Conclusion
Cybernetics 2.0

Therefore, we have briefly considered the history of cybernetics and its state-of-the-art, as well as the development trends and prospects of several components of cybernetics (mainly, control theory). What are the prospects of cybernetics? To answer this question, let us address the primary source—the initial definition of cybernetics as the science of CONTROL and COMMUNICATION.

Its interrelation with control seems more or less clear. At the first glance, this is also the case for communication: by the joint effort of scientists (including N. Wiener), the mathematical theory of communication and information appeared in the 1940s (quantitative models of information and communication channels capacity, coding theory, etc.).

But take a broader view of communication.[1] Both in the paper [181] and in the original book [221], N. Wiener explicitly or implicitly mentioned interrelation or intercommunication or interaction—*reasonability* and *causality* (*cause-effect relations*). Really, in *feedback control systems*, control-effect is defined by its cause, i.e., the state of a controlled system (plant); conversely, control supplied to the input of a plant is induced by its cause, i.e., the state of a controller, and so on. No doubt, the channels and methods of communication are important but secondary whenever the matter concerns universal regularities for animals, machines and society.

A much broader view of communication implies interpreting communication as INTERCOMMUNICATION, e.g., between elements of a plant, between a controller and a plant, etc. including different types of impacts and interactions (material, informational and other ones). "Intercommunication" is a more general category than "communication."

[1]Academician A. Kolmogorov was against such interpretation. In 1959 he wrote: "Cybernetics studies any-nature systems being capable to perceive, store and process information, as well as to use it for control and regulation. Cybernetics intensively employs mathematical methods and aims at obtaining concrete special results, both in order to analyze such systems (restore their structure based on experience of their operation) and to design them (calculate schemes of systems implementing given actions). Owing to this concrete character, cybernetics is in no way reduced to the philosophical discussion of reasonability in machines and the philosophical analysis of a circle of phenomena explored by it." We venture to disagree with this opinion of a great Soviet mathematician.

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In the general systems context, intercommunication corresponds to the category of ORGANIZATION (see its definition and discussion below). Therefore, a simple correction (replacing “communication” with “organization” in Wiener’s definition of cybernetics) yields a more general and modern definition of cybernetics: “the science of systems organization and their control.” We call it *cybernetics 2.0*.

Making such substitution, we get distanced from informatics. Consider the soundness and consequences of this distancing.

Cybernetics and informatics. Nowadays, cybernetics and informatics form independent interdisciplinary fundamental sciences [101]. According to a figurative expression of Sokolov and Yusupov [191], informatics and cybernetics are “Siamese twins.” Yet, in nature Siamese twins represent pathology.[2]

Cybernetics and informatics have a strong intersection (including the level of common scientific base—statistical information theory[3]). Their accents much differ. The fundamental ideas of cybernetics are Wiener’s “control and communication in the animal and the machine,” whereas the fundamental ideas of informatics are formalization (theory) and computerization (practice). Accordingly, in the mathematical sense cybernetics bases on control theory and information theory, whereas informatics proceeds from theory of algorithms and formal systems.[4]

The subject of modern informatics (or even the “umbrella brands” of *informational sciences*) covering information science, computer science and computational science [102] are informational processes.

Indeed, on the one hand, information processing arises everywhere (!), not only in control and/or organizing. On the other hand, informational processes and corresponding information and communication technology are integrated into control processes[5] so that their discrimination seems almost impossible. A close cooperation of informatics and cybernetics at partial operational level will be continued and even extended in future.

Organization. Organization theory. Organizational culture. According to the definition provided by Merriam-Webster dictionary, *an organization* is:

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[2]For instance, the definition of informatics as the “union” of general laws of informatics and control would induce a megascience without concrete content, subsisting at conceptual level exclusively.

[3]Note that mathematical (statistical) theory of communication and information operates quantitative assessments of information. Unfortunately, no essential advancements have been made in the field of substantial (semantic) value of information. This problem is still a global challenge of informatics.

[4]This distinction partly elucidates why some sciences often related to informatics or computer sciences have not been reflected in the book: theory of formal languages and grammars, “true” artificial intelligence (knowledge engineering, reasoning formalization, behavior planning, etc. instead of artificial neural networks as a modern empirical engineering science), automata theory, computational complexity theory, and so on.

[5]N. Wiener believed that control processes are, in the first place, informational processes: information acquisition, processing and transmission (see the above discussion of joint solution of problems appearing in control, computations and communication).

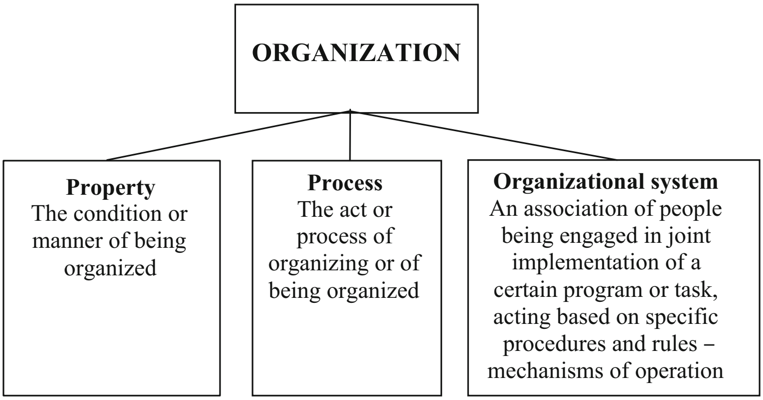

Fig. A.1 Definition of organization

1. The condition or manner of being organized;
2. The act or process of organizing or of being organized;
3. An administrative and functional structure (as a business or a political party); also, the personnel of such a structure—see Fig. A.1.

The present book uses the notion "organization" mostly in its second and first meanings, i.e., as a process and a result of this process. The third meaning (an organizational system) as a class of controlled objects appears in theory of control in *organizational systems* [131, 157].

At descriptive (phenomenological) and explanatory levels, "system organization" reflects HOW and WHY EXACTLY SO, respectively, a system is organized (organization as a *property*). At normative level, "system organization" reflects how it MUST be organized (requirements to the *property* of organization) and how it SHOULD be organized (requirements to the *process* of organization).

A scientific branch responsible for the posed questions (*Organization*[6]*theory*, or **O^3** (**organization as a property, process and system**, by analogy to C^3 as discussed above) has almost not been developed to-date. Yet, this branch obviously has a close connection and partial intersection with general systems theory and systems analysis (mostly focused on descriptive level problems and a little bit dealing with normative level ones), as well as with methodology (as the general science of activity organization [148]). **Creating a full-fledged Organization theory is a topical problem of cybernetics!**

[6]Note that there also exists "theory of organizations" ("organizational theory")—a branch of management science, both in its subject (organizational systems) and methods used. Unfortunately, numerous textbooks (and just a few monographs!) give only descriptive generalizations on the property and process of organization in their Introductions, with most attention then switched to organizational systems, viz., management of organizations (for instance, see the classical textbooks [47, 134]).

Table A.1 Types of organizational culture: a characterization [148, 152]

The types of organizational culture	The methods of normalization and translation of activity	The forms of social structure implementing the corresponding method
Traditional	Myths and rituals	Communities based on the kinship principle
Corporate-handicraft	Samples and recipe for their recreation	Corporations with a formal hierarchical structure (masters, apprentices, and journeymen)
Professional (scientific)	Theoretical knowledge in the form of text	Professional organizations based on the principle of ontological relations (relations of objective reality)
Project-technological	Projects, programs and technologies	Technological society being structured by the communicative principle and professional relations
Knowledge-based	(Individual) and collective knowledge about activity organization	Networked society of knowledge

Speaking about the notion of organization, one should not ignore the phenomenon of organizational culture. Different historical periods of civilization evolvement are remarkable for different types of activity organization now called *organizational culture*, see Table A.1.

Presently, the *knowledge-based type of organizational culture* gradually manifests itself. Here exactly (individual and collective) knowledge about activity organization (!) is the product and way of activity normalization and translation, while *networked society of knowledge*[7] is the form of social structure (nowadays, the term "knowledge economics" has wide spread occurrence). Cybernetics 1.0 *de bene esse* matched the project-technological type of organizational culture, whereas cybernetics 2.0 corresponds to the knowledge-based type (at the new stage of development, organization becomes crucial).

Consider the correlation of the two basic categories in the definition of cybernetics 2.0 ("organization" and "control").

