districts of the capital from the territory of the All-Russian Exhibition Center (VDNKh) to the Timiryazevskaya station of the Serpukhovsko-Timiryazevskaya metro line. Forming a separate transport company, MMTS is part of the Moscow Metro and operates according to unified tariffs and rules of use (Fig. 1 and 2).

The development and construction of MMTS was carried out in the period from 1998 to 2004. In accordance with the decree of the Government of the city of Moscow1 . The total length of the route along which passengers are transported was 4.81 km in double-track (9.62 km in single-track) with an average run length of 960 m. The development of the Monorail as a type of urban transport was primarily due to an attempt by the city authorities to find cheaper in terms of construction and operation alternatives to the metro. It was during that period of time that various projects of alternative systems were proposed, two of which were implemented: MMTS and the "light metro" in the Moscow region of Butovo.

For the first four years, the constructed monorail line was operated in the so-called "excursion" mode, which implied long intervals between trains and an increased cost of travel. The line switched to the mode of the passenger transport system in 2008 and worked in it until the end of 2016, after which the problem of wear and tear of rolling stock arose, and the line again switched to the "excursion" mode due to the lack of serviceable trains. The maximum volume of annual passenger traffic was reached in 2014 and amounted to 5.6 million passengers (Fig. 3).

The choice of routing the only monorail line was due to several factors: Moscow s struggle for the right to host the prestigious EXPO-2010 exhibition (which was later held in Shanghai), the presence of a finished alignment in urban development, left by the General Plan of Moscow for the development of the road network and other factors.

When the carriages are filled at the rate of 5 people/m^2, the capacity of a train with a length of 31.4 m is 200 passengers. The maximum carrying capacity is 6 thousand passengers per hour in one direction. While operating in the transport mode, MMTS successfully mastered, in addition to local, passenger flows in the transverse direction, between the Serpukhovsko-Timiryazevskaya and Kaluzhsko-Rizhskaya metro lines. The decrease in the role of MMTS in the transport system occurred gradually. In 2016, with the opening of the Moscow Central Ring (MCC), the task of connecting radial lines in the north of Moscow was solved with the help of a new, better transport service on the railway infrastructure, and the passenger traffic on MMTS significantly decreased. In the same year, the Fonvizinskaya metro station was opened, which also began to discuss the gravity area of the Milashenkova Ulitsa monorail station. Additionally, in 2022 it is planned to open the Savyolov-

