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THE ALGORITHM FOR FINDING THE FRACTAL DIMENSION OF CONTROL ACTIONS IN ACTIVE SYSTEMS

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ABSTRACT

The paper considers the issue associated with a change in the structure of an organization, defined as an active $\mathbf{A_s}$ system, under conditions of market turbulence. Such a change is carried out on the basis of using the fractality of the organization's potential $P\frac{A_s}{o}$, consisting of three components: external potential $P\frac{A_s}{ext}$, internal potential $P\frac{A_s}{int}$ and management potential $P\frac{A_s}{mng}$, in their activities. The concept of fractalization of $\mathbf{A_s}$ structures in the planning procedure π is advanced. Based on this concept, a procedure for evaluating the management efficiency of an active $\mathbf{A_s}$ system is given. An algorithm is proposed for finding the fractal dimension D of control actions that regulates the activity of $\mathbf{A_s}$ in a turbulent market environment. It is stated that the fractal Ac model is the pinnacle of organizational structures with tremendous potential. In addition, this model demonstrates amazing survivability in any environment, both turbulent, ordered, and chaotic.

Keywords. *Active System, Fractal Model, Fractal Dimension, Market Turbulence, Potential Of The Active System, Planning Procedure, Controlling Influence.*

1. INTRODUCTION

The stable existence of any organizational structure (active A_s system [1]) largely depends on its potential and on $P\frac{A_s}{o}$ the use of this potential in certain relationships [2] for a given goal -$\Psi_{As}(X)$. This A_s potential consists of three components: external potential $P\frac{A_s}{ext}$, internal potential $P\frac{A_s}{int}$ and control potential $P\frac{A_s}{mng}$ i.e.:

$$P\frac{A_s}{o} = P\frac{A_s}{ext} \& P\frac{A_s}{int} \& P\frac{A_s}{mng} \qquad (1)$$

In general, the state A_s is described by the variable y∈U belonging to the admissible set A [1]. The state of the system at the moment in time depends on the control actions $\eta \in U\left(P\frac{A_s}{mng}\right)$, $y = G(\eta)$ selected by the A_s center. Suppose that on the set U × A a functional Φ (η, $P\frac{A_s}{o}$) is defined that determines the efficiency of the active system. The quantity K (η, $P\frac{A_s}{o}$) ⊂Φ (η, $P\frac{A_s}{o}$) is called the control efficiency η∈U.

There $P\frac{A_s}{o} = P\frac{A_s}{ext} : P\frac{A_s}{int} : P\frac{A_s}{mng}$ - expresses the potential of the active system As, on the basis of which the planning procedure $\pi: X \rightarrow S$ of the activity As is carried out. With this formulation of the problem of assessing the control efficiency of As, taking into account the use of components $P\frac{A_s}{o}$ in a certain proportion, it becomes relevant.

It is clear that after the beginning of the activity, the As center will use components $P\frac{A_s}{o}$ in a different ratio depending on the plan *X* and the type of $y=G(\eta)$ control actions to fulfill the adopted plan.

2. FRACTAL FINDING

For a given goal $\Psi_{A_c}(X)$, the center of the A_s, on the basis of plan *X*, determines the orientation of the activity of the active system, which ensures the effectiveness of control of the A_s. This orientation depends on market turbulence

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[3-5].In this case, there are three options for orienting the activities of A_s: oriented to $P\,\frac{A_s}{ext}$, orto$P\,\frac{A_s}{int}$, or to$P\,\frac{A_s}{mng}$. These options are chosen as the center A_s will use the components in the process $\pi{:}X\rightarrow S$, where S is the message about the implementation of the plan. This is the meaning of strategic planning [6].

In [7], the control action in A_s is expressed as follows: $U = (f \,\&\, q)$, where f is the force of the impact, q is the depth of the action, in order to successfully execute the plan X, the center A_s must work out a measure for U. This measure ensures the effectiveness of the effect on the members of the active system A_e depending on the fulfillment or non-fulfillment of X. By physical nature, this measure power-law depends on f [8]. Then, from the point of view of fractal geometry [9], the impact scale η∈U will be the impact force f, and the impact depth q will be a scale factor. From this point of view, the degree f will reflect the fractal dimension D of the impact $U\ (q\ \&\ f)$, which characterizes the measure of increasing (or decreasing) the impact on A_e, taking into account the non-fulfillment (or fulfillment) of plan X and market turbulence.

With this approach, the control action model in A_s will be evaluated by the following formula:

$$U(q\&f) \approx q \cdot f^{1-D}$$

The given formula expresses that the effectiveness of the effect depends on the power of the effect and is similar to the ratio of B. Mandelbrot [10].

Thus, the force of the impact f – may be an incentive procedure $\delta(\cdot,\cdot): \mathrm{A}_0 \times \mathrm{X} \rightarrow \mathrm{R}^1$. A depth of impact q – the degree of penetration of the existing state on the control object or the degree of mastery of the controlled situation by the $A_э$. This can be a cost function $c(\cdot,\cdot): \mathrm{A}\times\Omega \rightarrow \mathrm{R}^1$ active element a function of income A_e $h(\cdot,\cdot): \mathrm{A}\times\Omega\rightarrow \mathrm{R}^1$, $\Phi(\cdot,\cdot): \mathrm{A}_0 \times U \rightarrow R^1$ - a function of revenue center $H(\cdot,\cdot): \mathrm{A}\rightarrow \mathrm{R}^1$ action-dependent A_e etc

Thus, the components of the control action [5]:

$$f = \{\pi, \delta(\cdot,\cdot), \chi(\cdot,\cdot) \,|\, \pi{:}X\rightarrow\hat{S},\ \ \delta(\cdot,\cdot){:}A_0\times\ X\rightarrow R^1,\ \chi(\cdot,\cdot){:}A_0\times\ X\rightarrow R^1\}$$

$$q = \{c(\cdot,\cdot), \mathrm{h}(\cdot,\cdot), \widetilde{\Phi}(\cdot,\cdot), \mathrm{H}(\cdot,\cdot) \,|\, \mathrm{c}(\cdot,\cdot): \mathrm{A}_0\times\mathrm{X} \rightarrow \mathrm{R}^1, h(\cdot,\cdot): \mathrm{A}\times\mathrm{X}\rightarrow\mathrm{R}^1, \widetilde{\Phi}(\cdot,\cdot): \mathrm{A}_0\times U \rightarrow \mathrm{R}^1, \widetilde{\Phi}(\cdot,\cdot): \mathrm{A}_0 \times U \rightarrow \mathrm{R}^1, \mathrm{H}(\cdot,\cdot): \mathrm{A}\rightarrow\mathrm{R}^1\}$$

(2)

In this regard, when analyzing the effectiveness of management, you will have to take into account the manageability of each element of A s. The degree of controllability of each element of the structure and the whole as will be Expressed by the elements of the set R1. For example, if we evaluate the controllability from 0 to 1, i.e. on a scale of {0,0.25,0.5,0.75,1}, accordingly, unmanageable, poor handling, average handling, good handling, excellent handling. In this case, R1={0,0.25,0.5,0.75,1} and its corresponding provisions will be an element of the work A×X [10].

In physical terms, U=(f & q) depends powerfully on f .

As already noted, in order to successfully implement plan X, the As center must develop a measure of the selected impact on the A_s, depending on the implementation or non-implementation of X. With this approach, the model of control actions in As will be evaluated by the following formula [2].

And the fractal dimension D determines the extent to which these effects are applied [13]. Question definition B is an independent task in the organizational management of As.

