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The importance of complex modelling of the spatial-territorial system in assessing the implementation of investment and construction projects

This paper examines an approach to integrated modelling of a spatial-territorial system from the perspective of the interconnections and mutual influences of not just individual factors and components, but rather complex systems that form a natural and artificial spatial system. The fundamental distinction of this approach is that it considers the interactions of systems with the same goal but different resource directions in the formation of a unified system during the implementation of investment and construction projects. The socioeconomic nature of a spatial-territorial system, which takes into account the complex use of land plots with various land uses interconnected with technological process components during the construction of real estate with varying functionality, determines the task of quantifying the balance of the model. The level of capitalization of “undeveloped” (“undeveloped land” — a natural resource at the stage of the beginning of the territory organization process) land resulting from the implementation of investment and construction projects reflects the efficiency of its use, regardless of the functionality of spatial objects. Therefore, this indicator can serve as an integral criterion for the balanced state of a spatial-territorial system. Moreover, the direction of investment impact will be determined by the identified discrepancies in the functioning of individual elements of the system under study during the investment support of project implementation. This article examines a resource decomposition method for a model for all participants in territorial redevelopment, enabling the calculation of benchmark values for the system's economic parameters under the assumption of a balanced structure. These results were achieved through the creation of a comprehensive “territorial genesis” model, based on the interconnected and interdependent production processes of construction projects. Furthermore, the inclusion of humans as a key production factor played a significant role in the model's development. The influence of the human factor is reflected in the model both at the organizational stage and during the adoption and implementation of the investment construction process. Based on the model's decomposition, it was possible to obtain capitalization coefficients for each system element, the entrepreneur's profit level, the contractor's profit level, and the refinancing rate assuming no losses in a balanced system. These values can serve as benchmarks to strive for when developing territories in investment construction projects to ensure the structural balance of the spatial-territorial system, or they can reflect the balance of the real estate market and the state of its individual segments at the time of their assessment.

Keywords: *patterns of territorial functioning, investment activity, investment climate, complex redevelopment project, land capitalization level, capitalization ratio, entrepreneur's profit, key rate*

A territory is a specific concept that is defined by borders, area, properties, resources and is an object of human activity of the population that lives on it [1].

The development of the territory occurs as a result of human activity, which forms both the spatial system and the investment climate, including through the adoption of laws and regulations on the development of territories, structuring the financial system and attracting investment resources [2]. The study of dynamic changes occurring in the territory is not possible without modelling the spatial-territorial system, which includes man and the land as the main natural and intellectual resource for its development [3].

The territory formed in this way is not static. Depending on the development goals, external influences, and changes in the technological base of construction, the territory is transformed and changed.

The dynamics of territorial development can be observed through the analysis of the Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036¹.

¹ Strategy for Spatial Development of the Russian Federation through 2030 with a Forecast to 2036 : Order of the Government of the Russian Federation of December 28, 2024, No. 4146-r. URL: <http://government.ru/docs/all/157308/> (rus.).

The purpose of the spatial development of the Russian Federation is to form a balanced system of settlement and territorial organization of the economy of the Russian Federation, which will contribute to achieving national goals and ensuring national security.

The planning strategy is a document developed according to the territorial principle within the framework of strategic goal-setting according to the territorial principle. This principle fulfills the task of a key mechanism for implementing the strategy through current territorial planning documents (including the territorial planning schemes of the Russian Federation in various areas, the territorial planning schemes of the subjects of the Russian Federation). This work is carried out according to territorial land management schemes, which primarily provide for the redistribution of lands by combining, dividing and delimiting them based on their effective use under a certain type of land use. In this case, the reconstruction of territories is not considered in isolation, but in the general system of established land use, which significantly increases the possibility of economically efficient use of land [4].

The spatial development strategy is certainly based on innovative technologies that will ensure the breakthrough of modern environmentally oriented industry. Scientific and technological development, in

accordance with the strategy, provides for the creation of mechanisms to encourage investors to form infrastructure in territories with preferential regimes, on the basis of which critical and end-to-end technologies are created.

The analysis of the spatial development strategy of the Russian Federation has shown that the inertial scenario, which does not change the existing settlement system and the territorial organization of the economy, does not contribute to the development of the spatial-territorial system and in this case will have to rely only on the implementation of individual local projects. The target scenario, which achieves the goal of developing a spatial-territorial system, is determined by two factors: the equilibrium structure of the self-developing system and the external resource impact that supports the components of the system for structural equilibrium, which is focused on the development of the system [5].

The Strategy defines a digital platform as the basis for making managerial decisions.

However, for urbanized territories, market value and the achievement of quantitative indicators set out in the Strategy prevail as a quantitative characteristic. The methodology used to calculate the market value, for determining which, with the dominant principle of the most efficient use, is purely aimed at the economic exploitation of land, rather than its effective use, ignores the main social and environmental factors and leads to the gradual degradation of territories. And the absence of such an indicator as the level of land use efficiency, which is the main natural resource uniting all branches of the national economy of any country, does not allow us to quantify information about the growth and development of the spatial and territorial system [5]. A digital indicator of the development of a spatial-territorial system should include a set of relationships between all the resources of the spatial-territorial system, starting from land, the main natural resource, and ending with human relations during the construction and operation of real estate.

