https://doi.org/10.46813/2022-141-124

GRAPH-ANALYTICAL MODELS OF COMPLEX SYSTEMS FOR STATE ASSESSMENT "ORGANISM – ENVIRONMENT"

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Practicism in business is generally associated with obtaining high-performance goal-setting solutions. Cost reduction in the case of making a decision requires weight components identification in the object "state (environment) – system processes – system end state" associated with the structure or functionality of systems (processes), which themselves arbitrarily determine the target result. The works aim is to determine model type of a complex structured object of any purpose, which adequately reflects system state and interaction with the environment "(environment – system) – process – (system state – environment)" in a situation of varying degrees uncertainty. Assessment of systemic formation state is due to the grouping of methods, their complex application in the study of the interaction "system – environment", which is determined by the corporative relations between the components. To solve the problem of quality assessment of such system objects, structural and graphical approach information and methodological support was offered as a set of methods.

PACS: 519.2

1. RELEVANCE OF SUBJECT, RESEARCH TASK

The fundamental possibility of developing a comprehensive generalized approach to complex systems study and their simulation models determining is theoretically based on a number of common interdependent patterns acceptable to such different nature systems:

- the interaction of parts and whole (integrity – emergence and integrativeness), a pattern that is twofold to integrity – physical additivity (summation effect) and singularity in independence;
- hierarchical ordering (communicative, hierarchical);
- functioning and development (historicity, self-organization);
- systems implementation (equivalence, law of the required diversity, potential efficiency);
- target their formation.

On the basis of these regularities the rational choice of appropriate research methods, "synthesis" them for the purposes of providing the general methodological base of complex systems studying is substantiated.

Practicism in business is generally associated with obtaining high-performance goal-setting solutions. Cost reduction in the case of making a decision requires weight components identification in the object "state (environment) – system processes – system end state" associated with the structure or functionality of systems (processes), which themselves arbitrarily determine the target result, that is, they are self-organizing. At the end of the analytical and evaluation study of a complex object, it is necessary to have information about its status and compliance with effective functionality requirements (whether the factors of achieving this due to the implementation of DM) are revealed. The situations uncertainty with the "system – environment" object is eliminated by increasing the information content and reducing the entropy at the negentropy process.

The works aim is to determine model type of a complex structured object of any purpose, which adequately reflects system state and interaction with the environment "(environment – system) – process – (system state – environment)" in a situation of varying degrees uncertainty.

In accordance with the stated study goal in the article proposes to consider the following justifications for the adoption of graph-analytical models of information-entropy content and suggestions for their use:

1) consider a complex system in accordance with its physicochemical nature and systemic structure, interaction with the environment, determine the arbitrary processes location of self-organization to maintain stationarity in the object on the example of "organism – environment";

2) to substantiate the expediency of using appropriately graphic models and structural matrices for the functioning dynamics study of an object view "system^0 – process – system^1" on the example of interaction "organism – environment";

3) give an example of practical implementation of the proposed complex objects structural modeling in the form of nested graphical constructs based on cognitive analysis.

2. LITERATURE REVIEW

Unstable objects state leads to qualitative transformations, changes and restructuring, which requires timely detection based on a comprehensive state assessment of "system – environment", compliance analysis with an acceptable safety level of the environmental systems functioning consequences to prevent dangerous situations. Particular importance in such studies is the information component, which takes into account the qualitative systems characteristics, quantitative assessments of their interaction with the environment allows to solve problematic tasks in assessing the security level of complex objects at different organization levels based on computer software systems development processing ecological research data in accordance with the system analysis theory and providing knowledge methods in the field of modern scientific research.

