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Mathematical Modeling of Socio-Psychological Potentials of the Management Team

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Abstract: The current issue of the innovative organized consulting is a selection of the managers that are efficient in learning professional purviews. The research is based on program of psychological audit of V.G. Gryazeva-Dobshynskaya. According to the audit revealed the command and role structure of management. Identification of potential development of the management team might be based on the methods of mathematical modeling correlation of activity tendency, aimed at modifications or preservation of the organization functioning parameters. The model of the self-developing biological systems by V. Volterra was adapted. The model of optimum point of the training impact was built on result of mathematical modeling the data psychological diagnosis. On the basis of modeling of socio-psychological potentials of team can build differentiated educational programs of new competencies for different groups of managers. This increases the efficiency of innovative management consulting and optimization of cost organizations for staff training.

Key words: Team role structure · Team innovative potentials · Mathematical modeling of social-psychological potential of development of the management team · Modeling method in social psychology

INTRODUCTION

Modern organizations are open developing systems for which for the successful introduction of innovation it is necessary to identify and effectively use the existing social and psychological potentials of managers and train the new competencies. In practice of organizational consulting leaders raise the question of the selection of managers, effective in introducing innovation and able to learn. Indicators of activity of managers, relevant for innovations, are researched and included in the author's program of psychological innovation audit. [1, 2] Relevant is the problem of increasing of the effectiveness of training managers to manage innovation activity, which is connected with the need to identify the best actions (for example, in training, in the process of teaching). The aim of the study was to identify mathematical modeling of social and psychological potentials of enterprises management teams to determine the optimal impact and effectiveness of their learning in innovation. 155 managers of enterprises took part in the research.

The theoretical foundations of the study are the following principles and provisions. First, historical and evolutionary approach of A.G. Asmolov, which laid down the principles of self-developing systems for the description of psychological research, in particular, the principle of interaction of two opposing tendencies of system functioning – the tendency to preserve and the tendency to modify [3]. Second, the theoretical basis of innovative psychological audit of enterprise management, developed by V.G. Gryazevoy-Dobshinskoy including diagnosis of innovative leadership as a systemic phenomenon appearing in the balance of two tendencies of manager's activity – the tendency to preserve and tendency to modify the functioning of the organization [2, 4-6]. Third, self-evolving methods of mathematical modeling of biological systems, developed in the population biology of E. Odum, V. Volterra [7, 8, 9].

The main hypothesis – identifying of social and psychological potentials of development of innovative management team may be based on the methods of mathematical modeling of correlation of tendencies to

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modify – the preservation of the system parameters. On the basis of mathematical types of interaction in self-developing biological systems and data of the parameters of psychological diagnosis "balance point" can be defined with each member of the team where the minimum impact defines the subsequent state of the system.

Private Research Hypotheses:

- Using analytical calculations based on mathematical models of interaction types "cooperation" and "competition" with the diagnostic differentiation of team roles each team member can define the "balance point" as the point of optimum exposure.
- On the basis of the results of mathematical modeling of data of differentiation team roles of team members it is possible to identify subgroups of managers with different optima predicted effects for training command and role-based competencies.

MATERIAL AND METHODS

Methods for Studying the Trends of Activity of Managers:

- The technique of "Roles in team work," R.M. Belbin [10].

Psychological diagnosis manager's activity in team work includes detecting the level of the tendency to maintain the organization's functioning parameters (indicators on the roles "coordinator", "analyst", "implementer", "controller") and level of the tendency to modify the parameters of the functioning of the organization (indexes by role "generator of ideas "," prospector of resources "," motivator "," harmonizer ").

- Methods of mathematical modeling by V. Volterra [7]

Mathematical modeling of the different parameters of manager's activity was based on the system of differential equations of Volterra, one of equations of which describes the tendency to preserve (1) and the tendency to modify (2):

$$\frac{dx}{dt} = a_1 x + b_{12} xy - c_1 x^2$$
$$\frac{dx}{dt} = a_2 x + b_{21} xy - c_2 y^2$$

In the system of differential equations a_1 and a_2 - the factors of dominance (the sum of the meanings of dominant team roles in a range of 6 to 10 stans) and c_1 and c_2 – dissipation factors (sum of the meanings of team roles in the stans, which have a minimum expression, that is, in the range 1 to 5 stans), x and y – a strong trend the preserve and modify, respectively.