The task of expressing the state of the spatial-territorial system in digital terms is associated with the issues of the mutual influence of systems of different nature and the multidirectional nature of their resources in the formation of a common integrated system. To achieve this goal, this article examines the application of a complex engineering approach that combines the relationship between subject systems and object systems, regardless of whether these systems are technical or organizational [6]. This approach made it possible to develop a model of the "genesis of territories" [7], decompose it, and switch to economic parameters that characterize each element of the model, provided that the spatial and territorial system is balanced [8]. The paper shows both the role of the behavior of stakeholders in a territorial redevelopment project and the role of the investment climate [9] in shaping the equilibrium structure of the system based on the interests of the project participants. The calculation of the quantitative value of each layer of the model, expressed in economic terms, contributes to the adoption of managerial decisions to create a balanced territorial organization of the economy. The paper shows that based on the equity participation of a particular stakeholder in the capitalization level of undeveloped land, it is possible to determine the conditions for the balance of an integrated system consisting of systems of various nature. Quantification of the capitalization level of "undeveloped land" makes it possible to compare territories with different functional purposes and types of land use, and this supports the digital transformation of the economy.

The basis of the research method published in this article is the model of the "genesis of territories". In this model, man takes

the place of the main geological force in the formation of the spatial and territorial system. As a cognitive process of the structural organization and balance of a complex system, it was chosen not the composition of the system based on empirical knowledge, but the method of decomposition of a single, integral balanced system into components. This model fractally repeats the structure of natural self-developing systems. In this case, the nonlinearity of the system change is determined by the proportion of the resource that is transferred to the land by the components included in the model. The resource that is transferred by each element of the "genesis of territories" model to the land as a result of an investment construction project determines the structural balance of the system. The role of the structurally organizing component is performed by the "spatial basis": an integrated system consisting of two systems — "land" and "human", interconnected under the influence of the driving force inherent in these systems, and formed to identify the resources and natural properties of the land to ensure the development of an ecologically sustainable spatial and territorial system.

To develop a comprehensive model of the "genesis of the territory", six prerequisites were adopted, which are specified in the following categories:

- "existence" is an integrally general category;
- "goal" is the most important prerequisite that determines the systematization of rules for the rational use of land in order to create conditions for the sustainable development of the spatial and territorial system by harmonizing the vital activity of human society with the Laws of Nature;
- "multitude of objects", which are understood as the laws of human society that determine the structural and functional organization of the spatial and territorial system;
- "one" — meaning the initial and final reason for the interaction of all elements of the model;
- "unity" — as a result of the structural and functional relationships of individual interdependent elements of the spatial and territorial system;
- "sufficiency", which asserts that no phenomenon can be true without a sufficient reason why this is the case.

These six prerequisites follow from the fundamental concept of the "Genetic energy-informational unity of the World", to which the formed model corresponds.

The structure of the model of the "genesis of the territory" contains a person, while the process of decomposition of the system reveals the mechanism of intellectualization of a person in the process of his activity to create a balanced structure of the system. Based on this, it can be concluded that the model of the "genesis of the territory" used describes a dynamic intellectual system. The model is presented infographically in Fig. 1, compiled by the author, and the choice of its formation is presented in the works [3, 7].

The developed model of the "genesis of the territory" is constructed in such a way that each upper layer determines the necessary functioning of the underlying layer, forming its social usefulness, that is, ultimately, the effective use of land to improve human well-being. The model contains a recurrent relationship between the components of the system (looking from the bottom up: each subsequent element of the system is formed by the interrelation of the two previous elements, and the capabilities of this element determine the activities of the previous ones).

Let's consider the structure of the model based on the resource, properties, characteristics and functional features of each layer of the system.

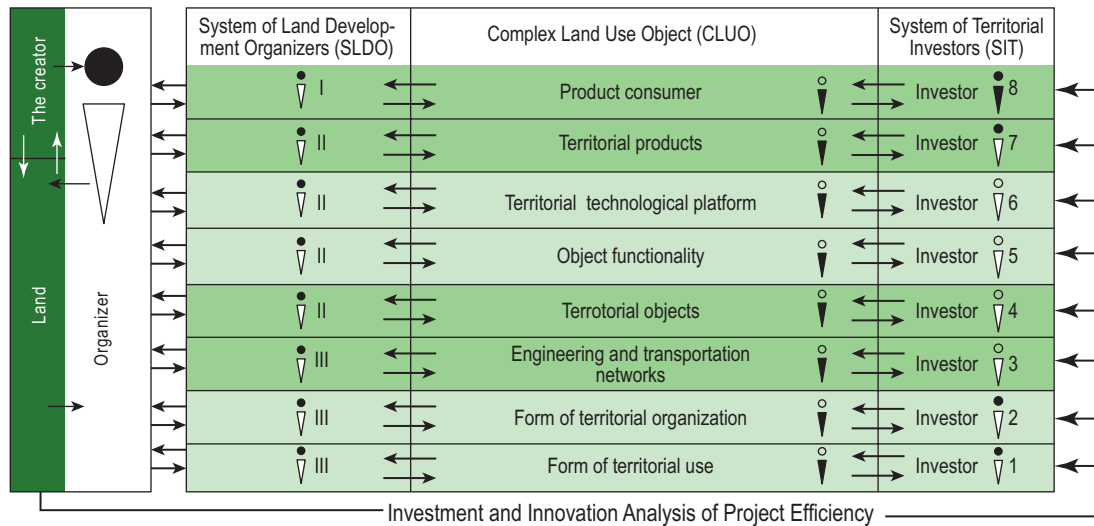


Fig. 1. Infographic representation of the “genesis of the territory” model [3]

Land, as an object in itself, initially has no value, since it is not the result of socially necessary labor and cannot be reproduced by labor, and land management projects created on the land are already the first step towards creating infrastructure and subsequent development of the territory by creating land plots. Human activity in the formation of land plots and land use rules determines the effectiveness of the use of a land resource in its subsequent use. The results of human activity are the subject of socially necessary labor invested for the existing territory and are inseparable from the factors of production and, together with the land, act as the main means of production and the operational basis.

