Advances in Systems Science and Application. 2012. Vol.12. № 3. P. 33 – 52.

Foundations of Control Methodology

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Abstract Control methodology is defined as the theory of control activity organization. Methodology of control activity, its characteristics, logical and temporal structures are described. Philosophical foundations of control methodology are introduced.

Keywords Control, Methodology, Control Activity, Control Philosophy

1. Introduction

Methodology is the theory of organization of an activity [1, 2]. Such definition uniquely determinates the subject of methodology which is organization of an activity (an *activity* is a purposeful human action). Methodology being treated as the theory of organization of an activity, one should naturally consider the notion of an "organization." According to the definition provided by Merriam-Webster dictionary and [3], an *organization* is:

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.

Thus, an organization may be considered as the *property* of being organized (the first meaning) and the *process* of organizing including the result of this process (the second meaning). The third meaning is an *organizational system* [3].

Let us classify an activity based on its ultimate goal (play-learning-labor [2]). In this case, one distinguishes among:

- the methodology of play activity (in the first place, play of children);
- the methodology of learning activity;
- the methodology of labor (professional) activity.

Next, professional (or practical) activity can be subdivided into:

- practical activity (in the fields of material and immaterial production). In the above sense, most of people are engaged in practical professional activity;
- specific forms of professional activity such as philosophy, science, art, and religion. Accordingly, we separate out philosophic activity, scientific activity, art activity, and religious activity.

In scientific literature, one can find relatively full coverage of the methodologies of scientific activity (research methodology), practical activity, educational activity, as well as the basics of the methodologies of art activity and play activity [1, 2].

Control activity is the primary subject of this paper. Control activity represents a type of practical activity, see Fig. 1. *Control methodology* is the theory of organization of control activity[1] [4]. Within the framework of general methodology approaches [2], it is possible to construct methodologies of other types of practical activity (learning activity, medical activity, etc.) by analogy with control methodology.

Methodology considers organization of an *activity*. Organizing an activity means arranging it as an integral system with clearly defined characteristics, a logical structure and the accompanying process of

[1] *Alternative approaches to the definition of methodology take place, as well. For instance, methodology is considered as the theory of methods* (*generally, methods of scientific research*). *Following such idea, one can understand control "methodology" as epistemological foundations of control science. Another approach lies in treating methodology as the theory of methods of practical activity. As a branch of cybernetics, the corresponding control "methodology" studies general methods* (*ways of implementation*) *of control, e.g., disturbance-based control or deviation-based control. In addition, there exist narrower "branchwise" interpretations, e.g., "project management methodology" as the whole set of general rules of efficient project management. Another example consists in "quality management methodology." And so on. And these are different control "methodologies"!*

its realization, the *temporal structure*. The corresponding reasoning lies in the pair of the dialectic categories "historical (temporal)" and "logical."

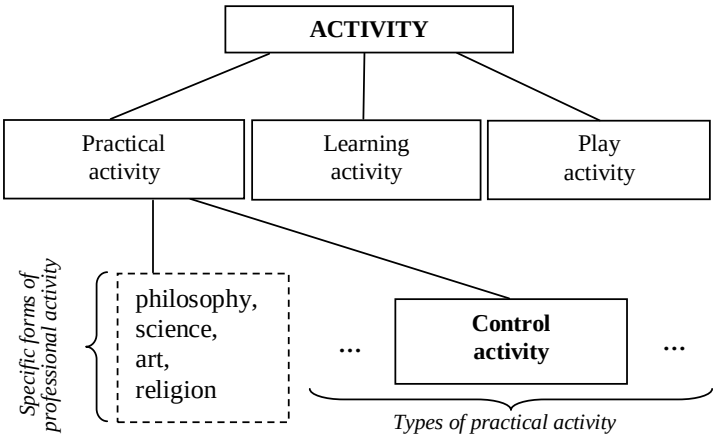

Fig. 1. Types of activity: A classification

The logical structure includes the following components of control activity: subject, object, topic, forms, means, methods, and result.

The following *characteristics of activity* are external with respect to this structure: features, principles, conditions, and norms.