From the point of view of fractal, the impact of η∈U be the impact force f and the depth of influence q be a major factor. From this point of view, the degree f will reflect the fractal dimension D of the impact U(q&f), which characterizes the measure of increasing(or decreasing) the impact on the AE, taking into account the implementation or non-implementation of plan X in conditions of chaos.

The aim of the work is to find such an acceptable control (action) for given ratios of the components of the potential$P\,\frac{A_s}{o}$of the active system, which maximized the value of its efficiency, i.e.

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$$\eta^* \in Argmax\, K\left(\eta, D, P\,\frac{A_s}{mng}\right) = \left\{\eta \in U \middle| \forall\gamma\ \cup K(\eta, D_\eta, P\,\frac{A_s}{mng}) \geq K(\gamma, D_\gamma, P\,\frac{A_s}{mng})\right\}$$

3. MAIN ALGORITHM TO FIND FRACTALS

Solution method. Apparently the birthplace of work in the field of fractal organization of enterprises considered the USSR. In the book of Hans-Jurgen Varnecke "Revolution in Entrepreneurial Culture. Fractal enterprise" [11] says the power of this model. However, the book was not received when it saw the light too soon. In 1993, there was simply no one to understand her.

The relevance of creating organizations built on a fractal basis is justified by the prevailing economic situation, which can be described as "vortex" or "turbulent" [5]. From a philosophical point of view, a fractal is a tiny brick from which nature builds all its diversity. On the one hand, he always remains himself. On the other hand, it changes endlessly, acquiring different forms depending on the randomness of the environment. A fractal organization is self-similar: all its principles carry even its only element.

It is no secret that the term chaos, first of all, means "disorder", "not mess", "confusion". The concept of "chaos" arose from the ancient Greek word χάος from χαίνω, meaning reveal, unfold. Only in the early Christian times did the word begin to ascribe the meaning of "disorder." In mathematics, chaos is the aperiodic deterministic behavior of a dynamical system that is extremely sensitive to the initial conditions [12]. In a domestic context, the word "chaos" means "to be in a state of disorder." Chaos theory says that complex systems are extremely dependent on the initial conditions, and small changes in the environment can lead to unpredictable consequences [13].

What is the difference between today's world and the world where we have lived for a long time? First, the speed of change in the world. In turn, it raises a simple question: people (AE) and (organizations) As able to first think faster, second react faster, and third act faster.

Secondly, it is uncertainty, it is the absence of parameterization, qualitative and quantitative parameters. This means that we can't describe the situation with either qualitative or quantitative parameters. Decision-making under such conditions is very different from deterministic methods of decision-making, just as discrete mathematics is different from all other mathematics.

In the third case, this is a very high level of complexity of the ongoing processes. Chaos destroys the outer simple shell of the world and shows the inner stuffing. There are many chaotic effects. The effect of krill butterfly: when a small detail destroys a big deal or as plans and destroys it. Thus, the speed of change, uncertainty, and a high level of complexity of the processes are the main fractal properties of chaos [14].

Automatically, high speed, high uncertainty, high complexity creates a high level of risk.

In General, in chaos, the second property is conjugate and follows from the first, if we do not process the uncertainty, then we are late in speed. Being late in speed, we lose the ability to recognize uncertainties. Thus, we do not delve into the essence of the complexity of the ongoing processes. This is the fractality of chaos.

This raises the question of how to take into account the human factor, and what parameters of the as will need to be adapted in this case in order to survive in the chaos?

To answer this question, we need to determine the fractal properties of, as that can be adapted to the environment of chaos. Since the fractal is a hidden order of chaos.

One of the important properties of chaos is that it is a "self-sustaining" system. Those. A system that "seeks" to maintain and maintain its state of "isotropy". It is this property of chaos that is the manifestation of "resilience" or "flexibility of organization" [14-16]. Fractal analysis to a greater extent characterizes not operational, but strategic behavior of the organization. It allows you to achieve their optimal combination [6].

The fractal structure of the potential of $A_s$makes it possible to create a model of a fractal control system. In addition, this model demonstrates tremendous survivability in any business environment, both orderly and chaotic. Such survivability depends on the choice of the type of control actions. This is a kind of initial

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condition for the effective existence of A_s. Moreover, the fractal dimension D determines the measure of application of these effects [17-20]. This is reflected in the following theorem.

Theorem. If we use $P\,\frac{A_s}{ext}$- as scale 1, then the internal potential $P\,\frac{A_s}{int}$must be used 1,6 times more than$P\,\frac{A_s}{mgn}$, and the control potential must be used three times more than $P\,\frac{A_s}{ext}$and two times more than$P\,\frac{A_s}{int}$, then for a given Dη, condition (5) is satisfied, i.e. :

$$\eta^* \in \mathrm{ArgmaxK}\left(\eta, \mathrm{D}, P\,\frac{A_s}{mgn}\right) = \left\{\eta \in \mathrm{U} | \forall\gamma \cup \mathrm{K}(\eta, \mathrm{D}_\eta, P\,\frac{A_s}{mgn}) \geq \mathrm{K}(\gamma, \mathrm{D}_\gamma, P\,\frac{A_s}{mgn})\right\}$$

Argument. To prove this theorem, we will represent the potential $A_s$in the form of paralelepid as shown in Fig. 1, a.

After the activity of $A_s$parallelepiped begins (Fig. 1, a) it turns into a pyramid (Fig. 1, b) [21]. Since the box represents A_s, the task of assessing the stability of this figure determines the effectiveness of the existence of the organizational system itself.

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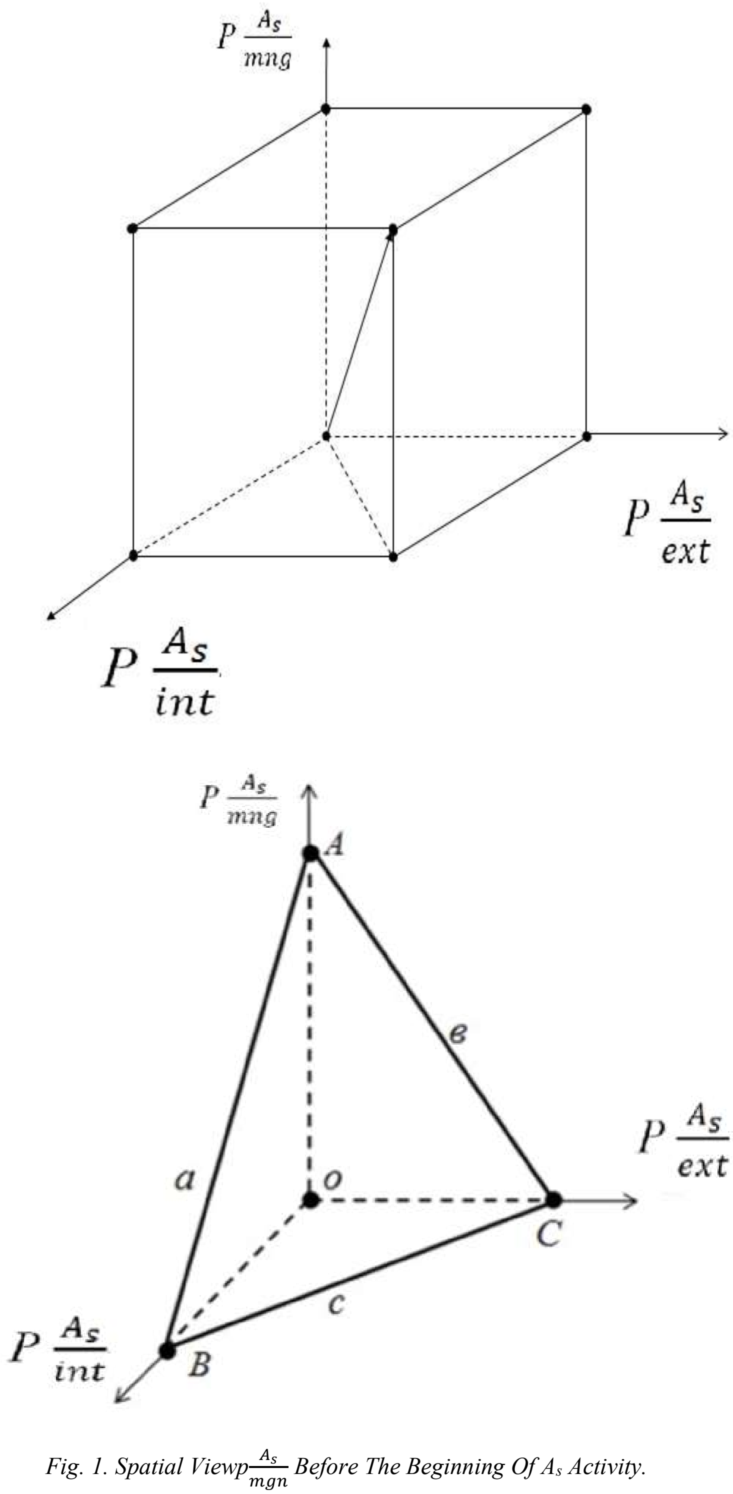