In this case, it is relevant to introduce a methodology for assessing the level of research objects security state, in particular the organism as a complex system, based on information and methodological support for the complex determination of systemic formations state that include methods of system analysis, synergetics, information theory and weakly structured systems modeling using information entropy functions. The theoretical and applied basis of these studies is based on domestic and foreign scientific and theoretical works, such as I.R. Prigogine [1], Xinghao Wang. [2], J. Kumari [3], Jae-Yoon Jung [4], Parvathi Chundi Rui Zhang [5], D. Abásolo et al. [6], V.L. Lazarev [7], E.I. Kucherenko [8], A.S. Savchenko [9], Ph.D. Pirnazarova [10], and the like.

3. MATERIALS AND METHODS, RESULTS, DISCUSSION

The proposed information and methodological complex of the research in a specific sequence of its implementation is aimed at identifying self-organizing structures and processes to achieve the goal (solving the stabilization problems, harmonization, obtaining new quality), which provide for the object:

- effective interaction with the environment (ensuring object sustainability) – analysis methods of topological and cognitive models, entropic correspondences evaluation;
- predictability of stability or change – cognitive analysis, comparative identification, probability estimation of destabilizing uncertainties manifestation – entropy-information estimation;
- support of stabilization arbitrary processes "environment – system" – thermodynamic changes analysis, entropic processes assessment;
- obtaining knowledge about the object "environment – system".

As an example of systemic formation, it is proposed to consider a complex system "organism", which is a component of study object "environment – organism" in the form of "system^0 – process – system^1" [11-13].

An organism is characterized by the matter fluctuation stability due to the high level of its self-organization, self-reproduction within nonequilibrium systems thermodynamics, the structure evolution and the ability to accumulate information *J*, which is characteristic of systems with a high degree of cooperation (interaction). The state continuity at the genetic level is due to the provided organism reserves and previous generations entropy [14]. Within the study of the object "environment – organism" distinguish cooperation internal, as the creation of relationships between systems within the organism, and external, as interaction with the environment that is stable integrity and defined by the manifestation of certain changes, phenomena, processes of positive and negative character [12, 13].

The fluctuation occurrence in organism systems is caused by the negentropy absorption from the surrounding space, which further determines some sequence of nonequilibrium states that, under the action of control parameters, direct the system to self-organization or degradation – disease of the organism with increasing entropy. The emergence of new structures, changes in the body at the level of entropy-information analysis is defined as the result of the cooperative integrity functioning "environment – organism" [12]. The specific organism in the process of individual development entropy enters the life path by parabola, which determines its temporal existence space: the more entropy after a minimum, the less time in the organism to reach its maximum value, that is, until the end of existence.

For all individuals, the parameters of the parabolic dependence differ only in the shift along the axis of entropy and have the form:

$$S^{\text{input}} = a(T+b)\cdot n + C, \qquad (1)$$

where T – lifetime; a, b, n, C – equation parameters.

Thus, according to expression (1), an organism with less entropy at a point on the time axis has greater prospects for existence [14].

From the standpoint of the complex study "state (environment – system) – process – system state" according to the provisions of nonequilibrium open systems thermodynamics of biological dynamic systems (BDS) functioning is associated with the production of entropy determined by Lyapunov function [15-17]. In an isolated system, this function increases over time, positively (or negatively) defined, asymmetrically stable in the equilibrium state, which is the attractor (attraction zone) of this function.

An organisms entropy background is described as a physico-chemical system, and use the Lyapunov function $F(x_1, x_2, .., x_N)$, which for some steady state system $\overline{X}(\bar{x}_1, \bar{x}_2, .., \bar{x}_N)$ is $\overline{F}(\bar{x}_1, \bar{x}_2, .., \bar{x}_N) = 0$ and marked in his environment, that is $F(x_1, x_2, .., x_N) \geq 0$ or $F(x_1, x_2, .., x_N) \leq 0$.