The process of activity implementation is usually considered within the framework of a project realized in a time sequence by phases, stages and steps. Furthermore, this sequence is common for all kinds of activity [2]. The completeness of an activity cycle (a project) is defined by the following three phases:

– *design phase*, which yields the models of activity of a control subject and a controlled system, as well as and the plan of their implementation;

– *technological phase*, which yields implementation of control actions;

– *reflexive phase*, which yields an estimate of the results of control activity and indicates the necessity of its further correction or "launching" of a new project (i.e., designing a new control system).

Therefore, it is possible to suggest the following "*scheme of control methodology*" [4]:

1. The characteristics of control activity (features and principles);

2. The logical structure of control activity including subject, object, topic, forms, means, methods, and result of control activity;

3. The temporal structure of control activity (phases, stages, and steps).

Let us outline the structure and logic of the paper. First the general scheme of any activity is discussed (see section 2). In section 3 characteristics, logical and temporal structures of control activity are presented. Philosophical foundations of control methodology are given in section 4.

2. Control Activity

Let us consider the basic *structural* (procedural [1, 5]) *components* of any activity of some subject, see Fig. 2 (for convenience, the margins of a subject (individual or collective one) are marked by the dotted rectangle. The chain "need → motive → goal → tasks → technology → action → result," highlighted by thick arrows in Fig. 2, corresponds to a single "cycle" of activity. The goal is decomposed with respect to conditions, norms and principles of activity into a set of *tasks*. Next, taking into account the chosen *technology* (that is, a system of conditions, forms, methods and means to solve tasks), a certain *action* is chosen; note that technology includes *content* and *forms*, *methods* and *means*. The above-mentioned action leads (under the influence of an environment) to a certain *result* of activity).

A particular position within the activity structure is occupied by those components referred to as either self-regulation (in the case of an individual subject) or *control* (in the case of a collective subject), see Fig. 4. Self-regulation represents a closed control loop. During the process of self-regulation the subject

modifies the components of his activity based on the assessment of the achieved results (see the thin arrow in Fig. 2).

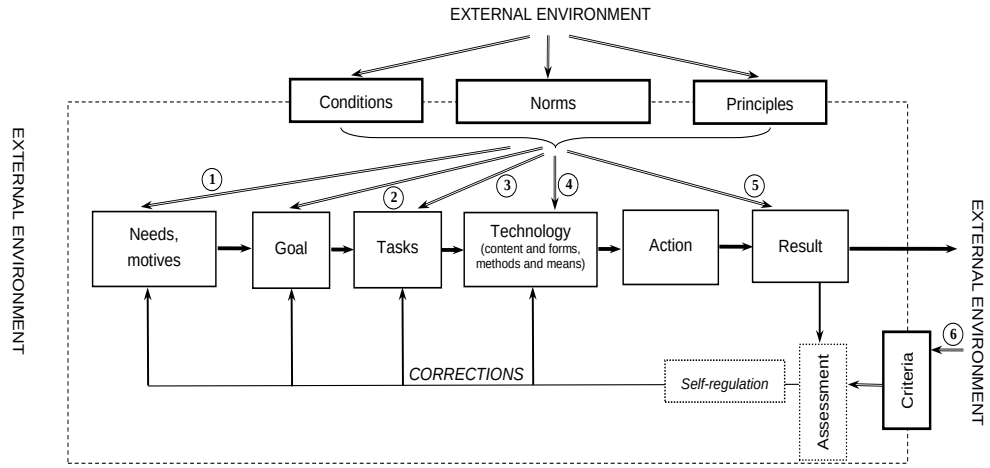

Fig. 2. Structural components of activity

Thus, we have discussed primary characteristics of activity and the corresponding structural components. Now, let us proceed to control issues.

Starting the discussion about control, one should precisely formulate what control is; therefore, below we give a series of common definitions, paying special attention to the purposefullness of control:

Control is "the process of checking to make certain that rules or standards being applied" (Macmillan Dictionary).

Control is "the act or activity of looking after and making decisions about something" (Merriam-Webster Dictionary).

Control is "an influence on a controlled system with the aim of providing the required behavior of the latter [3]."