1 Official portal of the Mayor of Moscow. URL: https://www.mos.ru/authority/documents/doc/15961220/

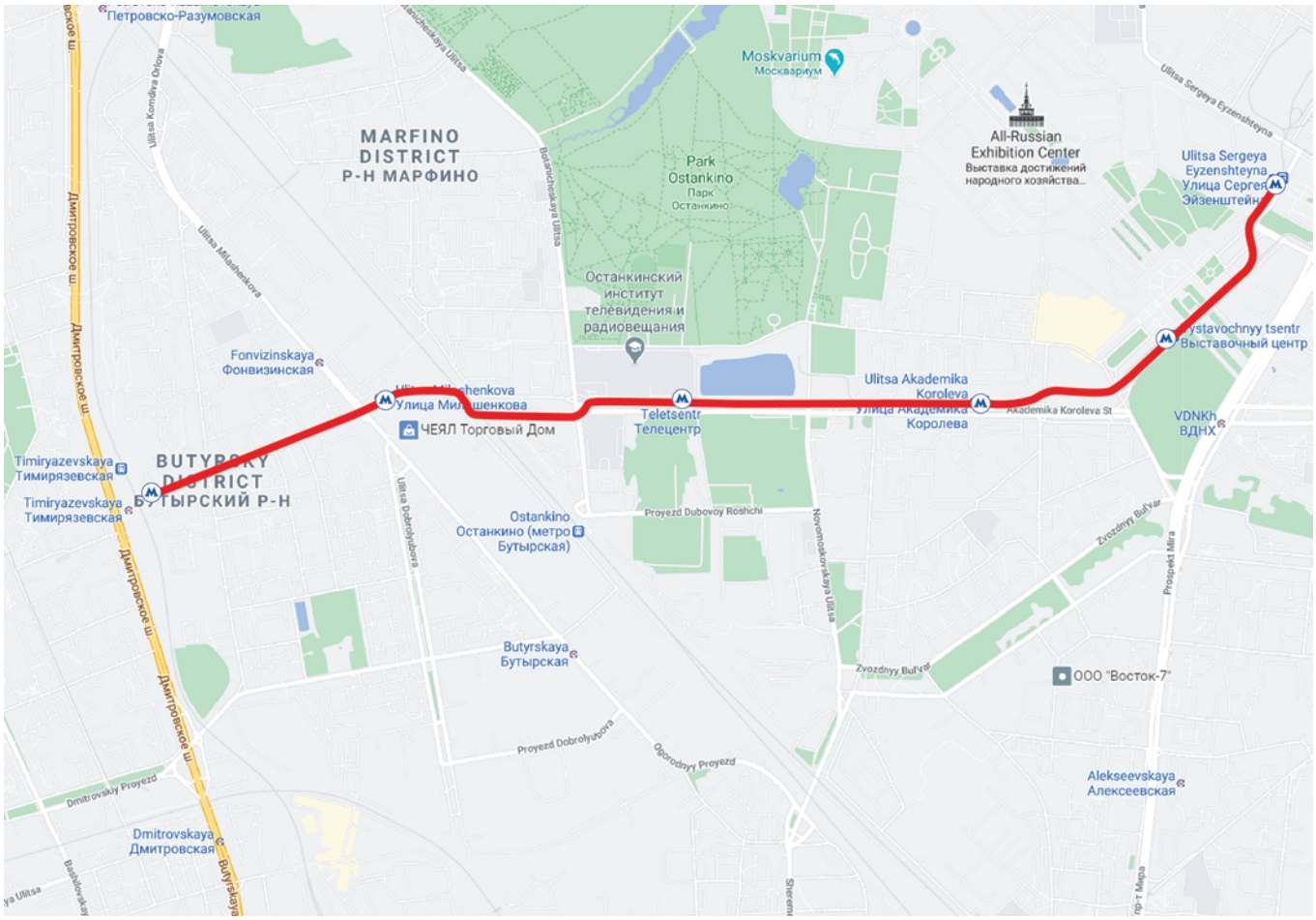


Fig. 1. Moscow monorail transport system

Fig. 2. Exterior of the rolling stock of the Moscow monorail transport system

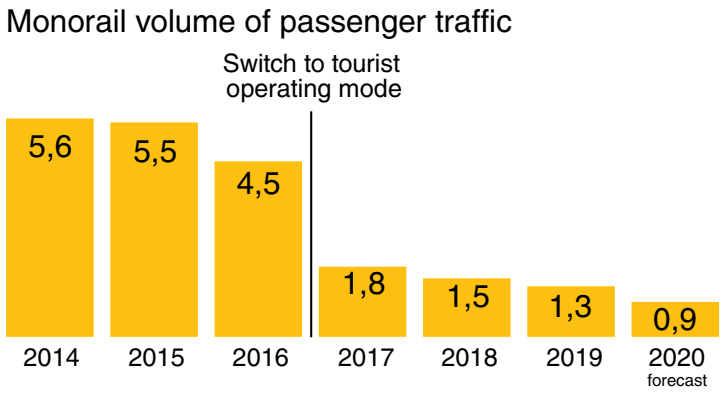


Fig. 3. Passenger traffic of the Moscow monorail transport system, million passengers/year

skaya-Rizhskaya section of the Big Circle Metro Line, which will duplicate the MMTS route from the south.

