Basic Theorizes of Regulatory Impact Logistics in Investment and Construction Sphere

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Abstract. Modern systems and subsystems of management are characterized by complexity of structure and increasing interlacing between its elements that demands knowledge of specific dynamic properties, both all system, and each subsystem, their behavior in space of a national economy. The paper presents the definition of boundaries for the preservation of dynamic stability, as well as the methodological basis for the development of methods for maintaining the trajectories of sustainable development of logistics management systems in the field of investment and construction activities.

1. Introduction
The main task of the management subsystem-is to ensure sustainable development of investment and construction sector. It is important to take into account ever-changing operating conditions. Modern management subsystem is characterized by the complexity of the structure and increasing interweaving between its elements. It is a result of the development of organizational forms (concentration, specialization and cooperation) of construction production, taking into account the placement factor. In these conditions, of particular importance are: justification of long-term strategies for sustainable development of investment and construction activities; development of optimal growth trajectories.

The application of methods and models created within the framework of logistics contributes to the solution of these problems. In this regard, it should be noted that logistics, as a rule, in the scientific literature refers to the material and technical, and sometimes staffing of certain systems. In the article this concept will be interpreted expanded, linking with it the provision of sustainable (balanced and optimal) development of such technical and economic system as investment and construction activities.

Based on the speed of the main and auxiliary processes taking place in the space of investment and construction activity, logistics has proposed a new approach to the concept of homeostatic state-the concept of dynamic optimum. With this approach, the goal of sustainable development of investment and construction activities and its subsystems is to maintain its optimal trajectory. In contrast to the simplified understanding, in which the optimal development is considered to be the automatic coincidence of the course of phenomena with a single pre-prescribed trajectory. Principles of logistics allow us to describe the concept of optimum from the standpoint of a complete technical and economic system-investment and construction activities. This definition of optimum implies identification and verification of industry and corporate level. Taking into account the various links existing between the subsystems of investment and construction activities and its areas of growth. It means that only within...
the framework of general sustainable development it is possible to ensure the optimal development of individual subsystems.

The specific mechanism by which the technical and economic systems ensure the growth of the optimal trajectory - is the management, control and solution.

Initially, the technical and economic system is displayed on the optimal trajectory of development, which, based on the main goal of the market economy, is determined by the further growth profitability of construction production, obtaining additional effect (profit) and increasing the occupied market share.

2. Design trajectories of sustainable development
The control subsystem provides monitoring of individual elements of investment and construction activities, as a technical and economic system, in accordance with the trajectory adopted in the program of its development.

In the event of deviations takes operational decisions in order to get back to this engine at the optimum for the whole investment and construction activities of the trajectory. Figure 1.

![Figure 1. Scheme of influence through the control subsystem](image-url)

An important aspect of sustainable development of construction companies is based on a reasonable benefit participation in investment and construction activities. In this regard, one of the objectives of the governance mechanisms is to quickly and effectively identify favourable market conditions in a given market and at the same time mitigate negative impacts, such as, for example, rising prices for certain types of resources, non-compliance by partners with deadlines, etc.

The problem of determining the conditions of dynamic stability is closely related to the sustainable development of technical and economic systems. In the interpretation of logistics concept dynamic stability is a property of a technical and economic system in which its deviations from a given growth path are within acceptable limits.

The definition of dynamic stability and on its basis the development of effective methods for maintaining the trajectories of sustainable development of technical and economic systems requires knowledge of specific dynamic properties, as the whole system and each subsystem, their behavior in
the space of the national economy. Developing an overall strategy for sustainable development and as a consequence of operational plans, it is very important to know exactly the structural and topological characteristics of investment and construction activities and each of its subsystems. In this aspect of logistic interpretation, methods and approaches are developed for verification of observed and achievable areas, as well as areas of growth and management.

To design the trajectories of sustainable development, as well as to justify the goals of operational and production plans, it is of particular importance to identify those areas of investment and construction activity. That characterize the potential growth of the technical and economic system at the levels of hierarchy—from structural units to the all construction industry.

An important step in the planning of sustainable development trajectories is the analysis of material, human and financial resources, as well as trends in structural changes. This allows you to fix the starting point of investment and construction activities.

