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**ATTESTATION WORK**

**THE MANAGER AS A TEACHER:**

**SELECTED ASPECTS**

**OF STIMULATION OF SCIENTIFIC THINKING**

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“Wars are won by school teacher”

Otto von Bismark

**Selected aspects of stimulation of scientific thinking**

As is generally known, science and education are one of strategic resources of the state, one of fundamental forms of culture of civilization, as well as competitive advantage of every individual. Global discoveries of modern life occur both deep in and at the junction of various sciences, and at that, often and often the more unusual the combination of sciences is, the wider range of scientific prospects is promised by non-standard conspectus of their combination, for example, biology and electronics, philology and mathematics, etc. Discoveries in one area stimulate development in other spheres of science as well. Scientific development of a society is a programmable and predictable phenomenon, and this issue is specifically dealt by the futurology science. Modern techniques of pedagogy, psychology, medicine and other sciences do not only enable orientation and informational “pumping” of human brain, but also the formation of an individual’s character optimally suitable for the role of scientist. Unlike a computer, any human being has intuition - the element of thinking so far in no way replaceable (although some developments in this sphere are coming into being). Narrow specialization of scientists tapers the scope of their activity and is explained by an immense volume of information required for modern scientist. This problem is being solved (partially though) through a variety of actions – intellectualization of computers, “simplification” of information (its reduction to short, but data intensive/high-capacity formulas and formulations), application of psycho-technologies. Psycho-technologies (mnemonics, educational games, hypnopaedia, (auto-) hypnosis, propaganda and advertising methods and techniques, including technotronic and pharmacological /nootropic preparations/, etc.) make it possible to solve the following problem. A “black box” concept applied in computer science designates a system into which the chaotic information is entered, and in a little while a version, hypothesis or theory is produced. A human being represents (with some reservations though) such a system. Information processing occurs consciously and subconsciously based on certain rules (program). The more information processing rules we enter, the fewer number of degrees of freedom remains in the system. Hence, it is desirable to enter the very basic axioms. Differences in programs (even mere default - but without lack of key information) form differences in opinions and argumentation. The longer the period of program operation is (including based on internal biological clock), the greater the effect one can expect. The provability of success is directly proportional to the quantity of samples/tests, hence it is desirable to build in basic mechanisms of scientific thinking at the earliest age possible in a maximum wide audience and to stimulate their active work, and in certain time intervals make evaluation and update of “programs” of thinking. “Comprehension by an individual of new skills occurs only step-wise. Transition between two following mental conditions takes place: “I’ll never understand how this can be done and I’ll never be able to do it” and “it is so obvious that I can’t understand what needs to be explained here”. Except for early childhood, the leaps of this kind occur when mastering reading and mastering writing, mastering all standard extensions of set of numbers (fractional, negative, rational numbers, but not complex numbers), when mastering the concept of infinitesimal value and its consequences (the limits), differentiation, when mastering integration, complex of specific abilities forming the phenomenon of information generating (in other words, in the course of transition from studying science or art to purposeful/conscious professional creative work). We hereby note that at any of these stages, for the reasons not quite clear to us, the leap may not occur. It means that certain ability has not turned into a stage of subconscious professional application and cannot be used randomly by an individual for the solution of problems he/she faces. At that, the required algorithm may be well known. In other words, an individual knows letters. He/she knows how to write them. He/she can form words from them. He/she can write a sentence. But! This work would require all his/her intellectual and mainly physical effort. For the reason that all resources of the brain are spent for the process of writing, errors are inevitable. It is obvious that despite formal literacy (the presence of knowledge of algorithm) an individual cannot be engaged in any activity for which the ability to write is one of the basic or at least essential skills. Similar state of an individual is widely known in modern pedagogy and is called functional illiteracy. Similarly, one can speak of functional inability to integrate (quite a frequent reason for the exclusion of the 1st and 2nd grade students from physical and mathematical departments). Curiously enough, at higher levels the leap does not occur so often, to the extent that it is even considered normal. The formula: “An excellent student, but failed to make proper choice of vocation. Well, he’s not a physicist by virtue of thinking – well, that’s the way” (the leap allowing to mechanically employ specific style of thinking / physical in this case / did not occur). As to automatic creativity, these concepts in general are considered disconnected, and individuals for whom the process of creation of new essentialities in science and culture is the ordinary professional work not demanding special strain of effort are named geniuses. However, a child sick with functional illiteracy would perceive his peer who has mastered writing to the extent of being able of doing it without looking into a writing-book, a genius, too! Thus, we arrive at the conclusion that creativity at the level of simple genius is basically accessible to everyone. Modern education translates to pupils’ knowledge (of which, according to research, 90 % is being well and almost immediately forgotten) and very limited number of skills which would in a step-wise manner move the individual to the following stage of intellectual or physical development. One should know right well that endless school classes and home work, exhausting sports trainings are no more than eternal “throwing of cube” in the hope that lucky number will come out – in the hope of a “click”. And the “click” may occur at the first dash. It may never occur as well. Accordingly, the philosophy “repetition is the mother of learning” in effect adds up to a “trial-and-error method” which has been for a long time and fairly branded as such by TRIZists (the followers of Inventive Problems Solution Theory). As a matter of fact, the uneven nature of transition between “in”-and “out”- states at the moment of “click” suggests that it is a question of structural transformation of mentality. That is, “click” requires destruction of a structure (a pattern of thought, a picture of the world) and creation of another one in which a new skill is included “hardwarily” to be used automatically. Restrictions stimulate internal activity. It is proven that creative task “Draw something” without setting pre-determined conditions with restrictions is carried out less productively and less originally than the task: “Draw an unusual animal with a pencil during 30 minutes” (Sergey Pereslegin). Required personal qualities – traits of character /temperamental attributes/ may be divided into four conventional groups: necessary, desirable, undesirable and inadmissible. Knowledge can be divided into two groups: means and ways of information processing (including philosophy, logic, mathematics, etc.), the so-called meta-skills or meta-knowledge/ which are universal and applicable in any field of activity), and the subject (subjects) matter per se. From the view point of methodology all methods of scientific knowledge can be divided into five basic groups: 1. Philosophical methods. These include dialectics and metaphysics. 2. General scientific (general logical) approaches and research methods - analysis and synthesis, induction and deduction, abstraction, generalization, idealization, analogy, modeling, stochastic-statistical methods, systemic approach, etc. 3. Special-scientific methods: totality of techniques, research methods used in one or another field of knowledge. 4. Disciplinary methods, i.e. a set of methods applied in one or another discipline. 5. Methods of interdisciplinary research – a set of several synthetic, integrative methods generated mainly at the cross-disciplinary junction of branches of science. Scientific cognition is characterized by two levels - empirical and theoretical. Characteristic feature of empirical knowledge is the fact fixing activity. Theoretical cognition is substantial cognition /knowledge per se/ which occurs at the level of high order abstraction. There two ways to attempt to solve a problem: search for the necessary information or investigate it independently by means of observation, experiments and theoretical thinking. Observation and experiment are the most important methods of research in the process of scientific cognition. It is often said that theory is generalization of practice, experience or observations. Scientific generalizations often imply the use of a number of special logical methods: 1) Universalization /globbing/ method which consists in that general points/aspects/ and properties observed in the limited set of experiments hold true for all possible cases; 2) Idealization method consisting in that conditions are specified at which processes described in laws occur in their pure form, i.e. the way they cannot occur in reality; 3) Conceptualization method consisting in that concepts borrowed from other theories are entered into the formulation of laws, these concepts acquiring acceptably /accurate/ exact meaning and significance. Major methods of scientific cognition are: 1) Method of ascending from abstract to concrete. The process of scientific cognition is always connected with transition from extremely simple concepts to more difficult concrete ones. 2) Method of modeling and principle of system. It consists in that the object inaccessible to direct research is replaced with its model. A model possesses similarity with the object in terms of its properties that are of interest for the researcher. 3) Experiment and observation. In the course of experiment the observer would isolate artificially a number of characteristics of the investigated system and examine their dependence on other parameters. It is necessary to take into account that about 10 - 25 % of scientific information is proven outdated annually and in the near future this figure can reach 70%; according to other sources, the volume of information doubles every 5 years. It means that the system of education/teaching and “non-stop” retraining applied in some cases will become a universal and mandatory phenomenon, whereas the boundary between necessary and desirable knowledge will become more vague and conventional. In modern conditions active and purposeful studying of someone’s future sphere (spheres) of activity should start 4-5 years prior to entering the university. Considerable development will be seen in “preventive” (pre-emptive, anticipatory) education taking into account prospects of development of science for 3-5-10 years from no on. Masterful knowledge of methods of scientific-analytical and creative thinking is becoming the same social standard and a sign of affiliation to elite social groups as, for example, the presence of higher education diploma. The law of inverse proportionality of controllability and the ability to development says the more the system is controllable, the less it is capable of development. Controllable development may only be overtaking/catching up/. Now, a few thoughts about errors in the course of training. Traditional approach tends to consider an error as the lack of learning, assiduity, attention, diligence, etc. As a result the one to blame is a trainee. Error should be perceived as a constructive element in the system of heuristic training. An educational institution is just the institute where the person should make mistakes under the guidance of a teacher. An important element of cognitive system is professional terminology. The lack of knowledge of terms would not release anyone from the need to understand … Each term contains the concentrated mass of nuances and details distinguishing the scientific vision of the matter in question from the ordinary, unscientific understanding… It should be mentioned that the process of teaching/educating/ is a stress which has pluses and minuses, whereas the process of studying is a much smaller stress. One of the main tasks in terms of (self-) education may be the formation of active desire (internal requirement) to study and be engaged in (self-) education with independent search of appropriate means and possibilities. Special consideration should be given to teaching/training means and methods, i.e. what is comprehensible to one group of trainees may be useless for others. Major differentiation would be seen in age categories plus individual features. Training games are quite a universal tool used for a wide range of subjects and development of practical skills, since the game reflects the trainee’s behavior in reality. It is a system that provides an immediate feedback. Instead of listening to a lecture the trainee is given the individual lesson adapted for his/her needs. Game is modeling of reality and method of influencing it by the trainee. Some minuses of game include conventionality and schematic nature of what is going on and the development of the trainee’s behavioral and cogitative stereotypes. Major strategic consequences of wide spread of scientific thinking skills may include systemic (including quantitative - qualitative) changes in the system of science, education and industry, sharp increase of labor force mobility (both “white” and “blue collar”) and possible global social-economic and social-political changes.

**Part 1. Meta-skills:**

Pass preliminary test by means of Kettel’s 16-factor questionnaire (form C), test your IQ (Intelligence Quotient) using Aizenc’s test. Undergo testing for operative and long-term memory, attention distribution, noise immunity and will. Plan the development of these qualities in your character.

Methods of work with the text

(W. Tuckman “Educational Psychology. From Theory to Application”. Florida. State University. 1992):

1. Look through the text before reading it in detail to determine what it is about.

2. Focus your attention on the most significant places (semantic nodes) in the text.

3. Keep short record (summary/synopsis) of the most significant facts.

4. Keep close watch of understanding of what you read. If something appears not quite understood, re-read the paragraph once again.

5. Check up and generalize (analyze) what you have read in respect to the purpose of your reading.

6. Check up the correctness of understanding of separate words and thoughts in reference literature.

7. Quickly resume the work (reading) if you have been interrupted.

Training of fast reading – “Fast Reader 32” Program. Download the program: http://www.nodevice.ru/soft/windows/education/trenning/5072.html http://kornjakov.ru/index.htm, http://www.freesoft.ru/? id=670591 - for handheld computer. Plan 2-week “result-oriented” trainings - your current maximum is + 50%.

**Methods of critical and creative thinking**

Critical thinking:

1. Analytical thinking (information analysis, selection of necessary facts, comparison, collation of facts, phenomena). Useful questions in this connection are “who?”, “what?”, “where?”, “when?”, “why?”, “where?”, “what for?”, “how?”, “how many/much?”, “what?”(“which?”) to be asked in the most unusual combinations, while trying to find (to suppose) all options of answers.

2. Associative thinking (determination of associations with the previously studied familiar facts, phenomena, determination of associations with new qualities of a subject, phenomenon, etc.).

3. Independence of thinking (the absence of dependence on authorities and/or stereotypes, prejudices, etc.).

4. Logic thinking (the ability to build the logic of provability of the decision made, the internal logic of a problem being solved, the logic of sequence of actions undertaken for the solution of the problem, etc.).

5. Systemic thinking (the ability to consider the object, the problem in question within the integrity of their ties/relations and characteristics).

Creative thinking:

1. Ability of mental experimentation, spatial imagination.

2. Ability of independent transfer of knowledge for the decision of new problem, task, search of new decisions.

3. Combinatory abilities (the ability to combine the earlier known methods, ways of task/problem solution in a new combined, complex way – the morphological analysis).

4. Prognostic abilities (the ability to anticipate possible consequences of the decisions made, ability to establish cause-and-effect relations).

5. Heuristic way of thinking, intuitive inspiration, insight. The above stated abilities can be supplemented by specific abilities to work with information, for which purpose it is important to be able to select required (for specific goals) information from various sources to analyze it, systematize and generalize the data obtained in accordance with the cognitive task set forth, the ability to reveal problems in various fields of knowledge, in the surrounding reality, to make grounded hypotheses for their solution. It is also necessary to be able to put experiments (not only mental, but also natural), make well-reasoned conclusions, build the system of proofs, to be able to process statistically the data obtained from test and experimental checks, to be able to generate new ideas, possible ways of search of decisions, registration of results, to be able to work in the collective, while solving cognitive, creative tasks in cooperation with others, at that playing different social roles, as well as to be master of art and culture of communication.

Research and search methods of information processing:

1. Independent search and selection of information on specific problem.

2. Information analysis for the purpose of selection of facts, data necessary for the description of the object of study, its characteristics, qualities; for selection of facts conducive to the provability and/or refutation of the vision of the task/problem solution; building of facts, data analyzed in the logical sequence of proofs, etc.

3. Definition, vision of problems that need examination and solution.

4. Making hypotheses with definition of ways to check (solve) them.

5. Determination of methods, ways of solution of the investigated problem, stages of its solution by an individual or joint, group effort.

6. Registration of results of research or search activity.

7. Argumentation of the results achieved.

8. Projecting the occurrence of new problems in the given area of knowledge, practical activities.

Universal plan of scientific management (SM)

1. Statement of an overall goal (task) - minimum, optimum and maximum.

2. Setting of intermediate goals (tasks), their prioritization, time-frames of implementation.

3. Mechanisms (methods, schemes) of their achievement.

4. Required logistical, informational and financial support.

5. Personnel (including statement of problem before each employee following detailed instructional advice and determination of implementation time-frames).

6. Ways and means of control, possible failures and disturbances, methods, time-frames, personnel, materials, equipment, information and finance to rectify the latter.

7. Task adjustment in case of changes of situation, adaptation of the work performed (at all stages) to a new problem.

TRIZ – Inventive Problems Solution Theory (IPST)

Algorithm of activity:

1. A. Set a task. B. Imagine ideal result (is there a problem at all?). C. What prevents from the achievement of a goal (find contradiction), why does it prevent from its achievement (reveal cause-and-effect relations). D. On what conditions prevention will not occur?

2. A. Required (possible) internal changes (the sizes: larger, smaller, longer, shorter, thicker, thinner, deeper, shallower, vertically, horizontally, sloping, in parallel, in ledges, in layers/slices, transpose/rearrange, crosswise, convergence, to surround, to mix/stir, borders; the quantity: more, less, proportions, to divide, attach, add, remove; form: usual, unusual, rounded, straight, jags, unevenness, rough, equal, even/smooth, damage proof, delays, accidents, “foolproofing” and protection from larceny, to add; movement: to accelerate, slow down, stir up/revive/brighten up, stop, direction, deviation, pulling, pushing away, to block, lift, lower/pull down, rotate, fluctuate, arouse; condition: hot, cooler, firmer, softer, opened, closed, pre-assembled, disposable, combined, divided, hardening, liquid, gaseous, powder-like, wearability, to grease, moist, dry, isolated, gelatinous, plasmic, elastic, resists, superposes/matches). B. Division of an object (and/or subject) into independent parts: a. Segregation of weak (including potentially weak) part (parts). b. Segregation of required and sufficient part (parts). c. Segregation of identical (including duplicating, similar) parts (including in other systems). d. Division into parts with different functions. C. External changes. D. Changes in the adjacent objects. a. Establishment of links between the previously independent objects performing one work (including a network). b. Removal of objects because of transfer of their functions to other objects. c. Increase in the number of objects at the expense of the reverse side of the area. E. Measurement of time: faster, more slowly, longer, eternal, single-step, cyclic, time-wise marked, update, variable. F. Ascertainment of ties with other fields of knowledge (how is this contradiction solved there? what can be borrowed from there at all?). Prototypes in nature. G. Read the dictionaries for verbal associations (including non-standard). H. In case of failure revert to the initial problem to expand its situation/formulation.

3. A. Introduce necessary changes in the object (work). B. Introduce changes in other objects connected with the given one. C. Introduce changes in methods and expand the sphere of use of the object. D. Ask questions “how can we achieve the same result without using this product (using it partially) or without doing this work (doing it partially)?”, “how can we make the product (work) easier, more durable, safer, cheaper, in a more accelerated manner, pleasant, useful, universal, convenient, “friendly”, more ergonomic, harmless, pure, reliable, effective, attractive and bright, portable, valuable, status ranking, etc. E. Conduct preliminary tests, finish off, if necessary. Develop IGM (income generation mechanism). F. Check the applicability of the solution(s) found in respect of other problems. G. Take out a patent for the idea. See also: www.triz-journal.com, http://www.altshuller.ru/

Concepts, substance and laws of dialectics

1) The world (the being, reality) exists objectively, i.e. irrespective of the will and conscience of a human being. 2) The world has not been created by anybody and cannot be destroyed by anybody. It exists and develops in accordance with natural laws. There are no supernatural forces in it. 3) The world is unique and there are no “extra-mundane” spheres and phenomena in it (standing “above the world” or “beyond the world”) that are absolutely abjoint from each other. Diverse objects and the phenomena of the reality represent various kinds of moving matter and energy. 4) The world is coherent and is in eternal, continuous movement, development. Objects of the reality interact with each other, influence upon each other. In the process of development qualitative changes in objects, including natural transition from the lowest forms to the higher, take place. 5) Natural development of a matter through a number of natural steps (the inorganic/inanimate nature/abiocoen/ – life – society) has led to the origin of human being, intellect, conscience. The crucial role in the segregation of human being from animality and the formation of its conscience was played by labor, its social nature, transition of the human being’s animal ancestors to regular production and application of instruments of labor. 6) Society being the higher step of development of substance includes all lowest forms and levels (mechanical, physical, chemical, biological) on the basis of which it has arisen, but is not reduced to them only. It exists and develops on the basis of social laws which qualitatively differ from the laws of the lowest forms. The paramount law of social development is the determinant role of production in the life of the society. Mode of production of material life conditions social, political and spiritual processes of life in general. 7) The world is knowable. Human knowledge is unlimited by nature, but is limited historically at each stage of its development and for each separate individual. The criterion for the verity of thinking and cognition is public practice. In recent years the need arose for the formation of higher form of dialectic-materialistic outlook - “spiritual materialism”. Spiritual materialism extends the line of classical materialism in terms of recognition of objective character of existence, its cognoscibility, natural evolution of substance from the lowest to the higher forms, exclusion of notions of supernatural from scientific beliefs/notions, etc. At the same time, spiritual materialism overcomes absolutization of superiority of material over the spiritual, contraposition and discontinuity of these fundamentals inherent in the former forms of materialism, and directs towards the revelation of their unity, complex interrelation, interpenetration, definite fixation of relations in which the material and spiritual determine each other in the process of functioning and development of objects. Three main laws of dialectics are: the law of transition from quantity to quality, the law of unity and conflict of opposites and the law of negation of negation. There is more to it than these three major laws in dialectics. Abscque hoc, there are a number of other dialectic laws concretizing and supplementing organic laws of dialectics expressed in categories “substance and phenomenon”, “content and form”, “contingency and necessity”, “cause and effect”, “possibility and reality”, “individual, special and general”, the dialectic triad: thesis, antithesis and synthesis. Categories and laws of dialectics exist within a certain system in which the substance/essence of dialectics proper is expressed.

**Analysis of the decision-making methods without use of numerical values of probability (exemplificative of the investment projects).**

In practice situations are often found when it is difficult enough to estimate the value of probability of an event. In such cases methods are often times applied which do not involve using numerical values of probabilities: maximax – maximization of the maximum result of the project; maximin – maximization of the minimum result of the project; minimax – minimization of maximum losses; compromise – Gurvitz’s criterion: weighing of minimum and maximum results of the project. For decision-making on realization of investment projects a matrix is built. Matrix columns correspond to the possible states of nature, i.e. situations which are beyond of control of the head of an enterprise. Lines of the matrix correspond to possible alternatives of realization of the investment project – strategies which may be chosen by the director. The matrix cells specify the results of each strategy for each state of nature. Example: The enterprise analyzes the investment civil-engineering design of a line for the production of new kind of product. There are two possibilities: the construction of a high power capacity line or to construct low power line. Net present value of the project depends on the demand for production, whereas the exact volume of demand is unknown, however, it is known that there are three basic possibilities: absence of demand, average demand and great demand. The matrix cells (see table 1) show net present value of the project at a certain state of nature, provided that the enterprise will choose the appropriate strategy. The last line shows what strategy is optimum in each state of nature. The maximax decision would be to construct a high power capacity line: the maximum net present value will thus be 300 which correspond to the great demand situation. The maximum criterion reflects the position of the enterprise director – the optimist ignoring possible losses. The maximin decision, i.e. to construct a low power line: the minimum result of this strategy is the loss of 100 (which is better than possible loss of 200 in case of construction of a high power capacity line). The maximin criterion reflects the position of the director who is in no way disposed towards taking risk and is notable for his/her extreme pessimism. This criterion is quite useful in situations where risk is especially high (for example when the existence of an enterprise depends on the results of the investment project). Threat is determined by two components: possibilities and intention of the contestant.

Table 1. Example of construction of the matrix of strategy and states of nature for the investment project.

|  |  |  |  |
| --- | --- | --- | --- |
| Strategy | State of nature : absence of demand | State of nature : medium demand | State of nature : great demand |
| Construct a low power line | 100 | 150 | 150 |
| Construct a high power capacity line | 200 | 200 | 300 |
| Optimum strategy for the given state of nature | Construct a low power line | Construct a high power capacity line | Construct a high power capacity line |

To apply the minimax criterion let us construct “a matrix of regrets” (see table 2). The cells of this matrix show the extent/value of “regret”, i.e the difference between actual and the best results which could have been achieved by the enterprise at the given state of nature. “Regret” shows what is being lost by the enterprise as a result of making wrong decision. The minimax decision corresponds to the strategy, whereby the maximum regret is minimal. In our case of low power line maximum regret makes 150 (in great demand situation) and for a high power capacity line – 100 (in the absence of demand). As 100 <150, the minimax decision would be to construct a high power capacity line. The minimax criterion is oriented not so much towards actual as possible damages or loss of profit.

Table 2.

Example of structure of the “matrix of regrets” for minimax criterion

|  |  |  |  |
| --- | --- | --- | --- |
| Strategy | State of nature: absence of demand | State of nature: medium demand | State of nature: great demand |
| Construct a low power line | (-100) – (-100) =0 | 200 – 150=50 | 300 – 150=150 |
| Construct a high power capacity line | (-100) – (-200) =100 | 200 – 200=0 | 300 – 300=0 |
| Optimum strategy for the given state of nature | Construct a low power line | Construct a high power capacity line | Construct a high power capacity line |

Gurvitz’s criterion consists in that minimum and maximum results of each strategy are assigned “weight”. Evaluation of result of each strategy equals to the sum of maximum and minimum results multiplied by corresponding weight.

Let’s assume that the weight of the minimum result is equal to 0.5, the weight of the maximum result equals to 0.5 as well (it is the probabilistic characteristic; in this case probability of onset of any option of events = 50 %, as far as we have 2 options : 50 % + 50 % = 100 %; if there will be 3 options, then the ratio can be 33,33 (%) for each or, for example, 20 %, 25 % and 55 %). Then the calculation for each strategy will be the following:

Low power line: 0.5 х (-100) + 0.5 х 150 = (-50) + 75 = 25;

High power capacity line: 0.5 х (-200) + 0.5 х 300 = (-100) + 150 = 50.

Gurvitz’s criterion testifies in favor of the construction of high power capacity line (as 50> 25). Advantage and simultaneously disadvantage of Gurvitz’s criterion consists in the necessity of assigning weights to the possible outcomes; it allows taking into account specificity of situation, however, assigning weights always implies some subjectivity. As a result of the fact that in real situations there is often lack of information on the probabilities of outcomes the use of the above methods in engineering of investment projects is quite justified. However, the choice of concrete criterion depends on the specificity of situations and individual preferences of an analyst (the company’s strategy).

“Data mining”, getting/acquisition of information (it should be noted that many modern “data mining” techniques focus mainly on search of information based on key parameters (words, images, matrixes, algorithms), but in that way we will only be able to bring out ties/links that have already been exposed by someone else). According to the theory of information (Stanislav Yankovsky), requisite condition of activity of intellectual (higher) system is the redundancy of incoming and generated information, read and think “to lay up in store/as a reserve”, accumulate “assets” which expands your possibilities and get rid of “liabilities” which reduce your potential. Any phenomenon should be analyzed from the view point of what it gives to you and what it takes from you. Even two most universal resources – money and information (sometimes “time” is added thereto) – also limit to some extent the possibilities of their holder. A very important point in the evaluation of information is reliability of the source of information and credibility of data itself. Specific code of marking information carriers is applied for this purpose. Reliability of source: A – absolutely reliable source; B – usually reliable source; C – quite reliable source; D – not always reliable source; E – unreliable source; F - reliability of source cannot be defined. Credibility of data: 1 – credibility of data is proven by data from other sources; 2 – data are probably correct; 3 – data are possibly correct; 4 – doubtful data; 5 – data are improbable; 6 – credibility of data cannot be established. It should be noted that many elements of scientific, research and analytical activity are weakly formalizable, in which connection practical experience in the concrete field of activity gains great importance.

Issues recommended for independent study: the Game theory, the theory of fields, the theory of crises, the chaos theory, the theory of relativity, the management, strategy and tactics theories, basics of logic and statistics – concepts, substance/essence, stereotypes, paradoxes. See also: Software “Archivarius 3000” http://www.likasoft.com - highly effective searcher in database on the basis of keywords.

**Now, be prepared, it is going to be a little bit difficult.**

Part 2. Basics of general theory of systems (GTS) and systemic analysis

The world as a whole is a system which, in turn, consists of multitude of large and small systems. In the classical theory of systems one can single out three various classes of objects: the primitive systems, which structure is invariable (for example, the mathematical pendulum); analytical systems, which almost always have fixed structure, but sometimes undergo bifurcations – spasmodic changes of structure (simple ecosystem); chaotic systems continually changing their structure (for example, atmosphere of the Earth). Chaos is essentially an unstable structural system. In this sense chaos is a synonym of changeable, internally inconsistent, unstable developing system which cannot be referred to analytical structures. Having established the general principles of management in any systems, one can try to determine how the system should be organized to work most effectively. This approach to research of problems of management from general to particular, from abstract to concrete is named organizational or systemic. Such approach provides the possibility of studying of a considerable quantity of alternative variants, the analysis of limitations and consequences of decisions made. “The system is a set of interacting elements”, said Berthalanfie, one of the founders of the modern General Theory of Systems (GTS) emphasizing that the system is a structure in which elements somehow or other affect each other (interact). Is such definition sufficient to distinguish a system from non-system? Obviously, it is not, because in any structure its elements passively or actively somehow interact with each other (press, push, attract/draw, induce, heat up, get on someone nerves, feel nervous, deceive, absorb, etc.). Any set of elements always operates somehow or other and it is impossible to find an object which would not make any actions. However, these actions can be accidental, purposeless, although accidentally and unpredictably, they can be conducive to the achievement of some goal. Though a sign of action is the core, it determines not the concept of the system, but one of the essential conditions of this concept. “The system is an isolated part, a fragment of the world, the Universe, possessing a special property emergence/emergent factor, relative self-sufficiency (thermodynamic isolation)”, said P. Etkins. But any object is a part or a Universe fragment, and each object differs from the others in some special property (emergence/emergent factor – a property which is not characteristic of simple sum of all parts of the given system), including a place of its location, period of existence, etc. And at that, each object is to a certain degree thermodynamically independent, although is dependent on its environment. Hence, this definition also defines not only a system itself, but some consequences of systemic nature as well. Adequate/comprehensive/ definition of the concept “system” is possibly, non-existent, because the concept “goal/purpose” has been underestimated. Any properties of systems are ultimately connected with the concept of goal/purpose because any system differs from other systems in the constancy of its actions, and the aspiration to keep this constancy is a distinctive feature of any system. Nowadays the goal/purpose is treated as one of the elements of behavior and conscious activity of an individual which characterizes anticipation/vision of comprehension of the result of activity and the way of its realization by means of certain ways and methods. The purpose/goal acts as the way of integration of various actions of an individual in some kind of sequence or system. So, the purpose is interpreted as purely human factor inherent only in human being. There’s nothing for it but to apply the concept of “purpose/goal” not only to psychological activity of an individual, but to the concept of “system”, because the basic distinctive feature of any system is it designation for some purpose/goal. Any system is always intended for something, is purposeful and serves some definite purpose/goal, and the goal is set not only before the individual, but before each system as well, regardless of its complexity. Nevertheless, none of definitions of a system does practically contain the concept of purpose/goal, although it is the aim, but not the signs of action, emergence factor or something else, which is a system forming factor. There are no systems without goal/purpose, and to achieve this purpose the group of elements consolidates in a system and operates. Purposefulness is defined by a question “What can this object do?” “The system is a complex of discretionary involved elements jointly contributing to the achievement of the predetermined benefit, which is assumed to be the core system forming factor”. One can only facilitate the achievement of specific goal, while the predetermined benefits can only be the goal. The only thing to be clarified now is who or what determines the usefulness of the result. In other words, who or what sets the goal before the system? The entire theory of systems is built on the basis of four axioms and four laws which are deduced from the axioms: axiom #1: a system always has one consistent/invariable general goal/purpose (the principle of system purposefulness, predestination); axiom #2: the goal for the systems is set from the outside (the principle of goal setting for the systems); axiom #3: to achieve the goal the system should operate in a certain mode (the principle of systems’ performance) – law #1: the law of conservation (the principle of consistency of systems’ performance for the conservation of the consistency of goal/ purpose), law #2: the law of cause-and-effect limitations (the principle of determinism of systems’ performance), law #3: the law of hierarchies of goals/purposes (the principle of breakdown of goal/purpose into sub-goals/sub-purposes), law #4: the law of hierarchies of systems (the principle of distribution of sub-goals/sub-purposes between subsystems and the principle of subordination of subsystems); axiom №4: the result of systems’ performance exists independently from the systems themselves (the principle of independence of the performance result). Axiom #1: the principle of purposefulness. At first it is necessary to determine what meaning we attach to the concept “system”, as far as at first sight there are at least two groups of objects”: “systems” and “non-systems”. In which case the object presents a system? It is not likely that any object can be a system, although both systems and non-systems consist of a set of parts (components, elements, etc.). In some cases a heap of sand is a structure, but not a system, although it consists of a set of elements representing heterogeneity of density in space (grains of sand in conjunction with hollows). However, in other cases the same heap of sand can be a system. So, what is the difference then between the structure-system and the structure-non-system, since after all both do consist of elements? All objects can be divided into two big groups, if certain equal external influence is exerted upon them: those with consistent retaliatory actions and those with variable and unpredictable response action. Thus, if we change external influence we then again will get the same two groups, but their structure will change: other objects will now be characterized by the consistency of response actions under the influence of new factors, while those previously characterized by such constancy under the former influencing factors will have no such characteristics under the influence of new factors any more. Let us call the systems those objects consisting of a set of elements and characterized by the constancy/consistency of actions in response to certain external influences. Those not characterized by the constancy of response actions under the same influences may be called casual sets of elements with respect to these influences. Hence, the concept of “system” is relative depending on how the given group of elements reacts to the given certain external influence. The constancy and similarity of reaction of the interacting group of elements in respect of certain external influence is the criterion of system. The constancy of actions in response to certain external influence is the goal/purpose of the given system. Hence, the goal/purpose stipulates direction of the system’s performance. Any systems differ in constancy of performance/actions and differ from each other in purposefulness (predestination for something concrete). There is no system “in general”, but there are always concrete systems intended for some specific goals/purposes. Any object of our World differs from another only in purpose, predetermination for something. Different systems have different goals/purposes and they determine distinction between the systems. Hence, the opposite conclusion may be drawn: if there any system exists, it means it has a goal/purpose. We do not always understand the goals/purposes of either systems, but they (goals/purposes) are always present in any systems. We cannot tell, for example, what for is the atom of hydrogen needed, but we can not deny that it is necessary for the creation of polymeric organic chains or, for example, for the formation of a molecule of water. Anyway, if we need to construct a water molecule, we need to take, besides the atom of oxygen, two atoms of hydrogen instead of carbon or any other element. The system may be such group of elements only in which the result of their general interaction differs from the results of separate actions of each of these elements. The result may differ both qualitatively and quantitatively. The mass of the heap of sand is more than the mass of a separate grain of sand (quantitative difference). The room which walls are built of bricks has a property to limit space volume which is not the case with separate bricks (qualitative difference). Any system is always predetermined for some purpose, but it always has one and the same purpose. Haemoglobin as a system is always intended for the transfer of oxygen only, a car is intended for transportation and the juice extractor for squeezing of juice from fruit. One can use the juice extractor made of iron to hammer in a nail, but it is not the juice extractor system’s purpose. This constancy of purpose obliges any systems to always operate to achieve one and the same goal predetermined for them.