Fig. 1. Spatial Viewp$\frac{A_s}{mgn}$ Before The Beginning Of A_s Activity.

For a turbulent market environment, solving this problem essentially means evaluating the stability criterion for the parallelepiped shape (Fig. 1, a). And the stability of this figure depends on the stability of the pyramid shown in Fig. 1, b.

Thus, in order for A_s to work effectively, the pyramid must be stable. A pyramid will be stable if $S_{\Delta ABC} = \xi \cdot (OA)^2$, i.e. the principle of ‹ature of the golden ratio ›› [22] must be observed. With this approach, we can evaluate the relationships between the components$P\frac{A_s}{o}$ for use in the activities of A_s.

Assume that the spatial components$P\frac{A_s}{o}$ are interconnected, as in Fig. 1. A very interesting fact is observed here. If, while constructing the parallelepiped (Fig. 1,), we preserve the orthogonality of the quadrangular face of this parallelepiped (in principle, the parallelepiped is constructed by the center before the start of the $A_s$activity, i.e., in the planning procedure $\pi: X \to S$, then the planning procedure means building a parallelepiped) , then after the beginning of $A_s$activity, it looks like a type of Cheops pyramid (Fig. 1, b). In this case, К(η,$P\frac{A_s}{o}\Pi_o^{A_c}$)= $S_{\Delta ABC}$

Thus, $A_s$will be stable if the following condition is met $S_{\Delta ABC} = \chi \cdot (OA)^2$, where $\chi$is the numerical coefficient (3)

We compute$S_{\Delta ABC}$

$$a = (AB) = \sqrt{(OB)^2 + (OA)^2}$$
$$b = (AC) = \sqrt{(OC)^2 + (OA)^2}$$
$$c = (BC) = \sqrt{(OC)^2 + (OB)^2}$$

Based on the Heron formula, the area of the triangle ABC:

$$S_{\Delta ABC} = \sqrt{\mathrm{p}(\mathrm{p}-a)(\mathrm{p}-b)(\mathrm{p}-\mathrm{c})},$$

wherep$\frac{1}{2}(\mathrm{a} + \mathrm{в} + \mathrm{c})$

So, as the sides of the parallelepiped are orthogonal, i.e. OB=1,6 OC then

$$\mathrm{OC} = \frac{1}{1{,}6}\mathrm{OB} = 0{,}6\mathrm{OB}$$

Then,

$$\mathrm{BC} = \sqrt{(0{,}6)^2(OB)^2 + (\mathrm{OB})^2} = (\mathrm{OB})\sqrt{0{,}36 + 1} = 1{,}16(\mathrm{OB})$$
$$\mathrm{AC} = \sqrt{(0{,}6)^2(OB)^2 + (\mathrm{OA})^2}$$
$$\mathrm{AB} = \sqrt{(\mathrm{OB})^2 + (OA)^2}$$

If the sides of the box are an orthogonal quadrangle, i.e. OA = 1.6 (OB), then

$$\mathrm{BC} = 1{,}16 \cdot 0{,}6(\mathrm{OA}) \approx 0{,}7\mathrm{OA}$$
$$\mathrm{AC} = \sqrt{(0{,}6)^2(\mathrm{OA})^2 + (\mathrm{OA})^2} \approx \mathrm{OA}$$
$$\mathrm{AB} = \sqrt{(0{,}6)^2(\mathrm{OA})^2 + (\mathrm{OA})^2} \approx \mathrm{OA}$$
$$\mathrm{p} = \frac{1}{2} \cdot 2{,}7(\mathrm{OA}) = 1{,}3(\mathrm{OA})$$
$$S = \sqrt{\begin{matrix} 1{,}3(\mathrm{OA})(1{,}3(\mathrm{OA}) - (\mathrm{OA}))(1{,}3(\mathrm{OA}) \\ -0{,}7(\mathrm{OA})1{,}3(\mathrm{OA}) - (\mathrm{OA})) \end{matrix}}$$
$$S \approx 0{,}2(\mathrm{OA})^2$$

The result of these calculations will determine the relationship for the control potential $P\frac{A_s}{mng}$, the internal potential $P\frac{A_s}{int}$ and the external potential $P\frac{A_s}{ext}$ensuring the efficiency of fractal control:

$$(P\frac{A_s}{mng})^2 \approx 1{,}5(P\frac{A_s}{int})^2 + 0{,}5(P\frac{A_s}{ext})^2 \quad (4)$$

This ratio can be derived for the remaining orientation of the activity of A_s[1]. This formula shows that the internal potential of $A_s$should be used no more than three times more than the external potential, so that the activity of Ac is stable, i.e.

$$\eta^* \in \mathrm{ArgmaxK}\left(\eta, \mathrm{D}, P\frac{A_s}{mng}\right) = \left\{\eta \in \mathrm{U} | \forall\gamma \cup \mathrm{K}(\eta, \mathrm{D}_\eta, P\frac{A_s}{mng}) \geq \mathrm{K}(\gamma, \mathrm{D}_\gamma, P\frac{A_s}{mng})\right\}$$

In this case, the box will be expanding.

The theorem is proved.

Here we can state a very interesting pattern. If the sides of the parallelepiped are orthogonal in three cases, then we can talk about the stability of $V_c^{P_{As}}$. In this case, the following relationships are observed between the components $P\frac{A_s}{o}$:

$$P_{mgn}^{A_s} \approx 1.6P_{int}^{A_s}; \quad P_{int}^{A_s} \approx 1.6P_{ext}^{A_s}; \quad P_{mgn}^{A_s} \approx (1.6)^2 P_{ext}^{A_s} \quad (5)$$

If the active system A_s, having the potential $P\frac{A_s}{o}$ =($P\frac{A_s}{ext}$&$P\frac{A_s}{int}$) &$P\frac{A_s}{mng}$, when activating$P\frac{A_s}{mng}$, will use its potentials in each planning stage according to condition (4) and△ observe relation (5), then the activity of A_s will be stable [8].