Based on the processed information obtained in the process of analyzing the trends in the development of investment and construction activities, the achievable area of the system (investment and construction activities) is determined. The achievable area consists of a large number of trajectories along which the technical and economic system can develop. At the same time, it is necessary to take into account both the level of development, specific industry features, and the conditions for the growth of the system. On the basis of the strategy of sustainable development in the achievable area, the area of growth of the technical and economic system, or the trajectory of sustainable development (optimal growth) is revealed.

It is obvious that between the achievable area and the area of growth of the technical and economic system cannot be put an equal sign. Although theoretically different trajectories may be allowed, but if they do not fully utilize the aggregate growth potential of the system, from the point of view of the overall strategy of investment and construction activities are considered to be suboptimal. Therefore, when developing trajectories, only the growth area is taken into account. At the same time, the study of the achievable area precedes the identification of the growth area.

It is important to note that in the organization of effective control in the investment and construction, able to develop proactive measures in response to deviations from the optimal trajectory, the knowledge of the observed area and area of management of investment and construction activities. It can be obtained by the early identification of measures to ensure the full utilization of new growth reserves and to prevent situations where adjustment would be costly.

As mentioned above, logistics is particularly effective in the development of methods and algorithms for the design of trajectories of sustainable development in investment and construction activities at the levels of the hierarchy.

In this regard, it is necessary to specify the conditions to be met by the logistic models of the system or management parameters in order to ensure sustainable development.

3. Mathematical description of obtaining an trajectories and definition dynamics of growth

Within the framework of a single technical and economic system, there are certain elements (for example: construction sphere), the task of which is to accelerate the overall process of economic growth. Creation of regulated economic impacts, which are the driving force of the overall sustainable growth, in relation to investment and construction sphere is particularly important in planning and management in general, as well as in the design of development trajectories. Thus, the conditions are provided for the priority development of those elements of the system that accelerate its overall growth.

The dynamics of the variables of the state of investment and construction activity, which is described by the expression:

\[ z_{t+1} = F_t(z_t, z_{t-1}, \ldots, z_{t-t_1}); \]
\[ x_t, x_{t-1}, \ldots, x_{t-t_2}; y_t, y_{t-1}, \ldots, y_{t-t_3}. \]  

(1)
This expression can also be written in a simplified form:

\[ z_{t+1} = f_t(z_t, z_{t-1}, ..., z_{t-S}; x_t, x_{t-1}, ..., x_{t-S}; b) \]  

(2)

After S set the longest delay period that is caused by model variables:

\[ S = \max(\tau_1, \tau_2) \]  

(3)

Initial conditions, namely:
the initial time to the system optimization;
initial state \( z_{t_0-i} = a_{t_0-i}(i = 0, 1, ..., S) \);
initial control actions \( x_{t_0-i} = \eta_{t_0-i}(i = 0, 1, ..., S) \).

The value of \( a_{t_0-i} \) characterizes the level of development of investment and construction activities, \( \eta_{t_0-i} \) reflects the decisions that were made in the past planning periods and continue to have an impact. These parameters express the continuity of planning periods. In fact, investment measures initiated in one planning period are continued in subsequent periods and have an impact on decisions in the field of construction production, etc.

In practice, the following variants of the initial States of the system can be found known points in the investment and construction activities, which represent the initial state of the system:

\[ z_{t_0-i} = a_{t_0-i}(i = 0, 1, ..., S) \]  

(4)

Also the starting plane of the space on which the initial States of investment and construction activities are located is known.

In planning practice preparation of a new operational plan begins well in advance of its entry into force and, in addition, it is necessary to take into account the over-fulfillment or non-fulfillment of the indicators of the current plan. This discrepancy should be taken into account when optimizing the new operational plan. It is also clear that, in General, the starting plane should serve as a starting point for modeling investment and construction activities.

The purpose of investment and construction activity is defined by the following function:

\[ z_\tau = \omega(b) \]  

(5)

In logistics and in the design of sustainable development trajectories, the concept of the goal includes the most important elements of the development strategy. The components of the \( \omega(b) \) function reflect the level of efficiency of investment and construction activities to be achieved by the end of the planning period.

