The tectological function of investment-construction activities

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Abstract. The article considers the modeling of the function of investment-construction activities, which is an important theoretical and practical task. The author has reviewed the approaches of economic and mathematical modeling in this field. The use of the production function is briefly considered, and a tectological approach is proposed as a methodological basis. The article presents the methodological substantiation of tectological modeling and the basic provisions of the forming tectological mechanism. The author considers the investment-construction system as consisting of subsystems: an investment-construction complex and an investment-construction sphere. The system result is defined as a multiplicative dependence on the results of the functioning of the tectological subsystems. The result of the functioning of subsystems is presented in the form of dependence on activities and resistances, which are functions of the potential of actors, actor possibilities, goals or directions of action. Basic tectological principles are developed in the annex to investment and construction systems.

1 Introduction

Investment-construction activities are realized by a purposeful combination of elements that are distributed in a certain way in the socio-economic space and function in accordance with certain system regularities. The global function of the investment-construction system is the formation of the living environment and business as components of the next level system. Modeling the function of the investment-construction system is undoubtedly an important scientific task from the standpoint of both economic theory and the practice of managing investment-construction activities.

The set of system elements realizes functions on the basis of interaction of economic entities, internal and external links, system processes in the conditions of continuous change of the external environment. Accounting for relationships with the macrosystem in modeling investment and construction activities is an urgent scientific task in the modern turbulent economy. The solution of this problem meets the need for sustainable development of various socio-economic systems, including environmental optimization of investment and construction activities.

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2 Literature review

Scientists use different approaches [1-10] in the development of the economic and mathematical model of investment-construction activities: functional, institutional, streaming, equilibrium, parametric, communication, etc. Considering the basic property of the investment-construction system - functionality, - it is possible to apply the analytical logic of modeling a single-product economy on the basis of a functional approach. The methodology of a single-product economy traditionally uses a production function that characterizes the relationship between resources and output and describes the totality of technologically efficient methods. The use of the production function at the micro and macro levels has its advantages and disadvantages [11-13].

In comparison with production, the tectological function [14-24] is more versatile and can be more effectively used for modeling investment-construction activities in the light of solving a number of scientific problems. The rules of the tectological function make it possible to avoid the use of subjectively assigned values of production constants, coefficients of labor elasticity and of capital elasticity when analyzing the production system [18, 19]. These values take into account the system structure existing at the time of analysis and the allocation of resources that takes place. When the production function is designed, the shortcomings of the system potential that is not revealed and not analyzed remain unchanged and will be present in the future.

Considering the resource supply of the actor of investment-construction activities from the viewpoint of the system approach [25-27], it is necessary to identify the substantive character of the formation of resources. Moreover, the system result influences the development of the external environment, which further forms sources of resource provision and the possibilities for their use. These reciprocal links can be reflected by introducing the adequacy of the resource factor in the model of investment-construction potential, as was done in [27]. Also, mutual inverse systemic links, including ecological ones, can be revealed by revealing and analyzing the structure of the subject of research according to the rules of the tectological function.

We take for the methodological basis of this work the general organizational science of AA. Bogdanov [14] - tectology. The methodological approach based on the tectology of AA Bogdanov can have an application to various problems of investment-construction activity: economic stability, non-equilibrium state and development of systems, centralization and decentralization of management, the formation of economic policy and economic and legal field, the solution of environmental problems, etc. Theoretical and practical questions of the application of tectology in the field of management were considered in a number of works [15-24], which reflects the scientific interest in the use of tectological approach and the need for its development.

3 Materials and methods

We propose to use the standards of the system approach [28-31, etc.] with the development of functional modeling in the direction of the tectological function for a holistic and objective perception of the object of research and the preparation of information for further study of the system. We will justify the tectological function with the following methodological provisions:

- the possibility of conducting a structural and functional analysis of objects of any nature and complexity;
- the synergetic nature of the system result, taking into account external relationships, the results of subsystems and elements functioning;
- the identifying the underlying system factors - tectological activities and resistances;

- the expansion of a set of system resources;
- the possibility of analyze the formation, utilization and quality of resources,
- the possibility of optimize resources, tectological activities and resistances.