The principle of goal-setting. A car is intended for transportation, a calculator – for calculations, a lantern – for illumination, etc. But the goal of transportation is needed not for the car but for someone or something external with respect to it. The car only needs its ability to implement the function in order to achieve this goal. The goal is to meet the need of something external in something, and this system only implements the goal while serving this external “something”. Hence, the goal for a system is set from the outside, and the only thing required from the system is the ability to implement this goal. This external “something” is another system or systems, because the World is tamped only with systems. Goal-setting always excludes independent choice of the goal by the system. The goal can be set to the system as the order/command and directive. There is a difference between these concepts. The order/command is a rigid instruction, it requires execution of just “IT” with the preset accuracy and only “IN THAT MANNER” and not in any other way, i.e. the system is not given the “right” to choose actions for the achievement of the goal and all its actions are strictly defined. Directive is a milder concept, whereby the “IT” is set only the given or approximate accuracy, but the right to choose actions is given to the system itself. Directive can be set only to systems with well developed management unit/control block which can make choice of necessary actions by itself. None of the systems does possess free will and can set the goal before itself; it comes to it from the outside. But are there any systems which are self-sufficient and set the goals before themselves? For example, we, the people, are sort of able of setting goals before ourselves and carry them out. Well then, are we the example of independent systems? But it is not as simple as it may seem. There is a dualism (dual nature) of one and the same concept of goal: the goal as the task for some system and the goal as an aspiration (desire) of this system to execute the goal set before it: the Goal is a task representing the need of external operating system (super system) to achieve certain predetermined result; the Goal is an aspiration (desire) to achieve certain result of performance of the given system always equal to the preset result (preset by order or directive). The fundamental point is that one super system cannot set the goal before the system (subsystem) of other super system. It can set the goal only before this super system which becomes a subsystem in respect of the latter. We can set the goal before ourselves, but we always set the goal only when we are missing/lacking something, when we suffer. Suffering is an unachieved desire. Any physiological (hunger, thirst), aesthetic and other unachieved desires makes us suffer and suffering forces us to aspire to act until desires are satisfied. The depth of suffering is always equal to the intensity of desire. We want to eat and we suffer from hunger until we satisfy this desire. As soon as we take some food, the suffering ceases immediately. At that, the new desire arises according to “Maslow pyramid”. Desire is our goal-aspiration. When we realize our wish we achieve the objective/goal. If we achieve the objective we cease to act, because the goal is achieved and the wish disappears. If we have everything we can only think of, we will not set any goals before ourselves, because there is nothing to wish, since we have everything. Therefore, even a human being with all its complexity and developmental evolution cannot be absolutely independent of other systems (of external environment). Our goals-tasks are always set before us by the external environment and it incites our desire (goal-aspiration) which is dictated by shortage of something. We are free to choose our actions to achieve the goal, but it is at this point where we are limited by our possibilities. We do not set the goal-task, we set the goals-aspirations. Then if it is not us, can there be other systems which can set goals before themselves regardless of whatsoever? Perhaps, starting from any certain level of complication the systems can do it themselves? Such examples are unknown to us. For any however large and difficult system there might be another, even higher system found which will dictate the former its goals and conditions. Nature is integrated and almost put in (good) order. It is “almost” put in order, because at the level of quantum phenomena there is probably some uncertainty and unpredictability, i.e. unconformity of the phenomena to our knowledge of physical laws (for example, tunnel effects). It is this unpredictability which is the cause of contingencies and unpredictability. Contingency /stochasticity and purposefulness are mutually exclusive.

Principle of performance of action. Any system is intended for any well defined and concrete goal specific for it, and for this purpose it performs only specific (target-oriented) actions. Hence, the goal of a system is the aspiration to perform certain purposeful actions for the achievement of target-oriented (appropriate) result of action. The plane is designed for air transportation, but cannot float; for this purpose there is an amphibian aircraft. The result of aircraft performance is moving by air. This result of action is expectable and predictable. The constancy and predictability of functional performance is a distinctive feature of any systems – living, natural, social, financial, technical, etc. Consequently, in order to achieve the goal any object of our World should function, make any purposeful actions, operations (in this case the purposeful, deliberate inaction is in some sense an action, too). Action is manifestation of some energy, activity, as well as force itself, the functioning of something; condition, process arising in response to some influence, stimulant/irritant, impression (for example, reaction in psychology, chemical reactions, nuclear reactions). The object’s action is followed by the result of action (not always expected, but always logical and conditioned). The purpose of any system is the aspiration to yield appropriate (targeted) result of action. At that, the given object is the donor of the result of action. The result of action of donor system can be directed towards any other system which in this case will be the recipient (target) for the result of action. In this case the result of action of the donor system becomes the external influence for the recipient system. Interaction between the systems is carried out only through the results of action. In that way the chain of actions is built as follows: ... → (external influence) → result of action (external influence) →... The system produces single result of action for single external influence. No object operates in itself. It cannot decide on its own “Here now I will start to operate” because it has no freedom of will and it cannot set the goal before itself and produce the result of action on its own. It can only react (act) in response to certain external influence. Any actions of any objects are always their reaction to something. Any influence causes response/reaction. Lack of influence causes no reaction. Reaction can sometimes be delayed, therefore it may seem causeless. But if one digs and delves, it is always possible to find the cause, i.e. external influence. Cognition of the world only falls to our lot through the reactions of its elements. Reaction (from Latin “re” – return and “actio” - action) is an action, condition, process arising in response to some influence, irritant/stimulant, impression (for example, reaction in psychology, chemical reactions, nuclear reactions). Consequently, the system’s action in response to the external influence is the reaction of the system. When the system has worked (responded) and the required result of action has been received, it means that it has already achieved (“quenched”) the goal and after that it has no any more goal to aspire to. Reaction is always secondary and occurs only and only following the external influence exerted upon the element. Reaction can sometimes occur after a long time following the external influence if, for example, the given element has been specially “programmed” for the delay. But it will surely occur, provided that the force of the external influence exceeds the threshold of the element’s sensitivity to the external influence and that the element is capable to respond to the given influence in general. If the element is able of reacting to pressure above 1 atmosphere it will necessarily react if the pressure is in excess of 1 atmosphere. If the pressure is less than 1 atmosphere it will not react to the lower pressure. If it is influenced by temperature, humidity or electric induction, it will also not react, howsoever we try to “persuade” it, as it is only capable to react to pressure higher than 1 atmosphere. In no pressure case (no pressure above 1 atmosphere), it will never react. Since the result of the system’s performance appears only following some external influence, it is always secondary, because the external influence is primary. External influence is the cause and the result of action is a consequence (function). It is obvious that donor systems can produce one or several results of action, while the recipient systems may only react to one or several external influences. But donor elements can interact with the recipient systems only in case of qualitatively homogeneous actions. If the recipient systems can react only to pressure, then the systems able of interacting with them may be those which result of action is pressure, but not temperature, electric current or something else. Interaction between donor systems and recipient systems is only possible in case of qualitative uniformity (homoreactivity, the principle of homogeneous interactivity). We can listen to the performance of the musician on a stage first of all because we have ears. The earthworm is not able to understand our delight from the performance of the musician at least for the reason that it has no ears, it cannot perceive a sound and it has no idea about a sound even if (hypothetically) it could have an intelligence equal to ours. The result of action of the recipient element can be both homogeneous (homoreactive) and non-homogeneous, unequal in terms of quality of action (heteroreactive) of external influence in respect of it. For example, the element reacts to pressure, and its result of action can be either pressure or temperature, or frequency, or a stream/flow of something, or the number of inhabitants of the forest (apartment, city, country) etc. Hence, the reaction of an element to the external influence can be both homoreactive and heteroreactive. In the first case the elements are the action transmitters, in the second case they are converters of quality of action. If the result of the system’s actions completely corresponds to the implementation of goal, it speaks of the sufficiency of this system (the given group of interacting elements) for the given purpose. If not, the given group of elements mismatches the given goal/purpose and/or is insufficient, or is not the proper system for the achievement of a degree of quality and quantity of the preset goal. Therefore, any existing object can be characterized by answering the basic question: “What can the given object do?” This question characterizes the concept of the “result of action of an object” which in turn consists of two subquestions: What action can be done by given object? (the quality of result of action); How much of such action can be done by the given object? (the quantity of result of action). These two subquestions characterize the aspiration of a system to implement the goal. And the goal-setting may be characterized by answering another question: “What should the given object do?” which also consists of two subquestions: what action should the given object do? (the quality of the result of action); how much of such action should the given object do? (the quantity of the result of action). These last two subquestions are the ones that determine the goal as a task (the order/command, the instruction) for the given object or group of objects, and the system is being sought or built to achieve this goal. The closer the correspondence between what should and what can be done by the given object, the closer the given object is to the ideal system. The real result of action of the system should correspond to preset (expected) result. This correspondence is the basic characteristic of any system. Wide variety of systems may be built of a very limited number of elements. All the diverse material physical universe is built of various combinations of protons, electrons and neutrons and these combinations are the systems with specific goals/purposes. We do not know the taste of protons, neutrons and electrons, but we do know the taste of sugar which molecular atoms are composed of these elements. Same elements are the constructional material of both the human being and a stone. The result of the action of pendulum would be just swaying, but not secretion of hormones, transmission of impulse, etc. Hence, its goal/purpose and result of action is nothing more but only swaying at constant frequency. The symphonic orchestra can only play pieces of music, but not build, fight or merchandize, etc. Generator of random numbers should generate only random numbers. If all of a sudden it starts generate series of interdependent numbers, it will cease to be the generator of random numbers. Real and ideal systems differ from each other in that the former always have additional properties determined by the imperfection of real systems. Massive golden royal seal, for example, may be used to crack nuts just as well as by means of a hammer or a plain stone, but it is intended for other purpose. Therefore, as it has already been noted above, the concept of “system” is relative, but not absolute, depending on correspondence between what should and what can be done by the given object. If the object can implement the goal set before it, it is the system intended for the achievement of this goal. If it cannot do so, it is not the system for the given goal, but can be a system intended for other goals. It does not mater for the achievement of the goal what the system consists of, but what is important is what it can do. In any case the possibility to implement the goal determines the system. Therefore, the system is determined not by the structure of its elements, but by the extent of precision/accuracy of implementation of the expected result. What is important is the result of action, rather than the way it was achieved. Absolutely different elements may be used to build the systems for the solution of identical problems (goals). The sum of US$200 in the form of US$1 value coins each and the check for the same amount can perform the same action (may be used to make the same purchase), although they consist of different elements. In one case it is metal disks with the engraved signs, while in other case it is a piece of a paper with the text drawn on it. Hence, they are systems named “money” with identical purposes, provided that they may be used for purchase and sale without taking into account, for example, conveniences of carrying them over or a guarantee against theft. But the more conditions are stipulated, the less number of elements are suitable for the achievement of the goal. If we, for example, need large amount of money, say, US$1.000.000 in cash, and want it not to be bulky and the guarantee that it is not counterfeit we will only accept US$100 bank notes received only from bank. The more the goal is specified, the less is the choice of elements suitable for it. Thus, the system is determined by the correspondence of the goal set to the result of its action. The goal is both the task for an object (what it should make) and its aspiration or desire (what it aspires to). If the given group of elements can realize this goal, it is a system for the achievement of the goal set. If it cannot realize this goal, it is not the system intended for the achievement of the given goal, although it can be the system for the achievement of other goals. The system operates for the achievement of the goal. Actually, the system transforms through its actions the goal into the result of action, thus spending its energy. Look around and everything you’ll see are someone’s materialized goals and realized desires. On a large scale everything that populates our World is systems and just systems, and all of them are intended for a wide range of various purposes. But we do not always know the purposes of many of these systems and therefore not all objects are perceived by us as systems. Reactions of systems to similar external influences are always constant, because the goal is always determined and constant. Therefore, the result of action should always be determined, i.e. identical and constant (a principle of consistency of correspondence of the system’s action result to the appropriate result), and for this purpose the system’s actions should be the same (the principle of a constancy of correspondence of actual actions of the system to the due ones). If the result fails to be constant it cannot be appropriate and equal to the preset result (the principle of consistency/permanency of the result of action). The conservation law proceeds/results/ from the principle of consistency/permanency of action. Let us call the permanency of reaction “purposefulness”, as maintaining the similarity (permanency/consistency) of reaction is the goal of a system. Hence, the law of conservation is determined by the goal/purpose. The things conserved would be those only, which correspond to the achievement of the system’s goal. This includes both actions per se and the sequence of actions and elements needed to perform these actions, and the energy spent for the performance of these actions, because the system would seek to maintain its movement towards the goal and this movement will be purposeful. Therefore, the purpose determines the conservation law and the law of cause-and-effect limitations (see below), rather than other way round. The conservation law is one of the organic, if not the most fundamental, laws of our universe. One of particular consequences of the conservation law is that the substance never emerges from nothing and does not transform into nothing (the law of conservation of matter). It always exists. It might have been non-existent before origination of the World, if there was origination of the World per se, and it might not be existent after its end, if it is to end, but in our World it does neither emerge, nor disappear. A matter is substance and energy. The substance (deriving from the /Rus/ word “thing”, “object” ) may exist in various combinations of its forms (liquid, solid, gaseous and other, as well as various bodies), including the living forms. But matter is always some kind of objects, from elementary particles to galaxies, including living objects.Substance consists of elements. Some forms of substances may turn into others (chemical, nuclear and other structural transformations) at the expense of regrouping of elements by change of ties between them. Physical form of the conservation law is represented by Einstein’s formula. A substance may turn into energy and other way round. Energy (from Greek “energeia” - action, activity) is the general quantitative measure of movement and interaction of all kinds of matter. Energy in nature does not arise from anything and does not disappear; it only can change its one form into another. The concept of energy brings all natural phenomena together. Interaction between the systems or between the elements of systems is in effect the link between them. From the standpoint of system, energy is the measure (quantity) of interaction between the elements of the system or between the systems which needs to be accomplished for the establishment of link between them. For example, one watt may be material measure of energy. Measures of energy in other systems, such as social, biological, mental and other, are not yet developed. Any objects represent the systems, therefore interactions between them are interactions between the systems. But systems are formed at the expense of interaction between their elements and formations of inter-element relations between them. In the process of interaction between the systems intersystem relations are established. Any action, including interaction, needs energy. Therefore, when establishing relations/links/ the energy is being “input”. Consequently, as interaction between the elements of the system or different systems is the relation/link between them, the latter is the energy-related concept. In other words, when creating a system from elements and its restructuring from simple into complex, the energy is spent for the establishment of new relations /links /connections between the elements. When the system is destructed the links between the elements collapse and energy is released. Systems are conserved at the expense of energy of relations/links between its elements. It is the internal energy of a system. When these relations/links are destructed the energy is released, but the system itself as an object disappears. Consequently, the internal energy of a system is the energy of relations/link between the elements of the system. In endothermic reactions the energy used for the establishment of connections/links/relations comes to the system from the outside. In exothermic reactions internal energy of the system is released at the expense of rupture of these connections between its internal own elements which already existed prior to the moment when reaction occurred. But when the connection is already formed, by virtue of conservation law its energy is not changed any more, if no influence is exerted upon the system. For example, in establishing of connections/links between the two nuclei of deuterium (2D2) the nucleus 1Не4 is formed and the energy is released (for the purpose of simplicity details are omitted, for example, reaction proton-proton). And the 1Не4 nucleus mass becomes slightly less than the sum of masses of two deuterium nuclei by the value multiple of the energy released, in accordance with the physical expression of the conservation law. Thus, in process of merge of deuterium nuclei part of their intra-nuclear bonds collapses and it is for this reason that the merge of these nuclei becomes possible. The energy of connection between the elements of deuterium nuclei is much stronger than that of the bond between the two deuterium nuclei. Therefore, when part of connections between elements of deuterium nuclei is destructed the energy is released, part of it being used for thermonuclear synthesis, i.e. the establishment of connection/bond between the two deuterium nuclei (extra-nuclear connection/bond in respect to deuterium nuclei), while other part is released outside helium nucleus. But our World is tamped not only with matter. Other objects, including social, spiritual, cultural, biological, medical and others, are real as well. Their reality is manifested in that they can actively influence both each other and other kinds of matter (through the performance of other systems and human beings). And they also exist and perform not chaotically, but are subjected to specific, though strict laws of existence. The law of conservation applies to them as well, because they possess their own kinds of “energy” and they did not come into being in a day, but may only turn one into another. Any system can be described in terms of qualitative and quantitative characteristics. Unlike material objects, the behavior of other objects can be described nowadays only qualitatively, as they for the present the have no their own “thermodynamics”, for example, “psychodynamics”. We do not know, for example, what quantity of “Watt” of spiritual energy needs to be applied to solve difficult psychological problem, but we know that spiritual energy is needed for such a solution. Nevertheless, these objects are the full-value systems as well, and they are structured based on the same principles as other material systems. As systems are the groups of elements, and changes of forms of substances represent the change of connections/bonds between the elements of substance, then changes of forms of substances represent the changes of forms of systems. Hence, the form is determined by the specificity of connections/bonds/ties between the elements of systems. “Nothing in this world lasts for ever”, the world is continually changing, whereby one kind of forms of matter turn into other, but it is only forms that vary, while matter is indestructible and always conserved. At the same time, alteration of forms is also subjected to the law of conservation and it is this law that determines the way in which one kind of forms should replace other forms of matter. Forms only alter on account of change of connections/ties between the elements of systems. As far as each connection between the system elements has energetic equivalent, any system contains internal energy which is the sum of energies of connections/bonds between all elements. The “form: (Latin, philos.) is a totality of relations determining the object. The form is contraposed to matter, the content of an object. According to Aristotle, the form is the actuating force that forms the objects and exists beyond the latter. According to Kant, form is everything brought in by the subject of cognition to the content of the cognizable matter - space, time and substance of the form of cognitive ability; all categories of thinking: quantity, quality, relation, substance, place, time, etc., are forms, the product of ability of abstraction, formation of general concepts of our intellect. However, these are not quite correct definitions. The form cannot be contraposed to matter because it is inseparably linked with the latter, it is the form of matter itself. The form cannot be a force either, although it probably pertains to energy because it is determined by energy-bearing connections within the system. According to Kant, form is a purely subjective concept, as it only correlates with intellectual systems and their cognitive abilities. Why, do not the forms exist without knowing them? Any system has one or other shape/look of form. And the system’s form is determined by type and nature of connections/relations/bonds between the system elements. Therefore, the form is a kind of connections between the system elements. Since the systems may interact, new connections/bonds between them are thus established and new forms of systems emerge. In other words, in process of interaction between the systems new systems emerge as new forms. The energy is always expended in the course of interaction between the systems. Logic form of the conservation law is the law of cause-and-effect limitations because it is corresponded by a logical connective “if....., then….” Possible choice of external influences (causes) to which the system should react is limited by the first part of this connective “if...”, whereas the actions of systems (consequences) are limited by the second part “then...”. It is for this reason that the law is called the law of cause-and-effect limitations. This law reads “Any consequence has its cause /every why has a wherefore/”. Nothing appears without the reason/cause and nothing disappears for no special reason/cause. There are no consequences without the reason/cause, there is no reaction without the influence. It is unambiguousness and certainty of reaction of systems to the external influence that lays the cornerstone of determinism in nature. Every specific cause is followed by specific consequence. The system should always react only to certain external influences and always react only in a certain way. Chemoreceptor intended for О2 would always react only to О2, but not to Na +, Ca ++ or glucose. At that, it will give out certain potential of action, rather than a portion of hormone, mechanical contraction or something else. Any system differs in specificity of the external influence and specificity of the reaction. The certainty of external influences and the reactions to them imposes limitations on the types of the latter. Therefore, the need in the following arises from the law of cause-and-effect limitations: execution of any specific (certain) action to achieve specific (certain) purpose; existence of any specific (certain) system (subsystem) for the implementation of such action, as no action occurs by itself; sequences of actions: the system would always start to perform and produce the result of action only after external influence is exerted on it because it does not have free will for making decision on the implementation of the action. Hence, the result of the system performance can always appear only after certain actions are done by the system. These actions can only be done following the external influence. External influence is primary and the result of action is secondary. Of all possible actions those will be implemented only which are caused by external influence and limited (stipulated) by the possibilities of the responding system. If, following the former external influence, the goal is already achieved and there is no new external influence after delivery of the result of action, the system should be in a state of absolute rest and not operate, because it is only the goal that makes the system operate, and this goal is already achieved. No purpose - no actions. If new external influence arises a new goal appears as well, and then the system will start again to operate and new result of action will be produced.

Major characteristics of systems. To carry out purposeful actions the system should have appropriate elements. It is a consequence of the laws of conservation and cause-and-effect limitations since nothing occurs by itself. Therefore, any systems are multi-component objects and their structure is not casual. The structure of systems in many respects determines their possibilities to perform certain actions. For example, the system made of bricks can be a house, but cannot be a computer. But it is not the structure only that determines the possibilities of systems. Strictly determined specific interaction between them determined by their mutual relation is required. Two hands can make what is impossible to make by one hand or “solitary” hands, if one can put it in that way. The hand of a monkey has same five fingers as a hand of a human being does. But the hand of a human being coupled with its intellect has transformed the world on the Earth. Two essential signs thereby determine the quality and quantity of results of action of any systems – the structure of elements and their relations. Any object has only two basic characteristics: what and how much work/many things/ it can do. New quality can only be present in the group of elements interacting in a specific defined mode/manner. “Defined” means target-oriented. “Interacting in a defined mode/manner” means having definite goal, being constructed and operating in a definite mode/manner for the achievement of the given goal. Defined mode/manner cannot be found/inherent in separate given elements and randomly interacting elements. As a result of certain interaction of elements part of their properties would be neutralized and other part used for the achievement of the goal. Transformation of one set of forms of a matter into others occurs for the account of neutralization of some properties of these forms of a matter. And neutralization occurs for the account of change of some connections/bonds between the elements of an object, as these connections/bonds determine the form of an object. For this reason we say “would be neutralized” rather than “destroyed”, because nothing in this world does disappear and appear (the conservation law). The whole world consists of protons, neutrons and electrons, but we see various objects which differ in color, consistence, taste, form, molecular and atomic composition, etc. It means that in the course of specific interaction of protons, neutrons and electrons certain inter-elementary connections are established. At that, some of their properties would be neutralized, while others conserved or even amplified in such a manner that the whole of diversity of our world stems from it. The goal of any system is the fulfillment of the preset (defined) condition, achievement of the preset result of action (goal/objective). If the preset result of action came out incidentally, then the next moment it might not be achieved and the designated/preset result would disappear. But if for some reason there is a need in the result of action being always exactly identical to this one and not to any other (goal-setting), it is necessary that the group of interacting elements retain this new result of action. To this end the given group of elements should continually seek to retain the designated/preset condition (implementation of goal/objective).

Simple systemic functional unit (SFU). The system may consist of any quantity of functional elements/executive component, provided that each of the latter can participate (contribute to) the achievement of the goal/objective and the quantity of such components is sufficient enough for realization of this goal. The minimal system is such group of “k” elements which, in case of removal of at least one of the elements from its structure, loses the quality inherent in this group of elements, but not present in any of the given “k” elements. Such group of elements is a simple systemic functional unit (simple, not composite SFU), the minimal elementary system having some property (ability to make action) which is not present in any of its separate elements. Any SFU reacts to external influence under the “all-or-none” law. This law is resulting from the definition of simple SFU (removal of any of its elements would terminate its function as a system) and discrecity of its structure. Any of its elements may either be or not be a part of simple SFU. And since simple SFU by definition consists of finite and minimal set of function elements and all of them should be within the SFU structure and be functional (operational), termination of functioning of any of these elements would terminate the function of the entire SFU as a system. Regardless of the force of external influence, but given the condition of its being in excess of a certain threshold, the result of its performance will be maximal, ( “all”). If there is no external influence, the SFU would nowise prove out (would not react, “none”). Simple SFU, despite its name, may be arbitrary complex – from elementary minimal SFU to maximal complex ones. The molecule of any substance consists of several atoms. Removal of any atom transforms this molecule from one substance into another. And even each atom represents a very complex constitution. Removal of any of its elements transforms it into an ion, other atom or other isotope. A soldier is a simple SFU of the system called “the army”. A soldier is a human being’s body plus full soldier’s outfit. The body of a human being is an extremely complex object, but removal of any of its parts would render the soldier invalid. At that, the soldier’s outfit/equipment is multi-component as well. But the equipment cannot shoot without man and the man cannot shoot without the equipment. They can only carry out together the functions inherent in SFU named “soldier”. Despite the internal complexity which may be however big, simple SFU is a separate element which looks as a whole unit with certain single property (quality) to fulfill one certain action elementary in relation to the entire system, i.e. to grasp a ball, molecule, push a portion of blood, produce force/load of 0.03 grams, provide living conditions for the animal (for example, one specific unit of forest area) or to an individual (apartment), fire a shot, etc. Any SFU, once it is divided into parts, ceases to be an SFU for the designated goal. It is due to interaction of the parts only that the group of elements can show its worth as SFU. When something breaks a good owner would always think at first where in his household the fragments may be applied and only thereafter he would throw them out, because one broken thing (one SFU) can be transformed into another, more simple one (another SFU). Haemoglobin is an element of blood circulation system and serves for capturing and subsequent return of oxygen. Hence, haemoglobin molecules are the SFU of erythrocytes. Ligands of haemoglobin molecules are the SFU of haemoglobin, as each of them can serve a trap for oxygen molecules. However, further division of ligand brings to a stop the function of retention of oxygen molecules, etc. The SFU analogues in an inorganic nature/abiocoen are, for example, all material particles possessing ability to lose their properties when dividing – elementary particles (?), atoms, molecules, etc. Viruses may probably be the systemic functional units of heredity (FUH). Thus, it is likely that at first polymeric molecules of DNA type came into being in the claypan strata or even in the interplanetary dust or on comets, based on a type of auto-catalytic Butler’s reaction, i.e. synthesis of various sugars including ribose from formaldehyde in the presence of Ca and Mg ions, ribose being a basis for the creation of RNA and DNA, and thereafter cellular structures emerged. These examples of various concrete SFU show that SFU is not something indivisible, since each of them is multicomponent and therefore can be divided into parts. Only intra-atomic elementary particles may pretend to be true SFU that are the basis of the whole of matter of our entire world as it is still impossible to split them into parts. It is for this reason that they are called elementary. It may well be that they are of a very complex structure, too, but formed not from the elements of physical nature, but of some different matter, and are the result of action of performance of systems of non-physical nature, or rather not of the forms of the World of ours. It is indicative of the existence of binate virtual particles, for example, positron and electron, emerging ostensibly from emptiness, vacuum and disappearing thereto after all. We cannot cut paper with scissors made of the same paper material. It’s unlikely that we can “cut” elementary particles with the “scissors” made of the same matter either.

