Modeling of organizational and functional components of investment and construction controlling in the reproduction of eco-residential real estate

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Abstract. This article is devoted to the development of a structural and functional model for the formulation of high-performance regional business systems in the context of implementing eco-projects at various levels in a situation where supply exceeds demand. This approach generally corresponds to the current problems of macro and micro levels in the domestic and global economy and takes into account its negative impact on the construction industry. The theory is based on situational modeling with the identification of two key situations according to the principle of transformational development of local internal competition. The paper proposes zoning of a standardized life cycle of planning and controlling of the regional environmental programs. A structural and functional model of system formation of consortium-type organizational structures has been developed to regulate local and cluster competitiveness in construction on the meso-level. It suggests a principal situational economic model of functioning of mortgage and investment projects and programs for the development of competitiveness in territorial reproduction systems. It also provides the conceptual model of the life cycle of managing the cost of mortgage and investment programs and observes two periods of the life cycle of managing investment projects.

1. Introduction
Today's complex micro and macroeconomic situation, further negative forecast scenario of development of the world and national economy significantly complicate prospects of Russian construction industry [1]. The domestic construction complex is replete with not only constraining problems [2], but also reducing the competitiveness of production and economic activities in comparison with foreign ones [3]. To ensure competitiveness, a construction company needs a certain innovative potential [4]. The main goal is an optimal combination of all organizational, technical and managerial aspects [5], which are the target criteria for long-term planning of construction production and its innovative development. Competition determines the key direction of development of construction production and acts as a mechanism for regulating industry proportions [6]. As a market institution, competition...
helps economic entities of the investment and construction complex to respond objectively to market signals [7], including information about demand for finished construction products [8]. Among other market institutions, competition is characterized by the absence of self-organization properties [9] and stability [10].

Formation and support of competition in the market is one of the key current tasks of regional authorities in the field of economic development. In this regard, there is a problem of providing the regional economy with institutional, market, information and other types of infrastructure that form a competitive environment. Its solution in the regions is carried out with the help of various measures and tools that improve the business environment within the framework of current federal legislation [11]. It was tasked to develop the structural-functional model on ecological levels in the situation of supply exceeding demand. In this regard, the study is based on the research of domestic and foreign experience in the development of the competitiveness of long-term mortgage and investment projects and sectoral programs in construction [12,13]. The implementation of such programs should be performed as a capital budget planning system with limited financial resources and monitoring indicators in the form of investment controlling for essential components of regulation.

2. Materials and methods

As a theoretical basis for structural and functional modelling, two principal situations are identified:

the first situation \((W_1)\) is characterized by the formation and development of local internal competitiveness in territorial reproduction systems \(KTVS_{I,j}\) based on competitive interactions of investment and construction enterprises in the production and technological regional integration of territorial construction complexes (TCC);

the second situation \((W_2)\) is the formation of high-performance and highly effective \(KTVS_{I,j}\) reproduction systems \(W_I\) through the transformational development of local internal competitiveness \(W_I\) into external highly active and highly competitive cluster business systems in eco-building. In this case, competitive advantages appear due to more active and aggressive competitive strategies due \(KTVS_{I,j}\) involvement into interregional, national and international territorial reproduction systems such as construction consortium.

The development of this model is based on the division into two stages:

I. Start-up short-term mortgage and investment eco-projects and programs of the consortium type \(MICP_{I,j}(c)\) [14] for the formation and development of competitive advantages of \(KTVS_{I,j}\) in local territorial markets of the municipal and regional levels - \(W_c[I]\);

II. Long-term mortgage and investment sustainable complexes (ecopark development) and consortium-type programs of mortgage and investment projects of the consortium type \(MICP_{I,j}(dk)\) for the transformational development of local internal competitiveness of \(W_c[I]\) into external highly active and highly competitive cluster business systems in ECOstructure - \(W_{ak}[II]\).

According to the accepted research paradigm, the following analytical structural blocks are accepted:

1. The program implementation areas:
   A. Territorial-industrial reproduction business systems \(KTVPS_{I,j}[M]\);
   B. Socio-infrastructure urban planning system \([SGS]\);
   C. Engineering and transport urban infrastructure system \([ITI]\);
   D. Territorial eco-housing and urban planning systems \([THS]\).

2. Control indicators:
   R1 - Managing \(KTVS_{I,j}\) productivity competitiveness;
   R2 - Cost management of \(KTVS_{I,j}\);
   R3 - Reliability management of \(KTVS_{I,j}\).

3. Structural and functional modelling of content processes of programs:
   3.1. Formation of local competitiveness of \(KTVS_{I,j}\);
   3.2. Regional competitiveness of \(KTVS_{I,j}\);
   3.3. Interregional high-performance cluster-type \(KTVS_{I,j}\) business systems;
3.4. Federal high-performance cluster-type KTVS_{ij} business systems;
3.5. International KTVS_{ij}.