A strong blow to the passenger flow of the monorail was the gradual strengthening of tram route No. 17 in the period from 2011 to 2020. This route duplicates the monorail track by 40 % of its length. The reduction of the interval in the schedule to 2…5 minutes, the introduction of a clock schedule and the introduction of modern rolling stock led to an increase in the attractiveness of the tram and a gradual outflow of passengers from the monorail. As a result, to date, MMTS serves small local passenger traffic, which is formed mainly due to the lack of direct communication by other modes of transport through the Oktyabrskoye direction of the railway.

All of the above led to the need to develop a project for the reconstruction of the Moscow monorail system and the development of documentation for the planning of the territory of a linear transport infrastructure facility, carried out by specialists from the Institute General Plan of Moscow, RUT (MIIT) and other specialized organizations commissioned by the Moscow Committee for Architecture and Urban Planning. As part of the work, a wide range of issues were considered, including: determining the need to extend the monorail line and options for its development.

Several main directions of development of the MMTS system were considered:

- extension of the monorail line and its integration with the lines of the Moscow Central Diameters, the metro and the MCC;
- various options for the reconstruction of the monorail line with the organization of tram traffic along the route;
- elimination of train traffic and the use of line supports to create a linear park and public space;
- preservation of the monorail line with its reconstruction and the use of new rolling stock;
- use of alternative rolling stock.

Line extension

Five options for extending the monorail line from the existing section near the VDNKh metro station were considered (Fig. 4):

- along Wilhelm Pieck Street to TPU Botanical Garden;
- along Prospect Mira to TPU Rostokino;
- along Boris Galushkina Street to the Yaroslavl direction of the Moscow Railways and further along the railway: either to the Malenkovskaya platform, or to the Rostokino TPU, or further, through Losiny Island to the promising development zone near the Bogatyrsky Bridge.

The extension from TPU Timiryazevskaya was deemed not promising and was not considered.

The implementation of all options is fraught with significant difficulties: passage through densely built-up urban areas, the need to organize construction in areas with a special natural, historical and cultural status. In addition, it is necessary to take into account the dynamic development of the city's passenger transport system: the project of the Moscow Central Diameters, the construction of the metro, the development of tram traffic and the entire system of ground passenger transport, and the increase in the carrying capacity of the Moscow Central Circle. This leads to an increased cost of extending the monorail, on the other hand, reduces the demand for its services. The calculations showed that the average load of the monorail section will be from 0.5 to 2.6 thousand passengers during the “peak” hour in the maximum direction. The maximum estimated value of passenger traffic on the stretch did not exceed 5.0 thousand passengers.