Elementary block of management (direct positive connection/bond, DPC). In order for any SFU to be able to perform it should contain certain elements for implementation of its actions according to the laws of conservation and cause-and-effect limitations. To implement target-oriented actions the system should contain performance /“executive”/ elements and in order to render the executive element’s interaction target-oriented, the system should contain the elements (block) of management/control. Executive elements (effectors) carry out certain (target-oriented) action of a system to ensure the achievement of the preset result of action. The result of action would not come out by itself. In order to achieve it performance of certain objects is required. On the example of plain with a feeler /trial balloon/ such elements are plains themselves. But it (the executive element) exists on itself and produces its own results of action in response to certain influences external with respect to it. It will react if something influences upon it and will not react in the absence of any influence. Interaction with its other elements would pertain to it so far as the results of action of other elements are the external influence in respect of it per se and may invoke its reaction in response to these influences. This reaction will already be shown in the form of its own result of action which would also be the external influence in respect to other elements of the system, and no more than that. Not a single action of any element of the system can be the result of action of the system itself by definition. It does not matter for any separate executive element whether or not the preset condition (the goal of the system) was fulfilled haphazardly, whether or not the given group of elements produced a qualitatively new preset result of action or something prevented it from happening. It in no way affects the way the executive elements “feel”, i.e. their own functions, and none of their inherent property would force them to “watch” the fulfillment of the general goal of the system. They are simply “not able” of doing so. The elements of management (the control block) are needed for the achievement of the particular preset result, rather than of any other result of action. Since the goal is the reaction in response to specific external influence, at first there is a need to “feel” it, to segregate it from the multitude of other nonspecific external influences, “make decision” on any specific actions and begin to perform. If, for example, the SFU reacts to pressure it should be able to “feel” just pressure (reception), rather than temperature or something else. For this purpose it should have a special “organ” (receptor) which is able of doing so. In order to react only to specific external influence which may pertain to the fulfillment of the goal, the SFU should not only have reception, but also single it out from all other external influences affecting it (selection). For this purpose it should have a special organ (selector or analyzer) which is able to segregate the right signal from a multitude of others. Thereafter, having “felt” and segregated the external influence, it should “make decision” that there is a need to act (decision-making). For this purpose it should have a special or decision-making organ able of making decisions. Then it should realize this decision, i.e. force the executive elements to act (implementation of decision). For this purpose it should have elements (stimulators) with the help of which it would be possible to communicate decision to the executive elements. Therefore, in order to react to certain external influence and to achieve the required result of action it is necessary to accomplish the following chain of guiding actions: reception → selection → decision-making → implementation of decisions (stimulation). What elements should carry out this chain of guiding actions? The executive elements (for example, plains) cannot do it, because they perform the action per se, for example, the capturing action, but not guiding actions. For this reason they are also called executive elements. All guiding actions should be accomplished by guiding elements (the control block) and these should be a part of SFU. The control block consists of: “X” receptor (segregates specific signal and detects the presence of external influence); afferent channels (transfer of information from the receptor to analyzer); the analyzer-informant (on the basis of the information from the “Х” receptor makes decisions on the activation of executive elements); efferent cannels (of a stimulator) (implementation of decision, channeling of the guiding actions to the effectors).

The “Х” receptor, afferent channels, analyzer-informant (activator of action) and efferent channels (stimulator) comprise the control block. The receptor and afferent channels represent direct positive communication (DPC). It is direct because inside SFU the guiding signal (information on the presence of external influence) goes in the same direction as the external influence itself. It is positive because if there is a signal there is a reaction, if there is no signal, there is no reaction. Thus, the SFU control block reacts to the external influence. It can feel and detect/segregate specific signal of external influence from the multitude of other external influences and depending on the presence or absence of specific signal it may decide whether or not it should undertake its own action. Its own action is the inducement (stimulation) of the executive elements to operate. There exist uncontrollable and controllable SFU. The control block of uncontrollable SFU decides whether or not it should act, and it would make such decision only depending on the presence of the external influence. The control block of controllable SFU would also decide whether or not it should act depending on the presence of the external signal and in the presence of additional condition as well, i.e. the permission to perform this action which is communicated to its command entry point. The uncontrollable SFU has one entry point for the external influence and one outlet /exit point/ for the result of action. The logic of work of such SFU is extremely simple: it would act if there is certain external influence (result of action), and no result of action is produced in the absence of external influence. For uncontrollable SFU the action regulator is the external influence itself. It has its own management which function is performed by the internal control block. But external management with such SFU is impossible. It would “decide” on its own whether or not it should act. That is why it is called uncontrollable. This decision would only depend on the presence of external influence. In the presence of external influence it would function and no external decision (not the influence) can change the internal decision of this SFU. The uncontrollable SFU is independent of external decisions. It will perform the action once it “made a decision”. The example of uncontrollable SFU is, for instance, the nitroglycerine molecule (SFU for micro-explosion). If it is shaken (external influence is shaking) it will start to disintegrate, thereby releasing energy, and during this process nothing would stop its disintegration. The analogues of uncontrollable SFU in a living organism are sarcomeres, ligands of haemoglobin, etc. Once sarcomere starts to reduce, it would not stop until the reduction is finished. Once the ligand of haemoglobin starts capturing oxygen, it would not stop until the capturing process is finished. Unlike uncontrollable SFU, the controllable SFU have two entry points (one for the entry of external influence and another one for the entry of the command to the analyzer) and one outlet/exit point/ for the result of action. The logic of work of controllable SFU is slightly different from that of the uncontrollable SFU. Such SFU will produce the result of action not only depending on the presence of the external influence, but the presence of permission at the command entry point. Implementation of action will start in the presence of certain external influence and permission at the command entry point. The action would not be performed in the presence of the external influence and the absence of permission at the command entry point. For the controllable SFU the action regulator is the permission at the command entry point. That is why such SFU are called controllable. The analogues of controllable SFU in a living organism are, for example, pulmonary functional ventilation units (FVU) or functional perfusion units (FPU), histic functional perfusion units (FPU), secretion functional units (cells of various secretion glands, SFU), kidney nephrons, liver acinuses, etc. The control block’s elements are built of (assembled from) other ordinary elements suitable in terms of their characteristics. It can be built both of executive elements combined in a certain manner and simultaneously performing the function of both execution and management, and from other executive elements not belonging to the given group and segregated in a separate chain of management. In the latter case they may be precisely the same as executive elements, but may be made of other elements as well. For example, muscular contraction functional units consist of muscular cells, but are managed by nervous centers consisting of nerve cells. At the same time, all kinds of cells, both nerve and muscular, are built of almost identical building materials – proteins, fats, carbohydrates and minerals. The difference between the controllable and uncontrollable FSU is only in the availability of command entry point. It is it that determines the change of the algorithm of its work. Performance of the controllable SFU depends not only on the external influence, but on the M disabling at the command entry point. The control block is very simple, if it contains only DPC (the “Х” receptor and afferent channels), the analyzer-informant and a stimulator. SFU are primary cells, executive elements of any systems. As we can see, despite their elementary character, they represent a fairly complex and multi-component object. Each of them contains not less than two types of elements (management/control and executive) and each type includes more and more, but these elements are mandatory attributes of any SFU. The SFU complexity is the complexity of hierarchy of their elements. There is no any special difference between the executive elements and the elements of management/control. Ultimately all in this world consists of electrons, protons and neutrons. The difference between them lies only in their position in the hierarchy of systems, i.e. in their positional relationship. The composite SFU contains 4 simple SFU. In the absence of the external influence all simple SFU are inactive and no result of action is produced. In the presence of the external influence of “Х”, if the command says “no” (disabling of /ban on action), all SFU would be inactive and no result of action produced. In the presence of external influence and if the command says “yes” (permission for action), all SFU would be active and the result of action produced. The “capacity” of the composite SFU is 4 times higher than the “capacity” of simple SFU. SFU is activated through the inputs of command of their control blocks. Every simple SFU has its own DPC and DPC common for all of them. Uncontrollable and controllable SFU may be used to build other (composite) SFU, more powerful than single SFU. In the real world there are few simple SFU which bring about minimal indivisible result of action. There are a lot more of composite SFU. For instance, the cartridge filled with grains of gunpowder is a constituent part of SFU (SFU for a shot), but its explosion energy is much higher that that of single grain of gunpowder. The composite SFU flow diagram is very similar to that of simple SFU. It is only quantity variance that stipulates the difference between the composite and simple SFU. Simple SFU contains only one SFU, just SFU itself, whereas the composite SFU contains several SFU, so there is a possibility of strengthening of the result of action. Thus, simple and composite SFU contain two types of elements: executive elements (effectors performing specific actions for the achievement of the system’s preset ovearll goal) and the elements of management (block) (DPC, the analyzer-informant and the stimulator activating SFU). Composite SFU has the same control block as the separate SFU, i.e. the elementary one with direct positive (guiding) connection (DPC). Composite SFU perform based on the “all-or-none” principle, too, i.e. they either produce maximal result of action in response to external influence or wait for this external influence and do not perform any actions. Composite SFU only differ from simple SFU in the force or amplitude of reaction which is proportional to the number of simple SFU. If the domino dices are placed in a sequential row the result of their action would be the lasting sound of the falling dices which duration would be equal to the sum of series of drops of every dice (extension of duration of the result of action). If the domino dices are placed in a parallel row the result of their action would be the short, but loud sound equal to the total sound volume resulting from the drop of each separate dice (capacity extension). The performance cycle of an ideal simple and composite SFU is formed by micro cycles: perception and selection of external influence by the “X” receptor and decision-making; influence on the executive elements (SFU); response/operation of executive elements (SFU); function termination. The “X” receptor starts to operate following the onset of external influence (the 1st micro cycle). Subsequently some time would be spent for the decision-making, since this decision itself is the result of action of certain SFU comprising the control block (the 2nd micro cycle). Thereafter all SFU would be activated (joined in) (the 3rd micro cycle). The operating time of the SFU response/operation depends on the speed of utilization of energy spent for the SFU performance, for example, the speed of reduction of sarcomere in a muscular cell which is determined by speed of biochemical reactions in the muscular cell. After that all SFU terminate their function (the 4th micro cycle). At that, the SFU spends its entire energy it had and could use to perform this action. As far as the sequence of actions and result of action would always be the same, the measure of energy would always be the same as well (energy quantum). In order for the SFU to be able to perform a new action it needs to be “recharged”. It may also take some time (the time of charging). The way it happens is discussed in the section devoted to passive and active systems (see below). Any SFU’s performance cycle consists of these micro cycles. Therefore, its operating cycle time would always be the same and equal to the sum of these micro cycles. Once SFU started its actions, it would not stop until it has accomplished its full cycle. This is the reason of uncontrollability of any SFU in the course of their performance (absolute adiaphoria), whereby the external influence may quickly finish and resume, but it would not stop and react to the new external influence until the SFU has finished its performance. In real composite SFU these micro cycles may be supplemented by micro cycles caused by imperfection of real objects, for example, non-synchronism of the executive elements’ operation due to their dissimilarity. Hence, it follows that even the elementary systems represented by SFU do not react/operate immediately and they need some time to produce the result of action. It is this fact that explains the inertness/lag effect/ of systems which can be measured by using the time constant parameter. But generally speaking it is not inertness/lag effect/, but rater a transitory (intermittent) inertness of an object (adiaphoria), its inability to respond to the external influence at certain phases of its performance. True inertness is explained by independence of the result of action of the system which produced this result (see below). Time constant is the time between the onset of external influence and readiness for a new external influence after the achievement of the result of action. The analogues of composite SFU are all objects which operate similarly to avalanche. The “domino principle” works in such cases. One impact brings about the downfall of the whole. However, the number of downfalls would be equal to the number of SFU. Pushing one domino dice will cause its drop resulting just in one click. Pushing a row of domino dices will result in as many clicks as is the number of dices in the row. Biological analogues of composite SFU are, for example, functional ventilation units (FVU), each of which consisting of large group (several hundred) of alveoli which are simultaneously joining in process of ventilation or escape from it. Liver acynuses, vascular segments of mesentery, pulmonary vascular functional units, etc., are the analogues of composite SFU. Thus, simple SFU is the object which can react to certain external influence, while the result of its performance would always be maximal because the control block would not control it, i.e. it works under the “all-or-none” law. The type of its reaction is caused by the type of SFU. There are two kinds of simple SFU: uncontrollable and controllable. Both react to the specific external influence. But additional external permission signal at the command entry point is required for the operation of controllable SFU, whereas the uncontrollable SFU have no command entry point. Therefore, the uncontrollable SFU does not depend on any external guiding signals. The control block of controllable and uncontrollable SFU consists of the analyzer-informant and has only DPC (the “Х” informant and afferent channels). The composite Systemic Functional Unit is a kind of an object similar to simple SFU, but the result of its action is stronger. It works under the “all-or-none” law, too, and its reaction is stipulated by type and number of its SFU. It can really be that the constituent parts of composite SFU may be controllable and uncontrollable, and the difference between them may only be stipulated by the presence of command entry point in the general control block through which the permission for the performance of action is communicated. The control block of a system is elementary, too, and has only DPC and analyzer-informant. Hence, any SFU function under the “all-or-none” law. SFU is arranged in such a way that it either does nothing, or gives out a maximal result of action. Its elementary result of action is either delivered or not delivered. There might be SFU which delivers the result of action, for example, twice as large as the result of action of another SFU. But it will always be twice as large. Each result of action of a simple SFU is quantum of action (indivisible portion), at that being maximal for the given SFU. It is indivisible because SFU cannot deliver part (for instance, half) of the result of action. And as far as it is “the indivisible portion” there can not be a gradation. For instance, SFU may be opened or closed, generate or not generate electric current, secrete or not secrete something, etc. But it cannot regulate the quantity of the result of action as its result always is either not delivered or is maximal. Such operating mode is very rough, inaccurate and unfavorable both for the SFU per se and its goal/objective. Let’s imagine that instead of a steering wheel in our car there will be a device which will right away maximally swerve to the right when we turn a steering wheel to the right or will maximally swerve to the left if we turn it to the left. Instead of smooth and accurate trimming to follow the designate course of movement the car will be harshly rushing about from right to left and other way round. The goal will not be achieved and the car will be destroyed. Basically the composite Systemic Functional Unit could have delivered graded result of action since it has several SFU which it could actuate in a variable sequence. But such system cannot do so because it “does not see” the result of action and cannot compare it with what should be done/what it should be.

Quantity of the result of action. To achieve the preset goal the designation of the quality of the result of action only is not sufficient. The goal sets not only “what action the object should deliver” (quality of the result of action), but also “how much of this action” the given object should deliver (quantity of the result of action). And the system should seek to perform exactly as much of specific action as it is necessary, neither more nor less than that. The quality of action is determined by SFU type. The quantity is determined by the quantity of SFU. There are three quantitative characteristics of the result of action: maximum, minimum and optimum quantity of action. In the real world gradation of the results of action is required from the real systems. Therefore, the system performance should deliver neither maximum nor minimum, but optimum result. Optimum means performance based on the principle “it is necessary and sufficient”. It is necessary that the result of action should be such-and-such, but not another in terms of quality and adequate in terms of quantity, neither more nor less. Hence, the SFU cannot be the full-fledged systems. The systems are needed in which controllable/adjustable grading of the result of action would be possible. For example, it is required that the pressure of 100 mm Hg is maintained in the tissue capillaries. This phrase encompasses presetting of everything what is included in the concept “necessary and sufficient” at once. It is necessary... pressure, and it is enough... 10 mm Hg. It is possible to collate the SFU providing pressure, but not of 10 mm Hg, but, for instance, 100 mm Hg. It is too much. It is probably possible to collate the SFU which can provide pressure of 10 mm Hg and at the moment it might be sufficient. But if the situation has suddenly changed and the requirement is now 100 mm Hg rather than 10 mm Hg, what should be done then? Should one run about and search for SFU which may provide the 100 mm Hg? And what if it’s impossible to make such system which would be able to provide any pressure in a range, for example, from 0 to 100 mm Hg, depending on a situation? In order to provide the quantity of the result of action which is necessary at the moment, the grading of the results of action of systems is required. It could have been achieved by building the systems from a set of homotypic SFU of a type of composite SFU flow diagram. It has what is needed for the graduation of the result of action as it contains numerous SFU. If it could be possible to do it so that it enables actuating from one to all of SFU, depending on the need, the result of action would have as much gradation as many SFU is present in the system. The higher the required degree of accuracy, the more of minor gradations of the result of action should be available. Therefore, instead of one SFU with its extremely large scale result of action it is necessary to use such amount of SFU with minor result of action which sum is equal to the required maximum, while the accuracy of implementation of the goal is equal to the result of action of one SFU. However, composite SFU has no possibility to control the result of action as it has no the unit able of doing it. To deliver the result of action precisely equal to the preset one, it (the result of action) needs to be continually measured and measuring data compared with the task (with command, with “database”). The “database” is a list of those due values of result of action which the system should deliver depending on the magnitude of external influence and algorithm of the control block operation. The goal of the system is that each value of the measured external influence should be corresponded by strictly determined value of the result of action (due value). To this effect it is necessary “to see” (to measure) the result of action of the system to compare it to the appropriate/due result. And for this purpose the control block should have a “Y” receptor which can measure the result of action and there should be a communication/transmission link (reciprocal paths) through which the information from a “Y” receptor would pass to the analyzer-informant, where the result of this measurement should be compared with what should be/occur (with “database”). The control block of the system should compare external influence with the due value, whereas the due value should be compared with own result of action to see its conformity or discrepancy with the due value. Composite SFU still can compare external influence with eigen result of action, because it has DPC, whereas it can not any longer compare due value with the result of eigen action just because it does not have anything able of doing it (there are no appropriate elements).

Simple control block (negative feedback - NF). In order for the control block of the system to “see” (to feel and measure) the result of action of the system, it should have a corresponding “Y” receptor at the outlet/exit point/ of system and the communication link between it and a “Y” receptor (reciprocal path). The logic of operation of such control consists in that if the scale of the result of action is lager than that of the preset result it is necessary to reduce it, having activated smaller number of SFU, and if it is small-scale it is necessary to increase it by actuating larger number of SFU. For this reason such link is called negative. And as the information moves back from the outlet of system towards its beginning, it is called feedback/back action. As a result the negative feedback (NF) occurs. A “Y” receptor and reciprocate path comprise NF and together with the analyzer-informant and efferent cannels (stimulator) form a NF loop. Depending on the need and based on the NF information the control block would engage or disengage the functions of controllable SFU as necessary. The difference of this system from the composite SFU lies only in the presence of a “Y” receptor which measures the result of action and reciprocal paths through which the information is transferred from this receptor to the analyzer. The number of active SFU is determined by NF. The NF is realized by means of NF loop which includes the “Y” receptor, reciprocal path, through which information from “Y” receptor is transferred to the analyzer-informant, analyzer proper and efferent channels through which the control block decisions are transferred to the effectors (controllable SFU). Thus, the system, unlike SFU, contains both DPC and NF. Direct positive (controllable) communication activates the system, while negative feedback determines the number of activated SFU. For example, if larger number of alveolar capillaries in lungs will be opened compared to the number of the alveoli with appropriate gas composition, arterialization of venous blood will be incomplete, and there will be a need to close a part of alveolar capillaries which “wash” by bloodstream the alveoli with gas composition not suitable for gas exchange. If the number of such opened capillaries will be smaller, overloading of pulmonary blood circulation would occur and the pressure in pulmonary artery will increase and there will be a need to open part of alveolar capillaries. In any case the informant of pulmonary blood circulation would snap into action and the control block would decide what part of capillaries needs to be opened or closed. Hence, the diffusion part of vascular channel of pulmonary bloodstream is the system containing simple control block. The goal of the system is that the result of action of “Y” should be equal to the command “M” (Y=M). Actions of system aimed at the achievement of goal are implemented by executive elements. Control block would watch the accuracy of implementation of actions. The control block containing DPC and NF loop is simple. The algorithm of simple control blocks operation is not complex. The NF loop would trace continually the result of performance of executive elements (SFU). If the result of action turns out to be of a larger scale than the preset result, it needs to be reduced, and if the result is of a smaller scale than the preset one it needs to be increased. Control parameters (the “database”) are set through the command; for example, what should be the correlation between external influence and the result of action, or what level of the result of action will need to be retained, etc. At that, the maximum accuracy would be the result of action of one SFU (quantum of action). Systems with NF, as well as composite SFU, also contain two types of objects: executive elements (SFU) (effectors which carry out specific actions for the achievement of the preset overall goal of the system) and the control block (DPC and NF loop). But besides the “Х” informant, control block of the system also contains the “Y” informant (NF). Therefore, it has information both on the external influence and the result of action. Some complexification of the control block brings about a very essential result. The reason for such a complexification is the need to achieve optimally accurate implementation of the goal of the system. The NF ensures the possibility of regulation of quantity of the result of action, i.e. the system with NF may perform any required action in an optimal way, from minimum to maximum, accurate to one quantum of action. Generally speaking, any real system at that has the third type of objects: service elements, i.e. substructure elements without which executive elements cannot operate. For example, the aircraft has wings to fly, but it also has wheels to take off and land. The haemoglobin molecule contains haem which contains 4 SFU (ligands) and globin, the protein which does not participate directly in transportation of oxygen but without which haem cannot work. We have slightly touched upon the issue of existence of the third type of objects (service elements) for one purpose only to know that they are always present in any system, but we will not go into detail of their function. We will only note that they represent the same ordinary systems aimed at serving other systems. Systems with NF can solve most of the tasks in a far better manner than simple or composite SFU. The presence of NF almost does not complexicate the system. We have seen that even simple SFU is a very complex formation including a set of components. Composite SFU is as many times more complex compared to simple SFU as is the number almost equal to that of simple SFU. The system with NF is only supplemented by one receptor and the communication link between receptor and analyzer (reciprocal path). But the effect of such change in the structure of control block is very large-scale and only depends on the algorithm of the control block operation. Any SFU (simple and composite) can implement only minimum or maximum action. Systems with NF can surely deliver the optimal result of action, from minimum to maximum; they are accurate and stable. Their accuracy depends only on the value of quantum of action of separate SFU and the NF profundity/intensity/ (see below). Stability is stipulated by that the system always “sees” the result of action and can compare it with the appropriate/due one and correct it if divergence occurs. In real systems the causes for the divergence are always present, since they exist in the real world where there always exists perturbation action/disturbing influences. Hence, one can see that it is NF that turns SFU into real systems. How does the control block manage the system? What parameters are characteristic of it? Any control block is characterized by three DPC parameters and the same number of NF loop parameters. For DPC it is a minimal level of controllable input stimulus (threshold of sensitivity); maximal level of controllable input stimulus (range of input stimulus sensitivity); time of engagement of control (decision-making time). For NF loop it is minimal level of controllable result of action (threshold of sensitivity of NF loop – NF profundity/intensity); maximal level of controllable result of action (range of sensitivity of the result of action); time of engagement of control (decision-making time). Minimal level of controllable input signal for DPC is the sensitivity threshold of signal of the “Х” receptor wherefrom the analyzer-informant recognizes that the external influence has already begun. For example, if рО2 has reached 60 mm Hg the sphincter should be opened (1 SFU is actuated), if the рО2 value is smaller, then it is closed. Any values of рО2 smaller than 60 mm Hg would not lead to the opening of sphincter, because these are sub-threshold values. Consequently, 60 mm Hg is the operational threshold of sphincter. Maximum level of controllable entrance signal (range) for DPC is the level of signal about external influence at which all SFU are actuated. The system cannot react to the further increase in the input signal by the extension of its function, as it does not have any more of SFU reserves. For example, if рО2 has reached 100 mm Hg all sphincters should be opened (all SFU are activated). Any values of рО2 larger than 100 mm Hg will not lead to the opening of additional sphincters, because all of them are already opened, i.e. the values of 60-100 mm Hg are the range of activation of the system of sphincters. Time of DPC activation is a time interval between the onset of external influence and the beginning of the system’s operation. The system would never respond immediately after the onset of external influence. Receptors need to feel a signal, the analyzer-informant needs to make the decision, the effectors transfer the guiding impact to the command entry points of the executive elements - all this takes time. The minimal level of the controllable exit signal for NF is a threshold of sensitivity of a signal of the “Y” receptor, wherefrom the analyzer-informant recognizes whether there is a discrepancy between the result of action of the system and its due value. The discrepancy should be equal to or more than the quantum of action of single SFU. For example, if one sphincter is to be opened and the bloodstream should be minimal (one quantum of action), whereas two sphincters are actually opened and the bloodstream is twice as intensive (two quanta of action), the “Y” receptor should feel an extra quantum. If it is able of doing so, its sensitivity is equal to one quantum. Sensitivity is defined by the NF profundity/intensity. The NF profundity/intensity is a number of quanta of action of the single SFU system which sum is identified as the discrepancy between the actual and appropriate/proper action. The NF profundity/intensity is preset by the command. The highest possible NF profundity/intensity is the sensitivity of discrepancy in one quantum of action of single SFU. The less the NF profundity/intensity, the less is sensitivity, the more it is “rough”. In other words, the less the NF profundity/intensity, the larger value of the discrepancy between the result of action and the proper result is interpreted as discrepancy. For example, even two (three, ten, etc.) quanta of action of two (three, ten, etc.) SFU is interpreted as discrepancy. Minimal NF profundity/intensity is its absence. In this case any discrepancy of the result of action with the proper one is not interpreted by the control block as discrepancy. The result of action would be maximal and the system with simple control block with zero NF profundity/intensity would turn into composite SFU with DPC (with simplest/elementary control block). For example, the system of the Big Circle of Blood circulation for microcirculation in fabric capillaries should hold average pressure of 100 mm Hg accurate to 1 mm Hg. At the same time, average arterial pressure can fluctuate from 80 to 200 mm Hg. The value “100 mm Hg” determines the level of controllable result of action. The value “from 80 to 200 mm Hg” is the range of controllable external (entry) influence. The value of “1 mm Hg” is determined by NF profundity/intensity. Smaller NF profundity/intensity would control the parameter with smaller degree of accuracy, for example, to within 10 mm Hg (more roughly) or 50 mm Hg (even more roughly), while the higher NF profundity/intensity would do it with higher degree of accuracy, for example to within 0.1 mm Hg (finer). Maximal NF sensitivity is limited to the value of quantum of action of SFU which are part of the system, and the NF profundity/intensity. But in any case, if discrepancy between the level of the controllable and preset parameters occurs to the extent higher than the value of the preset accuracy, the NF loop should “feel” this divergence and “force” executive elements to perform so that to eliminate the discrepancy of the goal and the result of action. Maximal level of controllable outlet/exit signal (range) for NF is the level of signal about the result of action of the system at which all SFU are actuated. The system cannot react to the further increase in entry signal by increase in its function any more, because it has no more of SFU reserves. The time of actuating of NF control is the time interval between the onset of discrepancy of signal about the result of action with the preset result and the beginning of the system’s operation. All these parameters can be “built in” DPC and NF loops or set primordially (the command is entered at their “birth” and they do not further vary any more), or can be entered through the command later, and these parameters can be changed by means of input of a new command from the outside. For this purpose there should be a channel of input of the command. Simple control block in itself cannot change any of these parameters. Absolutely all systems have control block, but it cannot be always found explicitly. In the aircraft or a spaceship this block is presented by the on-board computer, a box with electronics. In human beings and animals such block is the brain, or at least nervous system. But where is the control block located in a plant or bacterium? Where is the control block located in atom or molecule, or, for example, the control block in a nail? The easier the system, the more difficult it is for us to single out forms of control block habitual for us. However, it is present in any systems. Executive elements are responsible for the quality of result of action, while the control block – for its quantity. The control block can be, for example, intra- or internuclear and intermolecular connections/bonds. For example, in atom the SFU functions are performed by electrons, protons and neutrons, and those of control block by intra-nuclear forces or, in other words, interactions. The intra-atomic command, for example, is the condition that there can be no more than 2 electrons at the first electronic level, 8 electrons at the second level, etc., (periodic law determined by Pauli principle), this level being rigidly designated by quantum numbers. If the electron has somewise received additional energy and has risen above its level it cannot retain it for a long time and will go back, thereby releasing surplus of energy in the form of a photon. At that, not just any energy can lift the electron onto the other level, but only and only specific one (the corresponding quantum of energy). It also rises not just onto any level, but only onto the strictly preset one. If the energy of the external influence is less than the corresponding quantum, the electron level stabilization system would keep it in a former orbit (in a former condition) until the energy of external influence exceeded the corresponding level. If the energy of external influence is being continually accrued in a ramp-up mode, the electron would rise from one level to other not in a linear mode but by leaps (which are strictly defined by quantum laws) into higher orbits as soon as the energy of influence exceeds certain threshold levels. The number of levels of an electron’s orbit in atom is probably very large and equal to the number of spectral lines of corresponding atom, but each level is strictly fixed and determined by quantum laws. Hence, some kind of mechanism (system of stabilization of quantum levels) strictly watches the performance of these laws, and this mechanism should have its own SFU and control blocks. The number of levels of the electron’s orbit is possibly determined by the number of intranuclear SFU (protons and neutrons or other elementary particles), which result of action is the positioning of electron in an electronic orbit. For example, in a nail system the command would be its form and geometrical values. This command is entered into the control block one-time at the moment of nail manufacture when its values (at the moment of its “birth”) are measured and is not entered later any more. But when the command is already entered the system should execute this command, i.e. in this case the nail should keep its form and values even if it is being hammered. In any control block type the command should be entered into at some point of time in one way or another. We cannot make just a nail “in general”, but only the one with concrete form and preset values. Therefore, at the moment of its manufacture (i.e. one-time) we give it the “task” to be of such-and-such form and values. The command can vary if there is a channel of input of the command. For example, when turning on the air conditioner we can “give it a task” to hold air temperature at 20°С and thereafter change the command for 25°С. The nail does not have a channel of input of the order, while the air conditioner does. Consequently, the system with simple control block is the object which can react to certain external influence, and the result of its action is graduated and stable. The number of gradation is determined by the number SFU in the system and the accuracy is determined by quantum of action (the size, result) of single SFU and NF profundity/intensity. The result of action is accurate because the control block supervises it by means of NF. Type of control is based on mismatch/error plus error-rate control/. Control would only start after the occurrence of external influence or delivery of the result of action. Stability of the result of action is determined by NF profundity/intensity. System reaction is conditioned by type and number of its SFU. Simple control block has three channels of control: one external (command) and two internal (DPC and NF). It reacts to external influence through DPC (the “Х” informant) and to its own result of action of the system (the “Y” informant) through NF, whereas it controls executive elements of the system through efferent channels. Analogues of systems with simple control block are all objects of inanimate/inorganic world: gas clouds, crystals, various solid bodies, planets, planetary and stellar systems, etc. Biological analogues of systems with simple control block are protophytes and metaphytes, bacteria and all vegetative/autonomic systems of an organism, including, for example, external gas exchange system, blood circulation system, external gaseous metabolism system, digestion or immune systems. Even single-celled animal organisms of amoebas and infusorian type, inferior animal classes (jellyfish etc.) are the systems with complex control blocks/units (see below). All vegetative and many motor reflexes of higher animals which actuate at all levels starting from intramural nerve ganglia through hypothalamus are structured as simple control blocks. If they are affected by guiding influence of cerebral cortex, higher type (complex) reflexes come into service (see below). Analogues of the “Х” informant receptors are all sensitive receptors (haemo-, baro-, thermo- and other receptors located in various bodies, except visual, acoustical and olfactory receptors which are part of the “C” informant, see below). Analogues of the “Y” informant receptors are all proprio-sensitive receptors which can also be haemo-, baro-, thermo- and other receptors located in different organs. Analogues of the control block stimulators are all motor and effector nerves stimulating cross-striped, unstriated muscular systems and secretory cells, as well as hormones, prostaglandins and other metabolites having any effect on the functions of any systems of organism. Analogues of the analyzer-informant in the mineral and vegetative media are only connections/bonds between the elements of a type of direct connection of “X” and “Y” informants with effectors (axon reflexes). In vegetative systems of animals connections are also of a type of direct connection of “X” and “Y” informants with effectors (humoral and metabolic regulation), as well as axon reflex (controls only nervules without involvement of nerve cell itself) and unconditioned reflexes (at the level of intra-organ intramural and other neuronic formations right up to hypothalamus). Thus, using DPC and NF and regulating the performance of its SFU the system produces the results of action qualitatively and quantitatively meeting the preset goal.