The basis of the formation tectological mechanism is the initial moment of the emergence and development of organizational forms - the connection of elements and subsystems. Systemic organization is achieved insofar as there is an identity of the direction of the activities of all elements. We consider the combination of economic entities in the investment-construction system as the formation of a finite set of active elements and relations between them, isolated and detached from the external environment. On the other hand, the investment-construction system is a set of interrelated elements, not only isolated from the external environment, but also continuously interacting with it. The interdependence of education and the functioning of the investment-construction system and environmental conditions - "positive or negative organizational selection" of circumstances - reflects the basic tectological principle. It is this approach that allows us to take into account, as objectively as possible, the interaction of the investment and construction system with the environment.

In the process of tectological modeling of investment-construction activities, we consider the methods of A.A .Katulskij [18,19], who attempted a structural-functional analysis of complex systems. The scientist worked out methods of estimating the use of resources that provide life cycles of systems, the element of which is a person. A.A. Katulskij investigated the potential of a complex ergatic system as a measure of the system's ability to perform specified functions, developed a multiplicative model of a tectological function in the form of a potential of a system depending on the potentials of the elements. We believe to develop the development of A.A. Katulskij in the direction of the dichotomy of activity-resistance elements of the investment-construction system in interaction with the environment.

We offer the tectological function of investment-construction activities as a dependence of the system result on the aggregate activity of system elements, taking into account the reciprocal relationship with the environment. Globally, the result of the activity of any socio-economic system must be seen as the satisfaction of the material and spiritual needs of the population, taking into account environmental, demographic, moral constraints and forms of ownership of the means of production. Almost the systemic result of the functioning of the socio-economic system is a relative effective quality of the combined use of system resources, changing in space and time, or a set of useful properties in the form of a flow of manufactured products.

4 Results

We consider the investment-construction system ICS as consisting of tectological subsystems: the investmen-construction complex ICC and the investment-construction sphere ICSP. If there are interconnected subsystems ICC and ICSP, then there is an system ICS that functions (fICS)

$$\text{ICC ICSP} \leftrightarrow \text{ICS} \rightarrow \text{fICS} \quad (1)$$

The investment-construction complex is an actor part of the investment-construction system, consists of system elements with their activities and resistances, forms the structure of the system, ensures the emergence and functioning of systemic interrelations, interactions and relationships. System interactions and relationships are formed within the framework of the investment-construction complex and are implemented in a certain direction with a certain intensity in the environment.

The open investment-construction system and every subject of investment-construction activity, like a microsystem, is preserved provided that system costs are balanced by the

assimilation of resources from outside, and can develop if the latter exceed the former. Tectologically, the preservation of any system "is the result of the mobile balance of the system with its environment, that is, it is formed by two streams of activities - assimilation, absorption and assimilation of activities from the outside and deassimilation, dissipation of activities, their loss, transition to the external environment. And this means two series, continuous and parallel, of the processes of progressive selection, positive and negative. ... each ... performs a special tectological role, has a special impact on the structure of the system. Both together regulate its development "[14].

The external environment creates the possibility of the existence of any socio-economic system and, at the same time, is opposed to the system. The organizational order of the system arises with a certain combination of external conditions, the range of which determines the stability of the investment-construction system. The proposed tectological model includes a model component - the investment-construction sphere, which has in its composition specific substantive elements with their activities and resistances. Such specific elements are natural resources, which are influenced by investment-construction activities and which, in turn, are used in this type of activity.

We apply the rule of the tectological function to the investment-construction system: the system is completely determined by the set of subsystems, increasing the results of each of them leads to an increase in the result of the system, and the tendency to zero deprives the system of destination. The result or systemic effect of investment-construction activity we consider in the form of a multiplicative dependence

$$E_{ICS} = \propto_{ICC} E_{ICC} \times \propto_{ICSP} E_{ICSP} \quad (2)$$

where E_{ICS} – the result of investment-construction activity,
$\propto_{ICC}$ – the coefficient of influence of the subsystem ICC,
E_{ICC} – the result of the subsystem ICC,
$\propto_{ICSP}$ – the coefficient of influence of the subsystem ICSP,
E_{ICSP} – the result of the subsystem ICSP.