The form of use of the territory is an integrated system of the territory, considered in the context of the “natural” environment in full, fixes the necessary requirements and restrictions on the land use of a particular site. The form of use of the territory provides an “infrastructural” resource through the consumption value of the formed land plots with a certain permitted use.

The form of organization of the territory is a complex system of the territory, considered in the context of the “natural” environment, to identify the elements of the planning structure, to establish the parameters of their planned development, zones of placement of objects of federal, regional and local importance, and including a land surveying project. The form of organization of the territory provides an “infrastructural” resource through the use value of the formed land plots.

Engineering and transport networks are a complex system of a territory that supplies resources for the implementation of functional support for real estate objects in the studied territory through an increase in the use value of formed land plots of a certain functionality.

The technological platform of a territory is a complex system of a territory that includes a set of technologies used in the construction of real estate, ranging from investment design to managing the execution of an investment project and supplying a resource by generating the consumer value necessary for the rational use of the formed land.

The functionality of the facility is an integrated system of the territory that ensures the implementation of functions to create the necessary efficiency of improvements on the land by creating real estate objects with public utility.

Territorial objects are a complex system of a territory, on the condition of which depends the implementation and provision of the necessary functions to ensure the vital activity of the population through the formation of a specific labor market for the creation of an object.

The product of a territory is a complex system of a territory that reflects the quality of a socially useful building or structure on a formed land plot due to the technologies used and the level of spiritual, scientific and technical development of a human resource when creating a traditional and innovative product.

A consumer of a product is a complex system of a territory that includes participants in the operational stage of the life cycle of real estate objects that ensure the reproduction of production capital by involving the resource of the land plot and improvements located on it in the economic sphere of the spatial and territorial system in accordance with the state of supply and demand in the market of the product being created.

This model reflects the technological chain of the investment process and the interconnection of construction participants. The model itself is a “complex system”, and each layer of this model, in turn, is essentially the same “complex system”. The unity of the model elements determines the functionality of various “platforms” of the territorial development cycle model [10], united by a single goal for the evolution of the system and capable of change.

The model of the “genesis of the territory” can be easily transformed into systems of a certain type of land use with specification of the functionality of each element. The proposed model takes into account the interrelationships and interdependencies of the elements: principles that correspond to models of natural systems and reflect the social significance of the land.

The components of the model essentially represent complex systems of organizers, users and investors, which consist of two system layers (elements). The first layer performs a creative and stimulating function (SLDO system), the second a creative one (SIT and CLUO systems).

From the consideration of the system's fractal integrity to natural systems and the human brain, the system decomposition method was applied. The system was divided into separate elements by converting the resources of the components of the system, described by physical constants, based on the postulates of the Evolutionary model of the Universe by B.A. Astafiev [11]. Calculations

Table 1. Sequence of layers of the “genesis of the territory” model (compiled by the author)

The conditioned layer of the “genesis of the territory” model	A number of equity participation components of the “genesis of territories” model for urbanized territories
Land Form of use of the territory + The consumer of the products	$0.076393 + 0.123607 = 0.200000$
Form of organization of the territory Engineering and transportation networks + Form of use of the territory	$0.076393 + 0.076393 = 0.152786$
Engineering and transportation networks Technological platform of the territory + Form of organization of the territory	$0.123607 + 0.123607 = 0.247214$
Objects of the territory Products of the territory + Functionality of the facility	$0.076393 + 0.076393 = 0.152786$
Products of the territory Consumer of products + Objects of the territory	$0.123607 + 0.123607 = 0.247214$
Total	1.00000

made on the basis of stakeholders' shared resource participation in the transformation of territories allowed us to move to “dimensionless quantities reflecting the economic efficiency of land use” [12]. The result of the decomposition of the model for urbanized territories is presented in Table 1.

The restructuring of the components of the “genesis of the territory” model by setting goals for them by the “organizer” determines not only the final result of the participants' activities in the development of territories, but also forms the vision of the “SLDO system of organizers” and “SIT investors”. This transforms the understanding of the project participants about the interrelationship of individual elements of the integrated system, which contributes to the transformation of the biosphere into the noosphere, which will ensure the effective and creative implementation of complex design and investment construction works in the relevant territories [13].

The behavior of stakeholders in the territorial development project is subordinated to various goals. The system of investors (SIT) and performers of work in (CLUO) is focused on making a profit, ensuring their expanded reproduction. The consumer is focused on the operational process of real estate and their purchasing power. In a balanced system, these multidirectional goals are formed and ensured by the investment climate [14], which should create conditions for the development of territories through the activities of the State, the State Bank, the “organizer” and the system of territory organizers (SLDO).

In this process, the determining role is played by the “technological platform” of the model, which plays a connecting role between the “land platform”: the operational base and the components that ensure the construction of buildings and structures.