Principle of independence of the result of action. As it was already repeatedly underlined, the purpose/goal of any system is to get the appropriate/due (target-oriented) result of action arising from the performance of the system. Actually external influence, “having entered” the system, would be transformed to the result of action of the system. That is why systems are actually the converters of external influence into the result of action and of the cause into effect. External influence is in turn the result of action of other system which interacted with the former. Consequently, the result of action, once it has “left” one system and “entered” into another, would now exist independently of the system which produced it. For example, a civil engineering firm had a goal to build a house from certain quantity of building material (external influence). After a number of actions of this firm the house was built (the result of action). The firm could further proceed to the construction of other house, or cease to exist or change the line of business from construction to sewing shop. But the constructed house will already exist independently of the firm which constructed it. The purpose of the automobile engine (the car subsystem) is burning certain quantity of fuel (external influence for the engine) to receive certain quantity of mechanical energy (the result of action of the engine). The purpose of a running gear (other subsystem of the car) is transformation of mechanical energy of the engine (external influence for running gear) into certain number of revolutions of wheels (result of action of running gear). The purpose of wheels is transformation of certain number of revolutions (external influence for wheels) into the kilometers of travel (result of action of wheels). All in all, the result of action of the car will be kilometers of travel which will already exist independently of the car which has driven them through. Photon released from atom which can infinitely roam the space of the Universe throughout many billions years will be the result of action of the exited electron. Result of a slap of an oar by water is the depression/hollow on the water surface which could have also remained there forever if it were not for the fluidity of water and the influence on it of thousand other external influences. However, after thousand influences it will not any more remain in the form of depression/hollow, but in the form of other long chain of results of actions of other systems because nothing disappears in this world, but transforms into other forms. Conservation law is inviolable.

System cycles and transition processes. Systems just like SFU have cycles of their activity as well. Different systems can have different cycles of activity and they depend on the complexity and algorithm of the control block. The simplest cycle of work is characteristic of a system with simple control block. It is formed of the following micro cycles: perception, selection and measurement of external influence by the “X” receptor; selection from “database” of due value of the result of action; transition process (NF multi-micro-cycle);

a) perception and measurement of the result of action by the “Y” receptor - b) comparison of this result with the due value – c) development of the decision and corresponding influence on SFU for the purpose of correction of the result of action – d) influence on SFU, if the result of action is not equal to the appropriate/due one, or transition to the 1st micro cycle if it is equal to the proper one – e) actuation of SFU – f) return to “a)”.

After the onset of external influence the “X” receptor would snap into action (1st micro cycle). Thereafter the value of the result of action which has to correspond to the given external influence (2nd micro cycle) is selected from the “database”. It is then followed by transition process (transition period, 3rd multi-micro-cycle, NF cycle): actuation of the “Y” receptor, comparison of the result of action with the due value selected from the “database”, corrective influence on SFU (the number of actuated SFU mill be the one determined by control block in the micro cycle “c”) and again return to the actuation of the “Y” receptor. It would last in that way until the result of action is equal to the preset one. From this point the purpose/goal is reached and after that the control block comes back to the 1st micro cycle, to the reception of external influence. System performance for the achievement of the result of action would not stop until there new external influence emerges. The aforementioned should be supplemented by a very essential addition. It has already been mentioned when we were examining the SFU performance cycles that after any SFU is actuated it completely spends all its stored energy intended for the performance of action. Therefore, after completion of action SFU is unable of performing any new action until it restores its power capacity, and it takes additional time which can substantially increase the duration of the transition period. That is why a speed of movement (e.g., running) of a sportsman’s body whose system of oxygen delivery to the tissues is large (high speed of energy delivery) would be fast as well. And the speed of movement of a cardiac patient’s body would be slow because the speed of energy delivery is reduced due to the affection of blood circulation system which is a part of the body’s system of power supply. Sick persons spent a long time to restore energy potential of muscular cells because of the delayed ATP production that requires a lot of oxygen. Micro cycles from 1st to 2nd constitute the starting period of control block performance. In case of short-term external influence control block would determine it during the start cycle and pass to the transition period during which it would seek to achieve the actual result of action equal to the proper one. If external influence appears again during the transition period the control block will not react to it because during this moment it would not measure “Х” (refractory phase). Upon termination of the transition period the control block would go back/resort/ to the starting stage, but while it does so (resorts), the achieved due value of the result of action would remain invariable (the steady-state period). If external influence would be long enough and not vary so that after the first achievement of the goal the control block has time to resort to reception “X” again, the steady value of the result of action would be retained as long as the external influence continues. At that, the transition cycle will not start, because the steady-state value of the result of action is equal to the proper/due one. If long external influence continues and changes its amplitude, the onset of new transition cycle may occur. At that, the more the change in the amplitude of external influence, the larger would be the amplitude of oscillation of functions. Therefore, sharp differences of amplitude of external influence are inadmissible, since they cause diverse undesirable effects associated with transition period.

If external influence is equal to zero, all SFU are deactivated, as zero external influence is corresponded by zero activation of SFU. If, after a short while there would be new external influence, the system would repeat all in a former order. Duration of the system performance cycle is also seriously affected by processes of restoration of energy potential of the actuated SFU. Every SFU, when being actuated, would spend definite (quantized) amount of energy, which is either brought in by external influence per se or is being accumulated by some subsystems of power supply of the given system. In any case, energy potential restoration also needs time, but we do not consider these processes as they associated only with the executive elements (SFU), while we only examine the processes occurring in the control blocks of the systems. Thus, the system continually performs in cycles, while accomplishing its micro cycles. In the absence of external influence or if it does not vary, the system would remain at one of its stationary levels and in the same functional condition with the same number of functioning SFU, from zero to all. In such a mode it would not have transition multi-micro-cycle (long-time repeat of the 3rd micro cycle). Every change of level of external influence causes transition processes. Transition of function to a new level would only become possible when the system is ready to do it. Such micro cycles in various systems may differ in details, but all systems without exception have the NF multi-micro-cycle. With all its advantages the NF has a very essential fault, i.e. the presence of transition processes. The intensity of transition process depends on a variety of factors. It can range from minimal to maximal, but transition processes are always present in all systems in a varying degree of intensity. They are unavoidable in essence, since NF actuates as soon as the result of action of the system is produced. It would take some time until affectors of the system feel a mismatch, until the control block makes corresponding decision, until effectors execute this decision, until the NF measures the result of action and corrects the decision and the process is repeated several times until necessary correlation “... external influence → result of action...” is achieved. Therefore, at this time there can be any unexpected nonlinear transition processes breaking normal operating mode of the system. For this reason at the time of the first “actuation” of the system or in case of sharp loading variations it needs quite a long period of setting/adjustment. And even in the steady-state mode due to various casual fluctuations in the environment there can be a minor failure in the NF operation and minor transition processes (“noise” of the result of action of real system). The presence of transition processes imposes certain restrictions on the performance and scope of use of systems. Slow inertial systems are not suitable for fast external influences as the speed of systems’ operation is primarily determined by the speed of NF loop operation. Indeed, the speed of executive element’s operation is the basis of the speed of system operation on the whole, but NF multi-micro-cycle contributes considerably to the extension of the system’s operation cycle. Therefore, when choosing the load on the living organism it is necessary to take into consideration the speed of system operation and to select speed of loading so as to ensure the least intensity of transition processes. The slower the variation of external influence, the shorter is the transition process. Transition period becomes practically unapparent when the variation of external influence is sufficiently slow. Consequently, if external influence varies, the duration of transition period may vary from zero to maximum depending on the speed of such variation and the speed of operation of the system’s elements. Transition period is the process of transition from one level of functional state to another. The “smaller” the steps of transition from one level on another, the less is the amplitude of transition processes. In case of smooth change of loading no transition processes take place. The intensity of transition processes depends on the SFU caliber, force of external influence, duration of SFU charging, sensitivity of receptors, the time of their operation, the NF intensity/profundity and algorithm of the control block operation. But these cycles of systems’ performance and transition processes are present both in atoms and electronic circuitry, planetary systems and all other systems of our World, including human body.

If systems did not have transition processes, transition process period would have been always equal to zero and the systems would have been completely inertia-free. But such systems are non-existent and inertness is inherent in a varying degree in any system. For example, in electronics the presence of transition processes generates additional harmonics of electric current fluctuations in various amplifiers or current generators. Sophisticated circuit solutions are applied to suppress thereof, but they are present in any electronic devices, considerably suppressed though. Time constant of systems with simple control blocks includes time constants of every SFU plus changeable durations of NF transition periods. Therefore, constant of time of such systems is not quite constant since duration of NF transition periods can vary depending on the force of external impact. Transition processes in systems with simple control blocks increase the inertness of such systems. Inertness of systems leads to various phase disturbances of synchronization and balance of interaction between systems. There are numerous ways to deal with transition processes. External impacts may be filtered in such a way that to prevent from sharp shock impacts (filtration, a principle of graduality of loading). Knowing the character of external impacts/influences in advance and foreseeing thereof which requires seeing them first (and it can only be done, at the minimum, by complex control blocks) would enable designing of such an appropriate algorithm of control block operation which would ensure finding correct decision by the 3rd micro cycle (prediction based control/management). However, it is only feasible for intellectual control blocks. Apparently it’s impossible for us to completely get rid of the systems’ inertness so far. Therefore, if the external impact/influence does not vary and the transition processes are practically equal to zero the system would operate cyclically and accurately on one of its stationary levels, or smoothly shift from one stationary level to another if external influence varies, but does it quite slowly. If transition processes become notable, the system operation cycles become unequal due to the emergence of transition multi-micro-cycles, i.e. period of transition processes. At that, nonlinear effects reduce the system’s overall performance. In our everyday life we often face transition processes when, being absolutely unprepared, we leave a warm room and get into the cold air outside and catch cold. In the warm room all systems of our organism were in a certain balance of interactions and everything was all right. But here we got into the cold air outside and all systems should immediately re-arrange on a new balance. If they have no time to do it and highly intensive transition processes emerge that cause unexpected fluctuations of results of actions of body systems, imbalance of interactions of systems occurs which is called “cold” (we hereby do not specify the particulars associated with the change of condition of the immune system). After a while the imbalance would disappear and the cold would be over as well. If we make ourselves fit, we can train our “control blocks” to foresee sharp strikes of external impacts to reduce transition processes; we then will be able even to bathe in an ice hole. Transition processes of special importance for us are those arising from sharp change of situation around us. Stress-syndrome is directly associated with this phenomenon. The sharper the change of the situation around us, the more it gets threatening (external influence is stronger), the sharper transition processes are, right up to paradoxical reactions of a type of stupor. At that, the imbalance of performance of various sites of nervous system (control blocks) arises, which leads to imbalance of various systems of organism and the onset of various pathological reactions and processes of a type of vegetative neurosis and depressions, ischaemia up to infarction and ulcers, starting from mouth cavity (aphtae) to large intestine ulcers (ulcerative colitis, gastric and duodenum ulcers, etc.), arterial hypertension, etc.

Cyclic recurrence is a property of systems not of a living organism only. Any system operates in cycles. If external influence is retained at a stable level, the system would operate based on this minimal steady-state cycle. But external influence may change cyclically as well, for example, from a sleep to sleep, from dinner to dinner, etc. These are in fact secondary, tertiary, etc., cycles. Provided constructing the graphs of functions of a system, we get wavy curves characterizing recurrence. Examples include pneumotachogram, electrocardiogram curves, curves of variability of gastric juice acidity, sphygmogram curves, curves of electric activity of neurons, periodicity of the EEG alpha rhythm, etc. Sea waves, changes of seasons, movements of planets, movements of trains, etc., - these are all the examples of cyclic recurrence of various systems. The forms of cyclic recurrence curves may be of all sorts. The electrocardiogram curve differs from the arterial pressure curve, and the arterial pressure curve differs from the pressure curve in the aortic ventricle. Variety of cyclic recurrence curves is infinite. Two key parameters characterize recurrence: the period (or its reciprocal variable - frequency) and nonuniformity of the period, which concept includes the notion of frequency harmonics. Nonuniformity of the cycle period should not be resident in SFU (the elementary system) as its performance cycles are always identical. However, the systems have transition periods which may have various cycle periods. Besides, various systems have their own cyclic periods and in process of interaction of systems interference (overlap) of periods may occur. Therefore, additional shifting of own systems’ periods takes place and harmonics of cycles emerge. The number of such wave overlaps can be arbitrary large. That is why in reality we observe a very wide variety of curves: regular sinusoids, irregular curves, etc. However, any curves can be disintegrated into constituent waves thereof, i.e. disintegration of interference into its components using special analytical methods, e.g. Fourier transformations. Resulting may be a spectrum of simpler waves of a sinusoid type. The more detailed (and more labour-consuming, though) the analysis, the nearer is the form of each component to a sinusoid and the larger is the number of sinusoidal waves with different periods.

The period of system cycle is a very important parameter for understanding the processes occurring in any system, including in living organisms. Its duration depends on time constant of the system’s reaction to external impact/influence. Once the system starts recurrent performance cycle, it would not stop until it has not finished it. One may try to affect the system when it has not yet finished the cycle of actions, but the system’s reaction to such interference would be inadequate. The speed of the system’s functions progression depends completely on the duration of the system performance cycle. The longer the cycle period, the slower the system would transit from one level to another. The concepts of absolute and relative adiaphoria are directly associated with the concept of period and phase of system cycle. If, for example, the myocardium has not finished its “systole-diastole” cycle, extraordinary (pre-term) impulse of rhythm pacemaker or extrasystolic impulse cannot force the ventricle to produce adequate stroke release/discharge. The value of stroke discharge may vary from zero to maximum possible, depending on at which phase of adiphoria period extrasystolic impulse occurs. If the actuating pulse falls on the 2nd and 3rd micro cycles, the myocardium would not react to them at all (absolute adiphoria), since information from the “X” receptor is not measured at the right time. Myocardium, following the contraction, would need, as any other cell would do following its excitation, some time to restore its energy potential (ATP accumulation) and ensure setting of all SFU in “startup” condition. If extraordinary impulse emerges at this time, the system’s response might be dependent on the amount of ATP already accumulated or the degree in which actomyosin fibers of myocardium sarcomeres diverged/separated in order to join in the function again (relative adiphoria). Excitability of an unexcited cell is the highest. At the moment of its excitation excitability sharply falls to zero (all SFU in operation, 2nd micro cycle) – absolute adiphoria. Thereafter, if there is no subsequent excitation, the system would gradually restore its excitability, while passing through the phases of relative adiphoria up to initial or even higher level (super-excitability, which is not examined in this work) and then again to initial level. Therefore, pulse irregularity may be observed in patients with impaired cardial function, when sphygmic beats are force-wise uneven. Extreme manifestation of such irregularity is the so-called “Jackson’s symptom” /pulse deficiency/, i.e. cardiac electric activity is shown on the electrocardiogram, but there is no its mechanical (haemodynamic) analogue on the sphygmogram and sphygmic beats are not felt when palpating the pulse. The main conclusions from all the above are as follows: any systems operate in cycles passing through micro cycles; any system goes through transition process; cycle period may differ in various systems depending on time constant of the system’s reaction to the external impact/influence (in living systems – on the speed of biochemical reactions and the speed of command/actuating signals); irregularity of the system’s cycle period depends on the presence of transition processes, consequently, to a certain degree on the force of external exposure/influence; irregularity of the system cycle period depends on overlapping of cycle periods of interacting systems; upon termination of cycle of actions after single influence the system reverts to the original state, in which it was prior to the beginning of external influence (one single result of action with one single external influence). The latter does not apply to the so-called generating systems. It is associated with the fact that after the result of action has been achieved by the system, it becomes independent of the system which produced it and may become external influence in respect to it. If it is conducted to the external influence entry point of the same system, the latter would again get excited and again produce new result of action (positive feedback, PF). This is how all generators work. Thus, if the first external influence affects the system or external influence is ever changing, the number of functioning SFU systems varies. If no external influence is exerted on the system or is being exerted but is invariable, the number of functioning system SFU would not vary. Based on the above we can draw the definitions of stationary conditions and dynamism of process.

Functional condition of system. Functional condition of the system is defined by the number of active SFU. If all SFU function simultaneously, it shows high functional condition which arises in case of maximum external influence. If none SFU is active it shows minimum functional condition. It may occur in the absence of external influence. External environment always exerts some kind of influence on some systems, including the systems of organism. Even in quiescent state the Earth gravitational force makes part of our muscles work and consequently absolute rest is non-existent. So, when we are kind of in quiescent state we actually are in one of the low level states of physical activity with the corresponding certain low level of functional state of the organism. Any external influence requiring additional vigorous activity would transfer to a new level of a functional condition unless the SFU reserve is exhausted. When new influence is set at a new invariable (stationary) level, functional condition of a system is set on a new invariable (stationary) functional level.

Stationary states/modes. Stationary state is such a mode of systems when one and the same number of SFU function and no change occurs in their functional state. For example, in quiescence state all systems of organism do not change their functional mode as far as about the same number of SFU is operational. A female runner who runs a long distance for quite a long time without changing the speed is also in a stationary state/mode. Her load does not vary and consequently the number of working (functioning) SFU does not change either, i.e. the functional state of her organism does not change. Her organism has already “got used” to this unchangeable loading and as there is no increase of load there is no increase in the number of working SFU, too. The number of working SFU remains constant and therefore the functional state/mode of the organism does not change. What may change in this female runner’s body is, e.g. the status of tissue energy generation system and the status of tissue energy consumption system, which is in fact the process of exhaustion of organism. However, if the female runner has duly planned her run tactics so that not to find herself in condition of anaerobic metabolism, the condition of external gas metabolism and blood circulation systems would not change. So, regardless of whether or not physical activity is present, but if it does not vary (stationary physical loadings /steady state/, provided it is adequate to the possibilities of the organism), the organism of the subject would be in a stationary state/mode. But if the female runner runs in conditions of anaerobic metabolism the “vicious circle” will be activated and functional condition of her organism will start change steadily to the worse. (The vicious circle is the system’s reaction to its own result of action. Its basis is hyper reaction of system to routine influence, since the force of routine external influence is supplemented by the eigen result of action of the system which is independent of the latter and presents external influence in respect to it. Thus, routine external influence plus the influence of the system’s own result of action all in all brings about hyper influence resulting in hyper reaction of the system (system overload). The outcome of this reaction is the destruction own SFU coupled with accumulation of defects and progressing decline in the quality of life. At the initial stages while functional reserves are still large, the vicious circle becomes activated under the influence of quite a strong external action (heavy load condition). But in process of SFU destruction and accumulation of defects the overload of adjacent systems and their destruction would accrue (the domino principle), whereas the level of load tolerance would recede and with the lapse of time even weak external influences will cause vicious circle actuation and may prove to be excessive. Eventually even the quiescent state will be the excessive loading for an organism with destroyed SFU which condition is incompatible with life. Usually termination of loading would discontinue this vicious circle.

Dynamic processes. Dynamic process is the process of changing functional state/mode/condition of the system. The system is in dynamic process when the change in the number of its actuated SFU occurs. The number of continually actuated SFU would determine stationary state/mode/condition of the system. Hence, dynamic process is the process of the system’s transition from one stationary level to another. If the speed of change in external influences exceeds the speed of fixing the preset result of action of the system, transition processes (multi-micro-cycles) occur during which variation of number of functioning SFU also takes place. Therefore, these transition processes are also dynamic. Consequently, there are two types of dynamic processes: when the system is shifting from one stationary condition (level) to another and when it is in transient multi-micro-cycle. The former is target-oriented, whereas the latter is caused by imperfection of systems and is parasitic, as its actions take away additional energy which was intended for target actions. When the system is in stationary condition some definite number of SFU (from zero to all) is actuated. The minimum step of change of level of functional condition is the value determined by the level of operation of one SFU (one quantum of action). Hence, basically transition from one level of functional condition to another is always discrete (quantized) rather than smooth, and this discrecity is determined by the SFU “caliber”. Then umber of stationary conditions is equal to the number of SFU of the system. Systems with considerable quantity of “small” SFU would pass through dynamic processes more smoothly and without strenuous jerks, than systems with small amount of “large” SFU. Hence, dynamic process is characterized by an amplitude of increment of the system’s functions from minimum to maximum (the system’s minimax; depends on its absolute number of SFU), discrecity or pace of increment of functions (depends on the “caliber” or quantum of individual SFU) and parameters of the function’s cyclic recurrence (speed of increase of actions of system, the period of phases of a cycle, etc.). It can be targeted or parasitic. It should be noted that stationary condition is also a process, but it’s the steady-state (stationary) process. In such cases the condition of systems does not vary from cycle to cycle. But during each cycle a number of various dynamic processes take place in the system as the system itself consists of subsystems, each of which in turn consists of cycles and processes. The steady-state process keeps system in one and the same functional condition and at one and the same stationary level. In accordance with the above definition, if a system does not change its functional condition, it is in stationary condition. Consequently, the steady-state process and stationary condition mean one the same thing, because irrespective of whether the systems are in stationary condition or in dynamic process, some kind of stationary or dynamic processes may take place in their subsystems. For example, even just a mere reception by the “Х” receptor is a dynamic process. Hence, there are no absolutely inert (inactive) objects and any object of our World somewise operates in one way or another. It is assumed that the object may be completely “inactive” at zero degrees of Kelvin scale (absolute zero). Attempts to obtain absolutely inactive systems were undertaken by freezing of bodies up to percentage of Kelvin degrees. It’s unlikely though, that any attempts to freeze a body to absolute zero would be a success, because the body would still move in space, cross some kind of magnetic, gravitational or electric fields and interact with them. For this reason at present it is probably impossible in principle to get absolutely inert and inactive body. The integral organism represents mosaic of systems which are either in different stationary conditions, or in dynamic processes. One could possibly make an objection that there are no systems in stationary condition in the organism at all, as far as some kind of dynamic processes continually occur in some of its systems. During systole the pressure in the aorta increases and during diastole it goes down, the heart functions continuously and blood continuously flows through the vessels, etc. That is all very true, but evaluation of the system’s functions is not made based on its current condition, but the cycles of its activity. Since all processes in any systems are cyclic, including in the organism, the criterion of stationarity is the invariance of integral condition of the system from one cycle to another. Aorta reacts to external influence (stroke/systolic discharge of the left ventricle) in such a way that in process of increase of pressure its walls’ tension increases, while it falls in process of pressure reduction. However, take, for example, the longer time period than the one of the cardiocycle, the integrated condition of the aorta would not vary from one cardiocycle to another and remain stationary.