The tectological approach requires systemic categories of activity and resistance to be used as system factors, which we suppose to express by the additive-multiplicative dependence of the subsystem results on the activities and resistances of the elements

$$E_{ICC} = \prod_{g=1}^{k} \alpha_{\mathrm{ICCg}} A_{\mathrm{ICCg}} - \prod_{h=1}^{l} \alpha_{\mathrm{ICCh}} R_{\mathrm{ICCh}} \quad (3)$$

where k – the quantity of positive factors of the subsystem ICC,
g – the number of the positive factor of the subsystem ICC,
$\propto_{ICCg}$ – the degree of freedom or external possibilities for using the activities of the subsystem ICC,
A_{ICCg} – the activity of the element subsystems ICC,
l – the quantity of negative factors of the subsystem ICC,
h – the number of the negative factor of the subsystem ICC,
$\propto_{ICCh}$ – the degree of freedom or external possibilities of using the resistances of the subsystem ICC,
R_{ICCh} – the resistance of the element subsystem ICC.

$$E_{ICSP} = \prod_{i=1}^{m} \alpha_{\mathrm{ICSPi}} A_{\mathrm{ICSPi}} - \prod_{j=1}^{n} \alpha_{\mathrm{ICSPj}} R_{\mathrm{ICSPj}} \quad (4)$$

where m – the quantity of positive factors of the subsystem ICSP,
i – the number of the positive factor of the subsystems ICSP,

$\propto_{ICSPi}$ – the degrees of freedom or external possibilities for using the activities of the subsystem ICSP,
A_{ICSPi} – the activity of the element subsystem ICSP,
n - the quantity of negative factors of the subsystem ICSP,
j - the number of negative factor of the subsystem ICSP,
$\propto_{ICSPj}$ – the degrees of freedom or external possibilities for using the resistances of the subsystem ICSP,
R_{ICSPj} – the resistance of element the subsystem ICSP.

The selection in the tectological model of the effects of the subsystem ICC and subsystem ICSP allows to take into account the specifics of heterogeneous elements of subsystems and extends the possibilities of differential research and optimization of investment-construction activities. From these positions, the dependence (3) is subjective, dependence (4) - substantial. These dependencies suggest a synergistic effect in the integration of various activities and resistances, taking into account the similarity of their systemic nature. We can take into account the quality of resources and the degree of use of this quality through the modeling of activities and resistances.

Activity A_e of any element of the investment and construction system is the subjective ability of the PI of this element to ensure the realization of its potential P_e in the form of an effective activity to achieve the system objectives G_s

$$A_e = F(PI, P_e, G_S) \tag{5}$$

The resistance R_e of the element is the subjective ability of the PR element to provide resistance to activity using the potential, taking into account the direction of the negative action P_s.

$$R_e = F(PR, P_e, P_S) \tag{6}$$

System factors PI and PR are close to the coefficients $\propto_{ICCg}$, $\propto_{ICCh}$, $\propto_{ICSPi}$, $\propto_{ICSPj}$, reflecting the possibilities of the external environment, but are considered already as individual capabilities of the actor. Introduction to the tectological model of the system objectives $G_s$or the directionality of the action on the P_s one hand reflects the reference to the overall systemic result, on the other - it allows to differentiate the private actions of the subjects of investment and construction activities. We apply qualitative simplification at the level of indication of the positive action of the activity or the negative action of resistance

$$A_e = PI \times P_e \tag{7}$$

$$R_e = PR \times P_e \tag{8}$$

In addition, we highlight the advantages of tectological modeling in relation to the systemic goal-setting by taking into account the investment-construction sphere: introduction of systemic effects beyond the scope of internal tasks of actors of investment-construction activities. Traditionally, the activity of the actor of the socio-economic system is determined by the dominance of the intraeconomic task of accumulating and realizing the potential for expanded reproduction of the object of activity as a goal over tasks external to the subject. We take into account the external tasks of investment-construction activities not only as ways to achieve subjective goals, but, more so, as functional system components aimed at shaping the environment of life and business.

The existence of activities and resistances elements allows the system to function, which is embodied in real system results. On the combination of activities and resistances and the synergistic effect of the system result affects both the source of activity - the system element (its goals, potential and opportunities), and the C_{SP} conditions created by the investment and construction sphere.

$$E_{ICS} = F(A_e\ , R_e\ , C_{SP}) \tag{9}$$

$$E_{ICS} = F(PI, P_e, G_S\ , PR, P_S, C_{SP}) \tag{10}$$

Moreover, the conditions C_{SP} form the degrees of freedom of investment and construction activity and are a function of the result of the activity of the subsystem ICSP. The result of subsystem ICSP can be viewed in two ways: on the one hand - as a direct contribution to the object of investment-construction activity, on the other - as an indirect contribution, that is, the formation of conditions for activities. We took into account in the tectological function the factors of interaction of system and system elements with an environment, ability of elements to provide realization of activity or resistance, system purposes and conditions of an environment.