4. Organizational structures for program implementation:
4.1. Formation of separate local organizational structures of the consortium type: LLC, CJSC, Funds, Agencies, etc.;
4.2. Formation of regional structures for investment projects and programs management;
4.3. Formation of interregional management organizations, consortiums, associations, etc.;
4.4. Formation of Federal structures, cluster business systems, and public self-regulatory bodies;
4.5. Formation of international organization structures of the consortium type.

5. Objects of reproduction in the system of W_{c[I]} and W_{dk[I]} which are proposed to be considered as territorial-portfolio land and property complexes of real estate of various industries and infrastructure as key elements of property and national wealth.

\[ TPLPC_{ij} = \sum(A)KTVS_i + \sum(B)SGS_1 + \sum(C)ITI_1 + \sum(D)THS_1 \] (1)

6. Subjects of reproduction in the W_{c[I]} and W_{dk[I]} systems – separate enterprises, business systems of territorial construction complexes (TCC) and partners of the consortium for the implementation of MICP_{ij} programs (banks, developers, state and municipal authorities, etc.).

7. Life cycles of investment projects, programs and competitive advantages in the system W_{c[I]} and W_{dk[I]}.

As a result of the analysis, taking into account the accepted basic elements of program modelling in the form of analytical structural blocks, a generalized structural and functional model of the evolutionary development of mortgage and investment housing programs in the formation of the eco-housing market in construction was developed (figure 1) The resulting model allows to predict the system of evolutionary development of programs to build competitiveness at the meso-level of construction and identify promising areas for the formation of highly competitive and high-performance territorial production systems for managing the market of affordable eco-housing.

**Figure 1.** Structural and functional model of system formation of consortium-type organizational structures for regulating local and cluster competitiveness in construction at the meso-level.

The catalyst for the acceleration of reproduction processes in \( TPLPC_{ij} \) is individual investment projects within the framework of programs for the development of industrial competitiveness of
KTVS, as well as the completion of the processes of stabilization of regional industrial reproduction systems as an external, more highly integrated reproductive organizational and production system that generates the flow of goods, services and income.

A reliable basis for the management effect is the methodological foundations of the theory of life cycles, which must be combined with modern theories of cost management. In this regard, it is proposed to form a single vertically integrated structure of competitiveness management when managing the cost of the software systems under study, in order to achieve maximum efficiency in the use of both budget funds and the maximum effectiveness of the target management functions of all partners in the consortium.

Investment programs must necessarily pass an examination to ensure compliance with the conditions for entering self-financing, using refinancing systems, calculating the payback period of investment funds, and other economic parameters for managing the cost of programs and investment projects [15,16].

The analysis showed that for a standardized life cycle of planning and controlling of environmental programs, it is advisable to allocate 6 typical zones:

1 zone - the “starting” zone of the eco-program, where it may be a significant predominance of budget funds and credit funds of temporary partners over non-budgetary ones. At this stage, it is proposed to determine the planned indicators for the development of programs and standards for the participation of federal, regional and extra-budgetary financing sources;

2 zone - a zone of stable inflow of extra-budgetary funds of temporary and permanent partners in order to ensure the commercial success of the eco-program. The level of return on participation in the project at the initial stage of the development program should be higher than the average regional return on investment due to planned instruments of state regulation. This ensures that budget funds from the commercial success of the program's projects are refinanced both back into this program and will ensure their repayment. The level of repayment of budget funds in the presence of non-commercial components (interest-free loans or social grants) will be less than the initially invested amount of budget funding. At this stage, a certain level of return on funds from temporary partners, especially state-owned ones, may already be planned for their accumulation and subsequent “launch” of other problematic socio-economic investment projects based on innovative competitive advantages [17,18].

3 zone - zone of balance of funds of temporary partners of the consortium and extra-budgetary sources of business systems of the developer type with increasing trends of withdrawal of budget and credit funds from project financing [19];

4 zone – zone of transition to the point of zero participation of funds of temporary partners, completion of the process of refinancing funds from the project and exit of temporary partners from the project;

5 zone – zone of the expiry of the refund time partners, including budget and credit transfer programs on extrabudgetary self-financing and self-development;

6 zone - zone of withdrawal of the state, municipality and other temporary partners from support of this program in view of its self-development on the basis of self-financing and economic self-regulation with the performance of the residual function of state monitoring [20].

The final result of the research is a basic situational economic model of the functioning of mortgage and investment projects and programs MICP for the development of competitiveness in KTVS within the framework of the consortium system of investment controlling, which is shown in Fig. 2.
3. Results

It is proposed to define the market value of the programs of the MICP_{1,I} (MVP) type as a multi-component structure of all participants of the investment consortium with the allocation of the total cost of the MVP (T) consisting of:

I. The consolidated value of temporary participants in the consortium (CT_p):
   1.2 state budget (SB),
   1.2 municipal budget (MB),
   1.3 cost of banking resources (BR);
   1.4 cost of competitive innovation (CI);