The complex model of the “genesis of territories” helps to determine this relationship. Since the model describes the organizational, socio-technical mechanism of territorial development, it allows us to consider the target function of the integrated system “technological platform”. The function of the “technology platform” is to integrate organizational and technological innovations into the resource development of territories. The purpose, or rather, the mission of the “technology platform” is to ensure and support the process of capitalization of territories, primarily land, including the process of “intellectual” capitalization of participants in an investment construction project.

The content of the “technology platform” layer influences other layers of the model in the process of innovative construction methods that are based on the principles of sustainable development,

i.e. “green” buildings. The concept of a “green” building is a building that equally meets the three principles of sustainable development related to the fields of ecology, economics and sociology. Such a building can be built only through the constant interaction of all project participants at all stages of its life cycle, including design, construction, operation, and disposal. This is the only way to achieve optimal solutions in terms of reliability, efficiency, rationality, functionality and style.

Let's consider the influence of the “territory technology platform” layer on other layers of the “territory genesis” model.

It should be noted that the reconstruction of the “technological platform” layer of the “genesis of the territory” model entails a change in the equipment used, affects the construction of engineering and transport networks and communication systems, and, as a result, determines the possibilities of obtaining innovative products that determine the level of capitalization of the land. Moreover, this relationship is present in all models of the “genesis of territories”, regardless of the type of land use.

The organizational restructuring of the functioning of enterprises in the territories, formed as innovative changes in their work, was investigated in a series of papers [15–17] related to the identification of the mechanism of economic innovative development of enterprises. As a result of modelling in this area of the economy, direct projections of the “technology platform” layer onto all layers of the “genesis of the territory” model were obtained. The resulting scheme of the complex object of innovative reconstruction of the territory is shown in Fig. 2. The arrows in the figure show the directions of the spread of innovative technologies from the “technology platform” layer to other layers of the model.

The integrated technology platform system includes not only “technical” but also social technologies that have been developed to date. According to [18]: “... Technology platforms are a new communication platform for discussing the most important technological development projects, for developing and implementing long-term priorities across the country's economy based on a common vision of modernizing existing and forming new sectors of the economy, as well as tools to influence the speed of the spread of promising technologies in all spheres of society”. Technology platforms combine the capabilities of science and business, applied throughout the development and production cycle of innovative products. Technological platforms are also becoming the basis for the formation of thematic areas within which the government will determine

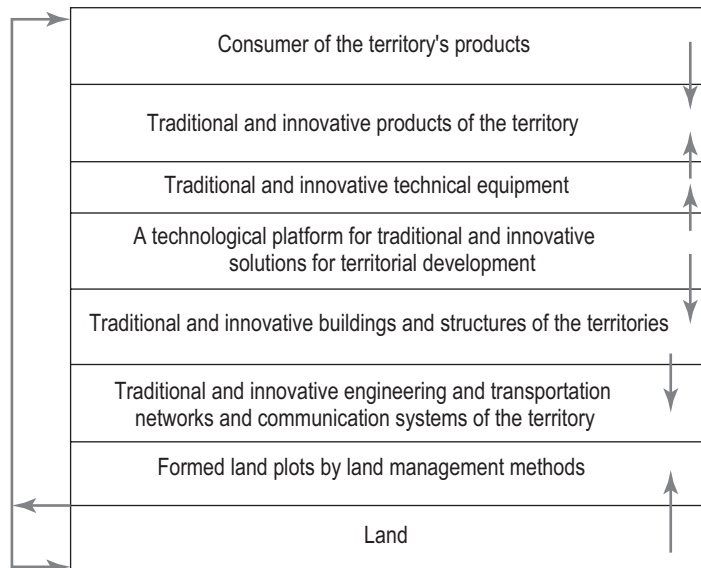


Fig. 2. Scheme of the complex object of innovative development of the territory

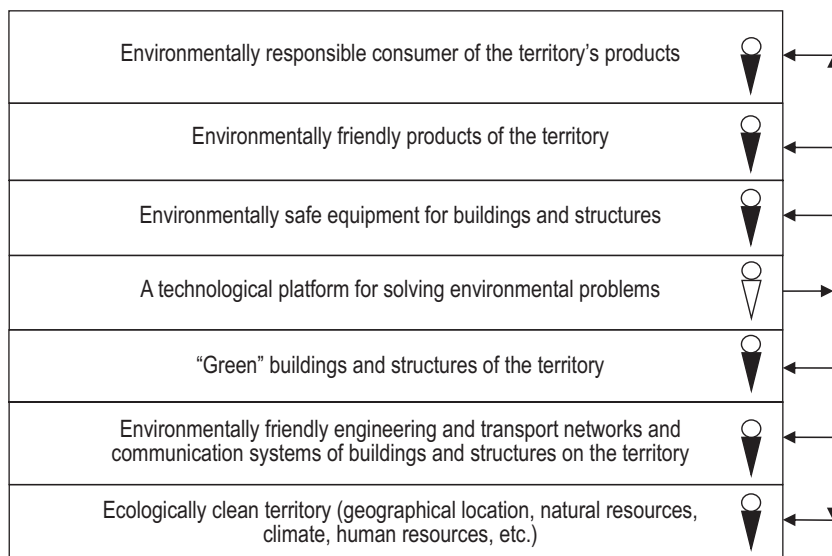


Fig. 3. An infographic view of the model of the "genesis of territories" in the ecological reconstruction of territories

priorities for various research activities, the results of which are planned to be introduced into production [18].