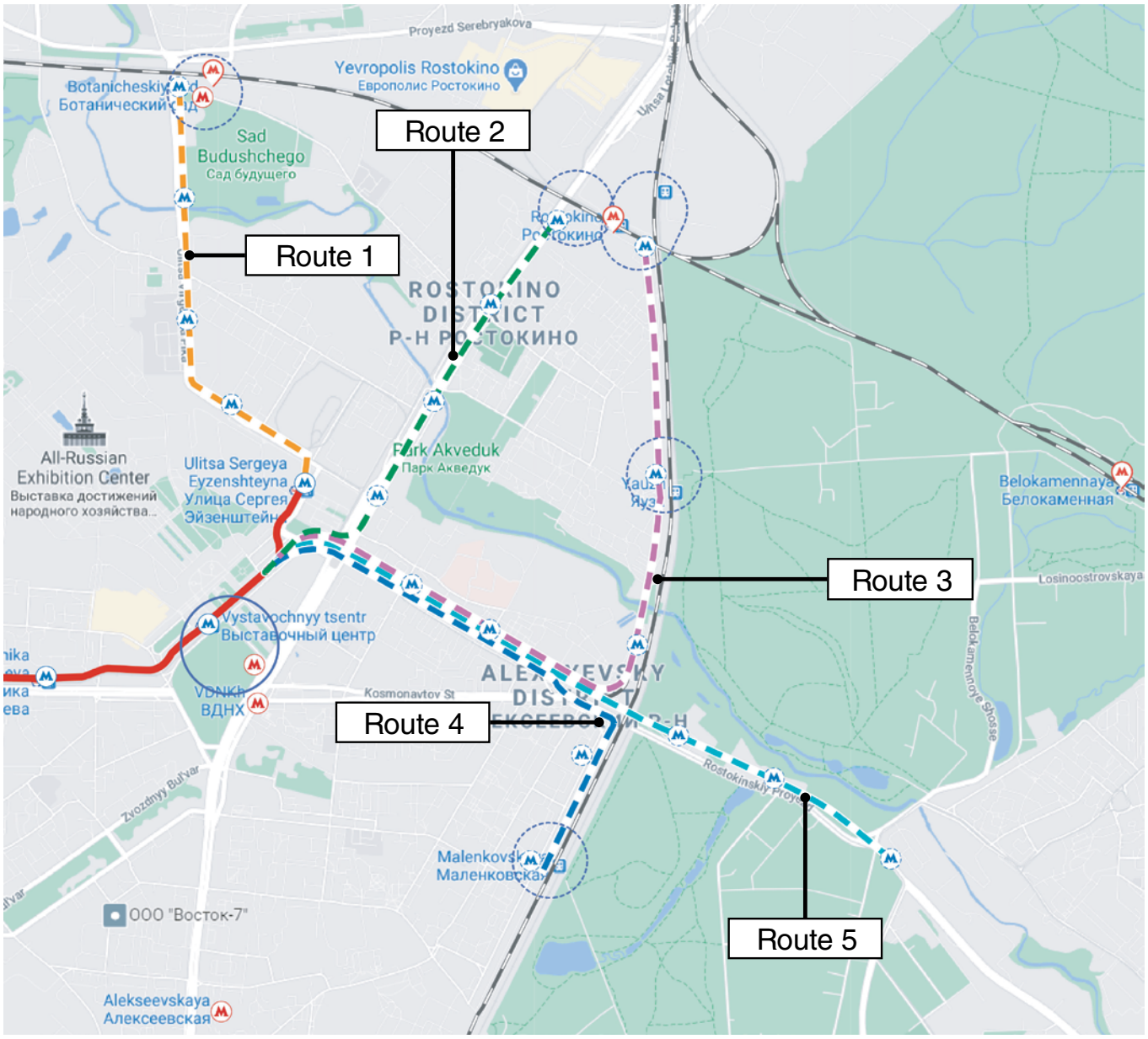
Despite the technical feasibility of the extension, the predicted value of passenger traffic and the forecast of the total amount of socio-economic effects do not allow us to say about the priority of this project. Modeling shows that with any of the options for extending the existing MMTS route, it is not possible to achieve passenger flows inherent in off-street rail transport lines. In the case of bringing MMTS to the parameters of a high-quality transport system in terms of speed and frequency of circulation, a passenger traffic of 4–6 million passengers per year can be achieved, which is equivalent to the transport mode of operation of MMTS in the period from 2008 to 2016. In the further calculation of the technical and economic parameters of the modernization of the monorail, just such target passenger flows can be used.

Organization of tram traffic

Several options were considered:

- the use of existing supports, beams and spans with the reconstruction of the track structure and the organization of tram movement along the existing route;
- dismantling of the monorail line and construction of a new tram line along its route;
- in both scenarios, the extension of the tram line through the Savelovskoe direction of the Moscow Railway and the connection with the existing tram network of the northern sector of the city was considered.