Control is "an element, function of different organized systems (biological, social, technical ones) preserving their definite structure, maintaining activity mode, implementing a program, a goal of activity." Control is "an impact on a controlled system, intended for ensuring its necessary behavior" [157].

[7]The author believes that "the knowledge-based type of organizational culture," "knowledge society," "knowledge management" and others are lame terms in this context. Really, a preceding type of organizational culture—the professional (scientific) one—was also founded on scientific knowledge. Nevertheless, these terms are widely used. Let us clarify the meaning of knowledge here. In the professional (scientific) type of organizational culture, the leading role belonged to scientific knowledge in the form of texts. The knowledge-based type of organizational culture operates knowledge of people and organizations about activity organization.

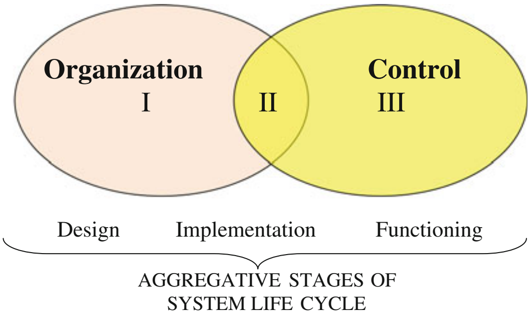

Fig. A.2 Organization and control

Consequently, the categories of organization and control do intersect, but do not coincide. The former fits system design and the latter fits system functioning[8]; they are jointly realized during system implementation and adaptation, see Fig. A.2. In other words, organization (strategic loop) “foregoes” control (tactical loop).

The domains in Fig. A.2 have the following content (as examples):

I. Design (construction) of systems (including their stuff, structure and functions) —organization but not control (despite that theory of control in organizational systems suggests stuff control and structure control).
II. Joint design of a system and a controlled object. Adaptation. Control mechanisms adjustment.
III. Functioning of controllers in technical systems-control but not organization.

Organization and control can have a “hierarchical” correlation.[9] On the one part, control process calls for organization (organization as a stage in Fayol’s management cycle and a function of organizational control, see [131]). On the other part, organization process (e.g., system life cycle) might and should be controlled.

Following the complication of systems created by mankind, the process and property of organization will attract more and more attention. Indeed, control of standard objects (e.g., controller design for technical and/or production systems) gradually becomes a handicraft rather than a science; modern challenges highlight standardization of activity organization technologies, creation of new activity technologies, etc. (*activity systems engineering*).

A fruitful combination of organization and control within cybernetics 2.0 would give a substantiated and efficient answer to the primary question of activity systems engineering: how should control systems for them be constructed? Actually, this is

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[8]A conditional analogy: organization corresponds to deism (the creator of a system does not interfere in its functioning), while control corresponds to teism (the opposite picture).

[9]Generally speaking, the correlation of organization and control is far from trivial and requires further perception. For instance, in multi-agent systems decentralized control (choosing the laws and rules of autonomous agents interaction) can be treated as organization. Another example is the Bible as a tool of organization [174] (a system of norms making common knowledge and implementing institutional control of a society).

a "reflexive" question related to second-order and even higher-order cybernetics. Mankind has to learn to design and implement control systems for complex systems (high-technology manufacturing, product life cycle, organizations, regions, etc.), similarly to the existing achievements in technical systems engineering.

Cybernetics is important from general educational viewpoint, since it forms the integral modern scientific world outlook.

Cybernetics 2.0. We have defined cybernetics 2.0 as the science of (general regularities in) systems organization and their control.

A close connection between cybernetics and general systems theory and systems analysis, as well as the growing role of technologies (see Figs. 1.9, 4.1 and 4.2) leads to a worthy hypothesis. Cybernetics 2.0 includes *cybernetics* (Wiener's cybernetics and higher-order cybernetics discussed in Sect. 1.2), Cybernetics, and *general systems theory* and *systems analysis* with results in the following forms:

- general laws, regularities and principles studied within metasciences—*Cybernetics* and *Systems analysis*;
- a set of results obtained by sciences-components ("umbrella brands"—*cybernetics* and *systems studies* uniting appropriate sciences);
- design principles of corresponding technologies.

We discuss the latter in detail. A *technology* is a system of conditions, forms, criteria, methods and means of solving a posed problem [148, 149]. Today technologies standardize *craft/skill*[10] and *art*[11] via identification and generalization of best practices; creation of technologies calls for appropriate scientific grounds, see Fig. A.3.

We separate out the following *general technologies*:

- *systems technologies* (general principles; activity organization);
- *informational technologies* (activity support type);
- *organizational technologies* (coordinated joint activity implementation).

Alongside with general technologies, there exist "*sectoral*" *technologies* of practical activity ("production"); they depend on application domains and possess specifics.

According to this viewpoint, complex study and design of any systems (whether machines, animals or society) within cybernetics 2.0 employs corresponding results obtained by method- and subject-oriented sciences, as well as by general and sectoral technologies—see Fig. A.4.

Keywords for cybernetics 2.0 are *control*, *organization* and *system* (see Fig. A.5).

Similarly to cybernetics in its common sense, cybernetics 2.0 has a *conceptual core* (Cybernetics 2.0 with capital C). At conceptual level, Cybernetics 2.0 is

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[10]A craft is a personal skill of routine operations based on experience.

[11]Art is a system of techniques and methods in some branch of practical activity; the process of talent usage; an extremely developed creative skill or ability.

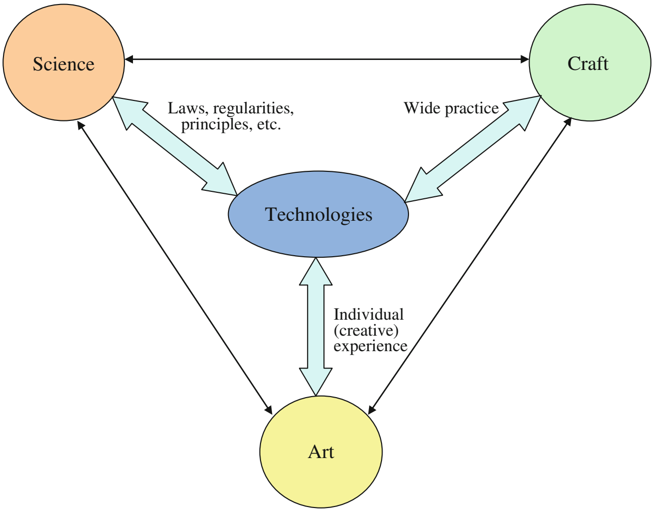

Fig. A.3 Science, technology, craft and art

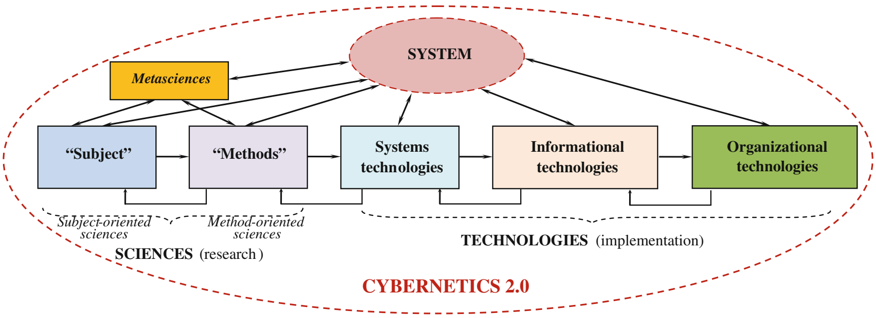

Fig. A.4 Sciences and technologies

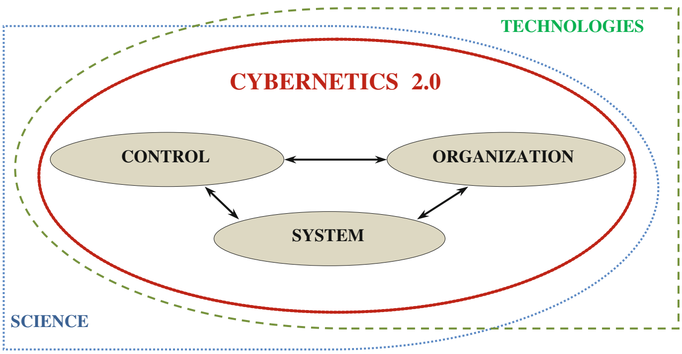

Fig. A.5 Keywords of cybernetics 2.0

composed of control philosophy (including general laws, regularities and principles of control), control methodology, Organization theory (including general laws, regularities and principles of (a) complex systems functioning and (b) development and choice of general technologies), as illustrated by Fig. A.6.