This makes it possible to consider the technology platform as a means of territorial development using cross-disciplinary approaches to the formation of reconstruction technologies. Note that when the "technology platform" layer is projected onto the "land" layer, the latter acquires the focus of innovative development. Moreover, the direction of modern zoning of the country's territories, which consists in choosing territories for priority reconstruction (accelerated development zones, sustainable development zones, support zones), involves the integrated development of the territories of the regions in which these zones have been created, will be created or are in the process of formation.

If the technological platform of the territory is focused on solving the environmental problems of the territory, then the "genesis of the territory" model takes the form of an integrated object of "environmental management of territories", shown in Fig. 3. The peculiarity of this model is the restructuring of the targets of the activities of

specialists involved in the reconstruction of the layers of the model, to comply with environmental standards in the process of territory reconstruction.

The technological platform, as a means of solving environmental problems of the territory, is also becoming the basis for the formation of thematic areas within which the state will determine priorities for various research activities, the results of which are planned to be introduced into production, including in the form of the best available technologies.

It is the social component of the "genesis of the territory" model that, due to the spirituality of the performers of the territorial development project, unites the capabilities of science and business applied throughout the cycle of development, production and consumption of environmental products of the territory, forms the corresponding organizational projects of this territory.

The peculiarity of the developed model of the "genesis of the territory" is the restructuring of the targets of the activities of specialists involved in the development of territories aimed at land use efficiency.

Table 2. Results of calculations of the capitalization coefficients of the elements and their share of a single real estate object in accordance with the model of the "genesis of the territory" for urbanized lands (compiled by the author)

Components		The fraction of energy transferred by an element to the Land	The capitalization coefficient of the element	The share of an element in an integrated system	The energy of the element fraction (4/3)	The share of the rental value of a component in the cost of a single object (column 5 × line 12)
Number	1	2	3	4	5	6
1	Type of land use	0.001194637	0.012244882	0.0763932	6.238786303	0.095657711
2	The consumer of the products	0.001766967	0.018111193	0.123607	6.824895349	0.104644371
3	Type of land use	0.001194637	0.012244882	0.0763932	6.238786303	0.095657711
4	Engineering and transport infrastructure	0.001162686	0.011917388	0.0763932	6.410230236	0.098286417
5	Facility of the territory	0.001881266	0.019282744	0.123607	6.410239095	0.098286552
6	The generated land plot	0.001932964	0.019812642	0.123607	6.238794339	0.095657834
7	Product of the territory	0.001092046	0.011193337	0.0763932	6.824881875	0.104644164
8	Functionality of the territory	0.001128539	0.011567385	0.0763932	6.604189091	0.101260338
9	The consumer of the products	0.001766967	0.018111193	0.123607	6.824895349	0.104644371
10	Technology platform	0.001826014	0.018716418	0.123607	6.604201754	0.101260532
11	Total	0.014946723	–	1.00000	–	1
12	Weight ratio 1/Total	66.90429735	–	–	0.015332744	–

The indicator of the level of capitalization of land, reflecting the effectiveness of its use in the implementation of an investment construction project, is determined by an investment and innovation analysis with the criterion of equilibrium of the model elements. A management decision is made based on the value of this indicator. The result of the decomposition of the "genesis of territories" model made it possible to calculate the capitalization coefficients of individual elements of the model [9], schematically these results are presented in Table 2.

Based on the data obtained, it is easy to determine the share of stakeholders in the cost of a single property. So, the main components used in estimating the value of real estate for an equilibrium system are equal:

- the capitalization coefficient of the land plot: $0.012244882 + 0.018111193 + 0.019812642 = 0.050168717$;
- the share of a land plot in a single real estate object: $0.095657711 + 0.104644371 + 0.095657834 = 0.295959915$;
- capitalization ratio for improvements = 0.103033347 ;
- percentage of improvements — 0.704040085 ;
- total capitalization ratio according to the investment group method: $0.050168717 \cdot 0.295959915 + 0.103033347 \cdot 0.704040085 = 0.087387536$.

The amount of an entrepreneur's profit is determined by the sum of capitalization coefficients reflecting human activity (capitalization coefficient of improvements), the total capitalization coefficient and the equilibrium refinancing rate: $0.103033347 + 0.087387536 + 0.0407 = 0.231166007$, this practically corresponds to an increase

in the share of the "Organizer" after the completion of the land development project — 0.231165946 .

The results of calculating the equity participation of a land plot in the total value of a real estate object were compared based on the decomposition of the "genesis of territories" model with data from the commercial real estate market. A comparison of the results is presented in Table 3.

The comparison shows that the value of the residual value of the land plot according to market data practically coincides in the upper part of the confidence interval with the results of the decomposition. The large variation in the value of the confidence interval, due to its lower part, indicates an unbalanced structure of the created real estate in the commercial segment. This allows us to conclude that the land capitalization coefficient is overestimated, leading to a decrease in the residual value of the land plot.

The obtained results of the analysis of the significance of complex modelling of the spatial — territorial system allow us to draw the following conclusions:

The use of information modelling methods in increasing the capitalization of the city territory is considered using the example of using an integrated approach to building an information model of a real estate object. This approach takes into account all the tangible and intangible resources that an object exchanges with its surroundings during the investment design process.