Thus, when analyzing changes in the system, the sign derived from the Lyapunov function is investigated dF/dt, stating the steady state is stable provided that the sign of the Lyapunov function F is different from the sign of its derivative dF/dt near the stationary point. If the signs of the Lyapunov function F coincide and its derivative dF/dt ascertain an unstable steady state:

$F \geq 0, dF/dt \leq 0$ or;
$F \leq 0, dF/dt \geq 0$ – state is stable;
$F \geq 0, dF/dt \geq 0$ or;
$F \leq 0, dF/dt \leq 0$ – state is unstable. (2)

It is proposed to analyze the system entropy state in the form of the Lyapunov function on the basis of a coefficients matrix of fluxes and forces that are connected in a linear fashion. This relation is determined by Ozanger's principle of thermodynamically describing open BDS equilibrium state.

A complex study of the system "BS state – environment" in accordance with the information-entropy approach provides a characterization of the state and the flow of certain processes by the entropy function, which is an informativeness measure. The study involves working with models in the form of a structural matrix, a topological graph, a cognitive map to determine the destabilization factors, disease causes, regulatory mechanisms.

Organization of the systemic entities study as “organism – environment” is associated with the implementation of research actions, as “object (system) metaset description” – “metamodel research”, which includes the following components:

$$M=\{M_O\,(Y, U, P), M_E(X), M_{OE}, M_D(Q), M_{MO}, M_{ME}, M_U, A, M_{\rm n}\}, \quad (3)$$

where $M_O\,(Y, U, P)$ – the identifying model of the object (system model) in which the vector Y – endogenous variables, U is managed variables vector, P is the resources vector; $M_E\,(X)$ is an environmental model where X is exogenous values; $M_{OE} = \{M_{SX}, M_{SY}\}$ – object-environment interaction model (M_{SX}, M_{SY} – Input and output environment communication models) $M_D(Q)$ – the system behavior model according to Q – the object perturbation effect; M_{MO}, M_{ME} – models for measuring the system state and the environment; M_U – model of the control system; A – the choice rule object change processes; M_n – researcher (“observer”).

Organism stabilization under the condition of its existence in the object “environment – system”, the functioning of its organs, tissues (blood), cellular elements at the local level are related to the course peculiarities of crystallization processes within the biological fluid, the specific thesiographic structures (STS) formation from multicomponent liquid environments of a living organism. Such processes are determined by the disorder reduction and the achievement of the minimum possible entropy state, which is zero entropy changes and the informative system maximum achievement [11, 13]. In this situation, new knowledge about the persistent elements evolution of the system low level behavior to a high level of living organization is minimized, with the minimum free energy consumption of the structured components.

The structural elements integration and the new states emergence allows to harmonize “environment – system/organism”, which is determined on the basis of entropy analysis of the system integrative properties emergence in nonlinear systems. Coordination, cooperation, joint action, that is, synergetics reveal the attractor that sets an arbitrary self-organizing mode of systems behavior by harmonizing structures.

Energy is the totality measure of the processes implemented, and the cause and effect relationships regarding the direction of these processes and changes in matter of the living and inanimate nature are information. Accordingly, any complex system of living and inanimate nature is a thermodynamic system whose state and changes in which are characterized by structural entropy (estimation of the equilibrium attainment degree) and information entropy – an integral approaching maximum and a local one that varies from 0 to 0.38, the so-called golden ratio (GR), the harmony of the living [19]. In search of a minimum cost of free energy, a living healthy system implements self-organization mechanisms. In case of disease, in extreme conditions, the process of structuring the STS does not correspond to the golden ratio.

In characterizing the interaction of living and nonliving, living systems and non-living systems with each other, adaptation in general to the environment of the studied object uses a local component of information entropy, which decreases in the process of removing the contradiction between the system and its environment, the transition of structural to information entropy with its maximum value. As a result, chaos and disharmony, which cause dysfunction and pathological conditions and life threatening, is reduced by structuring and positive processes in fixing and functioning of systematically stable elements of system behavior, its part or module – patterns that allow autonomous state analysis with situation recognition, use them by natural systems to evaluate self-organization process.