The result of the theorem is to determine the ratio for the control potential $P\frac{A_s}{mng}$, internal potential $P\frac{A_s}{int}$ and external capacity $P\frac{A_s}{ext}$ ensuring the effectiveness of fractal control:

$$(P\frac{A_s}{mng})^2 \approx 1.5(P\frac{A_s}{int})^2 + 0.5(P\frac{A_s}{ext})^2 \quad (6)$$

This ratio can be deduced for the other orientations of the As activity. This formula shows that the internal potential of A s must be used no more than three times more than the external potential in order for the activity of As to be stable.

There is a very interesting pattern here. If the sides of the parallelepiped are orthogonal in three cases, then we can talk about stability $V_c^{P\frac{A_s}{o}}$. In this case, the following relationships between the components are observed $P\frac{A_s}{o}$:

$$P_{mgn}^{A_s} = 1.6\,\Pi_{\text{вm}}^{A_c}; \quad P_{int}^{A_s} = 1.6P_{ext}^{A_s}; \quad \Pi_y^{A_c} = (1.6)^2 P_{int}^{A_s} \quad (7)$$

Then the used ratio of components in the Ac potential will be as:

$$P\frac{A_s}{o} \approx 1{,}6P\frac{A_s}{int} + P\frac{A_s}{ext} + 2.56\ P\frac{A_s}{mng} \quad (8)$$

If the active system As having the potential $P\frac{A_s}{o} = P\frac{A_s}{ext} \& P\frac{A_s}{int} \& P\frac{A_s}{mng}$ will be when activated $P\frac{A_s}{mng}$ use their potentials according to the condition and observe the ratio (6), then the activity of As will be stable. It can be seen from conditions (7) that the effectiveness of management depends on the use of internal and external potentials in a certain proportion. In the following example, we will show an algorithm for using the potential of the AU in the procedure for planning the activities of a Joint-stock company.

Example. Let's assume that As has $P\frac{A_s}{o}$, and it is necessary to carry out the plan X for the year. The center divides the implementation of this plan into four blocks: x_1, x_2, x_3, x_4. In this case, or in this scenario, the potential of As fractally looks like this:

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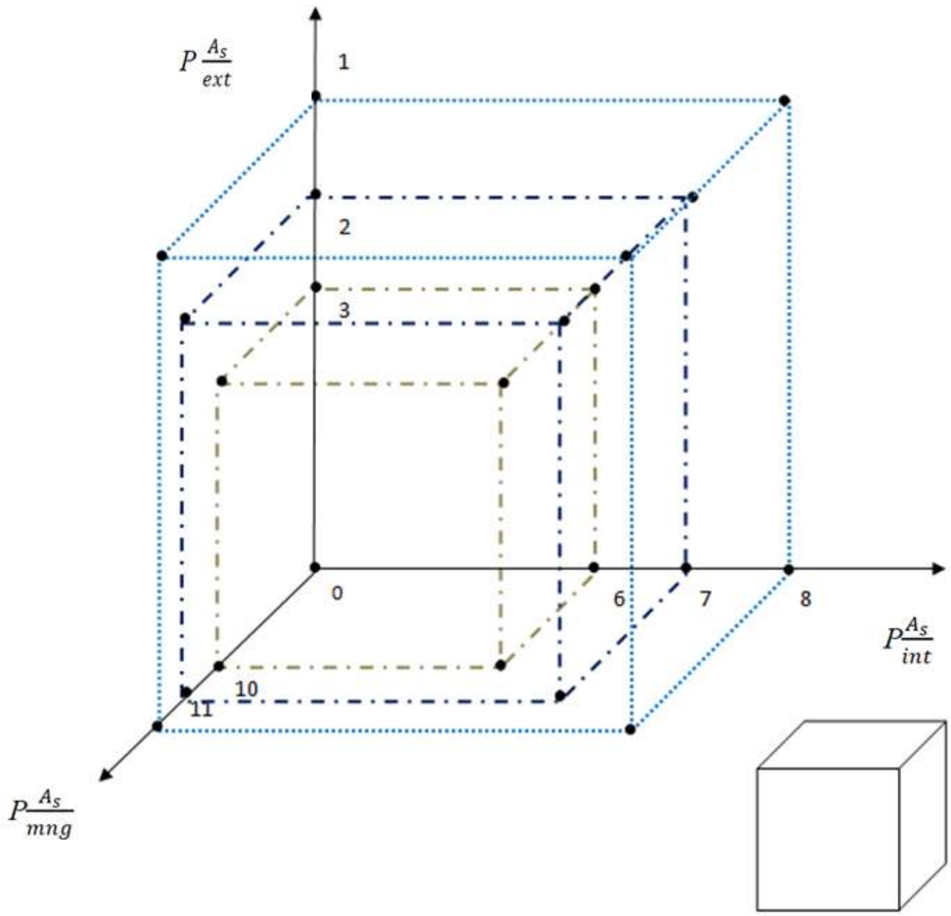

Figure 2. Algorithm Using The Potential A_s

The plan X of the active system is defined as the volume V of the parallelepiped (0,11,1,8), i.e. *X=V,* a $V = v_1 + \lambda_1 v_1 + \lambda_2 v_1 + \lambda_3 v_1$.

Here the volume of the first parallelepiped (0,9,4,5) will be the plan of the first quarter. v_1 is the x_1 plan for the first quarter. In this case, we need to evaluate the measure of each quarter's plan.

Let's say the center has defined the plan x_1 of the first quarter as x_1=v_1. we take this volume as the scale of δ_1 – planning:

$$v_1 = (1 \cdot 1{,}6 \cdot 2{,}56) = (1 \cdot (1{,}6) \cdot (1{,}6)^2) = (1{,}6)^3 = 4\delta$$

v_2 second quarterx_2 , $\lambda_1 = 1{,}6$.

$$v_2 = (1{,}6 \cdot (1{,}6)^2 \cdot (1{,}6)^3) = 16{,}7\delta$$

v_3 тthird quarter $\lambda_2 = 2{,}56 = {\lambda_1}^2$.

$v_3 = [(1{,}6)^2 \cdot (1{,}6)^3 \cdot (1{,}6)^4]$=52

v_4 fourth quarter$\lambda_3 = {\lambda_2}^2$.

$v_4 = [(1{,}6)^3 \cdot (1{,}6)^4 \cdot (1{,}6)^5] =$ 2.81,4.

ln4=1,38; ln17=2.83; ln52=3.15; ln2.81=5.6.

In this case, the measure of the plan for each quarter:

for the first quarter, the measure M_1=1.

for the second quarter, the measure M_2=2.1.

for the third quarter, the measure M_3=1.3.

for the fourth quarter, M_4=1.5.

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Then the distribution of the plan by quarter looks like:

$X = Mx_1 + M_2x_2 + M_3x_3 + M_4x_4 = x_1 + 2{,}1 \cdot x_1 + 1{,}3 \cdot x_1 + 1{,}5 \cdot x_1$ (a)

Condition (a) means that in the second quarter we must fulfill the plan 2.1 times more than in the first quarter, in the third quarter 1.3 times more than in the first, and in the fourth quarter 1.5 times more than in the first quarter.

For fractal control, it is important how the points that determine the dimension of fractals are located. The most optimal is the location of fractals on the principle of the "Golden" section. When we represent the organization's potential as a parallelepiped (figure 2), and when we use P A_s/ext as scale 1, the internal potential should be used 1.6 times more than PA_s/int, and the management potential PA_s/mng should be used three times more than P A_s/ext and twice as much as PA_s/int. The fractal control system built on this principle ensures not only the control efficiency [2], but also the stability of the system itself .A_s [3].

If the active system As having the potential A_s P/o =P A_s/ext&P A_s/int&P A_s/mng

will when activated PA_s/mng use their potentials in every stage of planning condition (4) and observe the relation (5), then the activities of the AU will be stable[8].