The advantage of this direction of development is the possibility of forming a single tram network in the northern sector of the city (today it is divided after the elimination of tram traffic on Prospekt



Existing railway lines

Existing monorail line

Possible monorail routes

Existing Moscow Metro station

Existing Moscow Central Circle station

Existing monorail station

Planned monorail station

Existing change

Planned change

Fig. 4. Options for extending the Moscow monorail transport system

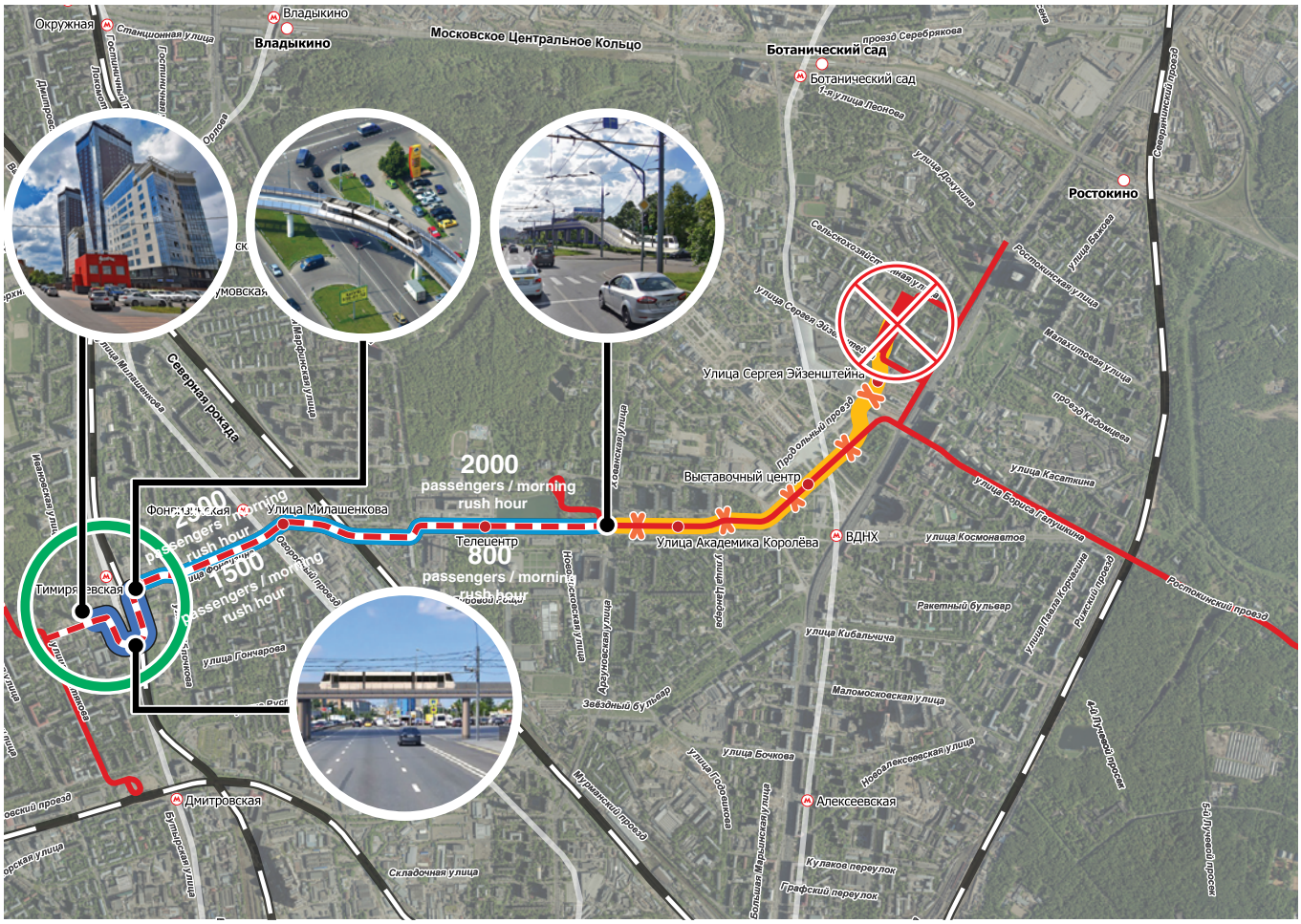


Fig. 5. Schematic diagram of the tram network connection in the northern sector of Moscow

Mira). A schematic diagram of the tram network connection is shown in Fig. 5.