Basic sciences for cybernetics 2.0 are control theory, general systems theory and systems analysis, as well as systems engineering—see Fig. A.6.

Complementary sciences for cybernetics 2.0 are informatics, optimization, operations research and artificial intelligence—see Fig. A.6.

The *general architecture of cybernetics 2.0* (see Fig. A.6) admits projection to different application domains and branches of subject-oriented sciences depending on a class of posed problems (technical, biological, social, etc.).

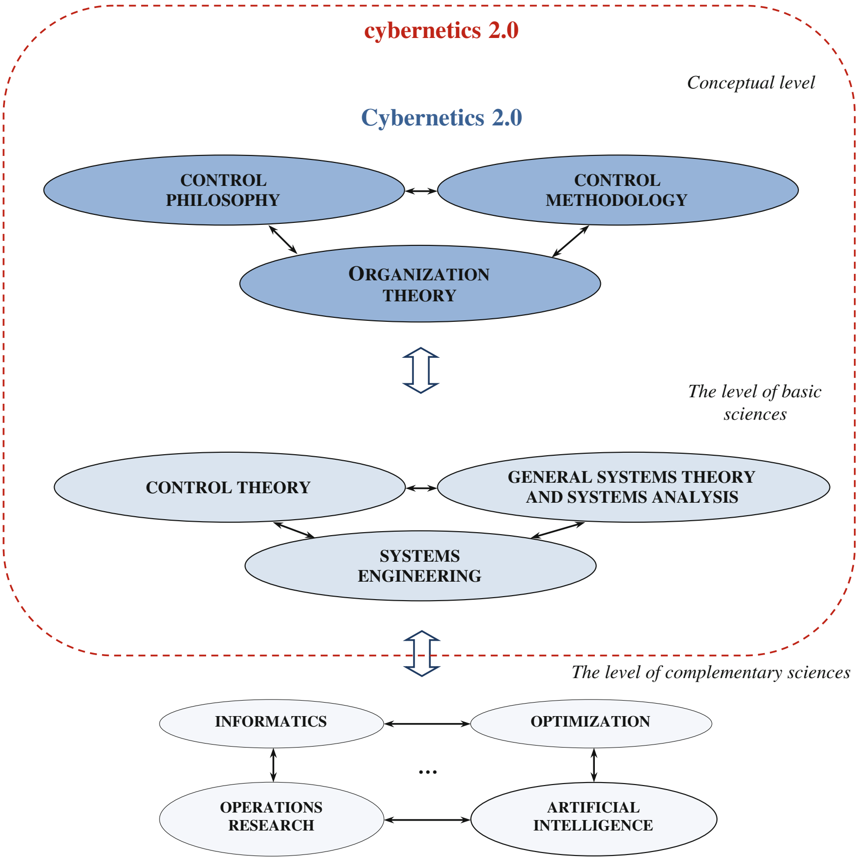

Fig. A.6 The composition and structure of cybernetics 2.0

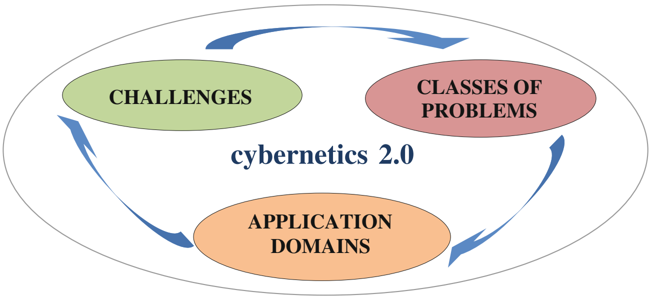

Fig. A.7 The challenges, classes of problems and application domains of cybernetics 2.0

The prospects of cybernetics 2.0. Further development of cybernetics has several alternative scenarios as follows:

- *the negativistic scenario* (the prevailing opinion is that "cybernetics does not exist" and it gradually falls into oblivion);
- *the "umbrella" scenario* (owing to past endeavors, cybernetics is considered as a "mechanistic" (non-emergent) union, and its further development is forecasted using the aggregate of trends displayed by the basic and complementary sciences under the "umbrella brand" of cybernetics);
- *the "philosophical" scenario* (the framework of new results in cybernetics 2.0 includes conceptual considerations only—the development of conceptual level);
- *the subject-oriented* (sectoral) *scenario* (the basic results of cybernetics are obtained at the junction of sectoral applications);
- *the constructive-optimistic* (desired) scenario (the balanced development of the basic, complementary and "conceptual" sciences is the case, accompanied by the *convergence and interdisciplinary translation of their common results*, with subsequent generation of conceptual level generalizations (realization of Wiener's dream "*to understand the region as a whole,*" see the epigraph to this book).

Let us revert to the trends and groups of subjects mentioned in Sect. 1.3. Note that the development of cybernetics 2.0 in the conditions of intensified sciences differentiation provides the following (see Fig. A.7):

- for scientists specialized in cybernetics proper and the representatives of adjacent sciences: the general picture of a wide subject domain (and a common language of its description), the positioning of their results and promotion in new theoretical and applied fields;
- for potential users of applied results (authorities, business structures): (1) confidence in the uniform positions[12] of researchers; (2) more efficient solution of

[12]The diversity and inconsistency of opinions and approaches suggested by experts (subordinates) always confuse customers (superiors).

control problems for different objects based on new fundamental results and associated applied results.

Main challenges are control in social and living systems. Several classes of *control* problems seem topical, namely:

- network-centric systems (including military applications, networked and cloud production);
- informational control and cybersafety;
- life cycle control of complex organization-technical systems;
- activity systems engineering.

Among promising *application domains*, we mention living systems, social systems, microsystems, energetics and transport.

There exists a series of global *challenges* to cybernetics 2.0 (i.e., observed phenomena going beyond cybernetics 1.0), see Chap. 5:

1. **the scientific Tower of Babel** (interdisciplinarity, differentiation of sciences; in the first place, in the context of cybernetics—sciences of control and adjacent sciences);
2. **centralization collapse** (decentralization and networkism, including systems of systems, distributed optimization, emergent intelligence, multi-agent systems, and so on);
3. **strategic behavior** (in all manifestations, including interests inconsistency, goal-setting, reflexion and so on);
4. **complexity damnation** (including all aspects of complexity and nonlinearity[13] of modern systems, as well as dimensionality damnation—big data and big control).

Thus, the main *tasks of cybernetics 2.0* are developing the basic and complementary sciences, responding to the stated global challenges, as well as advancing in appropriate application domains, see Fig. A.7.

And here are the main *Tasks of Cybernetics 2.0*:

1. ensuring the Interdisciplinarity of investigations (with respect to the basic and complementary sciences, as illustrated by Fig. A.6);
2. revealing, systematizing and analyzing the general laws, regularities and principles of control for different-nature systems within control philosophy; this would require new and new generalizations (see Fig. 1.10);
3. elaborating and refining Organization theory (O^3).

This book has described the phylogenesis of a new stage of cybernetics–cybernetics 2.0. Further development of cybernetics would call for considerable joint effort of mathematicians, philosophers, experts in control theory, systems engineering and many others involved.

[13]Figuratively, in this sense cybernetics 2.0 has to include nonlinear automatic control theory studying nonlinear decentralized objects with nonlinear observers, etc.

Appendix A
A List of Basic Terms[14]

ACTIVITY is an energetic interaction of a human being with an environment, where the former plays the role of a subject exerting a purposeful impact on an object and satisfies its needs. The basic structural components of activity are illustrated by Fig. 2.4.

ADAPTATION is a process establishing or maintaining system's adjustment (i.e., keeping up its key parameters) under changing conditions of an external and internal environment. Quite often, the term "adaptation" means the result of such process-system's fitness to some factor of an environment. The notion of adaptation was pioneered in the context of biological systems, first of all, a separate organism (or its organs and other subsystems) and then a population of organisms. Following the appearance of cybernetics, where an adaptation mechanism is a negative feedback loop ensuring a rational response of a complex hierarchical self-controlled system to varying conditions of an environment, the notion of adaptation has become widespread in social and technical sciences.

