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TOPOLOGY AND INTERACTION OF SETS

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ABSTRACT: THE PURPOSE OF THE ARTICLE IS TO PRESENT THE INTERACTION BETWEEN THEORETICAL, ANALYTICAL EVOLUTIONAL AND TOPOLOGICAL MODEL OF THE SET OF A SYSTEM.
THE ANALYTICAL MODEL IS DEVELOPED ON THE BASIS OF THE BOLTZMANN EQUATION.
THE EVOLUTIONARY MODEL IS AN ORIGINAL PRODUCT OF THE AUTHOR. IT REPRESENTS A SCALE OF RELATIVELY STABLE LEVELS OF ORGANIZATION OF PROCESSES. THESE PROCESSES ARE RELATIVELY INDEPENDENT. THEY ARE ARRANGED IN RISING SERIES OF VALUES OF THEIR TIME CONSTANT.
THE TOPOLOGICAL MODEL DEPICTS THE SPACE OF THE STATE OF A SYSTEM.
THE MUTUAL CROSSING OF THESE MODELS IS THEIR COMMON CHARACTERISTIC. IT HAS A PROJECTION ON THE STRUCTURE OF THE SET OF A SYSTEM. EACH SYSTEM HAS VARIABLE, NEUTRAL AND FIXED SET.
THE PROJECTION IS A MEANS OF CONCLUSIONS ABOUT THE BEHAVIOUR AND INTERACTION OF SYSTEMS.
THE MODELS ARE METHODOLOGICAL INSTRUMENTS IN OTHER AREAS OF THE KNOWLEDGE. FOR EXAMPLE: IN BORDERLINEAREAS OF THE KNOWLEDGE. THE THEORETICAL MODELS MAY HAVE A COMPUTER APPLICATION.

KEYWORDS: PSYCHOLOGY, SET, STRUCTURE, TOPOLOGY, THEORETICAL MODEL.

Entropy

The system includes a multitude of subsystems. Each subsystem might form a multitude of relatively stable conditions. They are departures from the set of the subsystem in various aspects. Each deviation might be rerpresented as a trajectory in the space of the state of a subsystem.

The deviations from the sustainability of subsystems form a network of trajectories in the space of the condition of the system that unites them. This network includes the conditions of subsystems that form a steady-state of the system that unites them.

The relationship between the possible subconditions and the entropy of the system is formulated by Ludwig Boltzmann in his kinetic theory of gases:

(1) $$S = k \log W,$$

where k - the constant of Boltzmann,

W- the number of possible subcondition in which the system may have a specific macro condition.

The condition characterizes a part of the variabile set of a system. If the current relation of the system is constant, then the variable set is represented by the condition of this system.

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The set of a system is determined by the combination of the sets of the subsystems by which it consist. The change of the set of a system is geared towards development or degradation. These processes are function of exponential law.

"When the entropy is equal to zero, it must be assumed that the accuracy of the set, its specific gravity is approaching to unit" [1], i. e. the logarithm of the set is equal to the value of the entropy:

(2) $$\mathbf{H = k.\ ln\ Z\ ,}$$

where **H** - entropy of a system,
Z - set of a system,
k – coefficient of proportionality.

If the system includes only one subsystem k = 1. The entropy H changes in the range from 0 to 1 → 1 < Z < e, where e ≈ 2.72.

The importance of each subsystem decreases when their number in the system increases. Respectively the value of k for concrete subsystem decreases.

Rank

The following processes on rank are [2]:

r1 - process of searching for a solution,
r2 – interaction (action, reaction) between subject and object
r3 – individual development of particular system,
r4 – development of the kind to which the system belongs,
r5 - trend of development of species to which the system belongs,
r6 - development of organization of the matter.

The human brain develops first (rank r1), then - the ability to move (rank r2) and finally - the ability to self-individual development (rank r3), in young age - the reproductive ability of the man (rank r4).

On this basis the equation (2) can be represented as:

(3) $$\mathbf{H = k^{r}\ .\ ln\ Z^{r}\ ,}$$

(4) $$\mathbf{\sum_{r=r1}^{r6} k^{r} = 1,}$$

$$\mathbf{0 < k^{r} < 1,}$$

[1] Бжалава И.Т.(1966) Психология установки и кибернетика, Наука, Москва, с.237.