So golden section (GS) pattern in the study of the brain is determined in five of its physiological states with a predominant spectrum of brain rhythm: sleep corresponds to the value of 1…3 Hz; perception of stress information – 3…8 Hz; rest – 8…13 Hz; mental work – 13…34 Hz; emotional disturbance – 34…55 Hz. The properties of the GS are set at time intervals of systole, diastole and complete cardiac cycle, in bifurcations of “heart tees”. Changes that occur in the system during self-organization determine the material, anatomical, physiological, biochemical and biophysical basis of its structural and functional organization, which is identified by positron emission tomography (PET) [20-24].

The work of the brain is naturally associated with interaction with the NA, despite the fact that its thinking functionality occurs in all conditions due to the reorganization of the activity of nerve cells in different brain areas: areas of support for certain activities; flashing zones are connected depending on external influences (causes), ie the presence of certain factors or their absence; correspondence zones to internal circumstances – resistance to monotony – self-organization and reorganization.

The functioning model of this system object is to represent the activity of environmental systems with the action factors determination on the system (brain) and its state, changes in the negative phenomena leveling with the inclusion of certain brain mechanisms. Provided that there is a complete / significant lack of information about the situation, the brain model is accepted a priori. Changes and correspondences of external and internal character are determined by a disparate facts set that fit into the posterior scheme of mapping the situation “environment – system”.

For complex structured objects is suggested to use the latest elements of graph theory and hypergraphs such as metagraphs, etchographs, and more.

Metagraph $S=(X,E)$ is determined by the set of generation X, which consists of elements and is a variable $X=\{x_1, x_2, \dots, x_n\}$ at the ends of the edges, that provided by the set of edges E defined by the generation set [27]. Today, in graph theory, a metagraph is defined by a design that combines ordinary graphs and hypergraphs. There is an ordering of pairs view $G=(X,E)$, where $X=\{x_i\}$, $i=\overline{1,n}$ – finite non-empty set of vertices with functions

$$f_1^l : g_1^l\left(x_1^l, e_1^l\right) \rightarrow$$
$$x_2^p, f_2^p, g_2^p\left(x_2^p, e_2^p\right) \rightarrow x_3^r, \dots, x_{n-1}^t, f_{n-1}^t, g_{n-1}^t\left(x_2^t, e_2^t\right) \rightarrow x_n;$$

$E=\{e_k\}, k=\overline{1,m}$ – the set of edges where $e_k=(V_i,W_i)$, $V_i,W_i \subseteq X, V_i \cup W_i \neq \varnothing$. Therefore, an edge of an n-dimensional graph connects two subsets of the vertices set, which is the concept of an embedded metagraph. The index i determines the level of nesting, and the indices l, p, r, ..., t are the number of vertices and edges at a certain level. Nested metagraphs are a generalization of ordinary graphs, hypergraphs, and metgraphs. For such constructions the vertices x_2^p are graphs hyperframes $g_1^l(x_1^l,e_1^l)$, tops x_2^r are graphs hyperframes $g_2^p(x_2^p,e_2^p)$ etc. In these structures, elementary vertices x_1 are distinguished, which in the absence $g_0^s(x_0^s,e_0^s)\to x_1$ under condition $\{x_0^s\}=\varnothing,\{e_0^s\}=\varnothing$ make a regular graph, and in the absence of the third level vertices $\forall x_2, x_3=\varnothing, e_3=\varnothing$ – metagrapher. The embedded metagraph is converted into a hypergraph when the second level of elementary vertices is unconnected (edges). Attached metagraphs define the overall system concept for describing complex synergistic objects. Such graphical models of real objects reflect a system of objects, phenomena, processes, and situations, each decomposing each of which receives interconnected components independently existing in the relations space with other complex objects [27].