ANALYSIS is a mental operation which decomposes a studied whole into parts, separates out particular attributes and qualities of a phenomenon or process, relations of phenomena or processes. Analysis procedures represent an integral component in any study of an object and usually form its first phase: a researcher passes from object exploration as a whole to revelation of its structure, composition, properties and attributes. Analysis is a theoretical method-operation inherent to any activity.

BEHAVIOR is one of several sequences of movements or actions possible in given conditions (a given environment). Behavioral phenomena are inseparably linked with the environment they take place in. Sometimes, human behavior means only the external manifestation of human activity.

BLACK BOX is a system whose internal structure and mechanism of functioning are very complicated, unknown or negligible within the framework of a given problem (i.e., only external behavior makes sense).

CONTROL is (1) an element, function of different organized systems (biological, social, technical ones) preserving their definite structure, maintaining activity mode, implementing a program, a goal of activity; an impact on a controlled

[14]Analysis methods for the terminological structure of a subject area were studied in [74].

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system, intended for ensuring its necessary behavior; (2) the science of control; (3) an object, i.e., a tool of control, a structure (e.g., a department) of several subjects performing control.

DEVELOPMENT is an irreversible, directed and consistent change of material and ideal objects. Development in a desired direction is called progress. Development in an undesired direction is called a regress.

DIVERSITY is a quantitative characteristic of a system, which equals the number of its admissible states or the logarithm of this number.

EXTERNAL ENVIRONMENT is a set of all objects and subjects lying outside a given system, whose behavior and/or changed properties affects the system and all objects/subjects whose behavior and/or properties vary depending on system's behavior.

FEEDBACK (FB) is a reverse impact exerted by the results of a certain process on its behavior; information on the state of a controlled system, which is supplied to a control system (see CONTROL). FB characterizes control systems in wild life, society and technology. There exist positive and negative FB. If the results of a process strengthen its effect, FB is positive. Negative FB takes place whenever the results of a process weaken its effect. Negative FB stabilizes process behavior, whereas positive FB often accelerates process evolution and causes oscillations. In complex systems (e.g., social or biological ones), it seems difficult or even impossible to identify FB types. In addition, FB loops are classified based on the character of bodies and media realizing them: mechanical (e.g., the negative FB realized by Watt's steam engine governor); optical (e.g., the positive FB realized by an optical cavity in a laser); electrical, and others. The notion of FB as a form of interaction plays an important role in the analysis of complex control systems (their functioning and development) in wild life and society.

FUNCTION is (1) (philosophy) a phenomenon dependent on another phenomenon, which varies simultaneously with the latter; (2) (mathematics) a law assigning a certain well-defined quantity to each value of a variable (argument), as well as this quantity itself; a ratio of two (or more) objects such that variation of one object causes an appropriate variation of another object (other objects); (3) a job performed by an organ or organism; (4) a role or meaning of something; a role a subject or a social institute plays with respect to the needs of an upper subsystem or the interests of its groups and individuals; a duty or circle of activity.

GOAL is anything strived for or to-be-implemented. In philosophy, a goal (of an action or activity) is an element in the behavior and conscious activity of a human being, which characterizes anticipation in thinking of the activity result and ways of its implementation using definite forms, methods and means. A goal represents a way of integrating different actions of a human being into a certain sequence or system.

HIERARCHY (from the Greek εραρχία "rule of a high priest") is a structural organization principle of complex multilevel systems, which lies in ordering the interaction between levels of a system (top-bottom), characterizes the mutual correlation and collateral subordination of processes at different levels and ensures its functioning and behavior in whole.

HOMEOSTAT (from the Greek ὁμοιος “like, resembling” and στάσις “a standing still ”) is (1) the capability of an open system for preserving its internal state invariable via coordinated responses for maintaining a dynamic equilibrium; (2) (biological systems) the permanence of characteristics essential for system’s vital activity under existing disturbances in an external environment; the state of relative constancy; the relative independence of an internal environment from external conditions [14, 41, 160].

MODEL (in wide sense) is any image, analog (mental or conditional, e.g., a picture, description, scheme, diagram, graph, plan, map, and so on) of a certain object, process or phenomenon (the original of a given model); a model is an auxiliary object chosen or transformed for cognitive goals, which provides new information about the primary object. Model design proper does not guarantee that the resulting model answers its purposes. For normal functioning, a model must meet a series of requirements such as inherence, adequacy and simplicity.

ORGANIZATION: is (1) the internal order, coordinated interaction of more or less differentiated and autonomous parts of a whole, caused by its structure; (2) a set of processes or actions leading to formation or perfection of interconnections between the parts of a whole; (3) an association of people engaged in joint implementation of a certain program or task, using specific procedures and rules, i.e., mechanisms of operation (a mechanism is a system or device determining the order of a certain activity). The last meaning of the term “organization” is the definition of an organizational system. The category of organization is a backbone element of control theory [157].

SELF-ORGANIZATION is a process leading to creation, reproduction or perfection of complex system organization. Self-organization processes run only in systems having a high level of complexity and a large number of elements with nonrigid (e.g., probabilistic) connections. Self-organization properties are inherent to objects of different nature, namely, a living cell, an organism, a biological population, biogeocenosis, a collective of human beings, complex technical systems, etc. Self-organization processes run via readjusting the existing connections and forming new connections among system elements. A distinctive feature of such processes is their purposeful, yet natural (spontaneous) character. Self-organization processes imply system interaction with an external environment, are somewhat autonomous and relatively independent from an environment.

SELF-REGULATION is generally defined as reasonable functioning of living systems; it represents a closed control loop (see FEEDBACK), where the subject and object of control do coincide. Self-regulation has the following structure: an activity goal accepted by the subject, a model of significant activity conditions, a program of actions proper, a system of activity efficiency criteria, information on real results achieved, an assessment of the existing correspondence between real results and efficiency criteria, decisions on the necessity and character of activity corrections.

STRUCTURE is a set of stable connections among the elements of a certain system, ensuring its integrity and self-identity.

SYNERGETICS is an interdisciplinary research direction of self-organization processes in complex systems, which describes and explains the appearance of qualitatively new properties and structures at the macrolevel as the result of interactions among the elements of an open system at the microlevel. Synergetics employs the framework of nonlinear dynamics (including catastrophe theory) and nonequilibrium thermodynamics.

SYNTHESIS is a mental operation which integrates different elements or sides of a certain object in a comprehensive whole (a system). Synthesis appears opposite to and has an indissoluble connection with analysis. Synthesis represents a theoretical method-operation inherent to any activity.

SYSTEM is a set of elements having mutual relations and connections, which forms a definite unity and is dedicated to goal achievement. Systems have the following basic features: integrity, relative isolation from an external environment, connections with the environment, the existence of parts and their connections (structuredness), whole system dedication to goal achievement.

UNCERTAINTY is the absence or incomplete definition or information.

Appendix B
Topics for Further Self-study

(1) The scientific discoveries of the 20th century. The interdisciplinary translation of results
(2) Ampere's cybernetics
(3) Trentowvski's cybernetics
(4) Bogdanov's tectology
(5) N. Wiener and its contribution to cybernetics
(6) W. Ashby and its contribution to cybernetics
(7) S. Beer and its contribution to cybernetics
(8) L. von Bertalanffy and general systems theory
(9) H. Foerster and general systems theory
(10) A. Berg and its contribution to cybernetics
(11) V. Glushkov and its contribution to cybernetics
(12) A. Kolmogorov and its contribution to cybernetics
(13) A.A. Lyapunov and its contribution to cybernetics
(14) The history of controller theory
(15) The history of control theory
(16) The history of general systems theory and systems analysis
(17) The history of informatics
(18) The history of artificial intelligence
(19) The history of operations research
(20) The history of cybernetics in the USSR and USA
(21) The history of systems science and systems engineering
(22) Ontological analysis of basic definitions in cybernetics
(23) Systems of systems
(24) Bibliometric analysis of general cybernetics and applied cybernetics
(25) Bibliometric analysis of conferences on cybernetics
(26) Second-order cybernetics
(27) Autopoiesis
(28) Third- and higher-order cybernetics
(29) Economic cybernetics
(30) Cybernetical physics
(31) Control philosophy
(32) Control methodology

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(33) The philosophy and methodology of informatics. Information philosophy
(34) The methodology of “soft” systems
(35) Boulding’s system classes
(36) Systems dynamics
(37) Laws, regularities and principles of control
(38) Solution methods for weakly formalized problems
(39) Hybrid models. The multimodel approach. Hierarchical modeling
(40) “Hard” and “soft” models
(41) Organization theory
(42) Emergent intelligence
(43) Big data and control problems.