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[Bjalava I.T. (1966) The psychology of the set and cybernetics. "Science", Moscow, p. 237].

[2] Ламбаджиев Г.(2012) Функционалност и установка, Хомо институт, София, с.141 [Lambadjiev G.(2012) Functionality and set, Homo Institute, Sofia, p. 141].

where $\mathbf{H}^{r}$ – entropy of system of rank r ,

$\mathbf{Z}^{r}$ – set of rank r of system,

$\mathbf{k}^{r}$ – percentage of entropy of rank r in entropy of system.

The behavior of system is designed for:

1. mainly - for preparation for reaction (r1) to external impact,
2. second - for formation of reaction (r2).
3. third in importance - control and regulation of individual development (r3).
4. for development of processes of higher rank.

In general by zero external disturbing impact:

$$\mathbf{k}^{r+1} < \mathbf{k}^{r}, \quad (5)$$

where $\mathbf{k}^{r+1}$, $\mathbf{k}^{r}$ – percentage of contribution of entropy of rank r+1 and r in the entropy of system.

The system focuses on processes of rank r1 and r2 by external impact. The system alternates between processes of rank r1 and r2 according to the circumstances.

Topology

The inner set of system can be displayed in topological space cone shaped. The cone is part of the topological space in which the system works normally. The cone represents the functional space of system.

The area to the base of the cone express the variabile set of the system (processes of rank r1 and r2). The system interacts with the environment by the variable set.

The area around the top of the cone expresses the fixed set. It characterizes the history of the system (processes of rank r4, r5…).

Between the top and the base of the cone is positioned the neutral set (processes of rank r3). It transforms information from the variabile to the fixed set and back.

The conical form FS of the set of the system illustrates:

- the evolutionary continuity of the processes in system of rank (4)
- the non-linear degree of importance of rank (5).

The process of searching for a solution (rank r1) goes through the various ranks and levels of organization. They change differently the starting information. That's why the search

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for a solution cannot be represented as a sum of the values of the entropy on the trajectory of the process. For example: the creativity of director and the creativity of worker cannot be compared, as they are applied to objects of different levels of organization.

Interaction

The contact between topological surfaces FS of the sets of systems might take place in point (fig. 1a) or on line (fig. 1b).

The contact in a point expresses:

- link between two concepts or categories through a single concept or terms,
- equality between levels of organization through which the systems interact (r2).

The contact on line FS expresses links between the sets of systems by rank and level of organization. These links are realized through various categories, concepts or terms (processes of rank r1 and r2). With increasing of the rank the role of the categories increases and their number gradually reduces. Above the rank r5 it is posible no formulated means for description of processes to be find.

Fig. 1. Topological schemes of contact (К) between conic functional spaces FS of systems S (FS-S) and O (FS-O)
a – point contact
b – line contact

In general, the active system realizes a contact with the passive system through part of its subsystems. These representatives of an active system have a low value of entropy (energycal or/and informational). For example: a company send its own experts for installation of its mashine.

The value of the entropy of a system pulses depending on:

- the program for individual development of the system (rank r3),
- the impact of the environment (rank r2),
- the factors that consistently participate in the process of searching for a solution (rank r1).

More complicated problem extends the range of variation of the entropy of the process of searching for a solution. To solve a complex problem it's possible to involve processes of higher rank.

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The trajectory of the search for a solution may take place in the limits of the functional space FS of the system or outside it. The outer trajectory is a result of the interaction of a system with other systems (fig. 2). This trajectory is an external functional space of FS.

The main reasons for the branches of FS are:

- insufficient potential of a system to realize success in concrete interaction (rank r2),
- excess of individual development potential of system (rank r3).

The branches of FS take part of the topological space. It's possible to form new branches of FS in the free topological space.

The polarity of the behavior of a system changes in the process of its individual development. Accordingly the polarity of some of the categories, concepts and terms that govern the behavior of this system changes.

