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The Interaction Stabilization Criterion.

II. N-Dimensional Interaction between Enterprises

in the Organizational Network Structure

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Abstract

Previously discussed interaction stabilization criterion for an arbitrary pair of enterprises. The conditions leading to dynamic stabilization of N-dimensional interaction in the organizational networks and their mathematical formalizations are studied in this article. Equilibrium state means parity situations for not the couple of selected enterprises but the economic entity arbitrary network.

Keywords: interaction stabilization, risk management, organizational network, Pareto efficiency

1 Introduction

Variants of stabilization problems and a task of giving reliability to the processes of economic interaction between organizational structures elements were widely discussed in the literature [1-14] and these are classical problems of the management theory. An important class of the organizational networks stability research problems is connected with real situation when enterprises in the network strive to increase their profit from network interaction and their interests come into conflict with interests of other enterprises in the network. This article is devoted to the consideration of this class of problems.

Let's consider an enterprises $P_1, P_2, ..., P_N$, located in the organizational network structure. There are network links between these enterprises. Due to the economic necessity, the processes of interaction and resources movement (material, financial and informational) appear between the enterprises $P_1, P_2, ..., P_N$

In practice, there are always some variants (programs) of interaction among the enterprises. These variants can differ from each other by terms of cooperation, by sale prices for goods and services, by ways of interaction and interaction duration, by shares of investments in joint projects and various terms of participation in these projects, by schemes of product procurement in different quantities. It is clear that when implementing various variants of cooperation $T_1, T_2, ..., T_m$ the enterprises $P_1, P_2, ..., P_N$ will receive different benefits.

2 N-dimensional interaction stabilization criterion

The criterion of stabilization between the couple of enterprises can be generalized to an arbitrary number N of interacted enterprises $P_1, P_2, ..., P_N$ in the structure of an organizational network G and also to the whole organizational network G.

In case of organizational and economic interaction of the group of enterprises $P_1, P_2, ..., P_N$ of the organizational network G the number M of all possible variants $T_1, T_2, ..., T_M$ of implementation the interaction between the G network enterprises increases. Also the volume of resources $V_i(T_s)$ supplied to an enterprise P_i in the result of implementation the variant of interaction T_s in understood as the sum of resources $V_{ji}(T_s)$ volumes, supplied to an enterprise P_i from each enterprise of the network G:

$$V_i(T_s) = \sum_{j=1}^{N} V_{ji}(T_s).$$

Exactly in the same way as in the case of a pair of cooperating enterprises, assessments of implementation the variant T_s of the network interaction for each network enterprise are calculated the following way:

$$\Delta k_{cond}^{(1)}(T_s),\ \Delta k_{cond}^{(2)}(T_s), ...,\ \Delta k_{cond}^{(j)}(T_s), ...,\ \Delta k_{cond}^{(N)}(T_s),$$

Where $\Delta k_{cond}^{(j)}(T_s)$ is an increment of enterprise P_j economic solvency assessment in the result of implementation a variant T_s of organizational and economic interaction in the G network. A variant of economic interaction T_s from multiplicity of all possible variants $T_1, T_2, ..., T_M$ of interaction in the organizational network G will be stable when it is Pareto efficiency, i.e. the conjunction of conditions is implemented for

the variant T_s:

$$\forall T_r \in \{T_1, T_2, ..., T_M\} \ \&_{i=1}^{N} \left(\Delta k_{cond}^{(i)}(T_r) \le \Delta k_{cond}^{(i)}(T_s)\right).$$

It means that there is no variant that improves results of interaction for an enterprise of G network and at the same time does not decrease results of interaction for some other enterprises of the G network among all possible variants $T_1, T_2, ..., T_M$ of implementation an interaction in the network G.

Geometrical interpretation of the results of the variant T_s of the organizational network G group of enterprises $P_1, P_2, ..., P_N$ consists in comparing each variant of interaction T_s with a point in N-dimensional space according to the following rule:

$$T_s \mapsto A_s\left(\Delta k_{cond}^{(1)}(T_s),\ \Delta k_{cond}^{(2)}(T_s), ...,\ \Delta k_{cond}^{(j)}(T_s), ...,\ \Delta k_{cond}^{(N)}(T_s)\right)$$

i.e. a point, whose coordinates are the results of implementation a variant of interaction T_s for each enterprise $P_1, P_2, ..., P_N$. Point A_s Pareto efficiency (stability of the network interaction T_s variant) means that there are no points corresponding to results of other possible variants of interaction $T_1, T_2, ..., T_M$ in the unlimited rectangle N-dimensional area with vertex at the point A_s and edges, directed parallel to the coordinate axes in positive direction (Fig. 1).