The area of growth of investment and construction activities. The limitations that arise in the development of technical and economic systems are the result of maintaining the necessary structural and production proportions. The General mathematical form expressing restrictions has the following form:

\[ I_\gamma(x, b) \leq 0 \text{ if } \gamma = 1, 2, ..., \hat{p} \]
\[ I_\gamma(x, b) = 0 \text{ if } \gamma = \hat{p} + 1, \hat{p} + 2, ..., p. \]  

(6)

The area of sustainable development of investment and construction activities is determined on the basis of solving equations and inequalities, as well as on the basis of the goal, which can be expressed as \( z_\tau = \omega(b) \). It is also assumed that the range of acceptable control parameters \( X \) and \( x_\tau \in X \) is known.

Efficiency of investment and construction activities serves as a determining element by which the optimality of the trajectory of sustainable development of investment and construction activities is checked. The decisive stage in determining the trajectories of sustainable development of the technical and economic system is the definition of the optimality criterion. In addition, the logistics concepts are
being used: admissible control; optimal control.

A valid control can be represented as \( \{x_t, b\} \), and \( x \in X \). In this case, \( X \) is a valid control area, and \( b \) represents the purpose of the control actions. Given a system state \( z_t \), management is controlled via \( \{x, b, z_t\} \).

The control action will be optimal if the management goal is achieved with minimal costs. In this regard, the mathematical principle of the maximum, which makes it possible to create conditions under which the trajectory of sustainable development is provided, is of great importance as the basis for the optimization of dynamic systems, including investment and construction activities. The use of logistics methods makes it possible to determine the path of optimal growth for investment and construction activities and its subsystems. In order to determine the logistical properties of the trajectories of sustainable development of investment and construction activities should be based on the growth of the system.

We Express the vector of states of investment and construction activity as a technical and economic system as \( z_t \), then the sequence \( z_0, z_1, \ldots, z_T \), characterizing its growth trajectory, can be represented as:

\[
\{z_t\}_{t=0}^T.
\]  

(7)

In order to reproduce the phenomena observed in the space of investment and construction activity as accurately as possible, it is necessary to fully identify the structural and topological properties of the growth area. The mathematical model has the following form:

\[
z_{t+1} = f(z_t, x_t) \quad \forall x_t \in X.
\]  

(8)

Further, for the period from 0 to \( T \) from the initial state of \( z_0 \), you can output a set of growth paths that lead to the state of \( z_t \).

Here there is a problem of estimation of separate trajectories, the set of which is denoted as \( Z(0, T) \).

We denote here \( Z \) the space of States, and through \( Y \) the space of output quantities. Then the efficiency can be quantified by the function \( \phi \):

\[
\phi : Z \rightarrow Y
\]  

(9)

Thus, we obtain indicators to assess the effectiveness of investment and construction activities.

Accordingly, the growth trajectory \( \{z_{1T}\}_{0}^{T} \) is considered more efficient than the trajectory \( \{z_{2T}\}_{0}^{T} \) if 

\[
\phi(z_{1T}) > \phi(z_{2T})
\]  

by the end of the period \( T \).

Considering the above relation with respect to \( q \) different efficiency parameters, we obtain the following inequality:

\[
\phi_i(z_{1T}) \geq \phi_i(z_{2T}) \text{ if } i=1, \ldots, q
\]  

(10)

The growth trajectory \( \{z_{1T}\}_{0}^{T} \) is considered to be more efficient than the trajectory \( \{z_{2T}\}_{0}^{T} \) if it achieves large values of all considered efficiency parameters \( i \).

Thus, an order relation is introduced into the space of output quantities. A special problem is to determine the set of all trajectories on which the maximum is reached with respect to the order entered. The \( \{z_t\}_{0}^{T} \) growth path is considered more efficient if there are no other valid paths with large values for all efficiency parameters.

The set of effective trajectories forms a set of maximum points. Since there are always several maximum points, it is necessary to adopt a selection criterion to identify the trajectory that best meets the strategic goals. In order to propose a criterion that allows to rank all trajectories of the system growth from the point of view of efficiency, it is necessary to verify some structural and topological properties of the set of admissible trajectories \( Z(0, T) \).