There exist numerous alternative definitions, which consider control as a certain element, a function, an action, a process, a result, an alternative, and so on. We would not intend to state another definition; instead, let us merely emphasize that control being implemented by a subject[1] should be considered as an activity. Such approach, when control is meant as a type of practical activity[2] (*control activity*, *management activity*–see above) puts many things into place; in fact, it explains "versatile character" of control and balances different approaches to this notion.

Let us clarify the last statement. If control is considered as activity of a control subject (principal), then implementing this activity turns out to be a function of a control system; moreover, the control process corresponds to the process of activity, a control action corresponds to its result, etc. [3]. In other words, if a principal and controlled system both represent subjects (see Fig. 3), then control is activity (of principals) regarding organization of activity (of controlled subjects). Therefore, **control methodology is the theory of organization of control activity**, i.e., the activity of subjects controlling other subjects or objects.

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[1] *This eliminates from consideration situations when control is implemented by a technical system (activity is inherent to human beings only). Hence,* ***control methodology, as the theory of organization of control activity, studies exclusively (!) situations when control is performed by a human being or by a group of people****. Furthermore, choosing between two remaining alternatives (a controlled system comprises people or represents a techniqal system), we will be mainly focused on the first alternative as the most complicated one. In addition, we emphasize that the activity of a researcher designing a control system is not control activity but scientific activity. Similarly, the activity of an engineer designing a technical system is not control activity but practical* (*engineering*) *activity.*

[2] *At first glance, interpreting control as a sort of practical activity seems a bit surprising. The reader knows that control is traditionally seen as something "lofty" and very general; however, activity of any manager is organized similarly* (*satisfies the same general laws*) *to that of any practitioner, e.g., a teacher, a doctor, an engineer. Moreover, sometimes "control"* (*or management activity*) *and "organization"* (*as a process, i.e., activity oriented to ensure the property of organization*) *are considered together.*

One can further increase the level of reflexion (who organizers whose activity). On the one hand, in a multilevel control system the activity of a top manager may be considered as activity regarding organization of activities of his subordinates; in turn, their activity consists in organization of activity of their subordinates, and so on. On the other hand, an army of consultants represent experts in organization of management activity (first of all, the matter applies to *management consulting*). Such consultants regularly operate the term "control methodology" (sometimes, incorrectly and inappropriately).

Let us take the general formulation of a control problem for a certain system. Assume there exist a *control subject* (a principal) and a *controlled system* or *control object* (in terminology of automatic control theory**)**. The state of the controlled system depends on external disturbances, actions of the control subject (control actions) and, probably, on actions of the system, see Fig. 3 (if the control object appears active). A problem of the control subject consists in performing control actions (see the thick line in Fig. 3) to ensure a required state of the control object. This is done using information on external disturbances (see the dashed line in Fig. 3). The so-called subject-object (input-output) structure of a control system is illustrated by Fig. 3. This is the basic structure used in control theory to study control problems for systems of different nature.

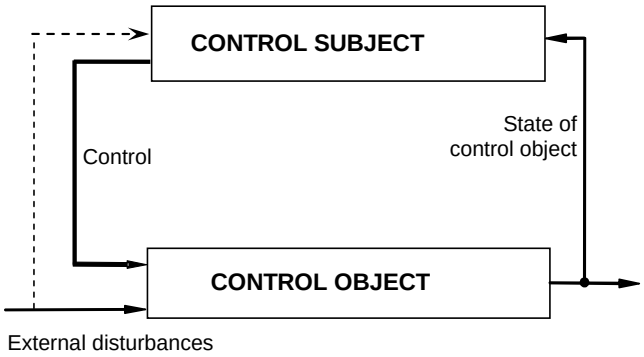

Fig. 3. Structure of a control system

The primary input-output structure of a control system illustrated by Fig. 3 bases on the scheme of activity presented by Fig. 2. The point is that both the control subject and control object carry out the corresponding activity. Combining the structure of both sorts of activity according to Fig. 2, one obtains the structure of control activity illustrated by Fig. 4.