Figure 1 shows an optimal point A_s that corresponds to results of implementation a variant T_s in the organizational network G consisting of tree enterprises $P_1, P_2, ..., P_N$. In this case space of results interpretations is three-dimensional and corresponding rectangular area with vertex at the point A_s, which is free from other variants of interaction, can be visually presented at the figure.

Thus, as variants (strategies) of economic cooperation, stabilizing processes of interaction in N-dimensional networks and leading them to equilibrium state, should be considered only variants (strategies of network element interaction) that have in correspondence points of results of interaction in N-dimension area. These conditions are generalization of Pareto efficiency criterion of network interaction, regarding as a joint game strategy of interaction N different participants.

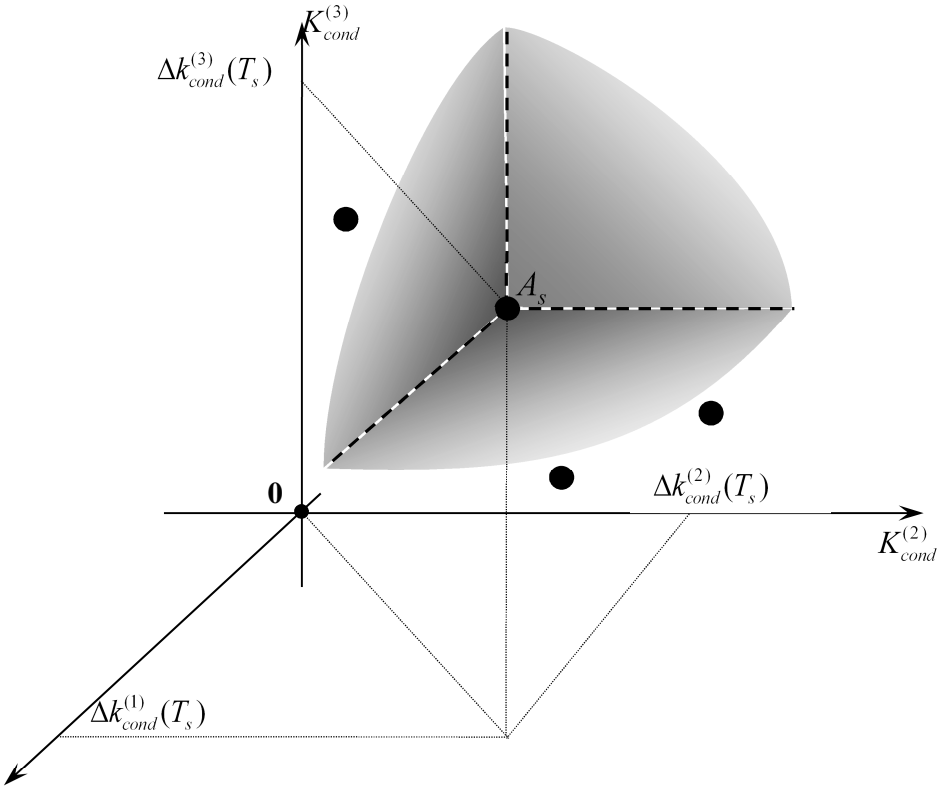

Fig.1. Point A_s of the stable variant T_s of interaction in the organizational

3 Conclusion

Studying and analysis of general qualitative picture of interaction between elements of organizational networks and the basis of proposed model concepts allow formulating a common criterion of interaction stabilization between arbitrary fragments of organizational structure. The proposed mathematical formalization for criterion of interaction stabilization and corresponding mathematical apparatus allows calculating in practice equilibrium states of arbitrary fragments of organizational networks and allows giving practical recommendations for optimization, regulation and practical implementation of interaction between elements of organizational networks in order to achieve stability and effectiveness of network interaction.

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