The calculations showed that the geometric parameters of the route and the bearing capacity of the existing route will not be able to ensure the movement of the tram, i.e. in fact, it is necessary to demolish most of the monorail structures and rebuild, taking into account the static and dynamic loads from the tram rolling stock. In addition, a complete reorganization of the energy sector, the system of maintenance and operation of the monorail is required. The option with an extension is associated with significant costs for the construction of new transport facilities and the reconstruction of engineering networks. In general, the cost of constructing a tram line along the monorail route is estimated at 14–16 billion rubles.

Creation of a linear park and public space

The creation of linear parks on the site of former transport structures is becoming a fashionable trend in the mid-end of the twentieth century. The territory for the creation of linear parks was the former railway structures. The relocation of production from city centers in Europe and the United States made them unnecessary for freight traffic. Some of them were used to develop passenger traffic, some were eliminated, and some were used to organize linear parks — public spaces [7].

One of the first such projects was implemented in Paris, and the most famous one in New York, High-Land-Park. (Fig. 6). The project is a public green space, organized in the structures of a former railway overpass, which provides transportation of goods to enterprises located in the Manhattan area.

Fig. 6. Schematic diagram and appearance of High-Land-Park in New York

To date, a significant number of similar projects have been implemented in world practice, related not only to the transformation of the railway, but also to the reconstruction of the street and road network of cities:

- the Big Dig project in Boston [8], where a federal transit highway that passed through the city center on an overpass was rebuilt and removed into a tunnel that passes under the city center, meeting the Boston subway line and the Atlantic Ocean;
- the project for the restoration of the Cheonggyecheon River, when in the 60s of the last century the river was removed into a pipe, and a highway was built above it, and at the beginning of the 21st century the highway was liquidated, the channel was opened and a single public space was created.

The characteristic features of such projects are their high cost, significant implementation periods (most often in separate stages lasting for several years). An important aspect is a long-term public discussion of various options for transforming space. Given the need to make a prompt decision on the future fate of the monorail, this option does not seem appropriate.

Preservation of the monorail line with its reconstruction and the use of new rolling stock

The monorail system is based on the developments of Intamin, a Swiss engineering company. During the construction of the MMTS system, the following were redesigned: the drive, the central locking system that ensures traffic safety and the traffic control system.

To obtain significant results that allow assessing the safety of work and the technical condition of MMTS, the specialists of TOMAK LTD carried out tests and tests of starting, braking and energy modes of train operation on all existing tracks. To increase the reliability of the measurement results, at the suggestion of the monorail depot specialists, traction and energy tests were carried out on different trains.

Curves of movement were processed in accordance with an innovative method of processing test results, verified during state acceptance tests of subway trains of the “NeVa” project. It takes

