SECTION 2.
ENTREPRENEURSHIP, TRADE AND SERVICE SECTOR

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DECOMPOSITION APPROACH TO THE ANALYSIS OF LARGE CLUSTER STRUCTURES

The directions of development of national economies, due to the trends of globalization and territorial localization, as one of the important conditions for intensifying the use of innovation potential include the creation of groups of enterprises or clusters which are competitive in the global market and united by common goals [1-3]. World experience shows that in the modern economy a high level of competitiveness of certain areas is provided by the strong position of cooperating enterprises, which are a set of geographically concentrated firms that have numerous competitive advantages as a result of synergies from their interaction [4-7]. In this regard, research aimed at developing tools for effective interaction of cluster participants in order to increase their competitiveness and increase inclusion in the system of modernization relations.

To determine the directions of building an economic-mathematical model focused on the choice of the optimal structure of the cluster association, the rational composition of its members, as well as the goals of their associated activities in the cluster, significant methodological interest is the choice of those that determine its economic content as a special simulated design [8-10]. Taking into account the given clarifications of conceptual and terminological constructions of cluster problems, we present the characteristics of coordination of decision criteria for global (for the cluster as a whole) and local model blocks selected from it at decomposition of simulation model of cluster structure.

Suppose that a simulation model is created to study a complex financial-industrial cluster structure. As a criterion for the optimality of this cluster, the scalar objective function can be used (1):

$$P(X) \rightarrow max, \mathrm{X} \in \Omega, \tag{1}$$

where x – dimensional vector of parameters of the studied model, Ω - many valid parameter values $\Omega \subset E^n$. The objective function $P(X)$ allows to find the optimal variant of the parameters X^*, at which $P\ (X^*) = max\ P(X), X\ \in\ \Omega$

Suppose that it is possible to present a complex simulation model of an innovation cluster in the form of some set of m simplest models. Let X_k be the vector of parameters of the k-th selected model, $k\ \in M, M = 1, \dots, m$. Then the admissible solution of the global problem can be described by the composition of the vectors of local solutions $X = (x_1\ , \dots., x_m)$ of the selected models, and the criterion of the global model can be represented as (2):

$$P = (X_1, \dots., X_m) \rightarrow max \tag{2}$$

provided $X_k\ \in\ \Omega_k\,, \Omega_k \in \Omega$

This representation of the studied cluster model allows us to formulate an approach to the choice of solution for a particular k-th model. Let the selected model k include m_k participants, and each j_k - th participant has its own criterion $P_{jk}, j_k\ \in\ M_k M\ _k = 1, \dots, m_k$.

Then the task of each participant is built taking into account external relations:

$$P_{jk}\ (X_k) \rightarrow max, X_k\ \in\ \Omega_k(q_k), k\ \in M \tag{3}$$

Here $\Omega_k\ (q_k)$ is a set of admissible solutions to the k-th selected model, which depends on the external relations of this model, which are determined by resource-technological and other conditions given by the vector q_k. The optimal solution of the k-th selected model is to choose such a vector X_k^0 cluster parameters of this model, which ensures that each of the cluster members achieves the maximum guaranteed income in the planned interval $[t_0, \mathrm{T}]$ (4).

$$P_{jk}\ (X_k^0) = \max P_{jk}\ (X_k), j_k \in\ M_k\,, \tag{4}$$

moreover, an additional condition must be satisfied to ensure the stability of the k-th model (5):

$$P_{jk}\,(X_k^0) \geq\ P_{Hjk}\ (X_k^0), \tag{5}$$

where $P_{Hjk}\ (X_k^0)$ – maximum guaranteed income j_k- participant of the k-th group with its alternative independent activity.

The vector X_k^0 will be called the optimal solution of the k-th selected model. Building an optimal global solution based on the composition of locally optimal solutions is accomplished by adjusting the values of q_k. As a result of the analysis of the global task for the cluster as a whole redistribution of a resource between local models is carried out. The problem of reconciliation in the model system is understood as the reconciliation of local and global solutions. Let's present a global criterion in the form (6):

$$P(X) = \sum P_k\ \ (X_k), k = 1, \dots, m, \tag{6}$$

where $P_{jk}\ (X_k) =\ \sum P_{jk}\ \ (X_k), j = 1, \dots, m_k$. Then for the k-th selected model the task is built (7):

$$P_{jk}\,(X_k) \rightarrow max \tag{7}$$

provided $g_k\,(X_k) \leq\, q_k, X_k\, \in\, \Omega_k, j_k\, \in\, M_k$, where Ω_k- many valid solutions for the k-th model, which do not depend on the parameters of external relations, and the condition $g_k\,\,(X_k) \leq q_k$ reflects explicitly the dependence of the solution on external conditions. Obviously that (8):

$$\Omega_k\,(g_k) =\, \{X_k\, \in\, \Omega_k\, \cdot\, g_k\,(X_k) \leq\, q_k\} \tag{8}$$

Coordination of solutions of local problems is carried out by adjusting the parameters q_k. The purpose of the negotiation process is to determine such values of q_k^*, which would allow to obtain optimal solutions for local models that maximize the objective function (9):

$$P(X) = \sum\sum P_{jk}\,(X_k)\;\rightarrow max,\;\; k = 1, \dots., m, j_k = 1, \dots\;\;, M_k,$$

$$\sum g_k\;\,(X_k) \leq q, q = \sum q_k\,, k = 1, \dots, m, X_k\, \in\, \Omega_k. \tag{9}$$

The proposed simulation model can be used to quantify the feasibility of creating a territorial production association of the cluster type, taking into account the specifics of the territory (region) of the cluster, the sectoral affiliation of its potential participants, the degree of institutional environment for such associated interaction for specific participants and a specific territorially localized economic system.

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