In general, interaction "state – process" is the totality $S_1=\{S_n,S_2,..,S_p=S_ц\}$, which implements a sequence of changes in the form of the initial state S_n through a number of states $S_2,..,S_p$ to sustainable productive S_p, that realizes the target state $S_ц$ systems. In order to obtain the desired result, it is proposed to apply different combinations of control effects U to the initial states to obtain intermediate states $S_2,S_3,\ldots$, that drive development in the targeted direction. In general, the process of transition from one state to another is given in the form of an oriented graph $G=(S,V)$, where $S=\{S_1,S_2,..,S_p\}$ – the set of nested metagraphs that through many arcs $V=\{V_1,V_2,..,V_l\}$ implement control through interaction and influence on the state of relations between the systems elements and the systems themselves. The application of existing knowledge about system and the processes in it determines the correct management action at a certain level of change management in the direction of achieving the goal – the processes situational network. For information to analyze and calculate the governing action, refer to semantic structures for deep search in documents. The information discovery technology according to the enclosed metagram is in accordance with the structured document. The hyper-rib as a technological process is defined by the description of the name, operations, passages.

Specialized systems or embedded components, that focus on the visualization of specific graph models subclasses, include such as Higres, aiSee, yEd, and Cytoscape, a universal visualization system for BSD-licensed Visual Graph hierarchical graphs [25-28].

To study the state of a system object of the type "system – environment" is taken brain as an example, its functionality in the form of a structural matrix in accordance with the methodological support for the assessment of damage sites, a complex of neurons interactions within different zones among themselves by the results of structuring the external and internal environment of the brain (Fig. 1).

The basis for deciding whether to stabilize the complex system of the body as a brain is higher mental function (HMF). Due to the highly efficient monitoring of the distribution in the brain of a disappearing small (about 10^{10} atoms) amount of radioactive isotope 18-fluorodeoxy-glucose, the energy consumption patterns are studied, in the case of $H_2{}^{15}O$ water the local rate of cerebral circulation, etc. is established. The dynamics of the radiopharmaceuticals redistribution, depending on the type of activity reflects the inclusion of different brain areas in its provision. On the scans sections consistently open the entire brain, distinguish between the active zones, inactive and overactive. The latter reflect the disease, inactivity identified at activation of activity zones [21]. Thinking processes are studied using positron emission tomography, which combines two complementary approaches of local and global content – neurophysiological and neurochemical. Thus, the brain activity with the full identity of the stimuli given to the perception of auditory, visual signals changes the pattern of brain structures excitation.

For complex structural-graph analysis of brain activity, complementarity is given in the form of a systematic representation of the study object. When structuring the system "surrounding systems – the system core (zones included for a specific activity) – functionality" are considered rigid, constant, flexible, variable relationships, and to determine the level of its balance is used information-entropy evaluation of the implementation of connections in a particular component environment systems and between systems.

A holistic system-systemes approach for the determination of complex object "environment – brain" in order to evaluate "system state – changes – process– system functionality – conformity state" is considered on the basis of a complex presentation of higher mental function (HMF) realization of the brain according to N.P. Bekhtereva [20], the principle of structural and system organization A.S. Hadrianova, a general structural and functional model of the brain based on the neuropsychological data analysis A.R. Luria [22, 23].