Evaluation of functional state of systems. Evaluation may be qualitative and quantitative. The presence (absence) of any waves on the curve presents quality evaluation, whereas their amplitude or frequency is their quantitative evaluation. For the evaluation of functional condition of any systems comparison of the results of measurements of function parameters to those that should be with the given system is needed. In order to be able to judge about the presence (absence) of pathology, it is not enough to measure just any parameter. For example, we have measured someone’s blood pressure and received the value of 190/100 mm Hg. Is it a high pressure or it is not? And what it should be like? To answer these questions it is necessary to compare the obtained result to a standard scale, i.e. to the due value. If the value obtained differs from the appropriate one, it speaks of the presence of pathology, if it does not, then it means there is no pathology. If blood pressure value of an order of 190/100 mm Hg is observed in quiescent state it would speak of pathology, while at the peak maximum load this value would be a norm. Hence, due values depend on the condition in which the given system is. There exist standard scales for the estimation of due values. There exist maximum and minimum due values, due values of quiescence state and peak load values, as well as due curves of functions. Minimum and maximum due values should not always correspond to those of quiescence state or peak load. For example, total peripheral vascular resistance should be maximum in quiescence state and minimum when loaded. Modern medicine makes extensive use of these kinds of due values, but is almost unfamiliar with the concept of due curves. Due value is what may be observed in most normal and healthy individuals with account taken of affiliation of a subject to certain standard group of alike subjects. If all have such-and-such value and normally exist in the given conditions, then in order for such subject to be also able to exist normally in the same conditions, he/she should be characterized by the same value. For this purpose statistical standard scales are applied which are derived by extensive detailed statistical research in specific groups of subjects. These are so-called statistical mathematical models. They show what parameters should be present in the given group of subjects. However, the use of standard tables is a primitive way of evaluation of systems’ functions. First, they provide due values characterizing only a group of healthy individuals rather than the given concrete subject. Secondly, we already know that systems at each moment of time are in one of their functional states and it depends on external influences. For example, when the system is in quiescence state it is at its lowest level of functional condition, while being at peak load it is at its highest level. What do these tables suggest then? They probably suggest due values for the systems of organism in quiescence state or at their peak load condition. But, after all, the problems of patients are not those associated with their status in quiescence state, and the level of their daily normal (routine) load is not their maximum load. For normal evaluation of the functional condition of the patient’s organism it is necessary to use not tabular data of due values, but due curves of functions of the body systems which nowadays are almost not applied. Coincidence or non-coincidence of actual curves of the body systems’ functions with due curves would be a criterion of their sufficiency or insufficiency. Hence, application of standard tables is insufficient and does not meet the requirements of adequate diagnostics. Application of due curves is more of informative character (see below). Statistical mathematical models do not provide such accuracy, howsoever exact we measure parameters. They show what values of parameters should be in a certain group of subjects alike in terms of certain properties, for example, males aged 20-30 years, of 165-175 cm height, smokers or non-smokers, married or single, paleface, yellow- or black-skinned, etc. Statistical models are much simpler than those determined, but less exact though, since in relation to the given subject we can only know something with certain degree (e.g. 80%) of probability. Statistical models apply when we do not know all elements of the system and laws of their interaction. Then we hunt for similar systems on the basis of significant features, we somewise measure the results of action of all these systems operating in similar conditions (clinical tests) and calculate mean value of the result of action. Having assumed that the given subject closely approximates the others, because otherwise he/she would not be similar to them, we say: “Once these (people) have such-and-such parameters of the given system in such-and-such conditions and they live without any problems, then he/she should have these same parameters if he/she is in the same conditions”. However, a subject’s living conditions do always vary. Change or failure to account even one significant parameter can change considerably the results of statistical researches, and this is a serious drawback of statistical mathematical models. Moreover, statistical models often do not reveal the essence of pathological process at all. The functional residual capacity (FRC) of lungs shows volume of lungs in the end of normal exhalation and is a certain indicator of the number of functional units of ventilation (FUV). Hence, the increase in FRC indicates the increase in the number FUV? But in patients with pulmonary emphysema FRC is considerably oversized. All right then, does this mean that the number of FUV in such patients is increased? It is nonsense, as we know that due to emphysema destruction of FUV occurs! And in patients with insufficiency of pumping function of left ventricle reduction of FRC is observed. Does this mean that the number of FUV is reduced in such patients? It is impossible to give definite answer to these questions without the knowledge of the dynamics of external respiration system function and pulmonary blood circulation. Hence, the major drawback of statistical models consists in that sufficiently reliable results of researches can be obtained only in the event that all significant conditions defining the given group of subjects are strictly observed. Alteration or addition of one or several significant conditions of research, for example, stature/height, sex, weight, the colour of eyes, open window during sleep, place of residence, etc., may alter very much the final result by adding a new group of subjects. As a result, if we wish to know, e.g. vital capacity of lungs in the inhabitants of New York we must conduct research among the inhabitants of New York rather than the inhabitants of Moscow, Paris or Beijing, and these data may not apply, for example, to the inhabitants of Rio de Janeiro. Moreover, standards/norms may differ in the inhabitants of different areas of New York depending on national/ethnic/ identity, environmental pollution in these areas, social level and etc. Surely, one may investigate all conceivable variety of groups of subjects and develop specifications/standards, for example, for males aged from... to..., smokers or non-smokers of cigars (tobacco pipes, cigarettes or cigarettes with cardboard holder) with high (low) concentration of nicotine, aboriginals (emigrants), white, dark- or yellow-skinned, etc. It would require enormous efforts and still would not be justified, since the world is continually changing and one would have to do this work every time again. It’s all the more so impossible to develop statistical specifications/standards for infinite number of groups of subjects in the course of dynamic processes, for example, physical activities and at different phases of pathological processes, etc., when the number of values of each separate parameter is quite large. When the system’s details are completely uncertain, although the variants of the system’s reaction and their probabilistic weighting factors are known, statistical mathematical model of system arises. Inaccuracy of these models is of fundamental character and is stipulated by probabilistic character of functions. In process of studying of the system details of its structure become apparent. As a result an empirical model emerges in the form of a formula. The degree of accuracy of this model is higher than that of statistical, but it is still of probabilistic character. When all details of the system are known and the mechanism of its operation is entirely exposed the deterministic mathematical model appears in the form of the formula. Its accuracy is only stipulated by the accuracy of measurement methods. Application of statistical mathematical models is justified at the first stages of any cognition process when details of phenomenon in question are unknown. At this stage of cognition a “black box” concept is introduced when we know nothing about the structure of this “box”, but we do know its reaction to certain influences. Types of its reactions are revealed by means of statistical models and thereafter, with the help of logic, details of its systems and their interaction are becoming exposed. When all that is revealed, deterministic models come into play and the evaluation of the systems’ functions is made not on the basis of tabular data, but on the basis of due curve of the system function. Due curve of a system’s function is a due range of values of function of the given concrete system in the given concrete subject, with its load varying from minimum to maximum. Nowadays due curves are scarcely used, instead extreme minimum and maximum due values are applied. For example, due ventilation of lungs in quiescence state and in the state of peak load. For this purpose maximum load is given to individuals in homotypic groups and pulmonary ventilation in quiescence state and in the state of peak load is measured. Following statistical processing due values of pulmonary ventilation for the conditions of rest and peak load are obtained. The drawback of extreme due values consists in that this method is of little use for the patients. Not all patients are able to normally perform a stress test and discontinue it long before due maximum value is achieved. The patient, for example, could have shown due pulmonary ventilation, but he/she just stopped the load test too early. How can the function be estimated then? It can be only done by means of due curve. If the actual curve coincides with the due curve, the function is normal at the site where coincidence occurred. If actual curve is lower than the due one, it is a lagging curve. Inclined straight line consisting of vertical pieces of line is the due curve. Vertical dotted straight line is the boundary of transition of normal or lagging function into the inadequate line (a plateau). The drawback of due curves is that in order to build them it is necessary to use deterministic mathematical models of systems which number is currently very low. They are built on the basis of knowledge of cause-and-effect relationship between the system elements. These models are the most complex, labor-consuming and for the time being are in many cases impracticable. Therefore, these models are scarcely used in the sphere of applied medicine and this is the reason for the absence of analytical medicine. But they are the most accurate and show what parameters should be present in the given concrete subject at any point of time. Only the use of due curve functions allows for evaluating actual curves properly. The difference of the deterministic mathematical models from statistical tables consists in that in the first case due values for the concrete given subject (the individual’s due values) are obtained, while in the second case due values for the group of persons alike the given subject are developed. The possibility of building deterministic models depends only on the extent of our knowledge of executive elements of the system and laws of their interaction. Calculation of probability of a thrown stone hitting a designated target can be drawn as an example of statistical standard scale in the mechanic. After a series of throws, having made certain statistical calculations it is possible to predict that the next throw with such degree of probability will hit the mark. If deterministic mathematical model (ballistics) is used for this purpose, then knowing the stone weight, the force and the angle of throw, viscosity of air, speed and direction of wind, etc., it is possible to calculate and predict precisely the place where a stone will fall. “Give me a spot of support and I will up-end the globe”, said Archimedes, having in view that he had deterministic mathematical model of mechanics of movements. Any living organism is a very complex and multi-component system. It’s impossible to account all parameters and their interrelations, therefore statistical mathematical models cannot describe adequately the condition of systems of organism. However, joint use of statistical and deterministic models allows, with sufficient degree of accuracy, to evaluate parameters of living system. In the lapse of time in process of accumulation of knowledge statistical models are replaced by deterministic. Engineering/technology is much simpler than biology and medicine because the objects of its knowledge are rather simple systems (machinery/vehicles) constructed by a man. Therefore, its development and process of replacement of statistical mathematical models for deterministic ones has made great strides as compared with medicine. Nevertheless, on the front line of any science including technical, where there is still no clarity about many things and still a lot has to be learnt, statistics stands its ground as it helps to reveal elements of systems and laws of their interaction. What do we examine the subject and conduct estimation of functions of the systems of his organism for? Do we do it in order to know to which extent he/she differs from the homothetic subject? Probably, yes. But, perhaps, the main objective of examination of a patient is to determine whether he/she can normally exist without medical aid and if not, what kind of help might be provided. Pathological process is a process of destruction of some SFU of the organism’s systems in which one of the key roles is played by a vicious circle. However, vicious circles start to actuate only if certain degree of load is present. They do not emerge below this level and do not destroy SFU, i.e. no pathological process emerges and no illness occurs below a certain threshold of loading (mechanical, thermal, toxic, etc.). Hence, having defined a threshold of the onset of the existence of vicious circle, we can learn the upper “ceiling” of quality of life of the given patient. If his/her living conditions (tempo of life) allow him/her not to exceed this “ceiling”, it suggests that the given subject will not be in poor health under these conditions. If the tempo of life requires more than the capacity of his/her organism may provide, he/she will be in poor health. In order not to be ill he/she should stint himself/herself in some actions. To limit oneself in actions means to reduce one’s living standard, to deprive oneself of the possibility to undertake certain actions which others can do or which he/she did earlier, but which are now inaccessible to the given patient on the grounds of restricted resources of his/her organism because of defects. If these restrictions have to do only with pleasure/delight, such as, for example, playing football, this may be somehow sustained. But if these restrictions have to do with conditions of life of the patient it has to be somehow taken into account. For example, if his/her apartment is located on the ground floor, then to provide for quite normal way of life his/her maximum consumption of О2 should be, e.g., 1000 ml a minute. But what one should do if he/she lives, e.g., on the third floor and in the house with no elevator, and to be able to get to the third floor on foot he/she should be able to take up 2000 ml/min О2, while he/she is able to uptake take up only 1000 ml/min О2,? The patient would then have a problem which can be solved only by means of some kind of health care actions or by changing conditions of life. In clinical practice we almost do not assess the patient’s functional condition from the stand point of its correspondence to living conditions. Of course, it is trivial and we guess it, but for the time being there are no objective criteria and corresponding methodology for the evaluation of conformity of the functional reserves of the patient’s organism with the conditions of his/her life activity. Ergonomics is impossible without systemic analysis. Major criterion of sufficiency of the organism’s functions in the given conditions of life is the absence of the occurrence of vicious circles (see below) at the given level of routine existential loads. If vicious circles arise in the given conditions, it is necessary either to somehow strengthen the function of the organism’s systems or the patient will have to change his/her living conditions so that vicious circles do not work, or otherwise he/she will always be in poor health with all the ensuing consequences. So, we need not only to know due minimum or maximum values which we may obtain using statistical mathematical models. We also need to know the patient’s everyday due values of the same parameters specific for the given concrete patient so that his/her living conditions do not cause the development of pathological processes and destroy his/her organism. To this effect we need deterministic mathematical models.

Stabilization systems and proportional systems. There exist a great number of types of various systems. But stabilization systems and proportional systems are of special importance for us. In respect of the first one the result of action always remains the same (stable), it does not depend on the force of external influence, but on the command. For example, рН of blood should be always equal to 7.4, blood pressure to 120/80 mm Hg, etc., (homeostasis systems) regardless of external influences. In respect of the second one the result of action depends on the force of external influence under any specific law designated by the command and is proportional to it. For example, the more physical work we perform the more О2 we should consume and excrete СО2. Stabilization system uses two receptors, “Х” and “Y”. The “Х” receptor is used to start up the system depending on the presence of external influence, while the “Y” receptor is used for the measurement of the result of action. The command (the task specifying the value of the result of action) is entered to the command entry point of the stabilization system’s control block. Stabilization system should fulfill this task, i.e. support (stabilize) the result of action at the designated level irrespective of the force of external influence. Stability of the result of action is ensured by that the “database” of the control block contains the ratios/correlations of the number of active SFU and forces of external influence and is sustained according to the NF logic: if the result of action has increased, it is necessary to reduce it, and if it has decreased it’s necessary to increase it. For this purpose the control block should contain DPC and NF. Hence, the elementary control block (DPC) is not suitable for stabilization systems. At least simple control block which contains NF as well is necessary. In stabilization system the result of action of the system up to vertical dotted straight line is stable (normal function, the curve goes horizontally). Beyond the dotted straight line the function goes down (increases), stabilization was disturbed (insufficiency of function). With proportional system, its function increases (goes down) until vertical dotted straight line proportionally to the external influence (normal function). Beyond the dotted straight line the function does not vary (it entered the saturation phase, transited to a plateau condition - insufficient function). The measuring element in stabilization system continually measures the result of action of the system and communicates it to the control block which compares it to the preset result. In case of discrepancy of the result of action with the task this block makes decision on those or other actions to be taken and forces the executive elements to operate so that this divergence has disappeared. External influence may vary within various ranges, but the result of action should remain stable and be equal to the preset result. The system spends its resources to do it. If the resources are exhausted, stabilization system ceases to stabilize the result of action and starting from this point the onset of its insufficiency occurs. One of stabilization examples is stellar rotation speed in vacuum. If the radius of the star reduces, its rotational speed will increase and centrifugal forces will amplify, thus scaling up its radius and slowing down its rotational speed. If the radius of the star scales up, the entire process will go in a reverse order. A figure skater regulates the speed of rotational pirouettes he/she performs on the skating-rink based on the same principle. Proportional system should also use both “Х” and “Y” receptors. One of them measures the incoming influence, while another one measures the result of action of the system. The command (the task as to what the proportion between external influence and the result of action should be) is input to the entry point of the control block. It is for this reason that such systems are called proportional. External influence may change within the varying range. But the control block should adjust the performance of the executive elements so that the “prescribed” (preset by the directive) proportion between external influence and the result of action is maintained. Examples of proportional systems are, for example, amplifiers of electric signals, mechanical levers, sea currents (the more the water in the ocean is warmed up, the more intensive is the flow in the Gulf Stream), atmospheric phenomena, etc. So, the examples of stabilization and proportional systems are found in any medium, but not only in biological systems.

Active and passive systems. Passive systems are those which do not exspend energy for their actions. Active systems are those which do exspend energy for their actions. However, as it was repeatedly underlined, any action of any system requires expenditure of energy. Any action, even the most insignificant, is impossible without expenditure of energy, because, as it has already been mentioned, any action is always the interaction between systems or its elements. Any interaction represents communication between the systems or their elements which requires expenditure of energy for the creation thereof. Therefore any action requires energy consumption. Hence, all systems, including passive, consume energy. The difference between active and passive systems is only in the source of energy. How does the passive system operate then? If the system is in the state of equilibrium with the environment and no influence is exerted upon it the system should not perform any actions. Once it does not perform any actions, it does not consume energy. It is passive until the moment it starts to operate and only then it will start to consume energy. The balanced state of a pencil is stipulated by the balanced pushing (pressure) of springs onto a pencil. The springs are not simply incidental groups of elements (a set of atoms and molecules), but they are passive systems with NF loops and executive elements at molecular level (intermolecular forces in steel springs) which seek to balance forces of intermolecular connections/bonds which is manifested in the form of tension load of the springs. Since in case of the absence of external influence no actions are performed by the system, there is no energy consumption either, and the system passively waits for the onset of external influence. Both types of systems have one and the same goal: to keep a pencil in vertical position. In passive systems this function is carried out by springs (passive SFU, A and B) and air columns encapsulated/encased in rubber cans (passive SFU, D). The SFU store (use) energy during external influence (pushing a pencil with a finger squeezes the springs). In active system (C) the same function is achieved for at the expense of airflows which always collapse. These airflows create motor fans (active SFU) which spend energy earlier reserved, for example, in accumulators. Once these airflows are encapsulated/encased in rubber cylinders they will not collapse any more and will exist irrespective of fans, while carrying out the same function. But now it represents a passive system (D). Now external influence occurs and the pencil has diverged aside. The springs would immediately seek to return a pencil to the former position, i.e. the system starts to operate. Where does it take energy for the actions from? This energy was brought by the external influence in the form of kinetic energy of pushing by a finger which has compressed (stretched) the springs and they have reserved this energy in the form of potential energy of compression (stretching). As soon as external influence (pushing by a finger) has ceased, potential energy of the compressed springs turns to kinetic energy of straightening thereof and it returns a pencil back in the vertical balanced position. External influence enhances internal energy of the system which is used for the performance of the system. The influence causes surplus of internal energy of the system which results in the reciprocal action of the system. In the absence of influence no surplus of the system’s internal energy is available which results in the absence of action. External influence brings in the energy in the system which is used to produce reaction to this influence. Functions of springs may be performed by airflows created by fans located on a pencil. In order to “build” airflows surplus of energy of the “fans – pencil” system is used which is also brought in from the outside, but stored for use at the right time (for example, gasoline in the tank or electricity in accumulator). Such system would be active because it will use its internal energy, rather than that of external influence. The difference between airflows and springs consists in that the airflows consist of incidental groups of molecules of air (not systems) moving in one direction. Amongst these elements there are executive elements (SFU, air molecules), but there is no control block which could construct a springs-type system out of them, i.e. provide the existence of airflows as stable, separate and independent bodies (systems). These airflows are continually created by fan propellers and as they have no control block of their own they always collapse by themselves. Suppose that we construct some kind of a system which will ensure prevention of the airflows from collapse, let’s say, encase them in rubber cylinders, they then may exist independently of fans. But in this case the system of stabilization of the pencil’s vertical position will shift from the active category to the passive. Hence, both active and passive systems consume energy. However, the passive ones consume the external energy brought in by external influence, while the active ones would use their own internal energy. One may argue that internal energy, say, of myocyte is still the external energy brought in to a cell from the outside, e.g. in the form of glucose. It is true, and moreover, any object contains internal energy which at some stage was external. And we probably may even know the source of this energy, which is the energy of the Big Bang. Some kind of energy was spent once and somewhere for the creation of an atom, and this energy may be extracted therefrom somehow or other. Such brought-in internal energy is present in any object of our World and it is impossible to find any other object in it which would contain exclusively its own internal energy which was not brought in by anything or ever from the outside. Energy exchange occurs every time the systems interact. But passive systems do not spend their internal energy in the process of their performance because they “are not able” of doing it, they only use the energy of the external influence, whereas active systems can spend their internal energy. The passive system is the thorax which performs passive exhalation and many other systems of living organism.

Evolution of systems. Complex control block. For the most efficient achievement of the goal the system always should carry out its action in the optimum way and produce the result of action in the right place and time. The system’s control block solves both problems: where and when it is necessary to actuate. In order to be able to operate at the right place it should have a notion of space and the corresponding sensors delivering information on the situation in the given space. In turn, the time of delivery of the result of action with simple systems includes two periods: the time spent for decision-making (from the moment of onset of external influence till the moment of SFU activation) and the time spent for the SFU actuation (from the moment of the beginning of SFU activation till the moment the result of action is achieved). The time spent for the decision-making depends on duration of cycles of the system’s performance which issue was discussed above. The time spent for the SFU actuation depends on the SFU properties such as, for example, the speed of biochemical reactions in live cells or the speed of reduction of sarcomere in muscular cells which to a considerable degree depends on the speed of power consumption by these SFU and the speed of restoration of energy potential after these SFU have been actuated. These speeds are basically the characteristics inherent in SFU, but are also determined by service systems which serve these SFU. They may also be controlled by control block. Metabolic, hormonal, prostaglandin and vegetative neural regulation in living organism is intended just for this purpose, i.e. to change to some extent the speeds of biochemical reactions in tissue cells and conditions of delivery of energy resources by means of regulation of (service) respiratory and blood circulation systems. But the notion of “at the right time” means not only the time of actuation in response to the external influence. In many cases there is a need for the actuation to start before external influence is exerted. However, the system with simple control block starts to perform only after the onset of external influence. It is a very significant (catastrophic) drawback for living systems, because if the organism is being influenced upon, it may mean that it is already being eaten. It would be better if the system started to perform before the onset of this external influence. If the external situation is threatening by the onset of dangerous influence, the optimal actions of the system may protect it from such influence. For this purpose it is necessary to know the condition of external situation and to be able to see, estimate and know what actions need to be undertaken in certain cases. In other words, it is necessary to exercise control in order to forestall real result of action prior to external influence. In order to perform these actions it should contain special elements which can do it and which it does not have. Simple control block can exercise control only on the basis of mismatch (divergence/discrepancy) of real result of action with the preset one, because the system with simple control block cannot “know” anything about external situation until the moment this situation starts to influence upon the system. The knowledge of external situation is inaccessible to simple control block. Therefore, simple control block always starts to perform with delay. It may be sometimes too late to control. If the system (the living organism) does not know the external situation, it may not be able to make projection as to what the situation is and catch the victim or forestall encounter with a predator. Thus, simple control block cannot make decisions on the time and place of actuation. For this purpose control block needs a special analyzer which can determine and analyze external situation and depending on various external or internal conditions elaborate the decision on its actions. This analyzer should have a notion of time and space in which certain situation is deployed, as well as corresponding informants (sensors with communication lines between them and this special analyzer) which provide information on the external situation. The analyzer-informant has nothing of this kind. When the hunter shoots at a flying duck, it shoots not directly at the bird, but he shoots with anticipation as he knows that before the bullet reaches a duck it (the duck) will move forward. The hunter, being a system intended for shooting a duck, should see the entire situation at a distance, estimate it correctly, make the projection as to whether it makes sense to shoot, and he should act, i.e. shoot at a duck, only on the basis of such analysis. He cannot wait until the duck touches him (until his “X” is actuated) so that he then can shoot at it. In order to do so he should first single out a duck as the object he needs from other unnecessary objects, then measure a distance to a duck, even if it would be “by eye”. He does it by means of special (visual) analyzer which is neither “X” nor “Y” sensor, but is an additional “C” sensor (additional special remote receptors with afferent paths). Such receptors can be any receptors which are able of receiving information at a distance (haemo-, termo-, photoreceptors, etc). The hunter’s visual analyzer includes photosensitive rods and cone cells in the eye (photoreceptors), optic nerves and various cerebral structures. He should be able to distinguish all surrounding subjects, classify them and single out a duck against the background of these subjects and locate a duck (situational evaluation). In addition, by means of reciprocal innervation he should position his body in such a way that the gun is directed precisely to the place in front of the duck (forestalling/ anticipation) to achieve the goal, i.e. to hit the duck. He does all this by means of his additional analyzer which is the analyzer-classifier. Simple control block of systems with NF does not contain such additional analyzer-classifier. That is why it is called “simple”. It has only analyzer-informant which feels external influence by means of “X” sensor only when this influence has already begun; it measures the result of action by means of NF (“Y” sensor) only when this result is already evident and analyzes the information received after the result of action is already produced, because it takes time for the NF to activate. In addition, the analyzer-informant contains only “database” in which the table of due values of controllable parameters (data) which need to be compared to the data of measurements of external influence and results of action “is written down” in explicit or implicit form. It elaborates decisions on the basis of these comparisons. Its algorithm of control is based only on the comparison of the given measurements carried out by “X” and “Y” with the “database”. If the mismatch is equal to “M” it is necessary to perform, for example, less action, whereas if it is equal to “N”, then more action should be done. Simple control block cannot change the decision as to the alteration of the level of controllable parameter, time of actuation and the NF intensity, since it does not have appropriate information. To perform these actions it should contain special elements which can provide it with such information. What does it need for this purpose? In order to make a decision the given block should “know” the situation around the system which can cause certain external influence. For this purpose it should first of all “see” it, i.e. have sensors which can receive information at a distance and without direct contact (remote “C” informant). In addition, it should contain a special analyzer-classifier which can classify external environment and single out from it not all the objects and situations, but those only which may affect the implementation of its goals. Besides, it should have notions of space and time. The play of fish and even dolphin shoals in the vicinity of floating combatant ship cannot affect its movement to target destination. But the “game” of the enemy submarine in its vicinity may substantially affect the fulfillment of its task. The combatant ship should be able to “see” all its surroundings and, based on the external situation, single out from all possible situations only those that may create such external influences which can prevent it from the implementation of its objective. For this purpose it should “know” possible situational scenarios which may affect the achievement of the goal of the given system. To this effect it should have “knowledge base” containing the description of all those situations which can affect the implementation of the objective. If its “knowledge base” does not have the description of certain objects or situations it cannot distinguish (classify) an object or a situation and can not make correct decision. The “knowledge base” should store information not on the parameters of external influence which are stored in the “database”, but on the situations around (beyond) the system which may lead to specific external influence. The “knowledge base” may be introduced in the control block at the moment of its “birth” or later together with the command, at that it is being introduced in the given block by the systems external in relation to the given system. If its “knowledge base” does not contain the description of the given situation, it can not distinguish and classify it. The “knowledge base” contains the description of various situations and the significance of these situations for the system. Knowing the importance of real situation for the achievement of the goal the system can make projection and take decision on its actions depending on the projection made. In addition to the “knowledge base” it should have “decision base”– a set of ready/stored/ decisions that are made by the control block depending on the situation and the projection, (authorized decisions, instructions) in which appropriate decisions are stored that need to be made in respective situations. If it does not have ready decisions regarding external situation it cannot perform its objective. Having identified a situation and elaborated the decision, it gives a command to the analyzer-informant which activates a stimulator in an appropriate way. Thus, the control block is being complexificated on account of inclusion in its structure of the “C” informant and the analyzer-classifier containing the “knowledge base” and the “base of decisions”. That is why such control blocks are called “complex”. The more complex the decision-making block is, the more precise decision may be chosen. Consequently, complex control block includes both the analyzer-informant which has “database  
 and the analyzer-classifier which has the “knowledge base” and the “decision base”. Not any living cell has analyzer - classifier. Animate/organic/ nature is classified under two major groups: flora and fauna. Plants, as well as many other living forms of animate nature, such as corals and bacteria, do not possess remote sensors, although in some cases it may seem that plants, nevertheless, do have such sensors. For example, sunflowers turn their heads towards the sun as if phototaxis is inherent in them. But they actually turn their heads not towards the light, but towards the side wherefrom their bodies get more heated, and heat comes from the side wherefrom the light comes. Heat is felt locally by a sunflower’s body. It does not have special infra-red sensors. Photosynthesis process is not a process of phototaxis. Hence, plants are systems with simple control block. In spite of the fact that there are plants with a very complex structure that are even capable to feed on subjects of fauna, their control block is still simple and reacts only to direct contact. For example, a sundew feeds on insects; it can entice them, paste them to its external stomach and even contract its valves. It’s a predator and in this sense it is akin to a wolf, a shark or a jellyfish. It can do variety of actions like an animal, but it can only do it after the insect alights on it. A sundew cannot chase its victims because it does not see them (remote sensors are not available). Whatever alights on it, even a small stone, it will do all necessary actions and try to digest it because it does not have analyzer-classifier. This is why a sundew is a plant, but not an animal. Animate cells, including unicellular forms, even such as amoeba or infusoria types, are systems with complex control blocks since they possess at least one of spatial analyzers – chemotaxis. It is the presence of remote sensors that differs a cell of an animal from any objects of flora, in which such sensors controls are not present. Therefore the control block is a determinant of what kind of nature the given living object belongs to. The jellyfish is not an alga, but an animal because it has chemotaxis. Remote analyzer gives an idea about the space in which it has to move. That is why plants stay put, while animals move in space. Simple control block including only the analyzer-informant is a determinant of the world of minerals and plants. We will see below where the difference between the mineral and vegetative worlds/natures lies. Complex control block including the analyzer-classifier is a fauna determinant anyway. An amoeba is the same kind of hunter as a wolf, a shark or a man. It feeds on infusorians. To catch an infusorian it should know where the latter is and should be able to move. It cannot see the victim at a distance, but it can feel it by its chemical sense organs and seek to catch it as it has chemotaxis, possibly the first of the remote sensor mechanisms. But in addition to chemotaxis the amoeba should also have a notion (even primitive) of space in which it exists and in which it should move in a coordinated and task-oriented manner to catch an infusorian. In addition, it should be able to single out an infusorian from other objects which it can encounter on its way. Its analyzer-classifier is much simpler than, for example, that of a wolf or a shark because it does not have organs of sight and hearing and neural structures at all, but it can classify external situation. It has complex control block comprising the “C” informant, and that is why an amoeba is not a plant, but an animal. Since control blocks may be of any degree of complexity, reflexes may be of any degree of complexity, too, from elementary axon reflexes to the reflexes including the cerebral cortex performance (instincts and conditioned reflexes). The number of reflexes of living organism is enormous and there exist specific reflexes for each system of the organism. Moreover, the organism is not only a complex system in itself, but due to its complexity it has a possibility to build additional, temporary/transient/ systems necessary at the given point of time for some specific concrete occasion. For example, lamentation system is a temporary system which the organism builds for a short time interval. The lamentation system’s control block is the example of complex control block. The purpose of lamentation is to show one’s suffering and be pitied. This system includes, in the capacity of composite executive elements, other systems (subsystems) that are located sufficiently far from each other both in space and in terms of functions (lacrimal glands, respiratory muscles, alveoli and pulmonary bronchial tubes, vocal chords, mimic muscles, etc.). At first the external situation is identified and in case of need lamentation reflex (complex reflex, an instinct) is actuated under the certain program, which includes control of lifting up one’s voice up to a certain timbre (control over the respiratory muscles and vocal chords), sobbing (a series of intermittent sighs), lacrimation /excretion of tears/, specific facial expression, etc. All these remote elements are consolidated by the complex control block in a uniform system, i.e. lamentation system, with very concrete and specific purpose to show one’s sufferings to the other system. The lamentation reflex can be realized at all levels of nervous system, starting from the higher central cerebral structures, including vegetative neural system, subcortex and up to cerebral cortex. But we are examining only child’s weeping which is realized in neural structures not higher than subcortex level (instinctive crying). After the purpose has been achieved (sufferings have been explicitly demonstrated, and whether or not the child was pitied will be found out later) the reflex is brought to a stop, this complex control block disappears and the system disintegrates into the components which now continue functioning as part of other systems of organism. Lamentation system disappears (it is scattered). Whence the control block (at subcortex level) knows that it is necessary to cry now, but it is not necessary to cry at any other moment? For this purpose it identifies a situation (singles it out and classifies). The analyzer-classifier is engaged in it. Its “knowledge base” is laid down in subcortex from birth (the instincts). Simple control block cannot perform such actions. All actions of the systems controlled by elementary and simple control blocks would be automatic. Biological analogues of elementary control block are the axon reflexes working under the “all-or-none” law; those of simple control blocks are unconditional (innate, instinctive) reflexes when certain automatic, but graduated reaction occurs in response to certain external influence. Simple control block would be adapting the system’s actions better than the elementary one because it takes account of not only external influence, but the result of action of the system which has occurred in response to this external influence as well. But it cannot identify a situation. Complex control block can perform such actions. It reacts not to external influence, but to certain external situation which can exert certain external influence. Biological analogues of complex control block are complex reflexes or instincts. During pre-natal development the “knowledge” of possible situations “is laid down” into the brain of a fetus (the “knowledge base”). The volume of this knowledge is immense. A chicken can run immediately after it hardly hatches from egg. A crocodile, a shark or a snake become predators right after birth, i.e. they know and are able of doing everything that is required for this purpose. It speaks of the fact that they have sufficient inborn “knowledge base” and “base of decisions” for this purpose. In such cases we say that animal has instincts. Thus, the system with complex control block is the object which can react to certain external situation in which this influence may be exerted. But it can react only to fixed (finite) number of external situations which description is contained in its “knowledge base” and it has a finite number of decisions on these situations which description is contained in its “base of decisions”. In order to identify external situation it has the “C” informant and the analyzer-classifier. In other respects it is similar to the system with simple control block. It can also react to certain external influence and its reaction is stipulated by type and number of its SFU. The result of action of the system is also graduated. The number of gradations is defined by the number of executive SFU in the system. It also has the analyzer-informant with the “database”, DPC (the “X” informant) and NF (the “Y” informant), which control the system through the stimulator (efferent paths). There are no analogues with complex control block in inorganic /abiocoen, inanimate/ nature. Biological analogues of systems with complex control block are all animals, from separate cells to animals with highly developed nervous system including cerebrum and remote sense organs, such as sight, hearing, sense of smell, but in which it is impossible to develop reflexes to new situations, for example, in insects. The analogues of the “C” informant are all “remote” receptors: eyesight (or its photosensitive analogues in inferior animals), hearing and sense of smell. The analogues of analyzer-classifier are, for example, visual, acoustical, gustatory and olfactory analyzers located in the subcortex. Visual, acoustical, gustatory and olfactory analyzers located in the cerebral cortex are anyway referred to analyzers-correlators.