It is very important for the Manager of the active system to know the socio-psychological state of the active elements of the AE system when assessing the stability of the As. In the management of As, the most important factor is the human factor. Therefore, the structure of the As should have a monitoring system (algorithm) that evaluates the controllability of the active elements of the As. Without such an algorithm, the Manager will not be able to optimize the performance of control actions U(q&f).

Management efficiency into the system properties of the elements that make up the management capacity, the gain of which contributes to improving the quality of control, causing the required reaction of the controlled object. The higher the development of these properties, the more it reveals the capacity of the office, the higher the controllability of production. Hence the management effectiveness - is the result of increased management capacity, which, focusing on the mechanisms of vospriimchivosti active elements As to the control action G manifests itself in the performance of As. This largely depends on the human factor. In [13], this issue is considered from a conceptual point of view. On the other hand, taking into account the human factor in fractal management can be algorithmized in the following way.

If we analyze the parameters S, I, N, A1 in detail, we can estimate the controllability of the active element AE based on the MV coefficient [1,6]. To do this, you can schematically show the behavior of these parameters, namely, their mutual influence.

As established, each parameter of the AE response to U=G(q&f) captures a certain action of the control object, and the actions can be both General and specialized in nature, related to the professional field of activity. Each parameter also has, in addition to the code, an evaluation that characterizes the result of the implementation of the XI control object, which is assigned by the person responsible for the work of the staff. Using the assigned numerical estimates obtained by the subject of management(table 3.3.1), we calculate the high-level parameters S, I, A1, N using the formulas

$$S_{cp}^{P_i} = \frac{\sum_{i=1}^{k} A_i^{P_i}}{k}, \quad I_{cp}^{P_i} = \frac{\sum_{j=k+1}^{l} A_j^{P_i}}{l-k}, \quad N_{cp}^{P_i} = \frac{\sum_{m=l+1}^{n} A_m^{P_i}}{n-l}, \quad A1_{cp}^{P_i} = \frac{\sum_{f=n+1}^{h} A_f^{P_i}}{h-n}, \quad (9)$$

where Pi is the i-th evaluated active element of the organization;

k,l,n,h – the number of corresponding primary estimates included in the corresponding parameter (see table 1).

Using the final values of the parameters S, I, A1, N, you can get an integrated assessment of the MV (a measure of the susceptibility of the control action), which comprehensively assesses the manageability of the active element, the structure and the organization as a whole. This assessment serves as a kind of indicator that characterizes the manageability of not only the organization. Looking at the MV indicator, the As Manager can optimize the degree of control actions, i.e. D. Interestingly,MV(D,S,I,A1, N): π→U(q&f), i.e. the control of the As functionally depends on the planning procedure and on the human factor.

Naturally, if the AE of the organization(active system) is not willing to perform its duties, then it has S□max, which may result in A1 →min. Undoubtedly, if the AE does not perform his duties willingly, perhaps he wants to change his job (he is not satisfied with the working conditions, salary, or other reasons), then in this case he will have N →max. If they have found a new job, the parameters will be I →min, N →max in the organization where they work. Based on changes in these parameters, the head of the organization can optimize the function U=G(q&f) to draw appropriate conclusions. This is the essence of taking the human factor into account in organizational management, i.e., in the management of an active system.

Table 1. The Primary Parameters For Assessing The Psychological State Of A_E

Name of the rating parameter		***Code***	***Evaluation***
S	*Employee's refusal to transfer to another location together with the organization*	*A2*	*0,5*
	Refusal to continue working due to changes in working conditions	*A3*	*0,5*
	. . .	. . .	. . .
I	*Rejection of innovations*	*A33*	*0,5*
	Disclosure of information entrusted to an employee that contains state, official or legally protected secrets	*A6*	*1,0*
	. . .	. . .	. . .
N	*Failure to show up for work (partial absenteeism)*	*A0*	*0,25*
	More than 15 minutes late	*A1*	*0,1*
	. . .	. . .	. . .
A1	*Exemplary performance of work duties*	*A8*	*0,5*
	Continuous improvement of product quality	*A12*	*0,1*
	. . .	...	...

Schematically, the dependence of controllability on the values of parameters S, I, N, A1 is shown in Fig. 3.

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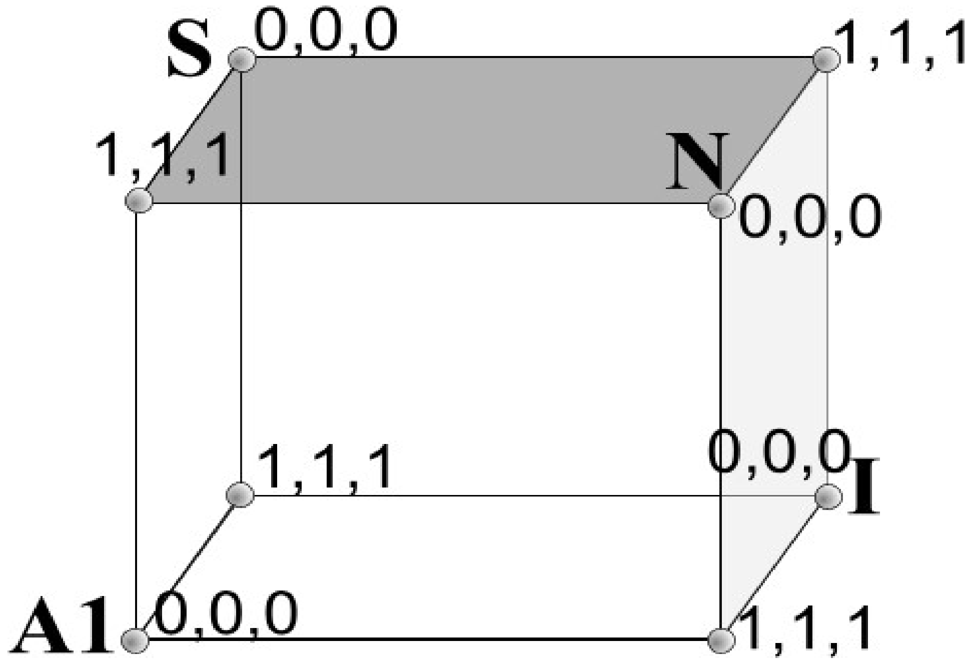
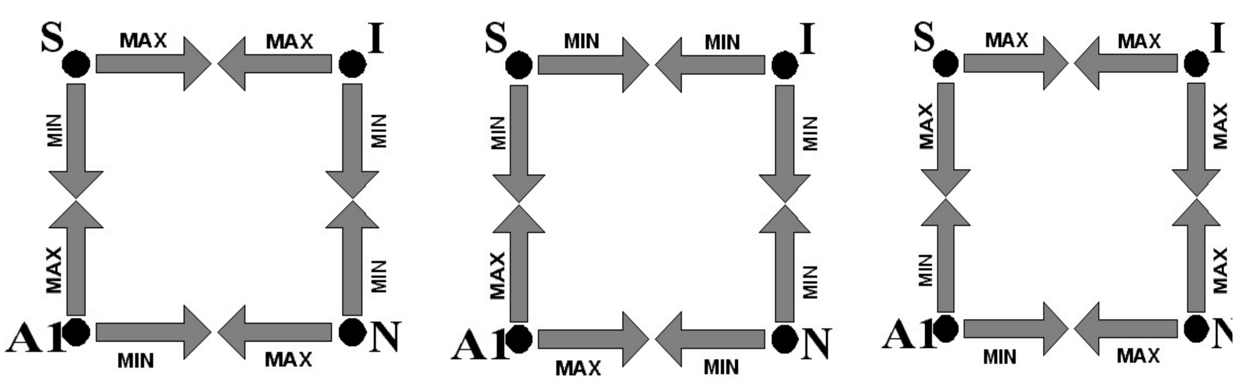


Figure 3. The Spatial Relationship Of The Parameters S, I, N, A1

Other option. Let's assume that the AE performs its duties in good faith. All the conditions created for him in this organization satisfy him. In this case, S →min, I →min, N → min, A1 →max. This means that the organization is working normally and MV →1.0. If, for example, an employee receives an offer to move to another place of work, where conditions are much better than in the organization where they work, then automatically the parameter I will tend to the maximum I →max, i.e. they start choosing conditions. The consequence of this is that the parameters S →max, N →max, and A1 →min will change.