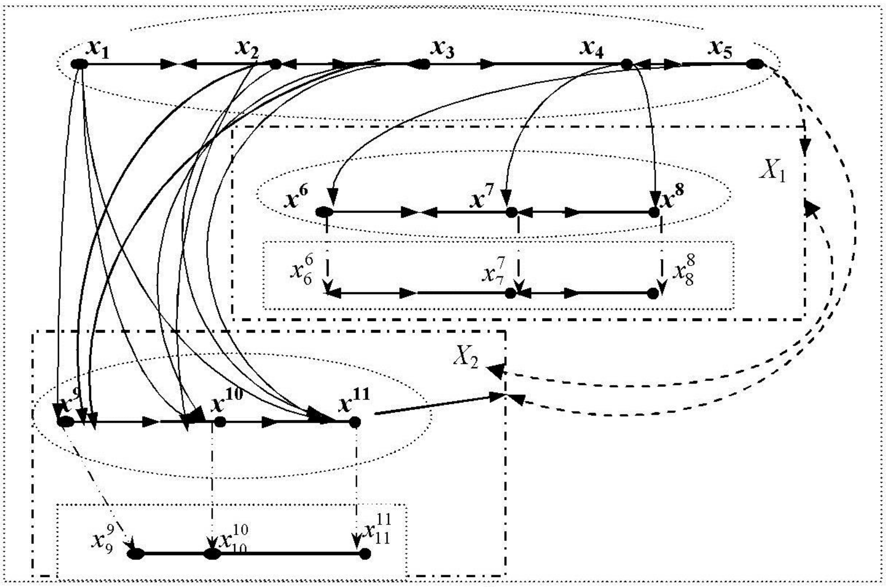
A comprehensive approach to studying the principles of brain organization N.P. Bekhtereva gives an idea of the integrative system of the brain work as a whole, which includes the following components:

1) microstructures at the submicroscopic level in the form of neurons, synapses, glial cells, neural contacts;

2) systems links of brain support of mental activity: rigid – obligatory constant participation in realization of mental functions; "Flexible" – a dynamic device for achieving variability of function.

X_j	X^i	Y_n	x_1	x_2	x_3	x_4	x_5	x_6^6	x_7^7	x_8^8	x_9^9	x_{10}^{10}	x_{11}^{11}
1	6	1				$\vert\rightarrow$	$\vert\rightarrow$	$\times$	$\leftarrow\vert$	$\Leftarrow\Vert$	$\leftarrow\vert$	$\leftarrow\vert$	$\leftarrow\vert$
1	7	1				$\vert\rightarrow$		$\vert\rightarrow$	$\times$	$\leftarrow\vert$		$\leftarrow\vert$	
1	8	1				$\vert\rightarrow$		$\Vert\Rightarrow$	$\vert\rightarrow$	$\times$		$\leftarrow\vert$	
2	9	2	$\Vert\Rightarrow$	$\Vert\Rightarrow$	$\vert\rightarrow$			$\vert\rightarrow$			$\times$	$\leftarrow\vert$	$\leftarrow\vert$
2	10	3	$\vert\rightarrow$	$\vert\rightarrow$		$\vert\rightarrow$		$\vert\rightarrow$	$\vert\rightarrow$	$\vert\rightarrow$	$\Vert\Rightarrow$	$\times$	$\leftarrow\vert$
2	11	4						$\vert\rightarrow$	$\vert\rightarrow$		$\vert\rightarrow$	$\Vert\Rightarrow$	$\times$

a



b

Fig. 1. System structural and graphical analysis of an object view "external environment – environment systems – brain – processes of internal order regulation – systems state": a – structural matrix of a system object; b – topological-cognitive graph view $X\{x_1, x_2, x_3, x_4, x_5\}$ – external inputs: gaseous, liquid, solid impurities, ionizing radiation, extreme factors; X_j – morpho-functional systems: $X_{j=1} = X^i\{x^6, x^7, x^8\}$ – regulatory – nervous; endocrine, immune systems;

$X_{j=2} = X^i\{x^9, x^{10}, x^{11}\}$ – provision – respiratory, digestive, cardiovascular;

$X_i^i\{x_6^6, x_7^7, x_8^8, x_9^9, x_{10}^{10}, x_{11}^{11}\}$ – core systems – neurons, hormones, immune cells and antibodies, O_2 and CO_2 in the blood, nutrients in the blood, nutrients and O_2 and CO_2 in tissues; $Y_n\{y_1, y_2, y_3, y_4\}$ – functions – regulation, exchange, digestion, circulation; connections: $\vert\rightarrow$ – permanent, $\Vert\Rightarrow$ – random

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1) microstructures at the submicroscopic level in the form of neurons, synapses, glial cells, neural contacts;

2) systems links of brain support of mental activity: rigid – obligatory constant participation in realization of mental functions; "Flexible" – a dynamic device for achieving variability of function.