References

1. Ackoff, R.: Towards a system of systems concepts. Manage. Sci. **17**(11), 661–671 (1971)
2. Ackoff, R., Emery, F.: On Purposeful Systems: An Interdisciplinary Analysis of Individual and Social Behavior as a System of Purposeful Events, 2nd edn, p. 303. Aldine Transaction, New York (2005)
3. Albertos, P., Mareels, I.: Feedback and Control for Everyone, 318 p. Springer, Berlin (2010)
4. Nisan, N., Roughgarden, T., Tardos, E., Vazirani, V.: Algorithmic Game Theory, 776 p. Cambridge University Press, New York (2009)
5. Amosov, N.: Modeling of Complex Systems, 81 p. Naukova Dumka, Kiev (1968) (in Russian)
6. Ampère, A.-M.: Essai sur la philosophie des sciences, pp. 140–142. Chez Bachelier, Paris (1843)
7. Anokhin, P.: Anticipatory reflection of reality. Russian Studies in Philosophy. No. 7. pp. 97–112 (1962) (in Russian)
8. Anokhin, P.: The Center-Periphery Problem in the Modern Physiology of Neural Activity. Gorky, pp. 9–70 (1935) (in Russian)
9. Anokhin, P.: Theory of Functional System as a Premise of Physiological Cybernetics Development. Biological Aspects of Cybernetics, pp. 74–91. USSR Academy of Sciences, Moscow (1962) (in Russian)
10. Antomonov, Y.: Modeling of Biological Systems: A Handbook, p. 259. Naukova Dumka, Kiev (1977) (in Russian)
11. Arbib, M.: The Metaphorical Brain: An Introduction to Cybernetics as Artificial Intelligence and Brain Theory, p. 384. Wiley, New York (1972)
12. Arrow, K.: Social Choice and Individual Values, p. 99. Wiley, New York (1951)
13. Asaro, P.: Whatever Happened to Cybernetics. Geist in der Maschine, pp. 39–50. Verlag Turia, Wien (2010)
14. Ashby, W.: An Introduction to Cybernetics, p. 295. Chapman and Hall, London (1956)
15. Ashby, W.: Design for a Brain: The Origin of Adaptive Behavior, p. 298. Wiley, New York (1952)
16. Astrom, K., Murray, R.: Feedback Systems: An Introduction for Scientists and Engineers, p. 408 (2012). Princeton University Press, Princeton. http://press.princeton.edu/titles/8701.html
17. Baker, K., Kropp, D.: Management Science: Introduction to the Use of Decision Models, p. 650. Wiley, New York (1985)
18. Barabanov, I., Korgin, N., Novikov, D., Chkhartishvili, A.: Dynamic models of informational control in social networks. Autom. Remote Control. **71**(11), 2417–2426 (2010)
19. Bar-Yam, Y.: Multiscale variety in complex systems. Complexity **9**(4), 37–45 (2004)
20. Bateson, G.: Steps to an Ecology of Mind, p. 542. Chandler Publication Co., San Francisco
21. Bauer, E.: Theoretical Biology, p. 206. All-USSR Institute of Experimental Medicine, Moscow, Leningrad (1935) (in Russian)

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DOI 10.1007/978-3-319-27397-6

22. Beer, S.: Brain of the Firm: A Development in Management Cybernetics, p. 319. Herder and Herder, London (1972)
23. Beer, S.: Cybernetics and Management, p. 214. The English University Press, London (1959)
24. Bernstein, N.: Sketches on the Physiology of Movements and the Physiology of Activity, 347 p. Meditsina, Moscow (1966) (in Russian)
25. Bertalanffy, L.: General system theory—a critical review. Gen. Syst. **7**: 1–20 (1962)
26. Bertalanffy, L.: General System Theory: Foundations, Development, Applications, 296 p. George Braziller, New York (1968)
27. Bertalanffy, L.: The theory of open systems in physics and biology. Science **111**, 23–29
28. Blauberg, I., Yudin, E.G.: The formation and essence of systems approach, 271 p. Nauka, Moscow (1973) (in Russian)
29. Bogdanov, A.: Algemeine Organisationslehre (Tektologie). Hirzel, Berlin (1926). I; 1928. II
30. Boulding, K.: General System Theory—The Skeleton of Science. Manag. Sci. **2**, 197–208 (1956)
31. Boxer P., Kenny V.: Lacan and Maturana: constructivist origins for a 3.0 cybernetics. Commun. Cogn. **25**(1), 73–100 (1992)
32. Boyd, S., Parikh, N., Chu, E., et al.: Distributed optimization and statistical learning via the alternating direction method of multipliers. Found. Trends Mach. Learn. **3**(1), 1–122
33. Breer, V.V., Novikov, D.A., Rogatkin, A.D.: Micro- and macromodels of social networks. Automation and Remote Control. Part 1: General Theory; Part 2: Identification and Simulation Experiments (2015)
34. Breer, V.V., Novikov, D.A., Rogatkin, A.D.: Stochastic models of mob control. Large-Scale Syst. Control. **52**, 85–117 (2014) (in Russian)
35. Bubnicki, Z.: Modern Control Theory, 423 p. Springer, Berlin (2005)
36. Burkov, V.: Foundations of Mathematical Theory of Active Systems, 255 p. Nauka, Moscow (1977) (in Russian)
37. Burkov, V., Enaleev, A.: Stimulation and decision-making in the active systems theory: review of problems and new results. Math. Soc. Sci. **27**, 271–291 (1994)
38. Burkov, V., Goubko, M., Korgin, N., Novikov, D.: Introduction to Theory of Control in Organizations, 352 p. CRC Press, New York (2015)
39. Burkov, V., Lerner, A.: Fairplay in Control of Active Systems/Differential Games and Related Topics, pp. 164–168. North-Holland Publishing Company, Amsterdam, London (1971)
40. Buslenko, N.: Modeling of Complex Systems, 420 p. Nauka, Moscow (1978) (in Russian)
41. Cannon, W.: The Wisdom of the Body, 312 p. Norton, New York (1932)
42. Casti, J.: Connectivity, Complexity and Catastrophe in Large-Scale Systems, 203 p. Wiley, Chichester (1979)
43. Checkland, P.: Soft system methodology: a thirty years retrospective. Syst. Res. Behav. Sci. **17**, 11–58 (2000)
44. Checkland, P.: Systems Thinking, Systems Practice, 331 p. Wiley, Chichester (1981)
45. Chernavsky, D.: Synergetics and Information, 288 p. Editorial URSS, Moscow (2004) (in Russian)
46. Chernyak, Y.: Systems Analysis in Economy Management, 191 p. Ekonomika, Moscow (1975) (in Russian)
47. Daft, R.: Organization Theory and Design, 11th edn, 688 p. Cengage Learning, New York (2012)
48. Dancoff, S., Quastler, H.: The Information Content and Error Rate of Living Things/Essays on the Use of Information Theory in Biology, pp. 263–274. University of Illinois Press, Illinois (1953)
49. Dennis, A., Wixom, B., Roth, R.: Systems Analysis and Design, 5th edn, 594 p. Wiley, New York (2012)
50. Diev, V.: Control. Philosophy. Society. Voprosy Filosofii. **8**, 35–41 (2010) (in Russian)