In this case, the head of the organization must understand that his employee has found a new job. This behavior of the parameters S, I, N, A1 indicates that they are interconnected in a spatial way that can be represented in three dimensions. If we assume that when encoding these parameters (see table.1) they change from 0 to 1, which results in the unit cube shown in figure 3. in this case, there are four zero vertices and four unit vertices.



Option 1 Option 2 Option 3

Figure 4. Conditions For Changing Parameters

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With this representation, the MMV indicator can be represented as a single cube, and its value will characterize the volume of this cube. Changes to each parameter S, I, N, And 1 cut off a certain part of the volume of this cube, since these Parameters negatively affect manageability. In this case, the remaining volume of the cube will characterize the degree of manageability of the employee. With this representation of the parameters S, I, N, A1, we can prove the validity of the following Lemma.

Lemma 1: if MV=V, where V is the volume of the cube shown in figure 4, then the volume of the cube will Express the manageability of the organization:

$$MB=V_{A1}-(V_N+V_S+V_I)$$

(10)

that is, in the ideal case $MB=V_{A1} \Rightarrow MB \rightarrow A1$.

With this representation of the relationship between the parameters S, I, N, And 1, the manageability of the organization will be interpreted taking into account the human factor.

Proof: Consider the dependence of the MV coefficient on the parameters S, I, N, A1. for S→min, N→min, I→min, A1→max follows. It follows that in the ideal case MV= A1, provided that A1→max.

Substituting the values of the estimation parameters from formula (9) into formula (10), we ge

$$MB=\frac{(l-k)(n-l)(h-n)\sum A_i^{P_i}-k(n-l)(h-n)\sum A_j^{P_i}-k(l-k)(h-n)\sum A_m^{P_i}-k(l-k)(n-l)\sum A_f^{P_i}}{k(l-k)(n-l)(h-n)}$$

(11)

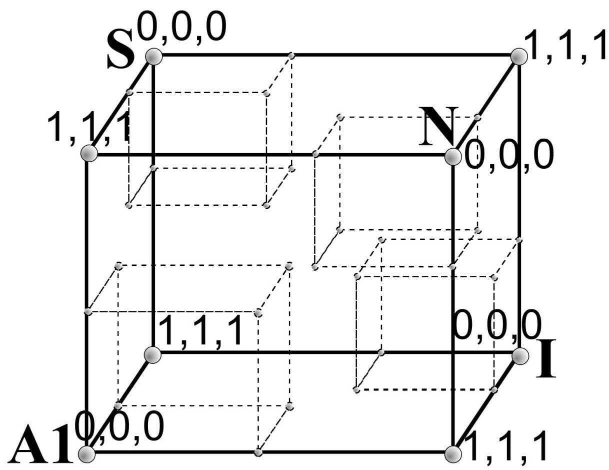

Fig.5. Spatial Representation Of The MV Indicator

On closer inspection, you will notice that the expression k(l-k)(n-l)(h-n) is a constant equal to the number of primary estimates for the control object. Thus, expression (11) will take the form:

$$MB=\frac{cons(\sum A_i^{P_i}-\sum A_j^{P_i}-\sum A_m^{P_i}-\sum A_f^{P_i})}{cons}$$

$$\Rightarrow MB\sum A_i^{P_i}-\sum A_j^{P_i}-\sum A_m^{P_i}-\sum A_f^{P_i}$$

(12)

Because

$$A1=\{A_i^{P_i}\};\quad N=\{A_j^{P_i}\};\quad S=\{A_m^{P_i}\};\quad I=\{A_f^{P_i}\},$$

then under the specified condition

$$\begin{gathered}\sum A_i^{P_i}\rightarrow\max;\sum A_j^{P_i}\rightarrow\min;\\ A_f^{P_i}\rightarrow\min;\\ A1\rightarrow 1;\\ \sum A_m^{P_i}\rightarrow\min;\sum N\rightarrow 0;\\ S\rightarrow 0;\\ I\rightarrow 0.\end{gathered}\tag{13}$$

Substituting the values (12) in equation (10), we get

$$MB = \sum A_i^{P_i} \text{ , т.е. } MB=V_{A1} \text{ ,}$$

what proves the validity of the expression (10).

Using the manageability scale, the Manager can assess the state of Affairs in the organization and, if necessary, take administrative measures. In our case, if MV<0.5 means that the organization is experiencing a decline in manageability, which makes it necessary to take measures to correct administrative control and develop management decisions that help stabilize and improve the situation in the organization. I.e., it is necessary to optimize the u function. To carry out such measures, the center must have reliable and up-to-date information S that allows identifying the "culprits" of distabilization, both at the upper and lower levels. This is done on the basis of the algorithm for accounting for the human factor in organizational management shown in figure 6.

In General, the As center observes the change in the coefficient of Mvogd and evaluates the manageability of the entire system. Further, the center can assess the socio-psychological state of each AE without communicating with them by looking at the Mvdep and MBE coefficients. All this gives the As center the opportunity to reduce communication time.

If we quantify the functional U = G(□(i,s,n,a1)), we can construct a functional that expresses the control action given in expression (2). Since the parameters i,s,n,a1 are reactions of AE to control actions, the functional G looks like:

$$G(\eta)=(\eta\to i)\&(\eta \to s)\&(\eta \to n)\&(\eta \to a1), \qquad (14)$$

где $i\in I;$ $s\in S;$ $n\in N;$ $a1\in A1,$ $\eta\in U,$ численные значения этих параметров берется из таб. 1.

The most characteristic reaction of subordinates that appears when there is a contradiction is the resistance S, selectivity I, activity A1, uncertainty N to the contradiction of managerial actions (figure 6). Contradiction is the result of interaction between parties with different degrees of perception and evaluation of the same phenomenon or object, which at the same time are in internal unity (within the same system) and are a source of development and knowledge.

It can be seen from (9) that G(□) takes two values 1 and 0. Naturally, AC works efficiently when G(η)=1. If we make a truth table (9), we will see the nature of optimization of control actions in the AC.

Let's assume that As has a goal $\Psi_{A_c}(X,\Omega)$ in the form of plans X and a set of active elements of the OU that perform these plans. The active element also has a goal $\Psi_{A_c}(x_i, y_i, r_i)$, where $x_j\in X,$ $y_i\in A,$ $r_j\in\Omega.$ Because of the difference (goal mismatch) $\Psi_{A_c}(X,\Omega)$ - $\Psi_{A_c}(x_i, y_i, r_i)$ you receive the active elements of psychological reactions $i\in I;$ $s\in S;$ $n\in N;$ $a1\in A1,$ on control actions $\eta\in U$ center's A_s. Such reactions are generated due to contradictions between the goals of As and the goals of AE. As a result, there is a need for the administrative control procedure AK: G (η) � ŝ, for the implementation of the plan XI ϵ x by the active elements of as. Ŝ –this is information about whether or not the plan is being implemented by the active elements of the As. This information is the "food" for the existence of the system itself, i.e. it plays the role of the "synovial shell" in the activity of the As. Where X is the set of AC plans that it should perform; XI is the plans that AE should perform; and A is the set of States of As after the effects of U; η - a set of AE types. The stages of contradictions for the Manager are an assessment of the manageability of A s. Correct assessment of the corresponding stage of contradictions can increase the controllability of the AU operation. The question arises, how can such communication be carried out?