According to the concept of A.S. Adrianova, different brain formations and systems have two main forms of structure and activity:

1) invariant, genetically determined;

2) motions, probably deterministic.

These provisions are in good agreement with the ideas of N.P. Bekhtereva about the existence of "rigid" and "flexible" systems links of brain support of man mental activity.

According to A.S. Andrianov concept it is provided for taking into account the inherent specific adaptive variability, despite the natural rigid organization of macro structures and macrosystems. The states variability of these systems is revealed at the microstructures level (microassemblies, microsystems) of the brain at synaptic, submicroscopic and molecular levels (functional neuromorphological studies of the brain) [20, 22].

Structural-systemic brain organization by A.S. Adrianov solves the following brain activity problems in the following systems:

1) projection – signals analysis and processing of the corresponding modality of somatic, visual, auditory, etc.;

2) associative – analysis and synthesis of multimodal signals;

3) integrative triggers – synthesis of different modality signals with biologically significant information and motivational influences;

4) limbico-reticular add influence to energy, motivational and emotional-vegetative.

All these brain systems work in close interaction with each other as simultaneously or sequentially excited structures that are dynamic in nature. The dynamics is determined by the peculiarities of the input afferent impulses, the specificity of the organism reaction, which is a consequence of the multifunctionality of different systems to different degrees.

According to the A.R. Luria model of brain is divided into three main structural and functional blocks: energy – regulation of the brain activity level – frontal and temples; information block – providing modal-specific processes, as well as receiving, processing, storing of extra-receptive information thanks to the work of the basic analyzer system (visual, auditory, skin-kinesthetic with three link composition of analyzers – receptors, conductors, central departments) – parietal, occipital, bark; programming block – programming, regulation and control of mental activity – motor, premotor, prefrontal cortex lobes with cortical and subcortical ligaments [20, 22].

Spatial and temporal changes of brain micro-ensembles depend on external and internal influences. In general, each micro system included in the macro system is dynamic. This system-functional structure of complex education is in harmony with a complex information-entropy approach, which is related to the knowledge acquisition about the WFP implementation with the reflection of brain structure as a substrate of mental activity. In a systemic structural-graphical model, the brain activity with elements of self-organization in coordinating the system structuring of providing activity, structural-systemic and structural-functional organization of the brain. The interconnection of brain systems, as a complex object of certain functional task realization, is provided by mechanisms of self-organization “system – system” due to the cooperative structure “environment – object”/“object – environment”. In the presence of a certain system of nerve connections, a person can reproduce whole system by one element, which simplifies the consolidation mechanism of skills and knowledge.

Thus, the flow of external information mainly in the field of visual excitation is concentrated in the extra-cortex, the predominance of auditory stimuli leads to excitation of the temples, frontal cortex, insula, lumbar gyrus, lenticular and caudate nuclei. The endogenous cannabinoid system supports brain homeostasis, modulates the release of excitatory and inhibitory nervous system substances, is involved in the immune system regulation (Fig. 2)