Calculations and Results: Mathematical modeling of the optimum point of impact based on psychological diagnosis of differentions of team roles With the help of mathematical modeling of data of psychological diagnosis of differentions of team roles models of optimum point of impact (the "point of balance") for each team member and the conditions for effective learning of different groups of manager's command and role-playing and leadership competencies were built.

In modeling the differentiation of team roles of managers the optimum point of impact ("point of balance"), in which further development trends to preserve – change the functioning of the organization is characterized by maximum uncertainty and maximum sensitivity to the impacts were analytically calculated.

Building a model of differentiation of team roles in the following manner was fulfilled in such a way (by the example of a few people, the results of which are presented in psycho tab. 1). At the first stage, the managers of the value points for team roles were transferred to the stans. Then, on the basis of the diagnostic data for all managers the dominant roles were identified (the value of which is equal or above 6 stans).

On the basis of mathematical modeling [7, 9] this communication dominant roles as "cooperation", the formula of which is shown below were revealed. In this case, team roles complement each other, contribute to the rapid and high-quality execution of the command.
"Cooperation":

$$\frac{dx}{dt} = a_1 x + xy - c_1 x^2$$
$$\frac{dx}{dt} = a_2 x + xy - c_2 y^2$$

Furthermore, the following factors are defined: a_1 and a_2 – factors of dominance (the sum of the dominant team roles in a range of 6 to 10 stans) and c_1 and c_2 – dissipation factor (sum of team roles in the stans, which have the lowest terms, that is in the range of 1 to 5 stans), x and y - a strong trend towards the preserve and modify, respectively.

For each person, taking into consideration type of interaction between his team roles system of differential equations was recorded. With the help of the system of equations analytically calculated "equilibrium point" analytically calculated. In the Cartesian coordinate system it is the intersection of the two tangents (relevant to tendencies of preserve and modify) is a stationary solution of this system of equations. "The point of balance" - the point of optimum conditions, in which the development tendencies to preserve – change is characterized by maximum uncertainty and maximum sensitivity to the impacts.

On distribution points of optimum impact at each company several groups characterized by the presence of a certain ratio of a significant trend towards the conservation and modify the functioning of the organization were identified.

$$\begin{aligned} a_1x + xy - c_1x^2 = 0 \\ a_2y + xy - c_2y^2 = 0 \end{aligned} \Rightarrow \begin{aligned} x = 0 \\ y = c_1x - a_1 \\ y = 0 \\ x = c_2y - a_2 \end{aligned}$$

For the first group of managers presence optimum exposure points with the same minimum severity of both trends is relevant ($0 < y < 3$, $0 < x < 3$). For optimum impact of these managers has minimal differentiation of roles (in the table. 1 sample results managers A, B, C). The first group of managers can be trained to modify the command-role structure (increasing tendency to modify at work in the introduction of innovations) with the initial phase of the "removal role differentiation," or stage of a "distributed leadership" when the functions of leadership (intellectual, emotional, etc.) are performed by all team members.

For the second group of managers the presence of optimum points of impact with minimal expression of the tendency to preserve ($0 < x < 1$) is specific and more expressed tendency to modify ($2 < y < 6,5$). Such managers are already managers - "agents of change" (in tab. 1 sample of results of managers L, M, N), training can be directed at improving of the efficiency potentials of innovative leadership role through the optimization of individual role structure and command-role structure and role ensembles.

The third group of managers is characterized by optimum points of impact with minimal expression of the tendency to modify ($0 < y < 1$) and more expressed tendency to preserve ($2 < x < 10$). These testees are managers, "custodians" conservatives who are the least efficient in the introduction of innovations (in tab. 1 sample of results management, D, E, F). In this group, you can select managers who have high resources of innovative leadership in other programs in innovation audit tests [2].