As noted, the center spends 50 to 90% of its time on communication. This seems improbable, but it becomes clear when you consider that the center does this in order to realize its roles in interpersonal relationships, information exchange, and decision-making processes, not to mention the managerial functions of planning, organizing, motivating, and controlling. Further, information is exchanged in all the main types of management activities. Let's call this process of influencing communication. To effectively implement impact communication, we need to algorithmize the assessment of socio-economic and psychological parameters that characterize the relationship of AE to the interests of As. Such characteristics can be socio-psychological parameters characterized by parameters S,A1,N,I. In practice, such parameters can be as shown in table 1.

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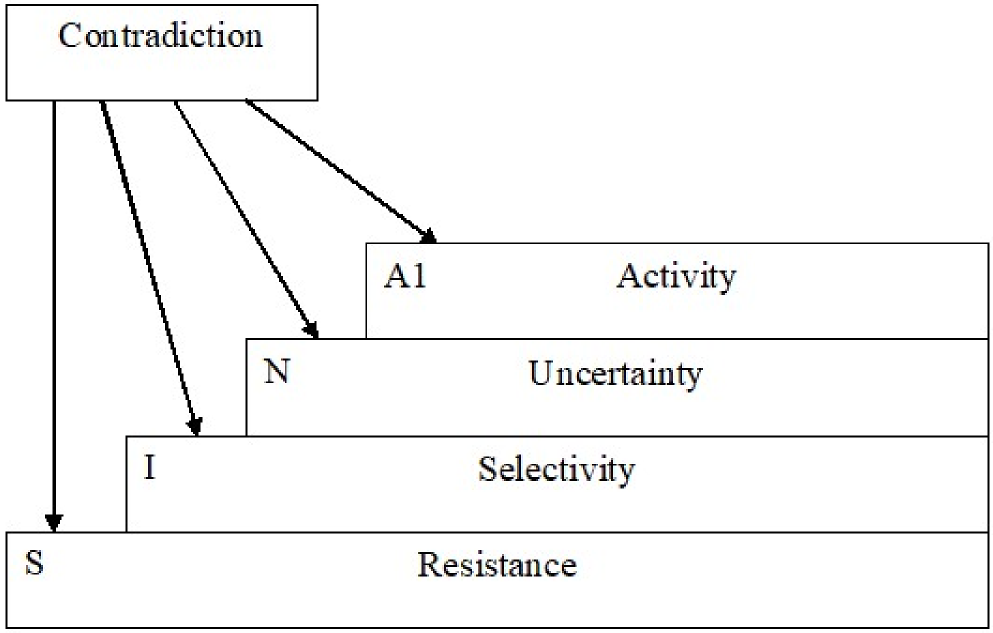

Figure 6 - Stages Of Communication

Now we can construct a functional of the susceptibility of the active element to control actions η, for example, as follows:

$$MB_{A_e}(\eta) = \begin{cases} 1 & if\ A_e\ perceives \eta; \\ 0.75 & if\ A_e\ partially\ perceives\ \eta; \\ 0.5 & if\ A_e\ indifferently perceives\ \eta; \\ 0.1 & if\ A_e\ partially\ does\ not\ perceive\ \eta; \\ 0 & if\ A_e\ absolutely\ does\ not\ perceive\ \eta. \end{cases} \quad (15)$$

This scale is set by the centerThis scale is set by the center A_c.

Every Traveler has a different perception of □. Functionality 〚MV〛 _(AA) (η)

its content expresses the degree of control of AE.

As already noted, if U=G(q□f) control actions, then 〚MV〛 _(A_e)(η) is a functional that evaluates the controllability of AE.

In this case, We (S, I, And 1, N) is a functional describing the type of active element A. in this case, the process of controlling the active element in the algorithmic sense can be written as:

$$U(M_i(S, I, A1, N)) = (\alpha_1^U(M_i), \ldots, \alpha_l^U(M_i)), \quad (16)$$

where $\alpha_1^U(M_i) = P_j(M_i)$ – control predicate of the active element.

In $P_i(M_i)$ - " $A_e \in \mathrm{M}_i$ " M_i – the degree of control.

Thus, U, acting on $A_e = M_i$ $(S, I, A1, N)$, determines the degree of its manageability.

Now we present an algorithm for estimating the fractal dimension D of the control actions U providing the efficiency of control of the active system A_s.

The fractal dimension of the impact η can be found when the planning procedure π for $A_s$is performed.

Suppose that $A_s$is set to plan X. To execute this plan, the center starts the planning procedure. For example, the execution of the plan is divided into several sub-plans for the execution of which the time t is determined.

1. The tasks of plan X are determined. The plan must be completed in time T. We divide the implementation of X into stages, i.e.

$$\begin{cases} X = x_1 + x_2 + x_3 + \cdots + x_i \\ T = t_1 + t_2 + t_3 + \cdots + t_i \end{cases} \quad (17)$$

2. To execute x_1, we determine the values $P\frac{A_s}{ext}$& $P\frac{A_s}{int}$&$P\frac{A_s}{mng}$(Fig. 2). We choose the scale for the external potential $P\frac{A_s}{ext}\cdot\lambda = 1$, then the scale for $P\frac{A_s}{int}\cdot\lambda_1 = 1.6\delta$,, for $P\frac{A_s}{mng} = (1.6)^2\delta$.
3. Then for i = 3 we get the set

$$X = \delta_1 x_1 + \delta_2 x_2 + \delta_3 x_3 \quad (18)$$

4. Forx_1

$$\lambda\eta = g\cdot(\lambda\delta)^{1-D}$$

5. For x_2

$$(1.6\cdot\delta)^{1-D} = \eta_1 \ln(\eta_1) = (1-D) = \ln(1.6\cdot\delta)$$

6. We found

$$1 - D = \frac{\ln\eta_1}{\ln(1.6\cdot\delta)} \quad (19)$$

Here $\eta_1$expresses the essence of the control actions for fulfilling the plan x_1.The fractal dimension of control actions for fulfilling plan X is estimated by formula (19).

To understand the essence of the proposed algorithm for a given A_s, we construct $P\frac{A_s}{o}$with volume V_c^1 (7,8,9) (Fig. 2). This volume expresses the plan X. After we built $P\frac{A_s}{o}$, the question arises of how to choose the points (1,2,3) that express the plan x_1, points (4,5,6) that express the plan x_2 and points (7,8,9) expressing the x_3 plan. The stability of the parallelepiped or the controllability of $A_s$depends on the choice of these points [7]. Suppose we organized an $A_s$with the potential $P\frac{A_s}{o}$to perform a certain job (such work could be the release of products, or the organization of some kind of service, etc.).

First of all, estimating $P\frac{A_s}{ext}$and $P\frac{A_s}{int}$and $P\frac{A_s}{mng}$we will build a parallelepiped, i.e.$P\frac{A_s}{o}$. Next, select point 7. The distance 07 is defined as the size L. After, select point 9. At the same time, the distance 09 will be equal to 1.6L. Next, select point 8. In this case, the distance 08 should be equal to $(1,6)^2$=2,56L. With this choice of points, the sides of the parallelepiped retain their orthogonality. The following points 4 and 1 are selected according to the principle of the "golden" section, i.e. 1,4/4,1=1,6.