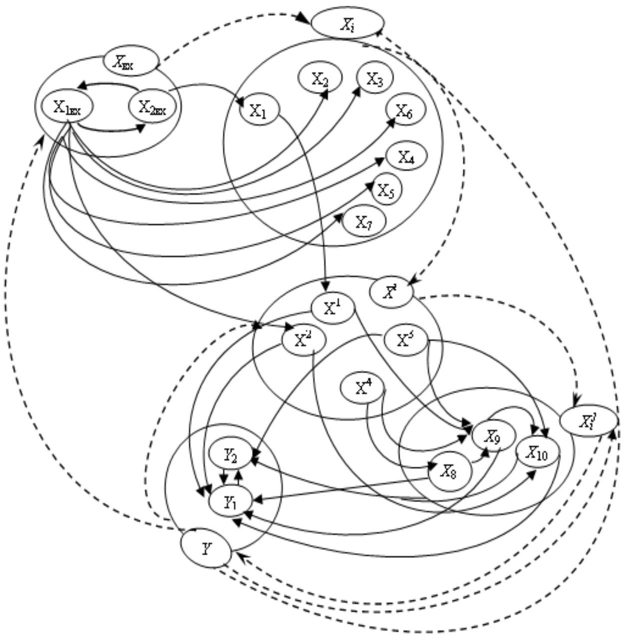

Fig. 2. System structural and graphical model of the object of perception of visual and auditory information «environment (input X_{input}) – brain microstructures ($X_i\{x_1, x_2, x_3, x_4, x_5, x_6, x_7\}$ – extrastriate cortex, reticulum, frontal cortex, insula, lumbar gyrus, lenticular and caudate nuclei) – structural and system organization ($X_j\{x^1, x^2, x^3, x^4\}$ – projective, associative, integrative-starting, limbico-reticular systems) – structural and functional blocks ($X_i^j\{x_8, x_9, x_{10}\}$ – energy, information, programming); regulation of internal order – systems of information perception ($Y_n\{y_1, y_2\}$ – nervous; the immune system

CONCLUSIONS

The study of the system behavior in a particular environment is associated with the identification of qualitative changes in the system trajectory at changes in the system structure, which determines the possibility of preserving the conditions of the so-called systemic homeostasis. Assessment of systemic formation state is due to the grouping of methods, their complex application in the study of the interaction “system – environment”, which is determined by the corporative relations between the components. To solve the problem of quality assessment of such system objects, structural and graphical approach information and methodological support is offered as a set of methods that allows:

1) to establish the features of system structure self-organization as a result of studied system interaction with the environment, which leads to achieve stationarity in the object "system – environment" in accordance with its objective function of state and functionality;

2) implement a complex system analysis of the complex objects state when introducing an entropy-information function of conformity to determine the assessment of the systems state degradation and mechanisms of their self-healing or priority means of quality functioning management "system – environment", which is considered on the study example of structural and functional state "organism – environment" (see Fig. 1);

3) build a graph-analytical model for study of "brain – environment" behavior, identifying on the basis of cognitive analysis the priority directions for stabilization of such a poorly structured system or the conditions for achieving its objective functionality (see Fig. 2).

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Article received 29.06.2022

ГРАФІЧНО-АНАЛІТИЧНІ МОДЕЛІ СКЛАДНИХ СИСТЕМ ДЛЯ ОЦІНКИ СТАНУ «ОРГАНІЗМ – НАВКОЛИШНЄ СЕРЕДОВИЩЕ»

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Практичність у бізнесі зазвичай пов'язана з отриманням високопродуктивних рішень для постановки цілей. Зниження витрат у разі прийняття рішення вимагає ідентифікації вагових компонентів у об'єкті «стан (середа) – системні процеси – кінцевий стан системи», пов'язаному зі структурою або функціональністю систем (процесів), які самі довільно визначають цільовий результат. Мета роботи – визначити тип моделі складного структурованого об'єкта будь-якого призначення, який адекватно відображає стан системи і взаємодія з оточенням «(середа – система) – процес – (стан системи – середа)» в ситуації різного ступеня невизначеності. Оцінка стану системного утворення обумовлена угрупованням методів, їх комплексним застосуванням при вивченні взаємодії «система – середовище», яке визначається корпоративними відносинами між компонентами. Для вирішення проблеми оцінки якості таких системних об'єктів, як комплекс методів, було запропоновано структурно-графічне обгрунтування інформаційно-методичного забезпечення.