II. Consolidated market value of participation of development structures and their business networks as permanent members of the consortium (CD),

$$\text{MVP} (0) = \text{MVP} (\text{CTp}) \{ \text{SB; MB; BR; CI} \} + \text{MVP} (\text{CD}),$$

$$\text{MVP} (\text{CTp}) = \sum_0^t V_{bt} \cdot \frac{1}{1 + i_{cb}}^t,$$

$$V_{bt}$$ is the amount of eco-program funding from the consolidated budgets of temporary participants of the investment consortium SB; MB; BR; CI as their sum for years from 0 to t;

$$l(1+i_{cb})^t$$ – weighted average discount rate of consolidated budgets of temporary participants of the investment consortium at the planned differentiated cost of budget sources of i_{cb};

$$\text{MVP} (\text{CD}) = \sum_0^t V_{kt} \cdot \frac{1}{1 + i_{cd}}^t,$$

$$V_{kt}$$ - the amount of funding for the program from the consolidated budget of development structures and their business networks as permanent members of the consortium;

$$l(1+i_{cd})^t$$ - discount rate of funds from development structures and their business networks as permanent members of the consortium at planned average weighted cost i_{cd}.
4. Summary

Thus, the research results allow us to form a conceptual picture of increasing competitive advantages in terms of productivity and efficiency in territorial production business systems of the developer type through investment consortium in the life cycles of investment projects and programs.

The analysis of models shows that state and municipal regulation, as well as innovative, mortgage and investment partnership development of competitive advantages, are characterized by cycles of activity with different parameters of cost management.

5. References

[1] Malysheva T V, Shinkevich A I, Zelenkina E V, Denisov I S, Vorotyntseva T M, Dmitrieva O A, Kurdyumov V I 2017 Development and concentration efficiency study of enterprises innovation activity in real sector of economy Eurasian Journal of Analytical Chemistry 12(7) 1347-1356

[2] Krygina A M 2013 Conceptual framework of development and transformation of organizational competitiveness of the territorial-reproducing systems in construction Basic research 10-5 996-1000

[3] Belyaeva S, Voronov D, Erypalov S 2017 Methodical principles of evaluation of competitive ability of construction industry and real estate development company MATEC Web of Conferences 08033

[4] Maslyukova E, Anoshina Y, Khakimov A, Aleksandrovskiy M 2018 Methodology for the development of innovation projects on the basis of competitiveness indexes MATEC Web of Conferences 08012

[5] Levitsky T Yu 2016 Competitive strategy of construction production in the conditions of innovative development of the industry Economics, management, law realities and perspectives 191-195

[6] Gumba Kh M, Belyaeva S V, Voronov D S, Erypalov S E 2017 Assessment of the competitiveness of the construction industry and enterprises: methodology and practice Economy and entrepreneurship 3-1(80) 894-900

[7] Tsatkhlanova T T, Ubushayeva B G, Erdnieva E V 2018 Formation of a competitive environment in the economy of the region Municipal Academy 3 93-99

[8] Krygina A M 2014 Formation of organizational and economic decisions in innovative housing construction Creative economy 7(91) 86-99

[9] Kudratova G M, Makarova L V 2018 Comprehensive analysis of the competitiveness of products and construction industry enterprises Science alley 3-5(21) 382-387

[10] Uchinina T V, Molokova T V 2019 Formation of a competitive strategy of a development company in the construction of multi-storey residential real estate Housing strategies 6-2 175-198

[11] Yusufova A M, Cetin T E 2018 The practice of formation of economic conditions for stimulation of construction production development in Russia Regional problems of economic transformation 12(98) 90-98

[12] Gusakova E A, Krygina A M 2012 Applying an innovative approach to managing changes in the implementation of investment and construction projects Real estate: Economics, management 2, 84-86

[13] Krygina A M 2013 Modeling of program-target organization and management of competitiveness of territorial reproduction systems in construction Industrial and civil construction 10 59-62

[14] Krygina A M, Krygina N M, Pozdnyakova E V 2016 Public-private partnership as an effective tool for the development of low-rise housing eco-construction Economics and entrepreneurship 2-2 (67-2) 412-416

[15] Naumov A E, Koshlich Yu A, Oberemok M I, Belousov A 2019 Comparative analyzes for increasing the energy efficiency of civil constructions 19th International Multidisciplinary
Scientific GeoConference SGEM 2019 Conference Proceedings 277-284

[16] Oberemok M I, Naumov A E Shchenyatskaya M A 2019 Qualitative analysis of view characteristics of residential property Bulletin of BSTU named after V.G. Shukhov 3 (4) 44-51

[17] Oberemok M I, Naumov A E 2019 Improving the implementation of space syntax concept in the design of commercial property Real estate: economics, management 4 58-62

[18] Avilova I P, Naumov A E, Krutilova M O 2019 Methodology of GHG emissions assessment caused at the construction of energy facilities. case study: hydropower IOP Conference Series: Materials Science and Engineering 552 012018

[19] Ananyeva E S, Korshunova N N 2020 Smart house as a new type of housing Construction Materials and Products 3 (1) 83 – 88

[20] Otsokov K A 2020 Innovative technologies in construction and their use in organizational and technological events Construction Materials and Products 3 (1) 7-13

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