The first fraction V_c^1 *(1,2,3)*, the second fraction V_c^2*(4,5,6)*and the third fraction V_c^3 *(7,8,9)*..

When there is a planning procedure $\pi{:}X\rightarrow S$the center will be guided by its $P\frac{A_s}{o}$. Suppose that the center of $A_s$has drawn up a development plan for X_{1m}focusing on V_c^1 *(1,2,3)*. After fulfilling this plan, the center will draw up a plan X_2focusing on V_c^2*(4,5,6)*, finally fulfilling the plan X_2, the center will draw up a plan X_3 focusing on V_c^3 *(7,8,9)*. This is how $A_s$will develop. As soon as $A_s$has exhausted his $P\frac{A_s}{o}$, the center should present a new target $\Psi\ A_s$or change the mission of A_s.

When there is a planning procedure $\pi{:}X\rightarrow S$the center will be guided by its $P\frac{A_s}{o} = V_c^1$ *(7,8,9)*. Suppose that the center of Ac has drawn up a development plan x1, focusing on Vc3 (1,2,3) corresponding to $P\frac{A_s}{o3}$. In this case, the functional $K_1(\eta_1, P\frac{A_s}{o} = c_1V_c^3\ (1,2,3))$ estimates the efficiency of the first fractal A_s. After fulfilling this plan, the center will draw up the x_2 plan, focusing on V_c^2*(4,5,6),* and the functional $K_2(\eta_2,\ P\frac{A_s}{o2} = c_2V_c^2(4,5,6)$ will evaluate the efficiency of the second fractal. And finally, having completed the x_2 plan, the center will draw up the x_3 plan based on = V_c^1 *(7,8,9)*. The functional $K_3(\eta_3, P\frac{A_s}{o1} = c_3V_c^1\ (7,8,9)$expresses the effectiveness of the first fractal. Each stage of the plan implementation depends on what measure of influence the center chooses. In choosing these measures, the center will need the fractal dimension D of the impact force f. Here c1, c2, c3 is determined from the fractal dimension D of each fraction (paralelepiped).

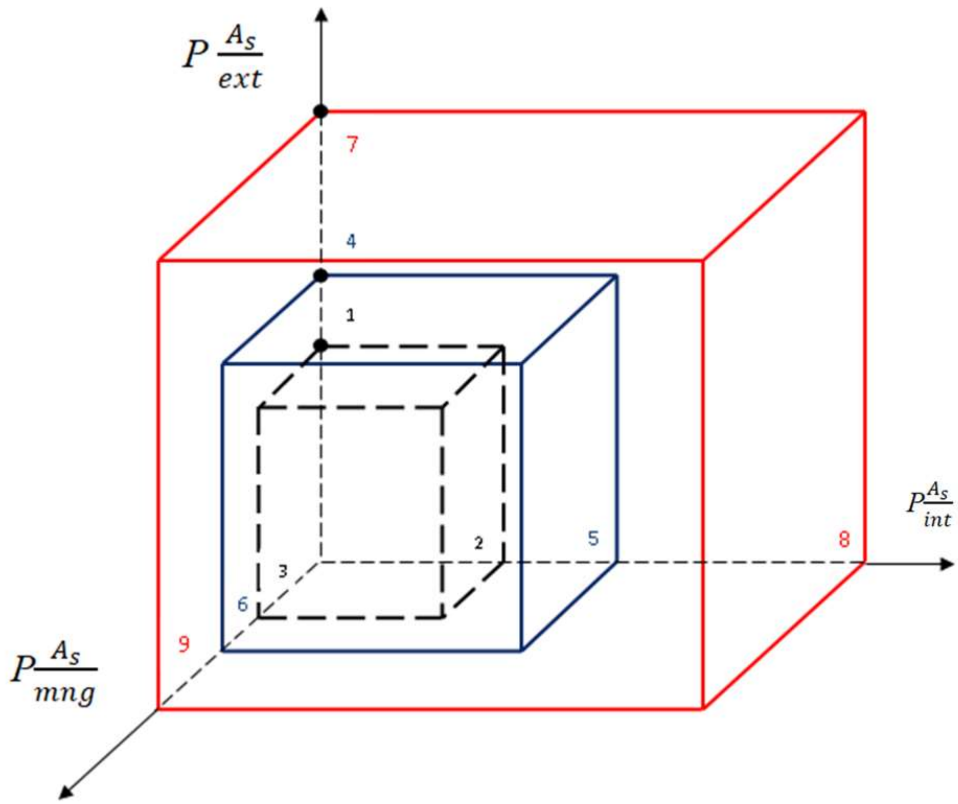

Fig. 2. Fractal Planning Procedure П:X→S

These dimensions are estimated from the following considerations: if a fractal is formed of *N* similar elements with similarity coefficients k_1, k_2....k_N, then its dimension can be found by the formula [10]:

$$D= \ln(N)/\ln(1/k) \quad (19)$$

At each stage of the implementation of the plan, new control actions take effect. This does not mean that the plans implemented so far are not taken into account, but it only means that to implement the new plan it is necessary to change the measure of control actions.

After the planning procedure, the components of the potential Ac are selected by formula (4), i.e. according to the “golden section" rule, the internal potential $\mathcal{X} = 1.6$ is used, i.e. $1.6 * P\frac{A_s}{int}$, and the control potential is selected according to the “golden section” rule with respect to the internal potential, i.e. $P\frac{A_s}{mgn}: \mathcal{X} = (1.6 \cdot 1.6)$.

as for the control action:

$$\eta = G(f) f^{1-0.6} = G(f) f^{0.4} \quad (20)$$

From this formula it follows that the depth of exposure should be $f^{0.4}$ greater than *f*.

So, thus:

$$U \sim f^{1-D} \quad (21)$$

i.e. effectiveness of the power depends on the strength of the effect. All of the above takes place for one parallelepiped. For the next box we use the law of self-similarity.

Conlusion. The fractality of the organization is formed depending on the form of the planning procedure *π:X→S*. The planning procedure based on $P\frac{A_s}{o}$ =($P\frac{A_s}{ext}$&$P\frac{A_s}{int}$) &$P\frac{A_s}{mng}$ allows us to estimate the fractal dimension for control actions

$y = G(\eta)$. The consequence of this will be an assessment of management effectiveness. Since the control action has strength and depth, this gives the A C center the ability to optimize

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the control actions. This optimization involves taking into account the human factor. In turn, such accounting allows the center to adjust the fractal dimension D of control actions accordingly. A adjustment D is made by adjusting the plan. For optimal determination of D, it is important to find the points that determine the dimension of fractals(planning stages). The most optimal point is the points located between the fractals defined by the "Golden section" principle. For fractal management, it is important how the points determining the dimension of the fractals are located (planning stages). The most optimal is the arrangement of fractals on the basis of the "golden section". When we present the form of the planning procedure in the form of a parallelepiped (Fig. 2), then the use of the organization's potential components will be the initial condition for the stability of A_s. It is relation (4) that is the regulator of $A_s$for a turbulent market. In principle, it is possible that turbulence can turn into chaos. In this case, when designing the AU, it will be necessary to take into account the fractality of the active system. Otherwise, the active system cannot quickly adapt to the fractals of chaos. Today, this is becoming relevant.The $A_s$and its control system built on this principle provide not only the efficiency of control [18], but also the stability of the $A_s$itself [3].

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