Information modelling is a technology for information support of the product creation process. This type of modelling makes it possible to clarify the impact of changes and risks in an object (including geodynamic risks) at all stages of the object's life cycle.

Table 3. Comparison of the results of the share of the formed land plot in value and income during decomposition and market data of the "commercial" real estate segment (compiled by the author)

Data source	Class A, B offices	Class C offices	Shopping malls	Free-use facilities
Decomposition result	0.296	0.296	0.296	0.296
Average market data	0.2	0.22	0.19	0.19
Confidence interval	0.11–0.29	0.13–0.3	0.1–0.28	0.11–0.27

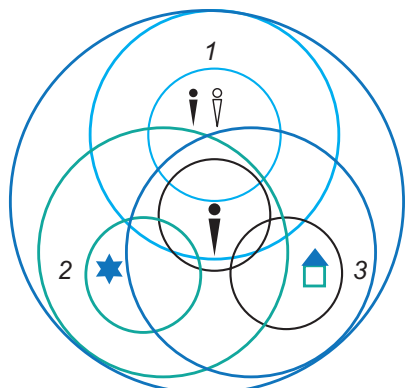


Fig. 4. An infographic model of the interaction of three systems, implemented in the model of the "genesis of the territory": 1 — "Society – Human" system; 2 — "Nature – Human" system; 3 — "Human – Artificial world" system

The use of an integrated approach makes it possible to describe the object of research, taking into account the practice of its implementation in several fields of activity, at the intersection of which the object is located, which, in turn, allows you to obtain a set of relevance and a set of points of novelty for a wide range of practical applications. At the same time, object representation models developed in a related field of research can be used to solve problems in the main field of research. In this case, the function of the "technology platform" is to ensure and support the investment process in construction, and the role played is the integration of organizational and technological innovation resources into the management of the development of the territory.

The integrated development of territories requires the development of a co-organization of three integrated systems. The systems "Nature – Human", "Society – Human", "Human – Artificial world".

The science of Ecology deals with the "Nature – Human" system. Social sciences study the "Society – Human" system, while economics studies the "Human – Artificial World" system. We get the task of a cross-disciplinary solution.

The developed model of the "genesis of the territory", by determining the interconnectedness and interdependence of the model elements, made it possible to determine the conditions for the co-organization of these three systems. At the same time, at the center of the complex system is a person on whose spiritual, intellectual level and creative activity the development of the spatial and territorial system on land depends. The interaction of these systems is shown infographically in Fig. 4.

Only by defining the interaction of these three systems can we approach the issue of the level of capitalization of territories and the sustainability of the spatial-territorial system.

The elements of the three systems create a common complex system with different attitudes to the use of resources and the Land and the humanity living on it. The unified formation of elements of a common system with various resources determines an integrated approach to the implementation of the spatial and territorial system. This view of the spatial and territorial system allows us to consider ways to implement the principles of sustainable development defined by the United Nations².

² Best Practices for Achieving Sustainable Development Goals in Russia and Globally. News Digest. Scientific and Educational Center for Sustainable Development. No. 1. 2020. URL: <https://web.archive.org/web/20220108001328/https://www.ranepa.ru/documents/digests-ifur/digest-ifur-1.pdf> (rus.).