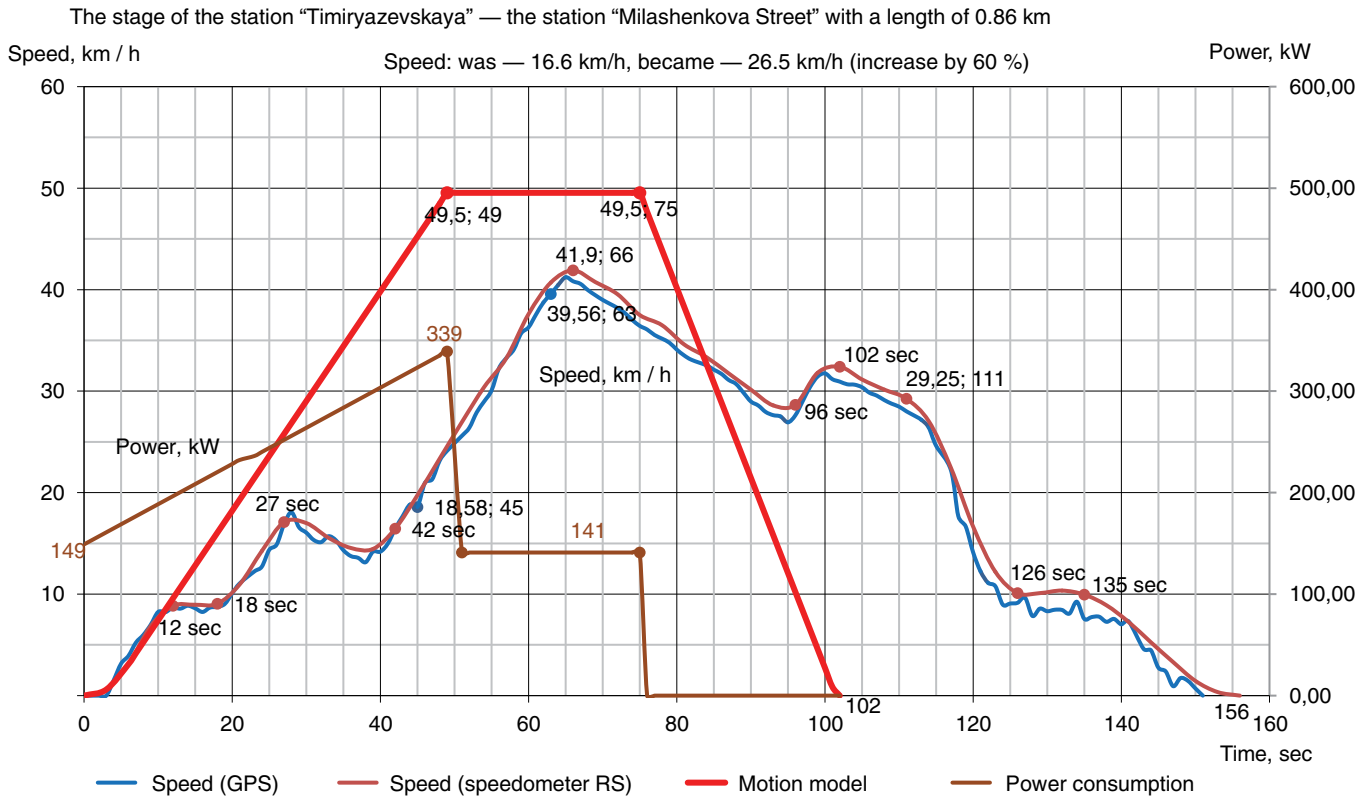


Fig. 7. Curves of thrust, energy and movement of a monorail train

into account not only the very energy of the movement of electric rolling stock, but also the influence of the track profile on it, which is very significant in the case of a sharply variable profile of the monorail track. Traction-energy calculations of motion were carried out according to it and proposals were developed to improve their traction, energy and braking characteristics [9–13].

It was found that in the operational mode of movement the speed of trains on the line is significantly underestimated. This is due to the various restrictions imposed on their movement by the complex track profile and the presence of small-radius curves on the track. In this regard, tests were carried out with increased (from 0.3 to 0.8 m/s^2) accelerations and decelerations. This made it possible to find out how an increase in the acceleration and deceleration of mono-trains affects the energy indicators of traction and the speed of communication. It was found that in the speed range of 30…60 km/h, the growth of acceleration is impeded by the characteristics of linear asynchronous traction motors, which do not have a field weakening mode, which allows maintaining a constant traction power.

Fig. 7 shows the results of experimental measurements and calculations of traction, braking and energy modes of train operation. The modernized train operating mode with a traffic speed of 26.5 km/h is applied to the normal operating mode with a communication speed of 16.6 km/h. The communication speed in the modernized mode has increased by 60 %, and the power consumption by 35 %.

As a result of the tests carried out, it was found that with the existing technique and technology of monorail traction, based on the use of linear asynchronous traction motors, the route speed of monorail trains can be increased by no more than 1.5 times (from 16 to 24 km/h). These results indicate the presence of an unused reserve for improving the quality of MMTS operation in the current conditions.