It can be assumed that there is a vector \( v = (v_1, v_2, \ldots, v_q) \), which allows us to obtain effective trajectories in the form of maximum points corresponding to a single criterion. In other words, the efficiency of the trajectory \( \{z_t\}_{0}^{T} \) can be described by:
\[ I_T = \sum_{i=1}^{n} v^i \varphi_i(z_T) \quad (11) \]

The components of the \( v \) vector \( v \) quantify the value of the efficiency criterion \( i \). Thus, for the case if the function \( \varphi_i \) is defined as \( \varphi_i(z_T) = z_T^i \), the evaluation of the control object (regulation) is based on the absolute values achieved in the period of time \( T \) by each component \( i \) of the state vector. In this interpretation, the trajectory \( \{z_{1t}\}_0^T \) is more preferable than the trajectory \( \{z_{2t}\}_0^T \) if for all \( i = 1, 2, \ldots, n \) has a relation:

\[ z_{1t}^i > z_{2t}^i \quad (12) \]

The definition of the achievable area and the area of growth of investment and construction activities at the levels of the hierarchy is based on the concept of the level of development, which gives a spatial and temporal representation of the state of the technical and economic system and the dynamics of its growth.

As is known, the technical and economic system \( S \) is characterized by the state vector \( z_t \), and its development is determined by the internal behavior, which is described as follows:

\[ z_t = \varphi(t, \tau, z_{\tau}, x_{(\tau,t)}) \quad (13) \]

The state of the system is denoted by \( z_t \) at the time \( \tau \), a \( x_{(\tau,t)} \) expresses the set of flows entering the system in the period \((\tau, t)\).

The level of development achieved by investment and construction activity \( S \) by the time \( t \) is displayed by an ordered pair of indicators:

\[ (t, z_t) \in T \times Z \quad (14) \]

where \( T \) is the period of time, \( Z \) is the space of States.

In order to establish the possible States of development that system can achieve within a certain period, it is first necessary to determine the allowable set of flows for the system at the input of \( X_S \).

The level of development \( (t_1, z_1) \) is achievable for a technical and economic system at the level of development \((\tau, z_\tau)\), if there are flows at the input \( x_{(\tau,t)} \) from the set \( X_S \), which lead the system to the time \( t_1 \) in the state \( z_1 \).

It is clear that the state of development \( (t_1, z_1) \) is achievable for investment and construction activities if the following condition:

\[ z_1 = \varphi(t_1, \tau, x_{(\tau,t_1)}) \quad (15) \]

In the future, through \( M_t[(t_0, z_0), X_S] \) denotes the set of all levels of development, which investment and construction activities can reach by the time \( t \), if it comes from the level of development \( (t_0, z_0) \).

In General, the achievable area of investment and construction activities within the Period \( T \) is obtained as:

\[ M_T = \bigcup_{t \in (t_0, T)} M_t[(t_0, z_0), X_S] \quad (16) \]

It is assumed that the system proceeds from the level of development \( (t_0, z_0) \).

The Union of \( M_T \) of achievable regions of \( M_t \) forms a cone in the space of levels of development, the vertex of which is at the point \( (t_0, z_0) \).

Based on the overall sustainable development strategy, the area of growth is contained in the achievable area:

\[ W_t \in M_t[(t_0, z_0), X_S] \quad (17) \]

The achievable area and growth area can also be described as follows:
\[ z_{t+1} = A_t z_t + B_t x_t. \] (18)

Such systems are an important class, and occur at all levels of the hierarchy. \( z_t \) - state vector, \( x_t \) – control, \( A_t \) and \( B_t \) - structural matrices of the system are denoted by \( z_t \).

4. Results and discussions

Identification logistics properties and trajectories of sustainable development in investment and construction activities is an important task in the framework of optimal management of technical and economic systems. In fact, the above equations does not describes the area of growth or the area of reachability, but the functioning of the system under the assumption of its linearity. The areas of reachability and growth can be found by examining this equation.

To determine the trajectories of sustainable development, it is necessary to accurately delineate the boundaries of the investment and construction activity space using logistics methods, which can be achieved at specified time intervals. Knowledge of these boundaries is of particular importance both for the development of long-term forecasts, operational and production plans, and for the effective management of subsystems.

At the corporate level, the identification of an achievable area and an area of growth opens up opportunities for increasing the volume of construction production, expanding the range of contract works, improving the technology and quality of construction products, etc. Also, knowledge of the probabilistic space of investment and construction sphere growth can be a useful for practice in construction planning, and also for the management systems. It describes processes of accelerating in the space of the national economics, and determinate the way of development.

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