REFERENCES

- Volkov S.N. Land management : Textbooks and teaching aids for students of higher educational institutions. Moscow, GUZ, 2013; 992. EDN UBSDHF. (rus.).
- Alekseev V.N. The evolution of the concept of "Investment climate" in the transitional economy of Russia. *Economic Problems and Legal Practice*. 2022; 18(1):173-179. EDN QPPVPD. (rus.).
- Svetlakov V.I. Choosing an approach to modelling a spatial-territorial system. *Bulletin of the Russian Academy of Natural Sciences*. 2022; 22(1):67-75. DOI: 10.52531/1682-1696-2022-22-1-67-75. EDN DOBXPB. (rus.).
- Tatarinov K.A. Workshop on Land Management Economics : Textbook. Irkutsk, BSU Publishing House, 2018; 141. URL: <http://sgal.bgu.ru/pub.aspx?id=23594> (rus.).
- Svetlakov V.I. Territorial planning — a mechanism for implementing the spatial development strategy. *Modern problems of project management in the investment sphere and environmental management*. Contemporary Project Management Issues in Investment and Environmental Management : Proceedings of the XVI International Scientific and Practical Conf. Moscow, Plekhanov Russian University of Economics, 2025; 187-193. EDN HRMTMB.
- Mokhov A.I. Modelling studies in the natural sciences on the basis of complexotechnics. *Bulletin of the Russian Academy of Natural Sciences*. 2015; 15(1):25-30. EDN TTVLLN. (rus.).
- Svetlakov V.I. Simulation in modern land management design. *Moscow Economic Journal*. 2022; 7(2):133-145. DOI: 10.55186/2413046X_2022_7_2_115. EDN UYBAKV. (rus.).
- Svetlakov V.I. Calculation of the land capitalization coefficient with structural homogeneity of the spatial-territorial system. *International agricultural journal*. 2024; 7(4):1300-1313. EDN NNWJOQ. URL: <https://iacj.ru/ru/nauka/article/102606/view> (rus.).
- Alekseev V.N., Mokhov A.I., Svetlakov V.I. Complex object of territorial redevelopment as a model of the structure of activities in the biosphere. *Russian Engineer 2025 : Collection*. URL: https://s3-oris.bmstu.ru/cms.bmstu.ru/rusengineer_new/sbornik_tezisov_russkiy_inzhener_2025_compressed.pdf (rus.).
- Svetlakov V.I., Mokhov A.I. A model of cycle of complex development of the territory. *Naukovedenie*. 2014; 6(25):68. DOI: 10.15862/68EVN614. EDN TTHKHH. (rus.).
- Astafiev B.A. The Universe: discoveries, theories, hypotheses. Moscow, Nauka, 2015; 612. URL: <https://search.rsl.ru/ru/record/01008059557> (rus.).
- Svetlakov V.I. On the choice of a criterion for the development of a spatial-territorial system. *International agricultural journal*. 2024; 4:1284-1299. DOI: 10.55186/25880209_2024_8_4_10. EDN QQYIJP. URL: <https://qje.su/ru/storage/download/218906> (rus.).
- Svetlakov V.I., Mokhov A.I., Mokhova L.A., Borovoy E.A. The Models of Integrated Area Renovation. *International Journal of Psychosocial Rehabilitation*. 2020; 24(3):2883-2904. DOI: 10.37200/IJPR/V24I3/PR2020323. EDN SCCVNZ. URL: <https://www.psychosocial.com/index.php/ijpr/article/view/3496> (rus.).
- Alekseev V.N., Ermilov V.G. Investment climate of Moscow: individual aspects. *Finance and Credit*. 2010; 13(397):2-6. EDN LARMNV. (rus.).
- Mokhov A.I., Minaev V.A., Faddeev A.O. System integration of BIM technologies and geodynamic risk models in the construction sector. *Territory Development*. 2016; 1:54-58. EDN YUXQEO. (rus.).
- Siluyanov A.V., Latyshev G.V., Latyshev K.V., Mokhov A.I. Complex technology for the reconstruction of automation systems of an "intelligent building". *Electrical and data processing facilities and systems*. 2012; 8(1):10-13. EDN OPFDHZ. (rus.).
- Mokhov A.I., Teodorovich N.N., Latyshev G.V., Vikulin D.Yu. Redevelopment of intelligent buildings. Management of investment, construction, housing and communal services complexes : International collection of scientific papers. Ed. by Doctor of Engineering Sciences, Prof. V.O. Chulkov. Moscow, MG AKKHIS, 2010; 277-285. (rus.).
- Bystrov A.V., Svetlakov V.I., Boikova I.V. Resources technological platform composed of complex object reconstruction site. *Modern problems of project management in the investment and construction sphere and environmental management : Proceedings of the VII International Scientific and Practical conference*. Moscow, Plekhanov Russian University of Economics, 2017; 287-291. EDN YMTSQP. (rus.).

Значимость комплексного моделирования пространственно-территориальной системы при оценке выполнения инвестиционно-строительных проектов

Рассматривается подход к комплексному моделированию пространственно-территориальной системы с точки зрения взаимосвязи и взаимовлияния не отдельных факторов и компонентов, а комплексных систем, которые формируют естественную и искусственную пространственную систему. Принципиальное отличие такого подхода состоит в том, что в нем рассматриваются взаимодействия систем с одинаковым целеполаганием, но разнонаправленным ресурсом при формировании единой системы в процессе выполнения инвестиционно-строительных проектов. Социально-экономический характер пространственно-территориальной системы, учитывающий комплекс использования земельных участков с различным видом землепользования, взаимосвязанных с компонентами технологического процесса при строительстве объектов недвижимости различной функциональности, детерминирует задачу количественного определения баланса модели. Уровень капитализации «чистой» («чистая земля» — природный ресурс на этапе начала процесса организации территории) земли в результате выполнения инвестиционно-строительных проектов отражает эффективность ее использования в независимости от функциональности пространственных объектов. Поэтому этот показатель может выступать в качестве интегрального критерия сбалансированного состояния пространственно-территориальной системы. При этом направленность инвестиционного воздействия определяется выявленным несоответствием функционирования отдельных элементов исследуемой системы в процессе инвестиционного обеспечения выполнения проектов. В статье рассматривается метод ресурсной декомпозиции модели для всех участников переустройства территории, позволивший рассчитать эталонные величины экономических параметров системы при условии ее сбалансированной структуры. Полученные результаты стали возможны после создания комплексной модели «генезиса территорий», которая сформирована исходя из взаимосвязанных и взаимообусловленных производственных процессов выполнения проектов строительства. Кроме этого, существенную роль в формировании модели оказало включение в нее человека в качестве основного производственного фактора. Влияние человеческого фактора реализовано в модели как на этапе организационных мероприятий, так и на этапе принятия и осуществления инвестиционного процесса строительства. По результатам декомпозиции модели удалось получить величины коэффициентов капитализации для каждого элемента системы, уровня прибыли предпринимателя, уровня прибыли исполнителей, величину ставки рефинансирования при условии отсутствия потерь в сбалансированной системе. Данные величины могут выступать в качестве эталонных, к которым следует стремиться при освоении территорий в инвестиционных строительных проектах для структурной сбалансированности пространственно-территориальной системы либо отражать сбалансированность рынка недвижимости и состояние отдельных его сегментов на момент их оценки.