51. Dorf, R., Bishop, R.: Modern Control Systems. 12th edn, 1111 p. Prentice Hall, Upper Saddle River (2011)
52. Druzhinin, V., Kontorov, D.S.: Introduction to conflict theory, 288 p. Radio i Svyaz', Moscow (1989) (in Russian)
53. Namatame, A., Kurihara, S., Nakashima, H. (eds): Emergent Intelligence of Networked Agents, 261 p. Springer, Berlin (2007)
54. Foerster, H.: The Cybernetics of Cybernetics, 2nd edn, 228 p. Future Systems, Minneapolis (1995)
55. Foerster, H.: Understanding Understanding: Essays on Cybernetics and Cognition, 362 p. Springer, New York (2003)
56. Forrest, J., Novikov, D.: Modern trends in control theory: networks, hierarchies and interdisciplinarity. Adv. Syst. Sci. Appl. **12**(3), 1–13 (2012)
57. Forrester, J.: Industrial Dynamics, 464 p. Pegasus Communications, Cambridge (1961)
58. Forrester, J.: Principles of Systems, 387 p. Pegasus Communications, Cambridge (1968)
59. Fradkov, A.: Cybernetical Physics: From Control of Chaos to Quantum Control (Understanding Complex Systems), 236 p. Springer, Berlin (2006)
60. Gelfand, I., Gurfinkel, V.S., Tseitlin, M.L.: On Tactics of Complex Systems Control in Connection with Physiology/Biological Aspects of Cybernetics, pp. 66–73. USSR Academy of Sciences, Moscow (1962) (in Russian)
61. George, F.: The Brain as a Computer, 437 p. Pergamon Press, New York (1962)
62. George, F.: The Foundations of Cybernetics, 286 p. Gordon and Breach Science Publisher, London (1977)
63. George, F.H.: Philosophical Foundations of Cybernetics, 157 p. Abacus Press, Kent (1979)
64. Germeier, Y.: Non-Antagonistic Games, 1976, 331 p. D. Reidel Publishing Company, Dordrecht (1986)
65. Gerovich, S.: From Newspeak to Cyberspeak: A History of Soviet Cybernetics, 383 p. MIT Press, Cambridge (2002)
66. Gershenson, C., Csermely, P., Érdi, P., Knyazeva, H., Laszlo, A.: The past, present and future of cybernetics and systems research// Systems. Connecting Matter Life Culture Technol. **1**(3), 4–13 (2013)
67. Gigch, J.: Applied General Systems Theory, 2nd edn, 736 p. Harper & Row, New York (1978)
68. Glushkov, V.: Introduction to Cybernetics. Ukr. SSR Academy of Sciences, Kiev 1964 (in Russian)
69. Gonçalves, C.: Quantum cybernetics and complex quantum systems science—A quantum connectionist exploration. Neuroqantology. **13**(1), 35–48 (2015)
70. Goode, H., Machol, K.: System Engineering: An Introduction to the Design of Large-scale Systems, 551 p. McGraw-Hill Book Company, New York (1957)
71. Gorsky, Y.: A System-Informational Analysis of Control Processes, 327 p. Nauka, Novosibirsk (1988) (in Russian)
72. Grössing, G.: Quantum Cybernetics. Toward a Unification of Relativity and Quantum Theory via Circularly Causal Modeling, 153 p. Springer, New York (2000)
73. Gubanov, D., Korgin, N., Novikov, D., Raikov, A.: E-Expertise: Modern Collective Intelligence, 150 p. Springer, Heidelberg (2014)
74. Gubanov, D., Makarenko, A., Novikov, D.: Analysis methods for the terminological structure of a subject area. Autom. Remote Control. **75**(12), 2231–2247 (2014)
75. Gubanov, D., Novikov, D., Chkhartishvili, A.G.: Social Networks: Models of Informational Influence, Control and Confrontation, 228 p. Fizmatlit, Moscow (2010) (in Russian)
76. Guide to the Systems Engineering Body of Knowledge (SEBoK) vol 1.3.2, 971 p. BKCASE, INCOSE (2015)
77. Haken, H.: Advanced Synergetics: Instability Hierarchies of Self-Organizing Systems and Devices. 2nd edn, 356 p. Springer, New York (1993)

78. Fishwick, P. (ed.) (2007) Handbook of Dynamic Systems Modeling, 760 p. CRC Press, New York (2007)
79. Kharitonov, V., Alekseev, A.O.: The Concept of Subject-Oriented Control in Social and Economic Systems/Polythematic Electronic Journal of Kuban State Agricultural University [Electronic source]. Kuban State Agricultural University, Krasnodar (2015). No. 05 (109). IDA [article ID]: 1091505043. Available at http://ej.kubagro.ru/2015/05/pdf/43.pdf (in Russian)
80. Heylighen, F.: Principles of systems and cybernetics: an evolutionary perspective. Cybernetics and Systems '92, pp. 3–10. World Science, Singapore (1992)
81. Heylighen, F., Joslyn, C.: Cybernetics and second-order cybernetics. Encyclopedia of Physical Science and Technology, pp. 155–170. 3rd edn. Academic Press, New York (2001)
82. Hillier, F., Lieberman, G.: Introduction to Operations Research, 8th edn, 1061 p. McGraw-Hill, Boston (2005)
83. Gertler, J. (ed.): Historic Control Textbook, 304 p. Elsevier, Oxford (2006)
84. Vus, M.A.: The History of Informatics and Cybernetics in Saint Petersburg (Leningrad). Vol. 1. Striking Historical Examples. Ed. by Corr. Member of RAS R.M. Yusupov; Institute of Informatics and Automation of RAS. St. Petersburg: Nauka, 2008. 356 p. (in Russian)
85. Fet, Y. (ed.): The History of Cybernetics, 339 p. Geo, Novosibirsk, (2006) (in Russian)
86. Hitchins, D.: Putting Systems to Work, 342 p. Wiley, New York (1993)
87. Il'in, V.: The Philosophy and History of Science, 432 p. Lomonosov Moscow State University, Moscow (2005) (in Russian)
88. Haskins, C. (ed.): INCOSE Systems Engineering Handbook Version 3.2.2—A Guide for Life Cycle Processes and Activities, 376 p. INCOSE, San Diego (2012)
89. Jackson, M.: Social and Economic Networks, 520 p. Princeton University Press, Princeton (2010)
90. Jaradat, R., Keating, C.: A histogram analysis for system of systems. Int. J. Syst. Syst. Eng. **5** (3), 193–227 (2014)
91. Julong, D.: Introduction to grey system theory. J. Grey Syst. **1**, 1–24 (1989)
92. Kahn, H., Mann I.: Techniques of systems analysis, 168 p. RAND Corporation, Santa Monica (1956)
93. Kalman, R., Falb, P., Arbib, M.: Topics in Mathematical System Theory. McGraw Hill Book Co. (1969)
94. Kaufman, A.: Introduction to Fuzzy Arithmetic, 384 p. Van Nostrand Reinhold Company, New York (1991)
95. Kenny, V.: There's nothing like the real thing. revisiting the need for a third-order cybernetics. Constructivist Found. **4**(2), 100–111 (2009)
96. Khalil, H.: Nonlinear Systems, 2nd ed, 734 p. Prentice Hall, Upper Saddle River (1996)
97. Klaus, G.: Kybernetic und Gesellschaft, 384 p. Veb Deutscher Verlag der Wissenschaften, Berlin (1964)
98. Klaus, G.: Kybernetik in Philosophischer Sicht, 491 p. Dietz Verlag Berlin, Berlin (1961)
99. Kobrinsky, N., Maiminas, E.Z., Smirnov, A.D.: Economic Cybernetics, 408 p. Ekonomika, Moscow (1982) (in Russian)
100. Kogan, A., Naumov, N.P., Rezhabek, V.G., Chorayan, O.G.: Biological Cybernetics, 384 p. Vysshaya Shkola, Moscow (1972) (in Russian)
101. Kolin, K.: Philosophical Problems of Informatics, 270 p. BINOM, Moscow (2010) (in Russian)
102. Kolin, K.: The Formation of Informatics as a Fundamental Science and a Complex Scientific Problem. Sistemy i Sredstva Informatiki. 2006. Special Issue on Scientific and Methodological Problems of Informatics, pp. 7–58 (in Russian)
103. Kolin, K.: The structure of scientific research on the complex problem of informatics. Sotsial'naya Informatika. Higher Commercial School, Moscow. pp. 19–33 (1990) (in Russian)