Use of alternative rolling stock

If a decision is made to change the type of rolling stock, the following requirements must be taken into account:

- maximum preservation of the existing linear infrastructure and depot;
- taking into account the bearing capacity of the main elements of the linear infrastructure;
- the possibility of increasing the length of the rolling stock (taking into account the available length reserve of platform sections);
- changing the layout of the rolling stock in accordance with modern requirements (through passage through the train, limited number of seats);
- the ability to fully automate the transportation process;
- improvement of the linear motor and, as an option, the introduction of a partial magnetic suspension system;
- etc.

As part of the work on the development of the project, the layouts of the monorail were carried out with possible suppliers of the new rolling stock for the monorail. Suppliers are ready to supply modern electric rolling stock for the modernization of MMTS, each with different traction technologies and various automation and control systems for train traffic safety.

In the future, it is necessary to estimate the costs of [14, 15] for the implementation of projects and holding open tenders with the participation of leading domestic and foreign manufacturers with the formation of legally binding commercial proposals.

Main conclusions:

- the construction of the Moscow monorail was completed in 2004. The system has been integrated into the Moscow passenger transport system, however, for the last 4 years the system has been operating at extended intervals due to wear and tear of the rolling stock and a number of other factors.
- five main options for the development of the monorail system are considered. The extension of the line was considered not promising due to the insignificant demand for monorail services in the considered sector of the city. The option of constructing a tram along the monorail route has a number of town planning advantages, but it has a high cost of implementation. The project of creating a linear park requires a long discussion with the public of the city and large costs;
- the most promising areas for the development of the system are: renewal of rolling stock or the use of alternative rolling stock.

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Реконструкция Московского монорельса

В мировой практике последних десятилетий активно развиваются системы монорельсового транспорта как элемент системы массового пассажирского транспорта. В Москве существует линия монорельса, которая исчерпала резервы эксплуатации и нуждается в реконструкции. В статье рассмотрены возможные направления развития монорельса в Москве. Определены пять возможных направлений развития, включая трансформацию линии в другие виды транспорта (трамвай), продление линий монорельса в различных направлениях, устройство городских общественных пространств и обновление подвижного состава. Строительство продлеваемой существующей линии монорельса, перестройка системы в трамвайный транспорт, устройство линейного парка являются очень затратными вариантами, требующими значительного времени для обсуждения проектов. Наиболее перспективным направлением развития системы является обновление подвижного состава или его полная замена с сохранением линейной части монорельса.

Ключевые слова: *городской пассажирский транспорт, Генеральный план города Москвы, монорельс, линейные парки, трамвай*

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Об авторах: **Власов Денис Николаевич** — доктор технических наук, заместитель руководителя Транспортно-инженерного центра, Советник РААСН; **Государственное автономное учреждение города Москвы «Научно-исследовательский и проектный институт Генерального плана города Москвы» (ГАУ «Институт Генплана Москвы»)**; 125047, Москва, ул. 2-я Брестская, д. 2/14; РИНЦ ID: 289259, Scopus: 57193410512, ResearcherID: A-6226-2017, ORCID: 0000-0001-8765-4485; vlasych@mail.ru;

Вакуленко Сергей Петрович — кандидат технических наук, профессор, директор Института управления и цифровых технологий; **Российский университет транспорта (РУТ (МИИТ))**; 127055, г. Москва, ул. Образцова, д. 9, стр. 9; РИНЦ ID: 289259, ORCID: 0000-0002-6471-8690; post-iuit@bk.ru;

Роменский Дмитрий Юрьевич — старший преподаватель кафедры управления транспортным бизнесом и интеллектуальных систем; **Российский университет транспорта (РУТ (МИИТ))**; 127055, г. Москва, ул. Образцова, д. 9, стр. 9; РИНЦ ID: 748301, ORCID: 0000-0002-3693-5508; romensky@miit.ru.

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Павлова Л.И. Иерусалим. Святой колодец. Офорт