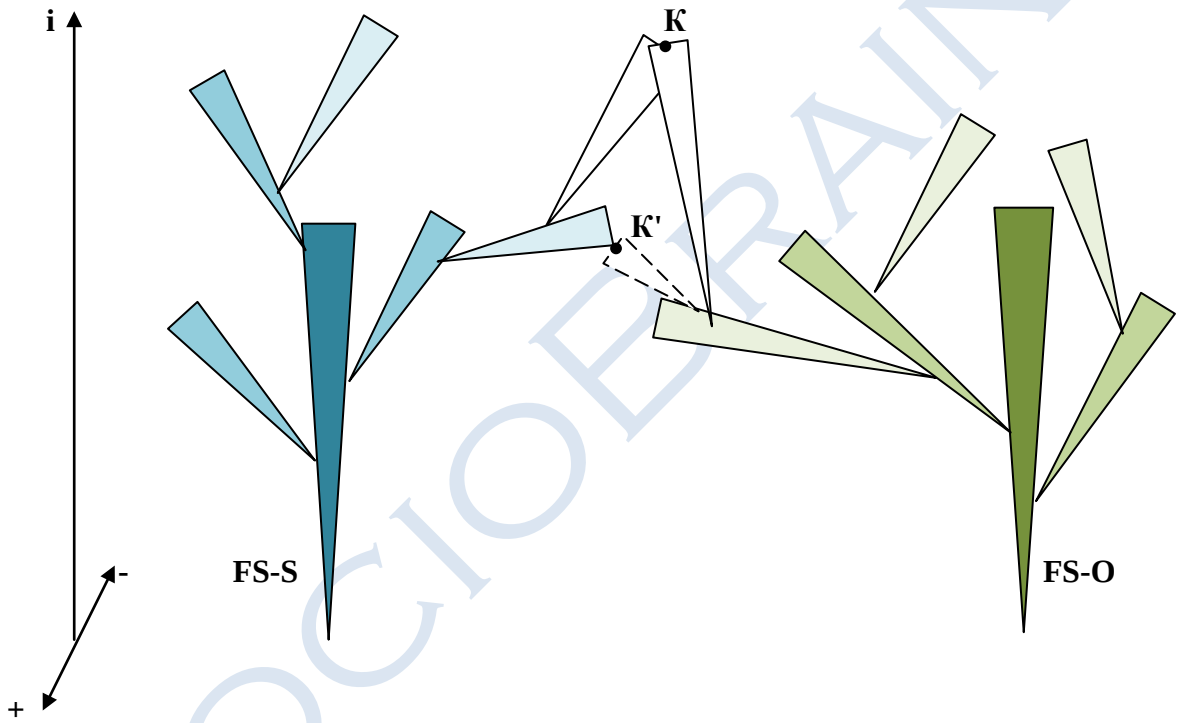

Fig.2. Scheme of topological branches of functional space FS-S of subject S and of functional space FS-O of object O by interaction between S and O in terms of levels of organization i

K – real contact between subsystems S and O

(K)' – potential contact between subsystems S and O

+/- – polarity of the importance of structures of FS in the process of interaction between S and O

- real branch of the FS

- potential branch of the FS

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In the process of the interaction between S and O the importance and the polarity of concepts with which they operate changes. Each concept or category has an individual FS. The branches of FS of the system are shifting in the topological space depending on the managing it concepts or categories. They dangle, bend, change shape and length.

The most dynamic structures are patterns of the variable sets of S and O. They represent behavior of concepts wich change their importance most quickly.

The concepts, which are amended with minimum speed or not amend, characterize the fixed sets of S and O.

The impact of a subject on an object realizes as a chain of FS of categories and concepts (fig. 3).

Different combinations of concepts and categories can be formed by computer modelling. These combinations:

- have a minimum entropy
- can be realized through real structures or processes
- form the desired results.

S may make contacts K1 and K2 with O at different trajectories (fig.3). The combination of different contacts increases resistance of the impact. The impact of contacts can be simultaneously or by alternation in time.