Note the following. From agent's point of view, the principal is a part of an external environment (numbers of actions in Fig. 2 and Fig. 4 coincide), which exerts an influence for a definite purpose (double arrows (1)-(4) and (6) in Fig. 2), see Fig. 4. Some components of environmental influence may even have a random (nondeterministic) character, and be beyond the principal's control. Along with actions of the controlled system, these actions exert an impact on the outcome (the state) of the controlled system (double arrow (5) in Fig. 2); see also external disturbances in Fig. 4.

The structure given by Fig. 4 may be augmented by adding new hierarchical levels. The principles used to describe control in multilevel systems remain unchanged. However, multilevel systems have specifics distinguishing them from a serial combination of two-level "blocks".

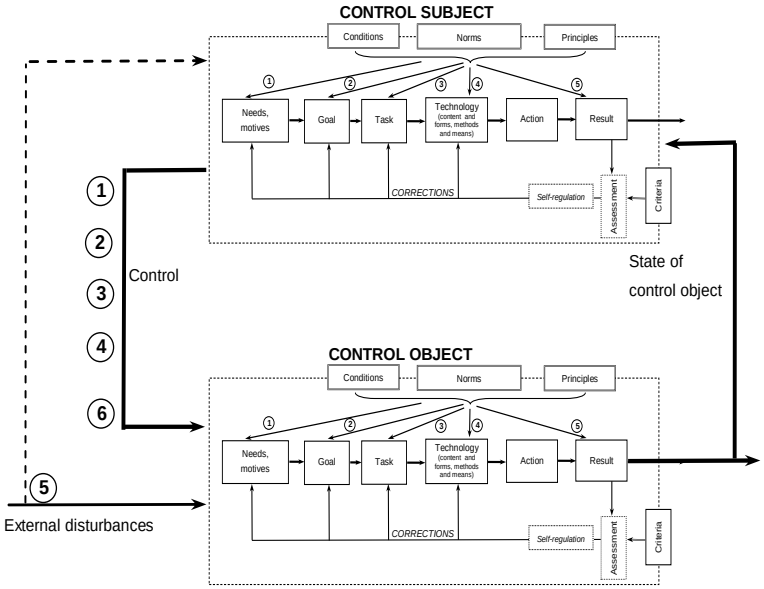

Fig. 4. Structural components of control activity

For a *controlled system*, a *criterion of operating efficiency* depends on its state and (in some cases) on the control actions. The most important feature is whose viewpoint serves a reference in efficiency analysis. Suppose that one knows the relationship between the state of a controlled system and control actions applied. Hence, it seems possible to consider operating efficiency of a controlled system as a certain function of control actions. Such function is referred to as a *control efficiency criterion*. Consequently, any *control problem*[1] could be formally stated as follows. Find feasible control actions ensuring the maximal efficiency (such controls are said *optimal*). To succeed, one should solve an *optimization* problem, notably, *choose* an optimal control (optimal controls).

We have provided the general scheme of any human activity. A cycle of activity terminates with achieving a certain result. Thus, the efficiency of activity is assessed in the sense of estimating the corresponding result. The presence of a measurable result (otherwise, control makes no sense!) allows for estimating the level of goal attainment as an anticipated, expected result of activity.

The efficiency of activity is a degree of conformity between the result and goals of the subject performing the activity. Exerting an impact on the components of activity (controlling them), one may influence on the result and efficiency of the activity. Control is the activity of a control subject with respect to a controlled system. When a control subject coincides with a controlled system, the matter concerns *self-regulation.*

The result of activity performed by a control subject is defined by his state and the state (the result of activity) of a controlled system. Hence, the efficiency of control activity (*control efficiency*) represents a degree of conformity between the result of operation of a controlled system and goals of a control subject. Evaluation of controls ensuring maximal efficiency is the scope of optimization.

In fact, *optimization* consists in finding the best (optimal) alternatives in a set of feasible alternatives under given conditions.

Let us emphasize the relevance of every word in this statement. Using the term "the best alternatives," we assume there is a certain *criterion* (several criteria) and a way (ways) to compare alternatives. It is of crucial importance to account for the existing conditions and constraints; varying them leads to optimality of other alternatives under the same criterion (criteria).