Ключевые слова: закономерности функционирования территории, инвестиционная деятельность, инвестиционный климат, комплексный объект переустройства, уровень капитализации земли, коэффициент капитализации, прибыль предпринимателя, ключевая ставка

СПИСОК ИСТОЧНИКОВ

1. Волков С.Н. *Землеустройство : уч. и уч. пособие для студентов высших учебных заведений. М. : ГУЗ, 2013. 992 с. EDN UBSDFH.*
2. Алексеев В.Н. Эволюция понятия «Инвестиционный климат» в переходной экономике России // *Проблемы экономики и юридической практики. 2022. № 18 (1). С. 173–180. EDN QPPVPD.*
3. Светлаков В.И. Выбор подхода к моделированию пространственно-территориальной системы // *Вестник РАЕН. 2022. № 22 (1). С. 67–75. DOI: 10.52531/1682-1696-2022-22-1-67-75. EDN DOBXPB.*
4. Татаринов К.А. *Практикум по экономике землеустройства : уч. Иркутск : Изд-во БГУ, 2018. 141 с. URL: http://sgal.bgu.ru/pub.aspx?id=23594*
5. Светлаков В.И. Территориальное планирование — механизм реализации стратегии пространственного развития // *Современные проблемы управления проектами в инвестиционной сфере и природопользовании : мат. XVI Междунар. науч.-практ. конф. М. : ФГБОУ ВО «РЭУ им. Г.В. Плеханова», 2025. С. 187–192. EDN HRMTMB.*
6. Мохов А.И. Моделирование исследований в естественных науках на основе комплексотехники // *Вестник РАЕН. 2015. № 15 (1). С. 25–30. EDN TTVLLN.*
7. Светлаков В.И. Моделирование в современном землеустроительном проектировании // *Московский экономический журнал. 2022. № 7 (2). С. 133–145. DOI: 10.55186/2413046X_2022_7_2_115. EDN UYBAKV.*
8. Светлаков В.И. Расчет коэффициента капитализации земли при структурной однородности пространственно-территориальной системы // *International Agricultural Journal. 2024. № 7 (4). С. 1300–1313. EDN NNWJOQ. URL: https://iacj.ru/ru/nauka/article/102606/view*
9. Алексеев В.Н., Мохов А.И., Светлаков В.И. Комплексный объект переустройства территории как модель структуры деятельности в составе биосферы // *Русский инженер-2025 : сборник. URL: https://s3-oris.bmstu.ru/cms.bmstu.ru/rusengineer_new/sbornik_tezisov_russkiy_inzhener_2025_compressed.pdf*
10. Светлаков В.И., Мохов А.И. Модель цикла комплексного развития территории // *Науковедение. 2014. № 6 (25). С. 68. DOI: 10.15862/68EVN614. EDN TTKHN.*
11. Астафьев Б.А. *Мироздание: открытия, теории, гипотезы М. : Наука, 2015. 612 с. URL: https://search.rsl.ru/ru/record/01008059557*
12. Светлаков В.И. О выборе критерия развития пространственно-территориальной системы // *International Agricultural Journal. 2024. № 67 (4). С. 1284–1299. DOI: 10.55186/25880209_2024_8_4_10. EDN QQYIJP. URL: https://qje.su/ru/storage/download/218906*
13. Svetlakov V.I., Mokhov A.I., Mokhova L.A., Borovoy E.A. *The Models of Integrated Area Renovation // International Journal of Psychosocial Rehabilitation. 2020. No. 24 (3). Pp. 2883–2904. DOI: 10.37200/IJPR/V24I3/PR2020323. EDN SCCVNZ. URL: https://www.psychosocial.com/index.php/ijpr/article/view/3496*
14. Алексеев В.Н., Ермилов В.Г. Инвестиционный климат Москвы: отдельные аспекты // *Финансы и кредит. 2010. № 13 (397). С. 2–6. EDN LARMNV.*
15. Мохов А.И., Минаев В.А., Фаддеев А.О. Системная интеграция BIM-технологий и моделей геодинамических рисков в строительной сфере // *Управление развитием территории. 2016. № 1. С. 54–58. EDN YUXQEO.*
16. Силюянов А.В., Латышев Г.В., Латышев К.В., Мохов А.И. Комплексотехника переустройства систем автоматизации «интеллектуального здания» // *Электротехнические и информационные комплексы и системы. 2012. № 8 (1). С. 10–13. EDN OPFDHZ.*
17. Мохов А.И., Теодорович Н.Н., Латышев Г.В., Викулин Д.Ю. *Переустройство интеллектуальных зданий // Управление инвестиционно-строительным и жилищно-коммунальным*

комплексами : Междунар. сб. науч. тр. / под ред. д-ра техн. наук, проф. В.О. Чулкова. М. : МГ АКХИС, 2010. С. 277–285.
18. Быстров А.В., Светлаков В.И., Бойкова И.В. Ресурсы технологической платформы в составе комплексного объекта переустройства территорий // Современные проблемы управления проектами в инвестиционно-строительной сфере и природопользовании : мат. VII Междунар. науч.-практ. конф. М. : ФГБОУ ВО «РЭУ им. Г.В. Плеханова», 2017. С. 287–291. EDN YMTSQP.

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For citation: Svetlakov V.I. The importance of complex modelling of the spatial-territorial system in assessing the implementation of investment and construction projects. *Real Estate: Economics, Management*. 2026; 1:28-36.

Для цитирования: **Светлаков В.И.** The importance of complex modelling of the spatial-territorial system in assessing the implementation of investment and construction projects // Недвижимость: экономика, управление. 2026. № 1. С. 28–36.



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