Self-training control block. No brain is able to hold enormous “knowledge bases” on all possible conditions of the entire world around. Therefore, one of the reasons why each species of animals occupies corresponding biosphere niche is the necessity to limit the volume of “knowledge base”. Antelope knows what the seal does not, and vice versa. In each separate ecological niche the quantity of possible situations is much less, than in all ecological niches all together. Therefore, relatively small volume of necessary knowledge is required in separate ecological niches. However, if one tries to somehow input /in the brain/ all the information currently available on all the situations which have already been occurring in the world, it would not help either, because the world alters continually and many situations have never ever arose. The “knowledge base” basically may not have information on what has not yet happened in the world. Naturally, the “base of decisions” cannot contain all the possible options of decisions either. “Genetic knowledge” contains only what the ancestors of animals have experienced. They materially cannot have knowledge of what is going to happen. When new situation arises, the system cannot identify, classify it and make decision on it. Even if this situation will occur repeatedly, if the system is unable of self-training it will every time fail to correctly identify a situation because such situations are not contained in its “knowledge base”. The ant runs along the fence, going up and down, and cannot guess that it is possible to easily bypass the fence. Millions years ago, when its genetically input “knowledge base” was formed the fences were non-existent. If one tries to sink a thread on the web the spider will leave this web and will weave a new one because it is not familiar with such situation and it does not know and cannot learn that it is possible to make a hole in a web so that the thread does not interfere. All this is due to the fact that insects as a class of animals are not capable of learning anything. They may be perfect builders amazing us with their sophisticated and fine webs, nests and other creations of their work. But they can only build based on their innate knowledge. They do have “knowledge base” (instincts), but they do not have cerebral structures (elements of control block) capable of supplementing their own “knowledge base” with new existential situations. They do not have reflexes on new stimuli/exciters/. To be able to identify and classify new situations the control block should be able to enter the descriptions of these situations in its “knowledge base”. But at first it should be able to identify that it is a completely new situation, for example, by comparing it to what already exists in its “knowledge base”. Then it should identify the importance (the value worth) of this particular situation for the achievement of its goal. If there is no any correlation between the new situation and the fulfillment of the goal of the system, there is no sense in remembering this situation, otherwise the brain “will be crammed with trash”. By singling out and classifying external situations (identifying them) and finding interrelation (correlation) between these situations, by decisions made and the achievement of the goal of the system the control block learns to develop appropriate decisions. Thus, the self-training decision-making block continually supplements its “knowledge base” and “base of decisions”. But under the conservation law nothing occurs by itself. In order for the control block to be able to perform the above actions it should have appropriate elements. The major element of the kind is the analyzer-correlator. It is the basis whereon reflex on new stimulus/exciter or a new situation may emerge. Its task is to detect a new situation, identify that it is new, determine the degree of correlation between this situation and its own goal. If there is no correlation between this new situation and implementation of the goal by the system, there is no sense in remembering and loading its limited “database” memory. If the degree of correlation is high it is necessary to enter this situation in the “knowledge base” and develop a decision on the choice of own actions for the achievement of its own goal and thereafter to define whether there is correlation between the decision made and the achievement of the goal. If there is no correlation between the decision made and the fulfillment of the goal by the system it is necessary to arrive at other solution and again determine the correlation between the decision made and the achievement of the goal. And it should be repeated in that way until sufficiently high correlation between the decision made and the achievement of goal is obtained. Only afterwards the correct computed decision should be entered into the “base of decisions”. This is the essence of self-training. Only the analyzer-correlator enables self-training process. As a matter of fact, the system’s self-training means the emergence of reflexes to new stimuli/exciters or situations. Consequently, these are only possible when the control block contains analyzer-correlator. Biological analogue of the analyzer-correlator is the cerebral cortex. The presence of cortex determines the possibility of emergence of reflexes to new situations. Cerebral cortex is only present in animals which represent sufficiently high level of development. Non-biological analogues of systems with such self-training control block are unknown to us. Computer self-training systems are built by man and the process of self-training at the end of the day always involves human cerebral cortex. There exist various so-called “intellectual” systems, but full-fledged intelligence is only inherent in human being. Let us specify that there are no self-training systems, but there are their self-training control blocks, because executive elements cannot be trained in anything. There may be systems with simple executive elements, but with control blocks of varying complexity. In order for the control block to be a self-training structure it should contain three types of analyzers: the analyzer-informant with “database”; the analyzer-classifier with the “knowledge base” and “base of decisions” (which is able of classifying external situation on the basis of the information from the “C” informant); the analyzer-correlator (able of identifying the interrelation – correlation between various external situations and the results of actions of the given system and transferring the knowledge obtained and decisions to the analyzer-classifier to enter them in the “knowledge base” and the “base of decisions”). Thus, the system with self-training control block is an object which can learn to distinguish new external influences and situations in which such influence may be exerted. For this purpose it has the analyzer-correlator. In other respects it is similar to the systems with complex control block. It can respond to specific external influence and external situation and its reaction would be stipulated by type and number of its SFU. The result of action of the system is also graduated. The number of gradations is determined by the number of executive SFU in the system. It also has analyzer-qualifier with “knowledge base” and “base of decisions” and the analyzer-informant with “database”, DPC (the “X” informant) and NF (the “Y” informant), which operate the system through the stimulator (efferent paths). In inorganic/inanimate nature there are no analogues of systems with self-training control blocks. Biological analogues of systems with complex control block are all animals with sufficiently developed nervous system in which it is possible to develop reflexes to new situations (should not be confused with conditioned reflexes). The analogue of analyzer-correlator is only the cerebral cortex.

Signaling systems. The appearance in the control block of the analyzer-correlator enabled the possibility to enhance its personal experience by self-training and continually update its “knowledge base” and “base of decisions”. But it cannot transfer its experience to other systems. Personal experience is limited howsoever an individual would try to expand it. In any case collective experience is much broader than that of an individual. In order for one individual to be able to transfer his/her experience to other individual separate device is needed enabling “downloading” the information from one “knowledge base” to another. For example, the antelope knows that the cheetah is very dangerous because it feeds on antelopes and wishes to transfer this knowledge to its calf. How can it be done? For example, the antelope can simulate a situation playing a performance in which all characters are real objects, i.e. it should expose itself to cheetah so that the calf could see it to gain its own experience by the example of its mum. The calf will see the situation and new reflex to new situation will be developed and the calf will be on its guard against the cheetahs. Of course, it is an absurd way as it does not solve the problem of survival. Anyway, only one out of the two antelopes will survive. So, what can be done in principle? How one self-training system can transfer its individual experience to other self-training system? It is necessary to simulate a situation by making a show in which all characters are abstract objects and replace real objects with others, which are conferred conventional connection/link between them and the real objects (abstracting of objects). Such abstract objects are prearranged signals. The systems “agree” (stipulate a condition) that if such-and-such signal occurs, it will speak of something agreed upon. It is the development of conditioned reflex that represents replacement of real influence for abstract influence. It is a so-called first signaling system which is based on conditioned reflexes. The appearance of cheetah causes producing a panic sound by an antelope. Consequently such sound is associated with the appearance of cheetah and it becomes an abstract substitute of cheetah itself, i.e. prearranged signal. Any motional signal may be an abstract substitute of danger, i.e. raising or dropping of tail, special jumps, producing special sounds, mimicry, etc. These motional signals affect the systems in the herd and based on this signal they may know about a danger nearby. In other words, there was a replacement of real external influence by some abstract thing associated with this object. Abstracting of real action by its symbol (vocal, motional, etc) took place. For such abstracting the control block needs to have an additional device – the analyzer-abstractor which should contain the “base of abstraction” (“base of prearranged signals”). The “base of abstraction” contains a set of descriptions of certain signals which are perceived as conditional situations and correspond to other certain situations. A prearranged signal is the appearance of some object or movement (situational signal) which usually does not appear in common routine situation. The occurrence of prearranged signal does not in itself affect in any way the achievement of the goals by the systems. For example, raising and fluffing out a tail does not influence in any way neither food intake, nor running, etc. But the occurrence of a signal is connected with the occurrence of such situation which can affect the achievement of goals by the systems. Given the ability to abstract from concrete situations, then not even seeing a cheetah, but having seen the lifted tails, may be conducive to guessing that a cheetah is nearby. Abstracting of real external influence by vocal or motional symbol is performed by the first signaling system. It supplements the analyzer-correlator and operates similarly to it, i.e. is self-training. Unlike the “knowledge base” the “base of abstraction” of a newly born system is empty. It is being filled out during the system’s lifetime on account of possibility of self-training, and the newly obtained knowledge is then downloaded in the “knowledge base”. Sometimes behavior of animals seems to be indicative of their possibility to transfer the information from one to another even before the occurrence of the respective situation. For example, some lions go to an ambush, others start driving the antelopes, so they kind of foresee the situation. But they only know about ambush possibilities based on their own experience. They do not have other means of transfer of such information to their younger generation except for demonstrating this situation to them. A new way for the development of systems (or rather their control blocks) is being opened at this point, the way of socialization – associations of animals in groups for the enhancement of their own experience because prearranged signals are only intended for an information transfer from one system (subject) to another. There are probably several levels of such analyzer-abstractor and the degree of abstraction which may be attained by this or other subject depends on the number of these levels. One may abstract external influences, external situations, real objects and even process of self-training proper. But in any case one should be able to abstract and understand abstract symbols. This is what analyzer-abstractor does. Abstracting of real external influence, object or situation by means of situational prearranged signal (a pose, a sound, a movement, some kind of action) may be performed by the first signaling system. Abstracting of real external influence, an object or a situation by means of sign /emblematic/ prearranged signal (symbol) can only be performed by second signaling system. Control block having the second signaling system is an intellectual control block. Intelligence depends on the presence and the degree of development (number of levels) of analyzer-abstractor. In animals the second signaling system is very poorly developed or undeveloped at all. If the horse dashes aside from a whip, it is not even the first signaling system that works in this case, but rather a reflex on the new situation which the horse has learnt when it first encountered a whip. If the horse is coarsely shouted at even without showing a whip to it, it will draw necessary conclusions. That’s the point at which the first signaling system takes effect. But if the horse is shown an inscription which reads that it now will be beaten, the animal will not react to in any way because it cannot and will never be able to read since it does not have second signaling system. There are animals which apparently are capable of speaking and understanding words, written symbols and even making elementary arithmetic operations. But the second signaling system is very poorly developed in them and is literally “in embryo” condition. When the trainer demonstrates the dog’s counting up to five, he bluffs in a way as in fact the dog picks up some motional signals from him, i.e. the second rather than the first signaling system takes effect. The second signaling system is developed to the utmost extent only in human beings. In human beings it is developed to the extent that it makes it possible to transfer all necessary information on our further actions to us in the nearest or even quite a distant future only by means of sign symbols. We can read a book containing just mere squiggles only, however such a full-blown and colorful pictures are open before us that we forget about everything on earth. Your dog for sure is surprised that its master looks for hours at a strange subject (the book) and does not move, run or make any sounds. And even if you try to explain to it that it is a book the dog will not understand it anyway, because it has not yet “matured”, it does not have second signaling system. Thus, the system with self-training control block containing the first signaling system is an object which can abstract external influences and situations by means of abstract situational prearranged signal. For this purpose it has an analyzer-abstractor of the first order. But it can inform of the presence of such action or situation only at the moment of their occurrence. It may transfer its experience to other systems only with the help of the situational prearranged signal which possibilities are limited. Such block has the “knowledge base” and “base of abstraction” which it accumulates in its brain within the lifespan. In the communities of systems with first signaling system accumulation of personal knowledge is possible, whereas accumulation of social knowledge is impossible because this knowledge is accumulated only in the control block (cerebrum) which possibilities are limited. The system which has self-training control block containing the second signaling system is an object which can abstract external influences and situations by means of abstract sign /symbolic/ prearranged signal. For this purpose it has an analyzer-abstractor of Z-order. It can transfer its experience to other systems by transfer of information to them in the form of conventional signs. Such blocks accumulate “knowledge base” outside its cerebrum in the form of script thanks to the developed “base of abstraction”. It gives an opportunity to absolve from dependence of accumulation of knowledge on the lifespan of an individual subject. In communities of systems with the second signaling system accumulation of social knowledge is possible and it strengthens the accumulation of individual knowledge. In other respects the control block with signaling systems is similar to the self-training control block examined above. It can react to definite external influence and learn to react to new external influence and an external situation, and its reaction is determined by type and number of its SFU. The result of action of the system is also graduated. The number of gradations is determined by the number of executive SFU in the system. It also has the analyzer-correlator, the analyzer-classifier with “knowledge base” and “base of decisions”, the analyzer-informant with the “database”, DPC (with the “Х” informant) and NF (the “Y” informant) which through a stimulator (efferent paths) operate the system. In an inanimate/inorganic nature there are no analogues of systems with control block having signaling systems. Biological analogues of systems with control block containing the first signaling system are all animals with sufficiently developed nervous system in which conditioned reflexes may be developed. As a rule such animals do already have social relations (flocks, herds and other social groups), as signals are transferred from one animal to another. Biological analogue of systems with control block containing the second signaling system is only the human being.

Self-organizing systems. Bogdanov has shown that there exist two modes of formation of systems. According to the first one the system arises at least from two objects of any nature by means of the third entity – connections (synthesis, generation). According to the second one the system is formed at the expense of disintegration (destruction, retrogression/degeneration) of the more complex system that previously existed [6]. Hence, the system may be constructed (arranged) from new elements or restructured (reorganized) at the expense of inclusion of additional elements in its structure or by exclusion from its structure of unnecessary elements. Apparently, there is also a third mode of reorganization of systems – replacement of old or worn out parts for the new ones (structural regeneration), and the fourth mode – changing of connections/bonds between internal elements of the system (functional regeneration). Generation (the first mode of reorganization) is a process of positive entropy (from simple to complex, complexification of systems). New system is formed for the account of expanding the structure of its elements. This process occurs for the account of emergence of additional connections between the elements and consequently requires energy and inflow of substances (new elements). The degeneration (the second mode of reorganization) is a process of negative entropy (from complex to simple, simplification of systems). New system is formed for the account of reduction of compositional structure of its elements. This process releases energy and elements from the structure. Both modes are used for the creation of new systems with the new goals. In the first case complexification of systems takes place, while in the second one their simplification or destruction occurs. Structural regeneration (the third mode of reorganization) is used for the conservation and restoration of the systems’ structure. It is used in the form of metabolism, but at that, the system and its goals remain unchanged. Energy and inflow of substances for the SFU restoration is required for this process. Functional regeneration (the fourth mode of reorganization) is used for the operation of systems as such. The principle of the systems’ functioning resembles generation and degeneration processes. In process of accretion of functions the system includes the next in turn SFU ostensibly building a new, more powerful system with larger number of elements (generation). During the reduction of capacity of functions the system deactivates the next in turn SFU as if it means to build a new system with fewer number of elements (degeneration). But these are all reversible changes of the system arising in response to the external influence which are effected for the account of the change of the condition of its elements and the use of DPC, NF and effectors. At that, the system’s structure kind of alters depending on its goal. New active and passive (reserve) SFU appear in it. This process requires energy and flow of substances for energy recovery, but not necessarily requires a flow of substances for the restoration of SFU. How does the organization (structuring) of system occur? Who makes decision on the organization or reorganization of systems? Who builds control block of the new or reorganized system? Who gives the command, the task for the system? Why is the NF loop built for meeting the given specific condition? Before we try to answer these questions, we will note the following. First, there is a need in the presence of someone or something “interested” in the new quality of the result of action who (or which) will determine this condition (set the goal) and construct the control block. Someone or something “interested” may be the case coupled with natural selection, whereby by way of extensive arbitrary search corresponding combinations of elements and their interactions may emerge that are the most sustained/lasting in the given conditions of environment. Thus, the environment/medium sets condition and the incident builds the systems under these conditions. At this point we do not consider the conditions in which generation or degeneration occurs and which are associated with redundancy or lack of energy (with positive or negative entropy). We only consider the need and expediency of creation of systems. The more complicated the system is, the more search options should be available and the more time it takes (the law of large numbers). We will note, however, that the goal is set to any systems from the outside, whether it is an incident, a person, natural selection or something else. But we cannot ignore the following very interesting consequence. Firstly, the survival rate is the main and general goal of any living organism. And as far as the goal is set from the outside, the survival rate is also something set to us from the outside and is not something that stems from our internal inspirations. In other words, the aim to survive is our internal incentive, but someone or something from the outside has once imbedded it in us. And prior to such imbedding it was not “ours”. Secondly, in order to ensure the possibility of building systems with any kind of control block, even the elementary one, the presence of such elements is necessary which quality of results of actions could in principle provide such a possibility. It follows from the conservation law and the law of cause-and-effect limitations that nothing occurs by itself. These elements should have entry points of external influence (necessarily), command entry points (not necessarily for uncontrollable SFU) and exit points of the result of action (necessarily). Exits and entries should have possibility to interact between themselves. This possibility is realized by means of combination of homo-reactivity and hetero-reactivity of elements. Physical homo-reactivity is the ability of an element to produce the same kind of result of action as is the kind of external influence (pressure → pressure, electricity → electricity, etc.). At the same time, characteristics of physical parameters do not vary (10g →10g, 5mV → 5mV, etc.). Homo-reactive elements are transmitters of actions. Physical hetero-reactivity is the ability of an element, in response to external influence of one physical nature, to yield the result of action of other physical nature (pressure → electric pulse frequency, electric current → axis shaft rotation, etc.). Hetero-reactive elements are converters of actions. The elements with physical hetero-reactivity are, for example, all receptors of living organism (which transform the signals of measurable parameters into nerve pulse trains), sensors of measuring devices, levers, shafts, planes, etc. In other words such elements may be any material things of the world around us that satisfy hetero-reactivity condition. Chemical reactions also fall under the subcategory of physical reactions as chemical reactions represent transfer of electrons from one group of atoms to others. Chemistry is a special section of physics. Logic hetero-reactivity is the ability of an element, in response to external influence of one type physical nature, to yield the result of action of the same physical nature (pressure → pressure, electric current → electric current, etc.), but with other characteristics (10g → 100g, 5mA → 0.5mA, 1Hz → 10Hz, 5 impulses → 15 impulses, etc.). Amplifiers, code converters, logic components of electronics are the examples of elements with logic hetero-reactivity. Neurons do not possess physical hetero-reactivity as they can perceive only potentials of action and generate the potentials. But they have logic hetero-reactivity and they can transform frequency and pulse count. They do not transform a physical parameter as such, but its characteristics. Any system consists of executive and operating elements. At the same time any control block of any system itself consists of some kind of parts (elements), so it also falls under the definition of systems. In other words, control block and its parts are specific systems (subsystems) themselves with their goals, and they have their own executive elements and local control blocks operating these executive elements. Compulsory condition for part of them is their ability to hetero-reactivity of one or other sort. The effect of their control action consists only in their relative positioning. Command is entered into the local control block (condition of the task, the goal/objective) and the latter continually watches that the result of action always satisfies the command. At that, the command can be set from the outside by other system external in relation to the given one, or the self-training block may “decide” independently to change the parameters (but not the goal) set by the command. So, the elements of control may be the same as the executive elements. The difference is only in relative positioning. Director of an enterprise is just the same kind of individual as any ordinary engineer. All elements of the system, both executive and controlling, are structured according to a certain scheme specific for each concrete case (for each specific goal), but all of them must have the “exit” point/outlet/, whence the result of action of the given element is produced, and two “entry points” – for external influence and for entry of the command. If the exit points of any elements are connected to the entry points for external influences of other elements, such elements are executive. In this case executive elements are converters of one kind of results of action into the other, because the results of actions of donor systems represent external influence for the recipient systems (executive elements). They (external influences) ostensibly enter the system and exit it being already transformed into the form of new results of action. If exit points of elements are connected to command entry points of other elements, such elements are controlling and represent a part of control block. In such cases the result of action of some systems represents the command for the executive elements, the instruction on how to transform the results of action of donor systems into the results of action of recipient systems. But the law of homogeneity of actions and homogeneous interactivity (homo-reactivity) of the exit-entry connection is invariably observed. If, for example, the result of action of the donor element is pressure, the entry point of external influence (for the command) of the recipient element should be able to react to pressure, or otherwise the interaction between the elements would be impossible.

Thirdly, in order to “hack” into the control of other systems the given system should have physical or any other possibility to connect its own exit point of result of action or own stimulator to the entry point of the command of any other system. In this case this other system becomes the subsystem subordinate to the given control block, i.e. the systems should have physical possibility to combine exits of their stimulators and/or results of action with the command entry points of other systems. For this purpose they should be mobile. There are types of devices for which the requirement of physical mobility is not necessary, but, nevertheless, information from one system may flow into control blocks of other devices. These are the so-called relay networks, for example, computer operating networks, cerebral cortex, etc., in which virtual mobility is possible, i.e. the possibility of switching of information flows. In such networks the information can be “pumped over”/downloaded/ in those directions in which it is required. For example, human feet are intended for walking, while hands – for handiwork. How is predestination effected? In principle hands and feet are structured identically, with the same autopodium, the same fingers (the same executive elements). Nevertheless, it is practically impossible, for example, to brush the hair with feet. Why? Because there are certain stereotypes of movements in the cerebral cortex, without which hands are not hands and feet are not feet. But we know cases when a person who lost both hands and nevertheless, he perfectly coped with many household affairs with the help of feet and took part in a circus show. How was it possible? Some kind of remodeling/change/ occurred in his brain and he changed his stereotypes. Cerebral structures which were previously controlling hands have “downloaded” their “knowledge bases” into those cerebral structures which operate the feet. Cerebral cortex was only able to do it thanks to the presence of its property of relay circuits, i.e. the possibility to turn information flows to the directions required for the given purpose. Organization and reorganization of systems may be incidental and target-oriented. In incidental organization or reorganization there is no special control block which has the goal and decision on building of a new system, even more so in such a detail that, for example, such-and-such exit point of a stimulator needs to be connected to such-and such command entry point. Fortuity is determined by probability. That’s where the law of large numbers works, which reads: “If theoretically something may happen, it will surely happen, provided a very large number of occurrences”. The more the number of cases is, the higher is the probability of appearance of any systems, successful and unsuccessful, because fortuity creates the systems, the probability sets their configuration and the external medium makes natural selection. Therefore evolution lasts very long, sorting out multitude of occurrences (development options). It is for this reason that various combinations of connections of parts of systems occur. Therefore, both nonviable monsters and the systems most adaptable to the given conditions may be formed. Those weak are annihilated, while those strong transfer their “knowledge bases” and “bases of decisions” to their posterior generations in the form of genetically embedded properties and instincts. It is not so important in the organization of systems which control block (simple or complex) the coalescing (organizing) systems have. What is only important is that the exit points of stimulators or results of action of one kind of systems connect to the command entry points of the others. Control blocks of coalescing systems may be of any kind, from elementary to self-training. At that, even if the self-training block (i.e. sufficiently developed) “would not want” to connect its command entry point to the exit point of stimulator or the result of action of other system, even the simplest one, it still won’t be able of doing anything if it fails to safeguard its command entry point. The virus “does not ask the permission” of a cell when it “downloads” its genetic information in the cell’s DNA. The decision on reorganization of the system (purpose) may come from the outside, from the operating system sited higher on a hierarchy scale. It is passive purposefulness, since the initiative comes from the outside. The external system “tells” the given system: “As soon as you see such-and-such system, affix it immediately to yourself”. The system can undertake active actions for such an organization, but it is not yet self-organizing as such, but an imposed (forced, prescriptive) organization. But if it “occurs” to the system that “it would be quite good if that green thing that stuck to me is included as a component in my own structure, since the experience shows it can deliver glucose for me from СО2 and light”, it would then mean self-organizing. Thus, perhaps, once upon a time chlorophyll was included in the structure of seaweed. Most likely, it did not happen purposefully, but rather accidentally (accidental organization), as we cannot be sure that those ancient seaweeds had a self-training control block, and the independent “thought” may only occur in the system with such control block. This example is only drawn to illustrate what we call a self-organizing system. But the idea to take a stick in one’s hands to extend the hand and get the fruit hanging high on the tree is only a prerogative of the higher animals and the human being, which is a true example of self-organization. Only the systems with self-training control block can evaluate the external situation, properly assess the significance of all the novelty surrounding the given system and draw conclusion on the expediency of reorganization. It is an active purposefulness anyway, since the initiative originated inside the given system and it “decided” on its own and no one “imposed” it on the system. External medium dictates conditions of existence of the systems and it can “force” the system to make the decision on reorganization. But the decision on the time and character of reorganization is taken by the system itself on the basis of its own experience and possibilities. Only systems with self-training control block can initiate active purposefulness, can be deliberately the self-organizing systems. Thus, a man has invented work tools, having thus strengthened the possibilities of its body. At that, it should be noted that the decision on self-organizing does not indicate at the freedom of choice of the goal of the system, but a freedom of choice of its actions for the achievement of the goal set from the outside. In order to implement its goal in a better way, for example, to survive in such-and-such conditions, the system makes the decision on reorganization so that to better adapt to external conditions and enhance its survival chances.