Table 1: The results of psychological diagnosis and modeling the command - role structure

	Results of psychological diagnosis the command - role structure								Results of modeling the point of balance	
	Severity tendencies of activity								Severity tendencies of activity	
	to preserve				to modify				to preserve	to modify
Managers	coordinator	analyst	implementor	controller	generator of ideas	prospector of resources	motivator	harmonizer	*x*	*y*
Managers with a minimum severity tendencies (model of "cooperation")										
A	5	4	4	6	6	5	5	4	0,50	0,46
B	4	5	5	4	4	5	6	4	0,03	0,46
C	5	2	6	3	5	5	7	2	0,66	0,64
Managers with a maximum severity tendency to modify (the model of "cooperation")										
L	5	2	4	3	6	3	6	6	0,44	6,15
Ì	3	5	5	4	3	0	6	7	0,26	4,42
N	4	3	7	6	0	2	6	6	2,92	7,46
Managers with a maximum severity tendency to preserve (the model of "cooperation")										
D	6	2	7	6	4	0	6	3	10,69	2,38
E	6	3	6	6	3	0	7	2	6,93	2,79
F	6	2	10	6	3	4	0	3	11,58	1,16
Managers with a maximum severity tendency to preserve (the model of "competition")										
D	6	*2*	*7*	6	4	0	6	3	9,27	0,47
E	6	*3*	*6*	6	3	0	7	2	6,06	0,19
F	6	*2*	*10*	6	3	4	0	3	10,48	1,05

For them it is necessary to identify the best learning conditions for command-role and leadership competencies. For this purpose another mathematical model - the model of "competition", the results of which showed the possibility of a reduction of the severity of the subjects to maintain the trend through the internal (personal) role conflict (in tab. 1 additional examples of the results of managers, D, E, F) was used. In addition, the modeling of balancing the maximum and minimum expressed "conflict" team roles was carried out balancing. Train of this subgroup of managers should include the initial phase of reflection of role conflict.

CONCLUSIONS

- Identification of potential development of the management team may be based on the methods of mathematical modeling ratio tendencies of activity aimed at modifying – preservation of the functioning of the organization. To model the tendency of innovative activity of management team model of the biological self-developing systems of Volterra is adapted.
- As a result of the mathematical modeling on the basis of the models of interaction types "cooperation" and "competition" and data of psycho diagnosis differentiation of command-roles and team of managers a model of the optimum points of impact to determine the conditions for further training command and role-playing and leadership competencies were built.
- Construction of models of team roles in the differentiation of managers variants optimum point of exposure are analytically identified. The first variant of the optimum point of impact has minimal differentiation of team roles in the team. For managers of this group the optimal formation of the new command and role structure must pass through a stage of dispersion role of differentiation or the distribution of roles and functions of among all members of the team, which is similar to the theory and practice of "distributed leadership."

The second version of the optimum point of impact is characterized minimal expression of the trend of activity of managers to reserve and more expressed tendency to modify the activity of the organization's functioning. For this group of managers the increasing of the role activity directed to changes bother and processes in training command and role-based competencies and in general in the command structure of the role of management in innovation is optimal.

In addition, as a result of constructing a model of differentiation of team roles third version of the optimum point of impact, which is characterized by minimal activity expressed tendency to modify and more expressed tendency to preserve the activity of the organization's functioning parameters is defined analytically. The results of modeling showed the possibility of reducing the severity of the managers tendencies of activity aimed at preserving and balancing of activity tendencies to modify - conservation. Effective training of managers of this group command and role-based competencies must include a special technology personal reflection role conflict at the first phase.

- The developed methods of mathematical modeling of social and psychological potentials of teams allows to identify the condition for construction a differentiated training programs in the organization. This increases the efficiency of management consulting of innovative organizations and optimization of the cost of organization of training of the stuff in innovation.

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