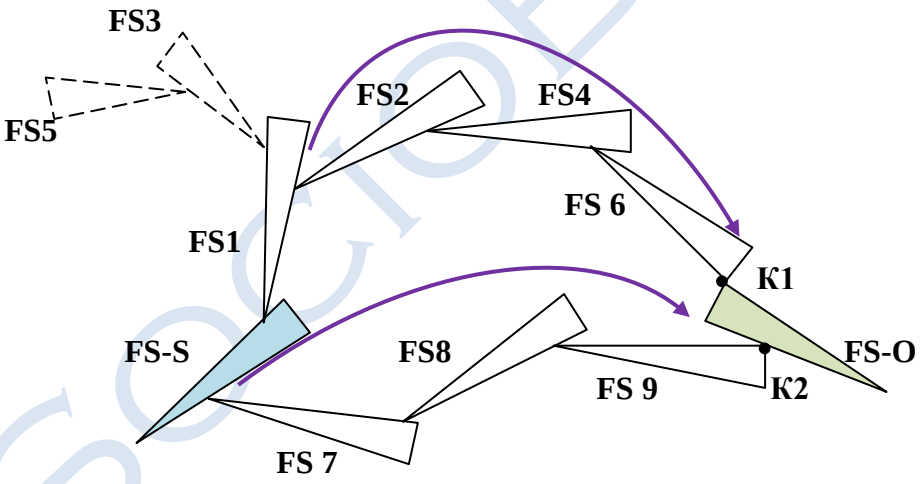

Fig.3. Scheme of correlation between cone functional spaces of rank r1 of the subject FS-S and the object FS-O through different combinations of FS (FS1, FS2, FS4, FS6, FS7, FS8, FS9) forming different contacts K1 and K2; FS3 and FS5 didn't form any contact with subject FS-O

direction of forming of the connection

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In the process of individual development of category, concept or term can extend the sphere of their importance. Some concepts acquire importance of categories. Respectively the volume of their FS increases as:

- the number of channels increases that form the specific link between S and O. The increase of the number of the channels is a prerequisite for increasing of the stability of this connection.
- the number of categories, concepts or terms which form a specific connection between the meanings (present) reduces. The reduction of the number of the intermediate elements increases the accuracy of the transmission of information.

The accuracy of the transmission of information in these channels is likely to rise if they are independent: for example, channels by rank or level of organization. The information that flows in the channels has a different semantic language.

In general the system of the subject consistently interacts with various objects. The interaction takes place through various management factors. In this process the subject quickly changes its set. This means that the periphery of FS of the subject dynamically orients to FS of an other system. This interaction may be presented through functional plane (cross-section of FS, in which the interaction realizes) (fig. 4).

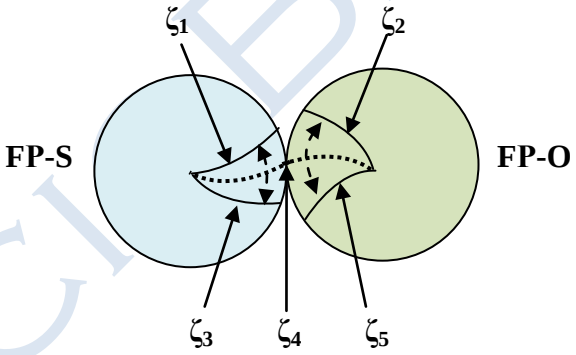

Fig.4. Topological scheme of contact between the functional plane FP-S of a subject S and the functional plane FP-O of an object O by managing factor ζ_4
ζ_1 , ζ_2 , ζ_3 , ζ_4 , ζ_5 - trajectories of governing factors, depicted in the cross-section of the functional spaces of the subject and the object

The subject may make simultaneous contact with different objects at different levels of their organization. Respectively FS of the subject can be twisted along its length with different dynamics.

The topological structure of the set of a system is similar to the coral, and its behaviour – of the seaweed. The fixed set may be presented through the roots of a tree. The neutral set may be presented through the trunk of a tree, and the variable set - by the branches of the tree. The leaves of the tree of the system contact with the environment.

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Conclusions

1. **The internal functional space of a system is a model of inner set of system. The internal functional space of a system in topological aspect represents a cone, that vibrates, twists and bends with variable dynamics in all its points.**
2. **The external functional space of a system is a model of the internal set of a system. The external functional space of the system in topological aspect represents spurs of cone in various directions. They pulsate depending on the environment.**
3. **From conclusions of 1 and 2 it follows that the set of a system developes as an adaptive system. The system searches options available in the functional space for its development through its external functional space.**
4. **In the general case the interaction between systems realizes by a chain of categories and concepts.**
5. **In the general case the contact of an active system with a passive system realizes by a category or concept, which have low entropy.**