Metabolism and types of self-organization. All the above was only concerning the creation of new systems and their development. But any systems are continually exposed to various external influences which sooner or later destroy them. Our world is in continuous and uninterrupted movement. The speeds of this movement may vary: somewhere events occur once in millions years, while somewhere else millions times a second. But most likely it is impossible to find a single place in the Universe where no movement of any kind (thermal, electric, gravitational, etc.) occurs. Hence, the process of negative entropy is always present. Any systems are always being reorganized at the expense of disintegration of more complex systems that have been existing earlier, which grow old (degenerate). Destruction is a process of loss by systems of their SFU. Systems of mineral nature (crystals, any other amorphous, but inanimate bodies, planetary, stellar and galactic systems) continuously undergo various external influences and are scattered with varying speed due to the loss of their SFU. Mineral nature grows old and changes, because the entropy law - from more complex to more simple - works. In the mineral nature complexification (generation) can only occur in case of excess of internal energy or its continuous inflow from the outside. Thus, in a thermonuclear pile of ordinary stars nuclei of complex atoms including atoms of iron were formed. But the energy of such piles is not yet sufficient for the formation of heavier nuclei. All other heavier nuclei were formed as a result of explosions of supernovae and the release of super-power energy. Therefore, figuratively speaking, our bodies are built of stellar ashes. But as soon as energy of thermonuclear synthesis comes to an end, the star starts to die out, passing through certain phases. We do not know yet all phases of the development and dying of stars, but if failing “to undertake some sort of measures” after a very long period of time not only stars, but atoms as well, including their components (protons, neutrons and electrons) will be shivered. Thus, the free neutron “unprotected” by intranuclear system breaks up into a proton, electron and neutrino within 12 minutes. Hence, the atomic and intranuclear system is the system of stabilization of a neutron protecting atom and its elements from disintegration. But even such stable and seemingly eternal stellar formations such as “black holes” “evaporate” in the course of time, expending their mass for gravitational waves. In the absence of energy inflow the system would just flake/scatter and lose its SFU. It follows explicitly from thermodynamics laws. The so-called “thermal entropic death” is coming forth. Destruction of systems under the influence of external environment is the forced entropic reorganization (degeneration), rather than self-organization. The objects of mineral nature possess only passive destruction protection facilities and one of the major means of protection is integration of elements in a system (generation). Consequently, the emergence of systems and their evolution in mineral nature represents means of protection of these elements from destruction. One can not conquer alone. The system is always stronger than singletons. Formation of connections/bonds between the elements and the emergence of generation type systems in mineral nature is the passive way of protection of elements against the destructive effect of negative entropy. The weakest bodies are ionic and gas clouds, while the strongest ones are crystals. However, all of them cannot resist external influences indefinitely long, because they react only after their occurrence, and they cannot resist entropy. Consequently, the presence of passive means for the protection against destruction is insufficient. Whatever solid and large the crystals might be, they would be scattered /flaked in the lapse of time either. In order to keep the system from destruction it is necessary to replenish destroyed parts continually. Systems of vegetative, animal and human nature also undergo various external influences and also are scattered (worn out) with varying speed. And it happens for the same reason and the same law of negative entropy, i.e. from more complex to more simple (degeneration) works. But these systems differ from the systems of mineral nature that actively try to resist destruction by continual renewal of their SFU structures. This renewal occurs at the expense of continuous building of new SFU in substitution of the destroyed ones. This process of renewal of destroyed SFU also represents structural regeneration as such – a purposeful metabolism. Therefore, metabolism of living organisms is an active way of protection of systems from destructive effect of negative entropy (from degeneration). In mineral nature metabolism may take place as well, but it essentially differs from metabolism of any living systems. Crystals grow from the oversaturated saline solution, the atmosphere exchanges water and gases with the seas, automobile and other internal combustion engines consume fuel and oxygen and discharge carbon dioxide. But if a crystal is taken out from saline solution, it will just collapse and will not undertake any measures on conservation of its structure. When a camshaft in the automobile engine is worn out the car does nothing to replace it. Instead, it is done by man. Any actions of the system directed towards the replacement of destroyed and lost SFU represent self-organization anyway, which in the living nature is called structural self-reorganization or metabolism. In mineral nature structural self-reorganization is nonexistent. Any living system, regardless of its complexity, would undertake certain actions for the conservation of its structure. At that, there are always two flows of substances in living systems – flow of energy and “structural”/constructive/ flow. The energy flow is intended to provide energy for any actions of systems, including structural self-reorganization, as it is necessary every time to build new connections/bonds which require energy (regeneration). “Structural” flow of substances is only used for structural regeneration, i.e. replacement of worn out SFU for the new ones (in this case we do not examine the system’s growth, i.e. generation). When we talk about self-reorganization we mean “structural” flow of substances, although such flow is impossible without energy. Myocardium in humans completely renews (regenerates) its molecular structure approximately within a month. It means that its myocardiocytes, or rather their elements (myofibrillas, sarcomeres, organelles, membranes, etc.) are continually being worn out and collapse, but are continually built again at the same speed. Outwardly we can see one and the same myocardial cell, but eventually its molecular composition is being completely renewed. Throughout the human lifespan the type of organization varies. In the early years of life organization occurs at the expense of inclusion of new additional elements in the structure (generation, the organism grows and develops), whereas starting from the mid-life period degeneration predominantly takes place, i.e. destruction process (disintegration of the previously existing more complex system). But these are now the particulars associated with imperfection of real living systems. For any system the overall objective is to exist in this World, and for this purpose it should counteract destructive influences, for which purpose it should have specific SFU which facilitate its operation and which continuously collapse and need to be continuously renewed, i.e. build anew, since regeneration is the essence of self-reorganization by means of metabolism. Hence, the living nature differs from inanimate first of all in that metabolism is intended for the conservation of its structure (structural regeneration). In principle, any reaction of any systems is directed towards conservation of the systems. Control block of systems takes care of it using all its possibilities for this purpose: DPC, NF and analyzers for the SFU operation. But in mineral nature there are only passive ways of protection. And when the system of mineral nature loses its SFU, it does not undertake any active measure to replace them. It would try to resist the external influence, but no more than that. In vegetative and animal nature and humans the systems cannot passively resist the destructive effect of environment either, they also collapse, but anyway they have active means of restoration of the destroyed parts, they have the purposeful metabolism aimed at replacement of the lost SFU (structural regeneration). It uses two mechanisms of the so-called genetic regeneration: reproduction of systems (the parent will die, but children will remain) and reproduction of elements of systems (regeneration of elements of cells and tissue cells themselves). These ways of conservation of systems are sufficiently effective. It is known how complex it is to get rid of weeds in the field. There are sequoias aged several thousand years that are found in nature. At the level of separate individuals of a species this genetic system proves as the system with simple control block, as simple automatic machine because the DNA molecule does not have remote sensors, is has no analyzer-correlator and it is impossible to develop conditioned reflexes in it during the lifespan of one individual. But at the level of species of living systems genetic mechanism proves anyway as a system with complex control block because it “has a notion” of space and it has collective memory in the form of conditioned reflexes and it is able of self-training (adaptation of species). It is for this reason that genetic accumulation of collective experience occurs, which then is shown in the form of instincts at the level of separate individuals of a species. This collective genetic mechanism watches that tomato looks like tomato, a cockroach looks like a cockroach and chimpanzee looks like a chimpanzee, and it watches that the behavior of the systems is relevant. We do not know yet all the details of this mechanism, although genomes of many living organisms, including human genomes, are developed. We know that genes contain recorded genetic information on how to structure this or another protein, but we do not know yet how, for example, how the form of the nose constructed from this protein is preset. The gene is known responsible for the generation of pigment that tinctures the iris /orbital septum/ but we do not know how the form and the size of this septum is coded. This mechanism is probably realized only partially in the DNA itself, as a genome of an insect has much more in common, let’s say, with a human genome, than the insect itself with the human being. We do not know how the feelers of any insect of such-and-such length are programmed and where it is recorded that it should have eight pedicles or one horn on its head. And why from these proteins programmed in one of the DNA genes structures in the form of the feelers should be built in this particular place, while the structures in the form of intestinal tubules should be built in another place. Protein molecules are very complex and gigantic formations in terms of molecular sizes with a very sophisticated three-dimensional configuration. Probably, separate molecules of certain albumen types, incidentally or non-incidentally, may approach each other so that to form, like in a puzzle, the albuminous conglomerate only of a specific shape. In that way it is possible to explain both the form and sizes of albuminous structures. We can also assume that casually assembled lame/poor forms have been rejected by evolution, while those successful were purposefully fixed in genes. Consequently, the difference of forms of organs constructed of identical proteins is explained by the difference of the protein molecules structure? It may be true... But why then keratin here is formed in the shape of elytra, and there – in the form of horns or some kind of septa in the insect’s body? DNA only programs building material – albumen/proteins, rather than the structure (form), i.e. the organs built of these proteins, since DNA contains a record of only how to structure the proteins (the “bricks” for building a structure). But where is “the drawing of the entire building” and its configuration recorded? There are no answers for the present. So, living systems have the purposeful genetic structural regeneration which is intended for continual renewal of elements of the system. Genetic mechanism uses the “database” recorded in DNA and realized by means of RNA. If it were not for the failures in this system, there would have been no mutations and variability of species. However, the “faulty” mechanism of mutations is too much subjected to contingencies and cannot be target-oriented just because of contingency (incidental self-organization). Reproductive mechanism of mutations allows making selection by some features, and this is exactly a purposeful mutation (purposeful self-organization). This mechanism can change its program due to cross mating or at the moment of changing life phases (larva→chrysalis→moth), although the possibilities of such change are still very limited. A wolf will never beget a tiger and a trunk will never grow in a wolf either, even if there would be a sudden need in it, at least, for sure, not during the lifespan of one generation. But if me myself, for example, need right now to “reconstruct” a hand to extend it and to tear off a fruit from a tree, should I then wait for several generations to pass for my hand to grow and extend? Can’t one get transmuted without resorting to metabolism? It is possible if “conscious” self-organization is added. All living beings, including humans, have genetic system of contingency self-organization and in this sense the human being is the same animal as any other animal. But “conscious” and purposeful type of self-organization is only inherent in human beings. Systems with preset (target-oriented) properties will always be forming only in the event that organization or reorganization of systems is purposeful. Only the control block “knows” about the goal of the system and only it can make a decision, including on the system reorganization. However, not each control block is suitable for target-oriented reorganization. In order to decide that “that system” needs to be attached to itself it is necessary to “see” this system, know its property and define, even prior to beginning interaction, whether these properties suit for the achievement of its own purpose. And for this purpose it is necessary to be able to “see” and assess the situation around the given system. All self-training systems are able of making such an analysis. Therefore, many higher animals can reorganize their body by enhancing its possibilities with additional executive elements. They use tools of work (stones, sticks, etc.) for hunting food. But these animals, perhaps, act at the level of instincts, i.e. at the level of genetic self-organization, because even insects can use work tools. True “conscious” self-organization at the given stage of evolution is only present in human being because only he/she has analyzers-abstractors of respective degree of complexity. Only the human being could develop instruments of labor up to the level of modern technologies because it has second signaling system which helped to accumulate the experience of the previous generations by fixing it in the abstract form, in the form of the script. And only the human being using this experience has realized that there exists metabolism in a living organism and that it is possible to influence an organism so that to reorganize, if the need arises (to cure sick organism). Structural regeneration is intended for conservation of the systems’ structure. However, metabolism is not a full warranty from the destruction of systems either. Plants cannot foresee the forthcoming destruction because they do not possess the notion of space and they do not see the situation around them, because they have simple control block. Fire will creep up and burn a plant, the animal will approach and eat it, while the plant will quietly waiting for its lot because it does not see the surrounding situation, does not know the forecast and it does not have corresponding decisions regarding specific situations. That is why the systems emerged with more complex control blocks (animals and humans) which can anticipate a situation and protect themselves from destruction. Animals know about space and see the situation around, because they have more complex control blocks. They can compete very effectively with mineral and vegetative media. But competition between the animal species has placed them in new circumstances. Now it is not enough to have only complex control block and to see the surrounding situation. In order to survive it is not enough only to be able of scampering or be strong physically, it is necessary to better orient itself in space and better assess the situation and be able to make conclusions of own failures in case of survival. For this purpose it is necessary to develop control blocks. The more complex the control block, the higher is the degree of safety. And now it is not physical strength which is a criterion of advantage, but cognitive ability, i.e. the more complex the control block is (the brain with all its hierarchy of neural structures), the better. Knowledge is virtue. At that, the purposes of metabolism in animals and humans are the same as in flora, i.e. reproduction of systems and reproduction of elements of systems. Hence, in process of evolution advancement to ensure higher degree of safety of systems, the possibilities of regeneration in the form of metabolism were supplemented by intellectual possibilities of control blocks. Regardless of what kind of nature the system belongs to (mineral, vegetative, animal or human) one of its main purposes is always to preserve itself and its structure. But in mineral nature there are only passive ways of conservation, whereas in the organic nature active ways of conservation do exist: self-organization at the expense of purposeful metabolism. Therefore, struggle for food has always been the foundation of existence. But metabolism only is not sufficient. Therefore, in animals new active ways of protection are added: assessment of external situation and protection from the destructive external influences (complex reflexes, behavioral reactions). However, complex reflexes are not enough either, as it is necessary also to learn new situations and be able of making new decisions (reflexes to new stimuli/exciters). But these appeared to be insufficient as well because of limitation of personal experience. Therefore, personal experience was supplemented by collective experience for the account of the first signaling system (conditioned reflexes: the first signaling system, complex behavioral reactions). And as far as the lifespan of each system is limited, in order to transfer experience to the subsequent generations second signaling system emerged which allows to save personal experience of each system in the form of the script regardless of the system’s lifespan. Consequently in order to better preserve itself, it is necessary for the system to change and complicate continually the structure (evolution and development of species) and, apparently to be on the safe side, it’s nevertheless better to be more complex rather than simpler (evolution race). Thus, a system may have: incidental organization; generation (incidental physical coincidence of exit points of stimulator or result of action of one systems with the command entry points of control block or entry points of external influence of other systems; may be present in systems with any control blocks, including elementary); degeneration (destruction, structural simplification, loss of SFU under the influence of environment – other systems, may be the systems with any control blocks, including elementary); purposeful organization; forced generation (purposeful physical combination of exit points of stimulator or result of action of one systems with the command entry points of control block or entry points of external influence of other systems; may be in systems with any control blocks, including elementary); forced degeneration (destruction, structural simplification, loss of SFU of the system due to the purposeful effect of other systems; may be in systems with any control blocks, including elementary); self-organization; functional regeneration (operation of the system proper, actuation or de-actuation of functions of own SFU, depending on situational needs, without change of the structure; may be in systems with any control blocks, including elementary); genetic structural regeneration in the form of metabolism and reproduction of individuals directed towards preservation of its structure (may be in systems with control blocks, starting from simple ones); genetic structural regeneration in the form of instinctive/subconscious/ structural reorganization aimed at strengthening the possibilities of an organism by using other systems, that are not an immediate part of the given system (subjects) (uses “genetic” memory and may be present in systems with control blocks, starting from simple ones); conscious structural regeneration directed to strengthening of possibilities of an organism by use of other systems, not being an immediate part of the given system (subjects) (various technologies; it is aimed at strengthening the possibilities of an organism, may be present in systems with control blocks, starting from complex ones with the second signaling system). As we can see, there is a succession present in the given classification of organization of systems, as it includes everything that exists in our World, starting from objects of mineral nature and including human activities in the form of industrial technologies.

Evolution of our World. We always say that the objects (systems) exist in our World /Unietse/and they operate in it. Therefore it is necessary to give a definition of the concept “our World”. We call “our World” the greatest and universal system in which based on the law of hierarchy all objects exist as its subsystems which can be part of it without coming into conflict with the laws of conservation and cause-and-effect limitations. Such objects are target-oriented associations of systemic functional units (SFU, elements) – the groups of elements interacting with specific goal/purpose (systems, or rather subsystems of our World). These include both the objects which existed before and are non-existent now and those that exist now and will appear in the future as a result of evolution. Absolutely all objects of our World have one or another purpose. We do not know these purposes and we can only guess them, but they are present in all the systems without exception. The purpose determines the laws of existence and architecture (“anatomy”) of objects, limits interaction between them or between their elements and stipulates the hierarchy of both sub-goals and subsystems for the achievement of these sub-goals. But this architecture is continually found insufficient (limited) because it is determined by the law of cause-and-effect limitations. It forces the systems to continuously seek the way to overcome these limitations, develops them and determines direction of evolution of the systems. That is why the systems develop towards their complexification and enhancement of their possibilities (evolve). If there would be no limitations, there would be no sense in evolution because ultimately the goal of evolution always consists in overcoming the limitations. All objects of our World have at least two primary goals: to be/exist in this World (to preserve themselves) to fulfill the goal and to have maximum possibilities to perform the actions for the achievement of the goal. However, any object of our World is limited in its possibilities to varying extent due to the law of cause-and-effect limitations and moreover, since the objects are continually exposed to various external influences destroying them, the systems have to continually protect themselves from such destruction. Therefore, the systems at first “have invented” passive and then active ways of protection against such destructive influence. The process of “invention” of these ways of protection and the enhancement of their possibilities is what evolution of objects of our World means exactly, at that it implies not only the evolution of living beings, but evolution of everything that exists in the world. Consolidation of objects in groups strengthens them and ensures the possibility for them to co-operate against destruction in a target-oriented manner. It is for the reason of “survival” of elements that the systems came into being, and complexification of elements just magnifies their possibilities. The simplest systems are those having only simple control block. Such objects include all objects of mineral nature, as well as plants. The possibilities of elementary particles are too small, and the lifespan of many of them is too short. The lifetime and possibility of an electron, proton or neutron are tenfold. Grouping of elements not only increases their lifetime, but also increases their possibilities. What can be done by electron (proton, neutron) cannot be done by elementary particles constituting them. What can be done by atoms can not be done separately by protons, neutrons and electrons. Grouping of atoms in molecules has enabled the development of more complex systems, up to human being, construction of which would have been impossible using elementary particles. However, although in process of further consolidation of atoms and molecules in conglomerates (mineral objects: gas clouds, liquid and solid bodies) the possibilities of these objects increase, but their lifetime starts to decrease sharply because the law of negative entropy works. Destruction is the loss by the object of its SFU. There are only two ways to prevent from destruction: increase in durability of connections/bonds between the SFU, restoration of the lost SFU, prevention of the SFU losses. The first one is passive, while the other two are active ways of protection. The increase in durability of connections/bonds between the SFU (the first way) is the passive way of protection against destruction. Mineral bodies have only these passive means of protection from the destructive effect of the external medium. The weakest of them are gaseous objects, while the strongest are crystalline. But even the strongest crystal may be destroyed. Metabolism is aimed at the restoration of the lost SFU (the second way) and is the active way of protection of systems from destruction. It is carried out at the expense of capture of necessary elements from the external medium. There is no metabolism in mineral objects, but it is present in all living objects, including plants. Hence, our World can be divided conditionally into two sub-worlds: inanimate/inorganic and animate nature. The criterion for such division is metabolism – the purposeful process of restoration of the lost SFU. But for such process the system should contain corresponding elements (metabolism organs) which are not present in the objects of mineral inorganic nature, but do exist in plants. Prevention of SFU losses (the third way) is also an active way of systems’ protection from their destruction. Systems may be prevented from destruction for the account of their behavioral reactions depending on the external situation. If the situation is threatening the system needs to escape from the given situation. But for this purpose it is necessary to be aware about this situation, to be able to see it, as well as to have organs of movement which are nonexistent in the systems of mineral and vegetative nature. For this purpose it is necessary to have at least complex control block. Hence, in the animate nature it is possible to single out two more sub-worlds/natures: flora and fauna. The criterion for such division is the complexity of the control block and its ability (the availability of possibility) to show behavioral reactions. The more complex the control block, the higher is the development of animal as a system. But at that, note should be taken of the fact that the development of systems from plants to animals was basically solving only one problem – to be/exist in this World. The purport of existence of plants and the majority (if not of all) of animals, except for humans, is only in the metabolism. If the system is hungry it operates, if is satiated it stays idle. Yes, with complication of the control block simultaneous increase in the possibilities of systems occurred too, but it still pursued the goals of metabolism. More adapted animal feeds better. If the system plays and lives jolly (emotional tint of behavioral reactions), such reactions as a rule are still directed towards self-training of systems for better hunting for other systems. Therefore such reactions are basically inherent in young animals. More adult individuals do not play any more. Note should be also taken of that division of animals into predators and herbivorous animals is quite conditional, since it is not eating meat that is a distinctive feature of a predator and plants may also be carnivorous (for example, sundew and the like). Absolutely all animals, and not only them, but plants as well, are predators, since they represent the systems which feed on other systems. Even among the objects of mineral nature mutual relations of a victim-predator type may be found. Some systems (plants and herbivores) feed on systems with simple control blocks (mineral objects and plants) because it is easier thing to do. However, other systems (carnivorous) feed or try to feed on systems with complex control blocks (other animals), although it is much more complex to do so. That is why the donkey is more stupid than a tiger. The human being differs from other objects of animate nature first of all in that it is not metabolism which is the main purport of his/her life, but cognition. Yes, the higher the level of knowledge, the better the nutrition. But the process of cognition in itself prevails over all other processes aimed at metabolism. And even the metabolism itself is raised to the rank of art (the cookery). It is also possible to single out the human nature in that way as well, since only a human being out of all objects of our World has second signaling system (the intellectual control block) and aspiration towards cognition. Hence, the purpose of our World was evolution which has stipulated the development of systems in the direction towards complexification of their control blocks up to a human being. And the purpose of this evolution was to develop systems to such a degree that they have learnt to cognize the World. We can look back and see the confirmation of it throughout the entire history of development of our World in general and biosphere in particular. We do not know what was before the Big Bang, and we do not even know to which extent such statement is qualified. However, after it only the emergence and complexification of systems in the Universe was taking place, at that it occurred only at the expense of complexification of their control blocks, because their primary SFU (elementary particles) practically have not changed since then neither qualitatively, nor quantitatively. And we, the people, are the consequence and the proof of this development either. The human being is the most complex system, the top of evolution which has occurred till nowadays. Experience of this evolution shows that major distinctive feature throughout the entire process of advanced development was only the development of control blocks of systems. We do not know the purposes of the majority of systems of our World, although we can fabricate a multitude of speculations on many issues of this subject. For example, nuclei of atoms of chemical elements that are heavier than iron in those quantities which exist now in our Universe, could only and only appear as the result of explosions of supernovas. Hence, is the purpose of stars with evolution of a supernova type is the production of nuclei of atoms harder than iron? It may be true, although no one would avouch for it for the present. But we can surely state that a human being in the shape it exists today and is known to us would not have been existent without the elements having atomic weight heavier that iron, because the structure of its organism requires the presence of such elements. So, there are sufficient grounds for the assumption that stars of a supernova type are necessary for the development of the humans. It sounds strange and extraordinary, but still it’s the fact. But we know for sure and without speculations the purposes of some of the World’s systems, in particular, the purposes of many systems of organism. We know one of the main objectives of any living organism – to survive in the environment, and we know the hierarchy of sub-goals into which this purpose is broken down. We see how living systems develop on the way of evolution, we see the differences of systems standing at different levels of evolutionary process and we can explain the advantage of some systems over the others. In other words, the possibility is opened to us to construct classification of all systems of our World, including that of living systems. Today there is no uniform classification of all objects of our World, but there are only separate classifications of various groups of these objects, including classifications of astronomical, geological, biological and other groups. At that, nowadays the underlying principle of the majority, if not of all of these classifications, including classification of both the entire animate nature and the diseases, is the organic-morphological analysis. But probably it is necessary to substitute it, as well as classification of diseases, for the classification based on systemic analysis – the analysis of the goals/purposes. And the basic principle of the new classification should be not external distinctions, such as the number of feet or cones on the teeth, but two basic differences: differences by types of control blocks and types of executive elements. Moreover, it is necessary to include all objects of our World in this classification – animate and inanimate, because our World is replete only with systems which differ from each other only in the degree of development of their control blocks and in the ways of protection against destruction by the external media. The world is uniform, because it is a system in itself. Therefore, it is necessary to create common and single classification of all systems of our World. And systems are any objects, including animate/organic and inanimate/inorganic. Then it will be possible to distinguish four worlds/natures (sub-natures) of objects in our World: the world of minerals/mineral nature/, vegetative, animal worlds/natures/ and the world of humans/the human nature/. The population of each world differs from each other, as it was repeatedly underlined, only in control blocks and metabolism. The objects of mineral and vegetative nature have simple control blocks. But the objects of mineral nature have only passive ways of protection against negative entropy (destruction). And all living subjects, including plants, have active ways of protection against the same negative entropy, i.e. active substitution of the destroyed SFU at the expense of metabolism. Animals, unlike plants, in addition to metabolism, have more complex control blocks which enable behavioral reactions and thus allow them to control in a varying degree surrounding situation. And the humans have the most complex control block which contains the second signaling system and consequently it is capable of cognizing the whole World, including themselves, but not just what happens/exists nearby. And within each type of nature classification we should also proceed further to include the criteria of complexity of control blocks and then the criteria of presence and the degree of development of executive elements, including the number of feet or cones on the teeth. In this case classification will be the one of cause-and-effect type and logical. For example, vegetative nature/the flora/ includes not only plants, but all the Earth’s population which possesses only simple control block and metabolism. And those are not only plants and not only metazoan. Procaryotes and eukaryotes, bacteria, phytoplankton, sea anemones, corals, polyps, fungi, trees, herbs, mosses and lichens and many others possessing and those not possessing chlorophyll are all flora. They simply grow in space and they have no idea of it because they “do not see” it. However, some plants, for example, trees or herbs, unlike corals, fungi or polyps, contain chlorophyll (specific executive element). Such classification of systems has one incontestable advantage: it aligns everything that populates our World – the systems. The whole World around us is classified by a single scale, where the unit of measure is only the complexity of control block and executive elements used by it. In that way it would be easier for us to understand what life is. May it be so that inanimate nature does not exist at all? Perhaps, “animate” differs from “inanimate” only in that it “has comprehended” its own exposure to destruction under the influence of environment and first has learnt self-restorability and then it learnt how to protect itself from destructions? Then Pierre Teyjar De Chardin is right asserting that evolution is a process of arousal of consciousness. Currently existing classifications do not provide the answer to this question. New classification of systems based on the systemic target-oriented analysis will make it possible to understand, where the “ceiling” of development of systems of each of the worlds is and which of its subjects are still at the beginning of the evolutionary scale and which of them have already climbed up its top. But this classification is based on the recognition of the first-priority role of the goal/purpose on the whole and purposefulness of nature in particular, which idea is disputable for the present and is not accepted by all. Therefore, queer position was characteristic for the XX century: the position of struggle with nature, position which is still shared by a great many. This position is fundamentally erroneous, because the nature is not our enemy, but the “parent”, the tutor and friend. It “produced” us and “nurtured” us, having provided a cradle, the Earth for us, and it has been creating greenhouse conditions throughout many millions years, where fluctuations of temperature were no more than 100ºC and the pressure about 1 atmosphere, with plenty of place, sufficient moisture and energy, although Space is characterized by range of temperatures in many millions degrees and of pressure in millions atmospheres. It has brought us up and made us strong, using evolution and the law of competition: “the strongest survives”. It is not our task “to take from it”, nor to struggle with it, but to understand and collaborate with it, because it is not our enemy, but the teacher and partner. It “knows” itself what we need and gives it to us, otherwise we would not have existed. This is not an ode to the nature, but the statement of fact of its purposefulness. Some may object that such combination of natural conditions which has led to the origination of human being is just a mere fortuity which has arisen under the law of large numbers only because the World is very large and all kind of options are possible in it. However, that many incidental occurrences are kind of suspicious. The nature continually “puts stealthily” various problems before us, but every time the level of these problems for some reason completely corresponds to the level of development of an animal or a human being. For some reason a man “has discovered” a nuclear bomb at the moment when he could already apprehend the power of this discovery. Nature does not give dangerous toys to greenhorns. If there were no problems at all, there would be no stimulus to development and as of today the Earth would have been populated by the elementary systems, if it were populated at all. However, if the problems sharply exceed the limit of possibilities of systems, the latter would have collapsed and the Earth would have not been populated at all, if it would be existent in abstracto. And in any case there would have been no development on the whole. But we do exist and it is the fact which has to be taken into account and which requires explanation. And the explanation only consists in the purposefulness of Nature.

Systemic analysis is a process of receiving answer to the question “Why is the overall goal of the system fulfilled (not fulfilled)?” The notion of “systemic analysis” includes other two notions: “system” and “analysis”. The notion of “system” is inseparably linked with the notion of the “goal/purpose of the system”. The notion “analysis” means examination by parts and arranging systematically (classification). Hence, the “systemic analysis” is the analysis of the goal/purpose of the system by its sub-goals (classification or hierarchy of the goals/purposes) and the analysis of the system by its subsystems (classification or hierarchy of systems) with the view of clarifying which subsystems and why can (can not) fulfill the goals (sub-goals) set forth before them. Any systems perform based on the principle “it is necessary and sufficient” which is an optimum control principle. The notion “it is necessary” determines the quality of the purpose, while the notion “is suficient” determines its quantity. If qualitative and quantitative parameters of the purpose of the given system can be satisfied, then the latter is sufficient. If the system cannot satisfy some of these parameters of the goal, it is insufficient. Why the given system cannot fulfill the given purpose? This question is answered by systemic analysis. Systemic analysis can show that such-and-such object “consists of... for…”, i.e. for what purpose the given object is made, of what elements it consists of and what role is played by each element for the achievement of this goal/purpose. The organic-morphological analysis, unlike systemic analysis, can show that such-and-such object “consists of... “, i.e. can only show of which elements the given object consists. Systemic analysis is not made arbitrarily, but is based on certain rules. The key conditions of systemic analysis are the account of complexity and hierarchy of goals/purposes and systems.

Complexity of systems. It is necessary to specify the notion of complexity of system. We have seen from the above that complexification of systems occurred basically for the account of complexification of control block. At that, complexity of executive elements could have been the most primitive despite the fact that control block at that could have been very complex. The system could contain only one type SFU and even only one SFU, i.e. to be monofunctional. But at the same time it could carry out its functions very precisely, with the account of external situation and even with the account of possibility of occurrence of new situations, if it had sufficiently complex control block. When the analysis of the complexity of system is made from the standpoint of cybernetics, the communication, informo-dynamics, etc. theories the subject discussed is the complexity of control block, rather than the complexity of the system. Note should be taken of that regardless of the degree of the system complexity two flows of activity are performed therein: information flow and a flow of target-oriented actions of the system. Information flow passes through the control block, whereas the flow of target-oriented actions passes through executive elements. Nevertheless, the notion of complexity may also concern the flows of target-oriented actions of systems. There exist mono- and multifunctional systems. There are no multi-purpose systems, but only mono-purpose systems, although the concept of “multi-purpose system” is being used. For example, they say that this fighter-bomber is multi-purpose because it can bomb and shoot down other aircrafts. But this aircraft still has only one general purpose: to destroy the enemy’s objects. This fighter-bomber just has more possibilities than a simple fighter or simple bomber. Hence, the notion of complexity concerns only the number and quality of actions of the system, which are determined by a number of levels of its hierarchy (see below), but not the number of its elements. Dinosaurs were much larger than mammals (had larger number of elements), but have been arranged much simpler. The simplest system is SFU (Systemic Functional Unit). It fulfills its functions very crudely/inaccurately as the law that works is the “all-or-none” one and the system’s actions are the most primitive. Any SFU is the simplest/elementary defective system and its inferiority is shown in that such system can provide only certain quality of result of action, but cannot provide its optimum quantity. Various SFU may differ by the results of their actions (polytypic SFU), but they may not differ either (homotypic SFU). However, all of them work under the “all-or-none” law. In other words, the result of its action has no gradation or is zero (non-active phase), or maximum (active phase). SFU either reacts to external influence at maximum (result of action is maximum – “all”), or waits for external influence (the result of action is zero – “none”) and there is no gradation of the result of action. Each result of SFU action is a quantum (indivisible portion) of action. Monofunctional systems possess only one kind of result of action which is determined by their SFU type. They may contain any quantity of SFU, from one to maximum, but in any case these should be homotypic SFU. Their difference from the elementary system is only in the quantity of the result of action (quantitative difference). The monofunctional system may anyway perform its functions more accurately as its actions have steps of gradation of functions. The accuracy of performance of function depends on the value of action of single SFU, the NF intensity and the type of its control block, while the capacity depends on the number of SFU. The “smaller” the SFU, the higher the degree of possible accuracy is. The larger the number of SFU, the higher the capacity is. So, if the structure of the system’s executive elements (SFU structure) is homotypic, it is then multifunctional and simple system. But at that, its control block, for example, may be complex. In this case the system is simple with complex control block. The multifunctional system is a system which contains more than one type of monofunctional systems. It possesses many kinds of result of action and may perform several various functions (many functions). Any complex system may be broken down into several simple systems which we have already discussed above. The difference of multifunctional system from the monofunctional one is that the latter consists of itself and includes homotypic SFU, while complex system consists of several monofunctional systems with different SFU types. And at that, these several simple systems are controlled by one common control block of any degree of complexity. The difference between monofunctional and multifunctional systems is in the quantity and quality of SFU. In order to avoid confusion of the complexity of systems with the complexity of their control block, it is easier to assume that there are monofunctional (simple) and multifunctional (complex) systems. In this case the concept of complexity of system would only apply to control block. In monofunctional system control block operates a set of own SFU regardless of the degree of its complexity. In multifunctional system control block of any degree of complexity operates several monofunctional subsystems, each of which has its SFU with their control blocks. It is complexity of control block that stipulates the complexity of the system, and not only the type of system, but the appurtenance of the given object to the category of systems. The presence of an appropriate control block conditions the presence of a system, whereas the absence of (any) control block conditions the absence of a system. Systems may have control blocks of a level not lower than simple. The full-fledged system can not have the simplest/elementary control block, whereas the SFU can.

So, the system is an object of certain degree of complexity which may tailor its functions to the load (to external influence). If its structure contains more than one SFU, the result of its action has the number of gradations equal to the number of its SFU or (identically) the number of quanta of action. The number of the system’s functions is determined by the number of polytypic monofunctional systems comprising the given system. In former times development of life was progressing towards the enlargement of animal body which provided some kind of guarantee in biological competition (quantitative competition during the epoch of dinosaurs). But the benefits has proven doubtful, the advantages turned out to be less than disadvantages, that is why monsters have died out. This is horizontal development of systems. If they differ in quality it is tantamount to the emergence of new multifunctional systems. Such construction of new systems is the development of systems along the vertical axis. The example of it is complexification of living organisms in process of evolution, from elementary unicellular to metazoan and the human being. What can be done by man can not be done by a reptile. However, what can be done by reptile can not be done by an infusorian (insect, jellyfish, amoeba, etc.). Complexification of living organisms occurred only for one cardinal purpose: to survive in whatever conditions (competition of species). Since conditions of existence are multifarious, the living organism as a system should be multifunctional. The character of a new system is determined by the structure of executive elements and control block features. If there is a need to extend the amplitude or the capacity of system’s performance the structure of executive elements should be uniform. To increase the amplitude of the system’s performance all SFU are aligned in a sequential series, while to increase the capacity – in a parallel series depending on the required quantity of the result of action (amplitude or capacity at the given concrete moment). Polytypic SFU have different purposes and consequently they have different functions. The differences of SFU stipulate their specialization, whereby each of them has special function inherent in it only. If the structure of any system comprises polytypic SFU, such system would be differentiated, having elements with different specialization. In systems with uniform SFU all elements have identical specialization. Therefore, there is no differentiation in such system. So, the concept of specialization characterizes a separate element, whereas the concept of differentiation characterizes the group of elements. The number of SFU in real systems is always finite and therefore the possibilities of real systems are finite and limited, too. Resources of any system depend on the number of SFU comprising its structure in the capacity of executive elements. The pistol may produce as many shots as is the number of cartridges available in it, and no more than that. The less the number of SFU is available in the system, the smaller the range of changes of external influence can lead to the exhaustion of its resources and the worse is its resistance to the external influence. By integrating various SFU in more and more complex systems it is possible to construct the systems with any preset properties (quality of the result of action) and capacities (amount of quanta of the result of action). At that, the elements of systems are the systems themselves, of a lower order though (subsystems) for these systems. And the given system itself may also be an element for the system of higher order. This is where the essence of hierarchy of systems lies.