104. Kolmogorov, A.: Mathematics—A Science and Profession. Kvant. No. 64. Nauka, Moscow (1988). pp. 43–62 (in Russian)
105. Korepanov, V., Novikov, D.: The diffuse bomb problem. Autom. Remote Control. **74**(5), 863–874 (2013)
106. Korepanov, V., Novikov, D.: Models of strategic behavior in the diffuse bomb problem. Control Sci. **2**, 38–44 (2015) (in Russian)
107. Korepanov, V., Novikov, D.: Reflexive colonel Blotto game. Control Syst. Inf. Technol. **1** (47), 55–62 (2012) (in Russian)
108. Korshunov, Y.: Mathematical Foundations of Cybernetics, 496 p. Energoatomizdat, Moscow, (1987) (in Russian)
109. Kozielecki, J.: Psychological Decision Theory, 424 p. Springer, London (1982)
110. Kozlov, V.: Systems analysis, optimization and decision-making, 176 p. Prospekt, Moscow (2010) (in Russian)
111. Krylov, S.: Neocybernetics: Algorithms, Evolution Mathematics and Future Technologies, 288 p. LKI, Moscow (2008) (in Russian)
112. Kuhn, T.: The Structure of Scientific Revolutions, 264 p. University of Chicago Press, Chicago (1962)
113. Kuzin, L.: The Foundations of Cybernetics. Energiya, Moscow (1979). **1**, 504 p., **2**, 584 (in Russian)
114. Larichev, O.: Systems analysis: problems and prospects. Autom. Remote Control. **36**(2), 241–249 (1975)
115. Lefevbre, V.: Algebra of Conscience, 372 p. Springer, London (2001)
116. Lefevbre, V.: Second-Order Cybernetics in the Soviet Union and Western Countries. Reflexive Processes Control **2**(1), 96–103 (2002) (in Russian)
117. Lefevbre, V.: The Structure of Awareness: Toward a Symbolic Language of Human Reflexion, 199 p. Sage Publications, New York (1977)
118. Lepsky, V.: The Philosophy and Methodology of Control in the Context of Scientific Rationality Development. XII All-Russian Meeting on Control Problems, pp. 7785–7796. Trapeznikov Institute of Control Sciences, Moscow (2014) (in Russian)
119. Lerner, A.: Fundamentals of Cybernetics, 294 p. Springer, Berlin (1972)
120. Malinetsky, G., Potapov, A.B., Podlazov, A.V.: Nonlinear Dynamics: Approaches, Results, Expectations, 3rd edn, 280 p. URSS, Moscow (2011) (in Russian)
121. Mancilla, R.: Introduction to Sociocybernetics (Part 1): Third-Order Cybernetics and a Basic Framework for Society. J. Sociocybernetics **42**(9), 35–56 (2011)
122. Mancilla, R.: Introduction to Sociocybernetics (Part 3): Fourth-Order Cybernetics. J. Sociocybernetics **44**(11), 47–73 (2013)
123. Mansour, Y.: Computational Game Theory, 150 p. Tel Aviv University, Tel Aviv (2003)
124. Maruyama, M.: The Second Cybernetics: Deviation-Amplifying Mutual Causal Processes. Am. Sci. **5**(2), 164–179 (1963)
125. Maturana, H., Varela, F.: Autopoiesis and Cognition, 143 p. D. Reidel Publishing Company, Dordrecht (1980)
126. Maturana, H., Varela, F.: The Tree of Knowledge, 231 p. Shambhala Publications, Boston (1987)
127. Maxwell, J.C.: On Governors. In: Proceedings of the Royal Society of London, vol. 16, pp. 270–283 (1868)
128. Mead, M.: The Cybernetics of Cybernetics. In: von Foerster H. et al. (eds.): Purposive Systems, pp. 1–11. Spartan Books, New York (1968)
129. Meadows, D.: Thinking in Systems, 218 p. Earthscan, London (2009)
130. Meadows, D., Randers, J., Behrens, W.: The Limits to Growth, 205 p. Universe Books, New York (1972)
131. Novikov D. (ed.): Mechanism Design and Management: Mathematical Methods for Smart Organizations, 163 p. Nova Science Publishers, New York (2013)

132. Mesarovic, M., Takahara, Y.: General Systems Theory: Mathematical Foundations (Mathematics in Science and Engineering), 322 p. Elsevier (1975)
133. Mesarović, M., Mako, D., Takahara, Y.: Theory of Hierarchical Multilevel Systems, 294 p. Academic, New York (1970)
134. Milner, B.: Theory of Organization, 2nd edn, 480 p. INFRA-M, Moscow (2000) (in Russian)
135. Mirzoyan, R.: Control as a subject of philosophical analysis. Russ. Stud. Philos. **4**, 35–47 (2010) (in Russian)
136. Moiseev, N.: Mathematical Problems of Systems Analysis, 488 p. Nauka, Moscow (1981) (in Russian)
137. Moiseev, N.: People and Cybernetics, 224 p. Molodaya Gvardiya, Moscow (1984) (in Russian)
138. Morris, W.: Management Science: A Bayesian Introduction, 226 p. Prentice Hall, New York (1968)
139. Morse, P., Kimball, G.: Methods of Operations Research, 258 p. Wiley, New York (1951)
140. Müller, K.: The New Science of Cybernetics: A Primer. J. Systemics Cybern. Inform. **11**(9), 32–46 (2013)
141. Myerson, R.: Game Theory: Analysis of Conflict, 568 p. Harvard University Press, London (1991)
142. NASA Systems Engineering Handbook, 360 p. (2007)
143. Nash, J.: Non-cooperative Games. Ann. Math. **54**, 286–295 (1951)
144. Nature (2008) September 3 (Special Issue)
145. Neumann, J., Morgenstern, O.: Theory of Games and Economic Behavior, 776 p. Princeton University Press, Princeton (1944)
146. Nikanorov, S.: Conceptualization of Subject Domains, 268 p. Kontsept, Moscow (2009) (in Russian)
147. Novick, D.: Program Budgeting, 88 p. Harvard University Press, Cambridge (1965)
148. Novikov, A., Novikov, D.: Methodology, 668 p. Sinteg, Moscow (2007) (in Russian)
149. Novikov, A., Novikov, D.: Research Methodology: From Philosophy of Science to Research Design, 130 p. CRC Press, Amsterdam (2013)
150. Novikov, D.: Analysis of Some Leading Conferences on Control Problems. Autom. Remote Control. **12**, 160–166 (2014) (in Russian)
151. Novikov, D.: Big data and big control. Adv. Syst. Stud. Appl. **15**(1), 21–36 (2015)
152. Novikov, D.: Control Methodology, 76 p. Nova Science Publishers, New York (2013)
153. Novikov, D.: Hierarchical Models of Warfare. Autom. Remote Control. **74**(10), 1733–1752 (2013)
154. Novikov, D.: Mechanisms of Functioning of Multilevel Organizational Systems, 150 p. Control Problems Foundation, Moscow (1999) (in Russian)
155. Novikov, D.: Models of strategic behavior. Autom. Remote Control. **73**(1), 1–19 (2012)
156. Novikov, D.: Regularities of Iterative Learning, 98 p. Trapeznikov Institute of Control Sciences RAS, Moscow (1998) (in Russian)
157. Novikov, D.: Theory of Control in Organizations, 341 p. Nova Science Publishers, New York (2013)
158. Novikov, D., Chkhartishvili, A.: Reflexion and Control: Mathematical Models, 298 p. CRC Press, London (2014)
159. Novikov, D., Rusyaeva, E.: Foundations of control methodology. Adv. Syst. Sci. Appl. **12** (3), 33–52 (2012)
160. Novosel'tsev, V.: Control Theory and Biosystems, 319 p. Nauka, Moscow (1978) (in Russian)
161. Ogata, K.: Modern Control Engineering, 5th edn, 905 p. Prentice Hall, Upper Saddle River (2010)
162. Orlovski, S.: Optimization Models Using Fuzzy Sets and Possibility Theory, 452 p. Springer, Berlin (1987)