5 Discussion

We can develop on the basis of the dependencies presented in the article an analytical description of investment-construction activities in various aspects, including socio-ecological. The functioning of the investment-construction system is characterized by the manifestation of systemic properties in a given set of system elements and systemic relations and represents a way of existence of the system in interaction with the external environment. The system function is set from the outside, formalizes the role of the investment-construction system in the macrosystem and consists in creating an environment for life and business, the conditions for implementing an extended reproduction cycle of the socio-economic development of society. The system function is based on the objectively existing capabilities of the investment and construction complex to process resource flows in conditions created by the investment-construction complex, in particular, by the natural environment.

Each element and investment and construction complex as a whole is surrounded by otherwise organized activities, which tectologically counter the system elements, develop in their directions. The first tectological principle of the investment-construction system is as follows: systemic discrepancy, non-optimal system existence presuppose a tendency of systemic development directed towards additional system components (connections, elements and processes). The ecological non-optimal of systemic existence leads to the formation of additional conjugation bonds, additional resource flows, dissipation of ecological activities. Dynamic condition for the preservation and sustainable development of the investment-construction system and each system element is the increase in its activities due to the environment [34-36].

The tectological principle of the second level is as follows: an environment of life and business is formed in the course of investment-construction activities, the quality of which acquires the role of an independent system category. The system result creates an integral characteristic of the created object - the value of the construction object TV

$$TV\ = F(E_{ICS}) \tag{11}$$

On the other hand, the overall value of the construction object is determined on the basis of the value components [32-33] as follows

$$TV\ = F(FV, EV), \tag{12}$$

where FV - the functional value of the construction object, EV - the socio-ecological value of the construction object.

Socio-ecological factors constitute a metainvelopment that significantly affects the outcome of investment-construction activities - the value of the construction object. Determination of the value of the property object to environmental factors takes place based

on an assessment of the main parameters of the qualitative state of the object and the natural environment surrounding the object under consideration. The criterion of non-negativity of the value of the construction object is the preservation of the socio-ecological potential in the form of a sum of tectological activities with observance of the conditions of the ecological and economic standard of consumption. Otherwise, the function of ecological, and often of social, value is zero, which in principle is not considered as an object of economic science.

The value of the construction object - the core of the newly created ecological and economic system - is a transitional systemic category to the formation of the result of this new system. The tectological principle of the third level is as follows: the object of capital construction becomes the main system-forming factor of the new ecological-economic system. The created ecological-economic system EES consists of tectological subsystems: object CO and environment SE. If there are interconnected subsystems of CO and SE, then there is an system EES that functions (fEES)

$$CO \wedge SE \leftrightarrow EES \rightarrow fEES \tag{13}$$

The construction object and the environment have activity A_{ee} and resistance R_{ee} created during the construction activity, which ensure the functioning of the new system. The natural environment affects the building object directly through activities and indirectly through the created condition C_{SE}. The systemic result E_{EES} of the ecological-economic system is defined as follows

$$E_{EES} = F(A_{ee}, R_{ee}, C_{SE}) \tag{14}$$

We consider the formation of the result of the newly created ecological-economic system on the basis of the value of the construction object, taking into account the activities and resistances of the ecological-economic system and the environmental conditions.

$$EV = F(A_{ee}, R_{ee}) \tag{15}$$

$$E_{EES} = F(EV, C_{SE}) \tag{16}$$

The tectological principle of the fourth level consists in the following: the created ecological-economic system as a part of the social-economic space influences the investment-construction system, transfers to the new stage of development of fICS 'investment-construction activities in the new conditions of the next level.

6 Conclusions

System elements, the complex and the investment-construction system as a whole interact with the environment and evolve under its influence. The investment-construction system is preserved insofar as the external environment forms the function of the system, the losses of system resources are balanced by the assimilation of all types of resources from outside. The system can develop insofar as the former are outweighed by the second. The increase in the amount of elementary activities of all kinds, including ecological ones, provides a relative guarantee for the preservation and sustainable development of the investment-construction system.

A synergetic condition for the preservation of any system element, investment-construction complex and the system as a whole is an increase in activities due to the environment. The conditions for the destruction of the investment-construction system must be represented in the form of a reduction in elementary and synergistic activities, their taking away of the environment. The listed system-significant factors are taken into account through the principles of tectological modeling. The next scientific task is undoubtedly the development of models of systemic activities, the identification of their influence on the

outcome of investment-construction activities, the determination of the possibility of regulation and optimization of the investment-construction system.

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