Hierarchy of goals/purposes and systems. The more complex the system, the wider the variety of external influences to which it reacts. But the system should always produce only specific (unique, univocal) reaction to certain influence (or certain combination of external influences) or specific series of reactions (unique/univocal series of reactions). In other words, the system always reacts only to one certain external influence and always produces only one specific reaction. But we always see “multi”-reactive systems. For example, we react to light, sound, etc. At the same time we can stand, run, lay, eat, shout, etc., i.e. we react to many external influences and we do many various actions. There is no contradiction here, as both the purposes and reactions may be simple and complex. The final overall objective of the system represents the logic sum of sub-goals/sub-purposes of its subsystems. The goal/purpose is built of sub-goals/sub-purposes. For example, the living organism has only one, but very complex purpose – to survive, by all means, and for this purpose it should feed. And for this purpose it is necessary to deliver nutriment for histic cells from the external medium. And for this purpose it is necessary first to get it. And for this purpose it is necessary to be able to run quickly (to fly, bite, grab, snap, etc.). Thereafter it is necessary to crush it, otherwise it won’t be possible to swallow it (chewing). Then it is necessary to “crush” long albumen molecules (gastric digestion). Then it is necessary to “crush” the scraps of the albumen molecules even to the smaller particles (digestion in duodenum). Then it is necessary to bring in the digested food to blood affluent to intestine (parietal digestion). Then it is necessary... And such “is necessary” may be quite many. But each of these “is necessary” is determined by a sub-goal at each level of hierarchy of purposes. And for every such sub-goal there exists certain subsystem at the respective level of hierarchy of subsystems. At that, each of them performs its own function. And in that way a lot of functions are accumulated in a system. However, all this hierarchy of functions is necessary for one unique cardinal purpose: to survive in this world. Any object represents a system and consists of elements, while each element is intended for the fulfillment of respective sub-goals (subtasks). The system has an overall specific goal and any of its elements represents a system in itself (subsystem of the given system), which has its own goal (sub-goal) and own result of action. When we say “overall specific goal” we mean not the goals/purposes of elements of the system, but the general/overall/ purpose which is reached by means of their interactions. The system has a goal/purpose which is not present in each of its element separately. But the overall goal of the system is split into sub-goals and these sub-goals are the purposes of its elements anyway. There are no systems in the form of indivisible object and any system consists of the group of elements. And each element, in turn, is a system (subsystem) in itself with its own purpose, being a sub-goal of the overall goal/general purpose/. To achieve the goal the system performs series of various actions and each of them is the result of action of its elements. The logic sum of all results of actions of the system’s subsystems is final function – the result of action of the given system. Thus, one cardinal purpose determines the system, while the sub-goal determines the subsystem. And so on and so forth deep into a hierarchy scale. The goal/purpose is split into sub-goals/sub-purposes and the hierarchy of purposes (logically connected chain of due actions) is built. To perform this purpose the system is built which consists of subsystems, each of which has to fulfill their respective sub-goals and capable to yield necessary respective result of action. That is how the hierarchy of subsystems is structured. The number of subsystems in the system is equal to he number of subtasks (subgoals) into which the overall goal is broken down. For example, the system is sited at a zero level of hierarchy, and all its subsystems are sited at a minus one, minus two, etc. levels, accordingly. The order of numeration of coordinates is relative. It means that the given system may enter the other, larger system, in the capacity of its subsystem. Then the larger system will be equalized to zero level, whereas the given system will be its subsystem and sited at a minus one level. The hierarchy scale of systems is built on the basis of hierarchy of goals/purposes. Target-specific actions of systems are performed by its executive elements, but to manage their target-oriented interaction the interaction of control block of the system with control blocks of its subsystems is needed. Therefore, the hierarchy scale of systems is, as a matter of fact, a hierarchic scale of control blocks of systems. This scale is designed based on a pyramid principle: one boss on top (the control block of the entire system), a number of its concrete subordinates below (control blocks of the system’s subsystems), their concrete subordinates under each of them (control blocks of the lower level subsystems), etc. At each level of hierarchy there exist own control blocks regulating the functions of respective subsystems. Hierarchical relations between control blocks of various levels are built on the basis of subordination of lower ranking blocks to those of higher level. In other words, the high level control block gives the order to the control blocks of lower level. Only 4 levels of hierarchy, from 0 to 3rd, are presented. The count is relative, whereby the level of the given system is assumed to be zero. The counting out may be continued both in the direction of higher and lower (negative) figures/values. The notions of “order” and “level” are identical. The notions of “system” and “subsystem” are identical, too. For example, instead of expression “a subsystem of minus second-order” one may say “a system of minus second-level”. And although a zero level is assumed the level of the system itself, the latter may be a part of other higher order system in the capacity of its subsystem. Then the number of its level can already become negative (relative numeration of level). Elements of each hierarchic level of systems are the parts of system, its subsystems, the systems of lower order. Therefore, the notions “part”, “executive element”, “subsystem”, “system” and in some cases even “element” are identical and relative. The choice of term is dictated only by convenience of accentuating the place of the given element in the hierarchy of system. The notion of hierarchic scale (or pyramid principle) is a very powerful tool and it embodies principal advantage of systemic analysis. Systemic analysis is impossible without this concept. Both our entire surrounding world and any living organism consist of infinite number of various elements which are relating to each other in varying ways. It is impossible to analyze all enormous volume of information characterizing infinite number of various elements. The concept of hierarchy of systems sharply restricts the number of elements subjected to the analysis. In the absence of it we should take into account all levels of the world around us, starting from elementary particles and up to global systems, such as an organism, a biosphere, a planet and so on. For global evaluation of any system it is sufficient to analyze three levels only: the global level of the system itself (its place in the hierarchy of higher systems); the level of its executive elements (their place in the hierarchy of the system itself); the level of its control elements (elements of control block of the system itself). To evaluate the system’s function it is necessary to determine the conformity of the result of action of the given system with its purpose – due result of action (global level of function of the system), the number of its subsystems and the conformity of their results of action with their purposes – due results of their action (local functional levels of executive elements) and evaluate the function of elements of control. In the long run the maximum level of function of system is determined by the logic sum of results of actions of all subsystems comprising its structure and optimality of control block performance. Abiding by the following chain of reasoning: “the presence of the goal/purpose for implementation of any specific condition, the presence of qualitative or quantitative novelty of the result of action, the presence of a control (block) loop” it is possible to single out elements of any concrete system, show its hierarchy and divide cross systems in which the same elements perform various functions. Systems work under the logical law which main principle is the fulfillment of condition “... if..., then….”. In this condition “if ..” is the argument (purpose), while “then...” is the function (the result of action). This condition stipulates determinism in nature and hierarchy scale. Any law, natural or social, requires implementation of some condition and the basis of any condition is this logical connective “... if..., then…” At that, this logical connective concerns only two contiguous subsystems on a hierarchic scale. The argument “... if” is always specified by the system which is on a higher step, whereas the function “then…” is always performed by the system (subsystem) sited immediately underneath, at a lower step of a hierarchic scale. Actions of elements per se and interaction between the elements may be based on the laws of physics or chemistry (laws of electrodynamics, thermodynamics, mathematics, social or quantum laws, etc.). But the operation of control block is based only on the logical laws. And as far as control block determines the character of function of systems, it is arguable that systems work under the logic laws. Sometimes in human communities the “bosses” would imagine they may govern/control/ at any levels, but such type of management is the most inefficient one. The best type of management is when the director (the control block of multifunctional system) controls/manages/ only the chiefs of departments (control blocks of monofunctional systems), sets forth feasible tasks before them and demands the implementation thereof. At that, the number of its “assistant chiefs” should not exceed 7±2 (Muller's number). If some department does not implement its objectives, it means that either the departmental management (control block of a subsystem) is no good because has (a) failed to thoroughly devise and distribute the tasks between the subordinates (the SFU), or (b) has inadequately selected average executives (SFU), or (c) impracticable goal has been set forth before the department (before system), or (d) the director himself (control block of the system) is no class for the management. In such cases the system’s reorganization is necessary. But if the system is well elaborated and performs normally there is no sense for the director to “pry” into the department’s routine affairs. A chief of department is available for this purpose. The decision of the system reorganization is only taken when the system for some reason cannot fulfill the objective (system crisis). In the absence of crisis there is no sense in reorganization. For the purpose of reorganization the system changes the structure of its executive and control elements both at the expense of actuation (de-actuation) of additional subsystems and alteration of exit-entry combinations of these elements. In such cases skipping of some steps of hierarchy may occur and the principle “vassal of my vassal is not my vassal” violated. This is where the essential point of the system reorganization lies. At the same time, part of elements can be thrown out from the system as superfluous (that’s how at one time we lost, for example, cauda and branchiae), while other part may be included in the system’s structure or shifted on the hierarchy scale. But all that may only happen in process of the system reorganization proper. When the process of reorganization comes to an end and the reorganized system is able of performing the goal set forth before it (i.e. starts to function normally), the control law of “vassal of my vassal is not my vassal” is restored.

**Consequences ensuing from axioms.**

Independence of purpose. The purpose/goal does not depend on the object (system) as it is determined not by the given object or its needs, but by the need of other object in something (is dictated by the external medium or other system). But the notion of “system” in relation to the given object depends on the purpose, i.e. on the adequacy of possibilities of the given object to execute the goal set. The goal is set from the outside and the object is tailored to comply with it, but not other way round. Only in this case the object presents a system. Note should be taken again of the singularity of the first consequence: the system’s purpose/goal is determined by a need for something for some other object (external medium or other system). Common sense suggests that supposedly survivability is the need of the given organism (the given system). But it follows from the first consequence that the need to survive proceeds not from the given organism, but is set to it by another system external with respect to it, for example, the nature, and the organism tries to fulfill this objective.

Specialization of the system’s functions. In response to certain (specific) external influence the system always produces certain (specific) result of action. Specialization means purposefulness. Any system is specialized (purposeful) and follows from the axiom. There are no systems in abstracto, there are systems that are concrete. Therefore, any system has its specific purpose/goal. Executive elements (executive SFU) of some systems may be homotypic (identical, non-differentiated from each other). If executive elements differ from each other (are multitype), the given system consists of differentiated elements.

System integrity. The system exerts itself as a unitary and integral object. It follows from the unity of purpose which is inherent only in the system as a whole, but not in its separate elements in particular. The purpose consolidates the system’s elements in a comprehensive whole.

Limited discrecity of system. Nothing is indivisible and any system may be divided into parts. At the same time, any system consists of finite number of elements (parts): executive elements (subsystems, elements, SFU) and management elements (control block).

Hierarchy of system. The elements of a system relate to each other in varying ways and the place of each of them is the place on the hierarchic scale of the system. Hierarchy of systems is stipulated by hierarchy of purposes. Any system has a purpose. And to achieve this purpose it is necessary to achieve a number of smaller sub-goals for which the large system contains a number of subsystems of various degree of complexity, from minimum (SFU) up to maximum possible complexity. Hierarchy is the difference between the purposes of the system and the purposes of its elements (subsystems) which are the sub-goals in respect to it. At that, the systems of higher order set the goals before the systems of lower order. So, the purpose of the highest order is subdivided into a number of sub-goals (the purposes of lower order). The hierarchy of purposes determines the hierarchy of systems. To achieve each of the sub-goals specific element is required (it follows from the conservation law). Management/control in a hierarchic scale is performed in accordance with the law “the vassal of my vassal is not my vassal”. In other words, direct control is only possible at the level “system - own subsystem”, and the control by super system of the subsystem of its system is impossible. The tsar, should he wish to behead a criminal, would not do it himself, but would give a command to his subordinate executioner.

System function. The result of the system’s performance is its function. To achieve the purpose the system should perform purposefully certain actions the result of which would be the system’s function. The purpose is the argument for the system (imperative), while the result of action of the system is its function. The system’s functions are determined by a set of executive elements, their relative positioning and control block. The notions of “system” and “function” are inseparable. Nonfunctional systems are non-existent. “Functional system” is a tautology, because all systems are functional. However, there may be systems which are non-operational at the moment (in a standby mode). Following certain external influence upon the system it will necessarily yield certain specific result of action (it will function). In the absence of the external influence the system produces no actions (does not function). When taking into account the purpose, the argument is not the external influence, but the purpose. One should distinguish internal functions of the system (sub-function) belonging to its elements (to subsystems, SFU) and the external functions belonging to the entire system as a whole. The system’s external function of emergent property is the result of its own action produced by the system. Internal functions of the system are the results of action of its elements.

Effectiveness of systems. Correspondence of the result of action to the goal set characterizes the effectiveness of systems. Effectiveness of systems is directly linked with their function. The system’s function in terms of effectiveness may be sufficient, it may by hyperfunction, decelerating and completely (absolutely) insufficient function. The system performs some actions and it leads to the production of the result of its action which should meet the purpose for which the given system is created. Effectiveness of systems is based on their specialization. “The boots should be sown by shoemaker”. Doing the opposite does not always result in real systems’ actions that meet the target/preset results (partial effectiveness or its absence). The result of action of the system (its function) should completely correspond qualitatively and quantitatively to the preset purpose. It may mismatch, be incidental or even antagonistic (counter-purposeful); at that, real systems may produce all these kinds of results of action simultaneously. Only in ideal systems the result may completely meet the preset purpose (complete effectiveness). But systems with 100% performance factor are unknown to us. Integral result (integral function) is the sum of separate collateral/incidental and useful results of action. It is this sum that determines the appurtenance of the given object to the notion of “system” with regard to the given purpose. If the sum is positive, then with respect to the preset purpose the given object is a system of one or other efficiency. If the sum is equal to zero, the object is not a system with respect to the given purpose (neutral object). If the sum is negative, the given object is an anti-system (the system with minus sign preventing from the achievement of the goal/purpose). It applies both to systems and their elements. The higher the performance factor, the more effective the system is. Discrepancy of the result of action of the given system with the due value depends on unconformity of quantitative and qualitative resources of the system, for example, owing to breakage (destruction) or improper and/or insufficient development of its executive elements (SFU) and/or control. Therefore, any object is an element of a system only in the event that its actions (function) meet the achievement of the preset goal/purpose. Otherwise it is not an element of the given system. Effectiveness of systems is completely determined by limitation of actions of the systems.

Limitation of system’s actions. Any system is characterized by qualitative and quantitative resources. The notion of resources includes the notion of functional reserve: what actions and how many of such actions the system may perform. Qualitative resources are determined by type of executive elements (SFU type), while quantitative resources by their quantity. And since real systems have certain and finite (limited) number of elements, it implies that real systems have limited qualitative and quantitative resources. “Qualitative resources” means “which actions” (or “what”) the given system is able to perform (to press, push, transfer, retain, supply, secrete, stand in somebody’s light, etc.). “Quantitative resources” means “how many units of measure” (liters, mm Hg, habitation units, etc.) of such actions the given system is able to perform.

Discrecity (“quantal capacity”) of the system’s functions. The system’s actions are always discrete (quantized) as any of its SFU work under the “all-or-none” law. There exists no smooth change of the system’s function, but there always exists phased (quantized) transition from one level of function to another, since executive elements actuate or deactivate regular SFU depending on the requirements of system. Transition of systems from one level of functions to another is always effected by way of a leap. We do not always observe this gradation/graduality because of the fact that the amplitude of the result of action of individual SFU can be very small, but still it is always there. The amplitude of these steps of transition from one level to another determines the maximum accuracy of the result of action of systems and is stipulated by the amplitude of the result of action of individual SFU (quantum of action). Probably, elementary particles are the most minimal SFU in our World and consequently indivisible into smaller parts subjected to laws of physics of our World.

Communicativeness of systems. Conjugate systems interact with each other. Such communication implicates the link/connection between the systems, i.e. their communicativeness. We discern open and closed systems. However, there are no completely isolated (closed) systems in our world which are not affected by some kind of external influence and which are nowise influencing any other systems. One may find at least two systems which are nowise interacting with each other (do not react) among themselves, but one can always find the third system (and probably the group of intermediate systems will be required) which will interact with (react to) the first two, i.e. be a link between them. If any system does not react at all to any influences exerted by any other systems and its own results of action are absolutely neutral with respect to other systems, and it is impossible to find the third system or a group of systems with which this system could interact (react to), it means that the given system does not exist in our World. Interaction between systems may be strong or weak, but it should be present, otherwise the systems do not exist for each other. Interaction is performed for the account of chains of actions: “... external influence → result of action...” By closing the end of such chain to its beginning we will get a closed (self-contained) system. The result of action after its “birth” does not depend on the system which has “gave birth” to it. Therefore, it may become external influence for the system itself. Then it will be a cyclically operating system, a generator with positive feedback. But the generator, too, requires for its performance the energy coming from the outside. Consequently, it is to some extent opened either. That is why the absolutely closed systems are non-existent. Each system has a certain number of internal and external links/connections (between the elements and between the systems, accordingly), through which the system may interact with other external systems. Closeness (openness) of a system is determined by the ratio of the number of internal and external links/connections. The larger the ratio, the greater the degree of closeness of a system is. Space objects of a “black holes” type are assumed to be referring to closed systems because even photons cannot break off from them. But they react with other space bodies through gravitation which means that they “are opened” through the gravitation channel through which they “evaporate” (disappear).

Controllability of systems. Any system contains elements (systems) of control which supervise the correspondence between the result of action of the system and the goal set. These control elements form the control block. Management of system is carried out through commands given to its control block, whereas the control over its executive elements is exercised through sending commands to their control blocks. Any reflex is the manifestation of the work of the control block. And as far as control block is the integral accessory of any systems, any systems have their own reflexes. Executive elements should fulfill the goal exactly to the extent preset by the command, neither more nor less than that (neither minimum nor maximum, but optimum) based on a principle “it is necessary and sufficient”. Control elements watch the fulfillment of the purpose and if the result exceeds the preset one, the control block would force the executive elements to reduce the system’s function, whereas if it is lower than the preset result it will force to increase the system’s function. The purpose is dictated by conditions external with respect to the system. The command is entered into the system through the special entry channel. All consequences represent continuation of axioms, are stipulated by purposefulness of systems, constructed under laws of hierarchy and limited by the conservation law. The list of consequences could be continued, but those listed above are quite sufficient for the evaluation of any system. Such evaluation applies to both the properties of the system and its interaction with other systems. Evaluation of the first consequence can be expressed in percentage, i.e. what is the percentage of fulfillment (failure of fulfillment) of the goal/purpose. The goal may be any due value. Other consequences may also be characterized either qualitatively or quantitatively, which actually represents the system evaluation, i.e. its diagnostics, systemic analysis. The system is characterized by: the purpose/goal (determines designation of the system); hierarchy (determines interrelations between all the elements of the system without an exception); executive elements (SFU performing actions); control block (watches the correctness of performance of actions for the achievement of the goal). Any object, not only material, is also a system, provided it satisfies the above listed axioms and their consequences. Groups of mathematical equations, logic elements, social structures, relations between people, intellectual/spiritual values, may also represent systems in which same principles of functioning of systems work under the same logical laws. All of them have a purpose, their own SFU and control blocks which watch the implementation of the goal/purpose. If the object has a purpose it is a system. And for the achievement of this purpose it should have corresponding executive elements and control block with corresponding analyzers, DPC and NF (which follows from the conservation law and the law of cause-and-effect limitations). Systemic analysis examines the systems and their elements in a coordinated fashion. The result of such analysis is the evaluation of correspondence of results of actions of the systems with their purposes and revealing the causes of the discrepancy for the account of determination of cause-and-effect relations between the elements of systems. The major advantage of systemic analysis is that only such an analysis allows establishing the causes of insufficiency of systems. The purpose/goal determines both the elementary structure of systems and interaction of its elements which is operated by the control block. The interaction of executive elements (SFU) only is not conducive to yielding stable result of action meeting the purpose preset for the system. Addition to a system of the control block adjusted to the preset purpose enables producing stable (constantly repeated) result of action of the system meeting the preset goal. The norm is such condition of a system which allows it to function and develop normally in the medium of existence which is natural for the given type of systems and to yield reactions of such qualitative and quantitative properties which allow the system to protect its SFU from destruction. The notion of “norm” is relative with respect to average state of the system in the given conditions. In case if conditions alter, the system’s condition should change, too. Reaction is the action of the system aimed at producing the result of action necessary for its survival in response to external influence, i.e. the system’s function. Reaction is always specific. Reaction may be: normal (normal reactivity), insufficient (hypo-reactivity), excessive (hyper-reactivity), distorted (unexpected reaction occurs instead of the expected one). Normal reactivity (normal reaction) means that functional reserves of systems correspond to the force of external influence and the operating possibilities of control block allow to adjust (control) SFU so that the result of action precisely corresponds to the force of external influence. Hypo-reactivity of the system (pathological reaction) arises in cases when functional reserves of the given system of living organism are insufficient for the given force of external influence. Hypo-reactivity is always a pathological reaction. Hyper-reactivity of the system (normal or pathological reaction) is the one where the result of action of the system exceeds the target. Distorted reaction is a reaction of the system which mismatches its purpose. Pathology is the lack of correspondence of the systems’ resources to usual norms. Pathology includes other two important notions: pathological condition (defect) and pathological process (including vicious circle). Restoration is active influence on the system with a view to: liquidate or reduce excessive external influences destroying the Systemic Functional Units; liquidate or reduce destructive effects of vicious circle if it has arisen; strengthen the function of the affected (defective) subsystem, provided it does not lead to the activation of vicious circle; strengthen the function of systems conjugated with the defective one, provided it does not lead to strengthening the destructive effect of the vicious circle associated with the affected system or the development of vicious circles in other conjugated systems (does not lead to strengthening of the “domino principle”); replace the destroyed SFU with the operational ones. Any owner of the car knows that if something is broken in his/her car (as a result of excessive external influence) and the defect turns up, the transportation possibilities of its car sharply recede. If failing immediately repairing the car, the breakages would accrue catastrophically (vicious circle) because the domino principle will be activated. And to “cure” the car it is necessary to protect it from excessive external influences and to liquidate the defects.

**Mark A. Gaides Hospitality named after Khaim Shiba, Tel Aviv, Israel.**

Crisis. According to Lewis Bornhaim, crisis is a situation where the totality of circumstances which were earlier quite acceptable, all of a sudden, due to the emergence of some new factor, becomes absolutely unacceptable, at that it’s almost inessential, whether the new factor is political, economic or scientific: death of a national hero, price fluctuations, new technological discovery; any circumstance may serve impetus for further events (“the butterfly effect”: the butterfly’s wing at the right place and time may cause a hurricane). A well-known scientist Alfred Pokran devoted a special work to crises (“Culture, crises and changes”) and arrived at interesting conclusions. First, he notes that any crisis arises long before it factually comes on the scene. For example, Einstein has published fundamentals of relativity theory in 1905-1915, i.e. forty years before his works have ultimately led to the beginning of a new epoch and emergence of crisis. Pokran also notes that every crisis implies the involvement of a great number of individuals and characters, all of them being unique: “It is difficult to imagine Alexander the Great in front of Rubicon or Eisenhower in the field of Waterloo; it is just as difficult to imagine Darwin writing a letter to Roosevelt about potential dangers associated with nuclear bomb. Crisis is the sum of blunders, confusions and intuitive flashes of inspiration, a totality of observed and unobserved factors (which in systemic analysis is called a “bifurcation point”), an unstable condition of a system that may result in a number of outcomes: recovery of stable level, transition to other steady equilibrium state characterized by new energy-and-informational level, or leap to a higher unstable level. At a bifurcation point a nonlinear system becomes very sensitive to small influences or fluctuations: indefinitely small influences may cause indefinitely wide variation of the condition of the system and its dynamics. Originality of any crisis hides its striking similarity with other crises. The unique feature of one and all /most and least/ crises is the possibility of prevision thereof in retrospect and irreversibility of solutions; characteristic frequencies of control processes sharply increase (a time trouble condition, shortage of time).

Power. Power is any possibility, whatever it is based on, to realize one’s own will in the given social relations, even notwithstanding counteraction. The power is also characterized as steady ability of achievement of the goals set with the support of other people. The concept of power is “sociologically amorphous”, i.e. the exercise of power does not imply the presence of any special human qualities (strength, intellect, beauty, etc.) or any special circumstances (confrontation, conflict, etc.). Any possible qualities and circumstances can serve for realization of will. These may include direct violence or threats, prestige or charm, any peculiarities of situation or institutional status, etc. An individual having a lot of money, holding senior position or being simply more charming person, the one who is able to use better than others the circumstances that turned up - that person, as a rule, would be the one having more power. For characterization of dictatorial/imperious capacity the concept of supremacy/domination is also used. Domination/supremacy implies the probability that the command of certain content will induce obedience in those to whom it is addressed. Domination/supremacy is a stronger notion than power. Domination is legitimate and institutionalized power, i.e. it is such a power which invokes the will to subordinate and fulfill the orders and instructions and which, at that, exists in a sustainable format accepted both by those dominating and dependent. With regard to the latter it is conventional to talk about domination structures. Such legitimate and institutionalized power is the state power. It is very important to distinguish the power from domination. For example, the person who is taken a hostage is under the authority of gunmen, but one can not say that they dominate over him/her. They force the hostage to obey by direct physical violence. But he/she does not want to obey and does not agree to recognize their right to dominate over him/her.

Elite. Elite is a group of individuals standing high in the ranks of power or prestige, which, thanks to their socially significant qualities (origin, wealth, some achievements), hold the highest positions in various spheres or sectors of public life. The influence of these people is so great that they affect not only the processes inside the spheres or sectors to which they belong, but also the social life as a whole. There are three basic classes of elite: authoritative/power-holding, valuе-associated and functional. Authoritative/power-holding elites are more or less closed groups having specific qualities, and “imperious” privileges. These are the “ruling classes” - political, military or bureaucratic. Value-associated elites are creative groups exerting special influence on the setup of minds and opinions of the broad mass. They are philosophers, scientific-research expert community, intelligentsia in the widest sense of this word. Functional elites are influential groups which in the course of competition stand out from the crowd in different spheres or sectors of society and undertake important functions in the society. These are rather open groups, accession to which requires the presence of certain achievements, for example holding managerial positions.

Group. Collective administrative actions differ from those individual in a variety of parameters. Thus, the group is more productive in generation of the most efficient and well-grounded ideas, comprehensive evaluation of one or other decisions or their projects, achievement of individual and team objectives. The basic drawback of the team decision-making is that it is more inclined to undertake higher risk. This phenomenon is explained in different ways: conformist pressure which manifests itself in that some team members do not dare express their opinions that vary from those stated before, especially the opinions of team leaders and the majority of team members, and criticize them; a feeling of reappraisal, overestimation of their possibilities which develops during intensive group communication (overrated feeling of “us” that weakens the perception of risk); mutual “contagion of courage”. This effect arises in group communications; in case of widespread notion (usually erroneous) that in group decisions responsibility rests with many people and the share of personal responsibility is rather insignificant (group failures are usually less evident/appreciable and are not perceived as sharply as individual’s failures); influence of leaders, especially formal heads whose vision of their main functions consists in indispensable inculcation of optimism and confidence in the achievement of the purpose. The symptoms of the “group thinking” and group pressure as a whole are: illusion of invulnerability of the group. Group members are inclined to overestimation of correctness of their actions and quite often perceive risky decisions optimistically; unbounded belief in moral righteousness of group actions. Group members are convinced of moral irreproachability of their collective behavior and uselessness of critical evaluations by independent observers (“the collective is always right”); screening of disagreeable or unwanted information. Data out of keeping with the group opinions are not taken into consideration and cautions are not taken into account either. Resulting from it is ignoring off necessary changes; negative stereotypification of the outsiders. The purposes, opinions and achievements of associations external in relation to the given group tendentiously treated as weak, hostile, suspicious, etc. Quite often “narrow departmental interests /localistic tendencies/” and “clannishness” and self-censorship arise thereupon. Separate group members because of fears of disturbance of the group harmony abstain from expression of alternative points of view and their own interests; illusion of constant unanimity. Because of self-censorship and perception of silence as a sign of consent external consensus is achieved very quickly without comprehensive discussion and approval when making decisions on the problems. In this situation internal dissatisfaction is being accumulated which may further lead to conflict which may arise because of formal insignificant ground; social (group) pressure on those who disagree. The requirement of conformist behavior, as a rule, leads to intolerance with respect to critical, disloyal (from the view point of the group) statements and actions and to “gag” the bearers thereof; restriction or reduction of possibilities of the outsiders’ participation in the formation of collective opinion and decision-making. Separate group members seek not to give the chance of participation in the group affairs to the people who do not belong to it, as they apprehend that it (including the information coming from them) will break the unity of the group.

Rational-universal method of decision-making implies an unambiguous definition of the substance of a problem and ways of its solution. Its basic advantage consists in that when realized it allows complete and radical solving the problem or a preset task. Branch method implies taking partial decisions directed towards the improvement of situation, rather than complete solution of a problem (for example, under conditions of insufficient clarity of a problem, ways and means of its solution, in the absence of full information on the situation, given the lack of possibility to foresee all the consequences of the radical solution, under the pressure of the influential forces inducing to compromises, the possibility of rise of sharp conflicts with unclear outcome, etc.). Mixed (mixed-scanning) method implies rational analysis of the problem and singling out of its main, key component which is attached a paramount importance and to which rational-universal method is applied. Other elements of the problem are solved gradually by making acceptable partial decisions that allows to focus efforts and resources on the key areas and at the same time have complete control over other elements of the situation, thus providing its stability.

Selection/choice mechanism. The optimal selection mechanism may be considered the consensus-based system in which each participant of decision-making votes not for one, but for all options (preferably more than two) and ranges the list of options in the order of his/her own preferences. Thus, if four possible options are offered the participant of decision-making (the voter) defines a place of each of them. The first place is given 4 points, the second, third and forth are given 3, 2 and 1 points, respectively. After voting the points given too each option (the candidacy/nominee) are summed up and selected option is determined based on the quantity thereof. If sums of scores for any options are found equal, repeated voting is held only for these options.

Networks. Network is determined as spatial, constantly changing dynamical system consisting of elements identical in terms of some parameters: actors (figures), activity and resources (key for this type of a network), connected among themselves by communication flows. The network structure is the description of boundaries of interrelations between the elements and position of elements in the network. The actors, activity and resources are connected with each other across the entire structure of network. The actors develop and maintain relations with each other. Various kinds of activity are also connected among themselves by relations, which may be called a network. Resources are consolidated among themselves by the same structure of network, and moreover, all the three networks are closely interconnected and represent a global network. Actors, activity and resources form the system in which heterogeneous (diverse) needs coalesce with heterogeneous offers. In that way they are functionally connected with each other. Even in case of destruction of considerable part of network, the functions of the latter as a system will not be harmed, as they will pass to other cells of the network (partially their resources as well). In an ideal network there is no uniform control (coordinating) centre, there is only “floating” centre (centers) functioning at each specific moment and its functions may be usually performed by any cell of the network.

So, we have examined separate aspects of stimulation of scientific thinking. All the studied materials require the development of skills for their practical application. See in addition: Alvin Toffler “Shock of the Future”, “Metamorphoses of Power”, “The Third Wave”. Francis Fukuyama. Our Posthuman Future. New York: Farrar, Straus and Giroux. 2002. 272 pp.), “The End of History and the Last Human”. (Samuel Huntington). "Think tanks" Paul Dickson, 1971.