163. Optner, S.: Systems Analysis for Business Management, 190 p. Prentice Hall, New York (1960)
164. Pareto, V.: Cours d'Economie Politique, vol. 2, 420 p. (1897)
165. Pawlak, Z.: Rough Sets: Theoretical Aspects of Reasoning about Data. Kluwer Academic Publishing, Dordrecht (1991)
166. Peregudov, F., Tarasenko, F.: Introduction to Systems Analysis, 320 p. Glencoe/McGraw-Hill, OH/Columbus (1993)
167. Pervozvansky, A. A.: Course on Automatic Control Theory. Nauka, Moscow (1986) (in Russian)
168. Peters, B.: Normalizing Soviet Cybernetics. Inf. Culture A J. Hist. Vol. **47**(2), 145–175 (2012)
169. Pickering, A.: The Cybernetic Brain, 537 p. The University of Chicago Press, Chicago (2010)
170. Polonnikov, R., Yusupov, R.M.: Will the 20th century perceive cybernetics. Problemy Upravleniya i Informatiki **6**, 132–152 (2001) (in Russian)
171. Polyak, B., Scherbakov, P.: Robust Stability and Control, 303 p. Nauka, Moscow (2002) (in Russian)
172. Polyak, B., Stepanov, O., Fradkov, A.L.: The 19th IFAC World Congress. Autom. Remote Control. **2**, 150–156 (2015) (in Russian)
173. Pospelov, I.: A Preface to Wiener's books "The Human Use of Human Beings. Cybernetics and Society" and "God and Golem", 248 p. Taideks, Moscow (2003) (in Russian)
174. Prangishvili, I.: Systems Approach and System-wide Regularities, 528 p. SINTEG, Moscow (2000) (in Russian)
175. Prigogine, I., Stengers, I.: Order Out of Chaos, 285 p. Bantam Books, New York (1984)
176. Pushkin, V., Ursul, A.D.: Informatics, Cybernetics, Intelligence: Philosophical Sketches, 341 p. Shtiintsa, Kishinev (1989) (in Russian)
177. Rapoport, A.: General System Theory: Essential Concepts & Applications, 250 p. Abacus Press, Kent (1986)
178. Rashevsky, N.: Outline of a New Mathematical Approach to General Biology. Bull. Math. Biophys. **5**, 33–47, 49–64, 69–73 (1943)
179. Fet Ya.I.: A Reading Book on the History of Informatics. In: Mikhailichenko B.G. (ed.) Institute of Computational Mathematics and Mathematical Geophysics, Siberian Branch of RAS, 559 p. Geo, Novosibirsk (2014) (in Russian)
180. Ren, W., Yongcan, C.: Distributed Coordination of Multi-agent Networks, 307 p. Springer, London (2011)
181. Rosenblueth, A., Wiener, N., Bigelow, J.: Behavior, purpose and teleology. Philos. Sci. **10**, 18–24 (1943)
182. Rukov, A.: Models and Methods of Systems Analysis: Decision-Making and Optimization, 352 p. Moscow Institute of Steel and Alloys, Moscow (2005) (in Russian)
183. Rzevski, G., Skobelev, P.: Managing Complexity, 216 p. WIT Press, London (2014)
184. Sadovsky, V.: Foundations of General System Theory, 280 p. Nauka, Moscow (1978) (in Russian)
185. Satzinger, J., Jackson, R., Burd, S.: Introduction to Systems Analysis and Design, 6th edn, 512 p. Course Technology, Boston (2011)
186. Schedrovitsky, G.: Selected Proceedings, 800 p. Higher School of Culturology, Moscow (1995) (in Russian)
187. Shannon, C.A: Mathematical theory of communication. Bell Syst. Tech. J. **27**, 379–423, 623–656 (1948)
188. Shannon, C., Weaver, W.: The Mathematical Theory of Communication, 144 p. University of Illinois Press, Illinois (1948)
189. Shoham, Y., Leyton-Brown, K.: Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, 504 p. Cambridge University Press, Cambridge (2008)
190. Smuts, J.: Holism and Evaluation, 368 p. Macmillan, London (1926)

191. Sokolov, B., Yusupov, R.M.: Analysis of Interdisciplinary Interaction between Modern Informatics and Cybernetics: Theoretical and Practical Aspects. In: XII All-Russian Meeting on Control Problems, pp. 8625–8636. Trapeznikov Institute of Control Sciences RAS, Moscow (2014) (in Russian)
192. Sokolov, B., Yusupov, R.M.: Neocybernetics in the modern structure of system knowledge. Robototekhnika i Tekhnicheskaya Kibernetika **2**(3), 3–10 (2014) (in Russian)
193. Steinbuch, K.: Automat und Mensch, 392 p. Kybernetische Tatsachen und Hypothesen. Springer, Berlin (1963)
194. Strogats, S.: Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering (Studies in Nonlinearity), 512 p. Westview Press, Boulder (2001)
195. Surowiecki, J.: The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations, 336 p. Doubleday, New York (2004)
196. Systems Engineering Guide, 710 p. MITRE Corporation, Bedford (2014)
197. Volkova, V.N., Emel'yanov, A.A.: Systems Theory and Systems Analysis in Control of Organizations: A Handbook, 848 p. Finansy i Statistika, Moscow (2006) (in Russian)
198. Taha, H.: Operations Research: An Introduction, 9th ed, 813 p. Prentice Hall, New York (2011)
199. Tesler, G.: New Cybernetics, 404 p. Logos, Kiev (2004) (in Russian)
200. Levine, W.: The Control Handbook, 2nd ed, 786 p. CRC Press, New York (2010)
201. Trentowski, B.: Stosunek Filozofii do Cybernetyki, Czyli Sztuki Rządzenia Narodem, 195 p. Warsawa (1843)
202. Tsetlin, M.: Studies on Automata Theory and Modeling of Biological Systems, 316 p. Nauka, Moscow (1969) (in Russian)
203. Turchin, V.: The Phenomenon of Science, 348 p. Columbia University Press, New York (1977)
204. Uemov, A.: Systems Approach and General Systems Theory, 272 p. Mysl', Moscow (1978) (in Russian)
205. Ugolev, A.: Natural Technologies of Living Systems, 317 p. Nauka, Leningrad (1987) (in Russian)
206. Umpleby, S.: A brief history of cybernetics in the United States. Austrian J. Contemp. Hist. **19**(4), 28–40 (2008)
207. Umpleby, S.: The science of cybernetics and the cybernetics of science. Cybern. Syst. **21**(1), 109–121 (1990)
208. Ursul, A.: The Nature of Information, 288 p. Politizdat, Moscow (1968) (in Russian)
209. Valachich, J., Jeorge, J., Hoffer, J.: Essentials of Systems Analysis And Design, 5th edn, 445 p. Prentice Hall, Pearson (2012)
210. Varela, F.A.: Calculus for self-reference. Int. J. Gen. Syst. **2**, 5–24 (1975)
211. Vassilyev, S., Zherlov, A.K., Fedosov, E.A., Fedunov B.E.: Intelligent Control of Dynamic Systems, 352 p. Fizmatlit, Moscow (2000) (in Russian)
212. Vittikh, V.A.: Evolution of Ideas on Management Processes in the Society: From Cybernetics to Evergetics. Group Decision and Negotiation. http://link.springer.com/article/10.1007/s10726-014-9414-6/fulltext.html. Published online on September 14, 2014
213. Volkova, V.: From the history of systems analysis evolution in Russia, 210 p. St. Petersburg State Technical University, St. Petersburg (2001) (in Russian)
214. Volkova, V., Denisov, A.A.: The Foundations of Systems Theory and Systems Analysis, 2nd edn, 512 p. St. Petersburg State Technical University, St. Petersburg (2001) (in Russian)
215. Voronov, A.: Controllability, Observability, Stability, 339 p. Nauka, Moscow (1979) (in Russian)
216. Vyshnegradsky, I.: On Direct-Action Controllers. Izvestiya St. Petersburg Practical Technological Institute **1**, 21–62 (1877) (in Russian)

217. Wagner, H.: Principles of Operations Research, 2nd edn 1039 p. Prentice Hall, NJ Upper Saddle River (1975)
218. Walter, G.: The Living Brain, 255 p. Pelican Books, London (1963)
219. Wasson, C.: System Analysis, Design and Development: Concepts, Principles and Practices, 832 p. Wiley, Hoboken (2006)
220. Weibull, J.: Evolutionary Game Theory, 256 p. The MIT Press, Cambridge (1995)
221. Wiener, N.: Cybernetics: or the Control and Communication in the Animal and the Machine, 194 p. The Technology, Cambridge (1948)
222. Wiener, N.: Ex-Prodigy: My Childhood and Youth, 317 p. The MIT Press, Cambridge (1964)
223. Wiener, N.: God and Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion, 99 p. The MIT Press, Cambridge (1966)
224. Wiener, N.: I Am Mathematician, 380 p. The MIT Press, Cambridge (1964)
225. Wiener, N.: The Human Use of Human Beings. Cybernetics and Society, 200 p. Houghton Mifflin Company, Boston (1950)
226. Wooldridge, M.: An Introduction to Multi-Agent Systems, 376 p. Wiley, New York (2002)
227. Young, S.: Management: A Systems Approach, 360 p. Scott, Foresman and Company, Glenview (1966)
228. Zadeh, L.: Outline of a New Approach to the Analysis of Complex Systems and Decision Processes. IEEE Trans. Syst., Man, Cybern. **3**(1), 28–44 (1973)