We have earlier discussed control efficiency. The efficiency being measured, control aims for efficiency *optimization* (in fact, maximization) under given constraints and conditions.

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[1] *A problem is something requiring execution or solution; a goal of activity specified in certain conditions. In this book, the term "control problem" has two meanings. The first* (*wide*) *one is searching for an optimal control within the framework of the general model* (*efficiency maximization as the goal of control activity*). *The second* (*narrow*) *meaning consists in searching for an optimal control of a certain type* (*e.g., resource allocation problems, operative control problems, etc.*).

Given the general structure of control activity, let's procedd to its characteristics, logical and temporary structures.

3. Characteristics, Logical and Temporal Structures of Control Activity

Characteristics, logical and temporal structures of control activity are presented in a summarised form in Tables 1-3 correpondingly (see details in [4]).

Table 1. Characteristics of control activity

Characteristics	**Organization of control activity**
Features of activity	1. The personalized nature of control activity; 2. Independent goal-setting by a control subject (principal); 3. The mediated outcome of control activity; 4. The creative character of control activity; 5. The necessity of modeling (predicting, forecasting the behavior of a controlled system under specific control actions); 6. The responsibility of a control subject for the process and result of his/her activity and activity of subjects and/or objects controlled by him/her; 7. Development and adaptation.
Principles of activity	Principles of hierarchy; unification; purposefulness; openness; efficiency; responsibility; non-interference; social and state control; development; completeness and prediction; regulation and resource provision; feedback; adequacy; well-timed control; predictive reflection; adaptivity; rational centralization; democratic control; coordination; ethics.
Conditions of activity	Motivational, personnel-related, material and technical, methodical, organizational, financial, regulatory and legal, and informational conditions.
Norms: 1) general; 2) specific	Universal ethical, legal and other norms.
	Norms of managerial ethics, organizational culture.

Table 2. The logical structure of control activity

Structural components	**Organization of control activity**
Active subject	Control subject (individual or collective).
The object of activity	Control object and/or controlled subject (individual or collective).
The subject of activity	Elements of a controlled system, components of activity of a controlled subject. For instance, in the case of organizational systems: staff of the system; structure of the system; constraints and norms of activity of participants; goals and preferences of participants; awareness of participants; the sequence of functioning.
The result of activity	State of a control object, result of activity of a controlled subject; consumed resources.
The forms of activity organization	Individual and collective control; unified and personalized control.
	Project- and process-based management; reflectory (situational) and forward-looking control.
	Hierarchical control, distributed control, and network control.
The functions of activity	In the case of organizational control: planning, organizing, motivating, and controlling.
Tasks	In the case of organizational control: monitoring and analysis of the actual state of a controlled system, forecasting the evolution of the system, goal-setting, planning and distributing the resources, motivation (incentives), control and operative management, analysis and improvement of activity.

Structural components	**Organization of control activity**
The methods of activity	In the case of organizational systems: staff control; structure control; institutional control (normative control, i.e., control of constraints and norms of activity); motivational control (economic control, i.e., control of preferences); informational control (socio-psychological control, i.e., control of information being available to controlled subjects at the moment of decision making).
The means of activity	In the case of organizational control: orders, directives, instructions, plans, strategies, policies, norms, standards, procedures, regulations concerning activity organization.
Mechanisms	In the case of organizational control: mechanisms of active expertise, mechanisms of active expertise, transfer pricing mechanisms, mechanisms of contract renegotiation, mechanisms of cost-benefit analysis, mechanisms of institutional control, mechanisms of informational control, integrated rating mechanisms (mechanisms of data aggregation), rank-order tournaments (tenders), multichannel mechanisms, mechanisms of assignment, mechanisms of exchange, mechanisms of predictive self-control, mechanisms of production cycle optimization, incentive mechanisms for cost reduction, resource allocation mechanisms (including costs and incomes), mechanisms of self-financing, mechanisms of structure choice, mechanisms of staff choice, mechanisms of joint financing, mechanisms of consent, incentive mechanisms, insurance mechanisms, etc.

Table. 3. Organizing the process (temporal structure) of control activity

Temporal structure			**A control activity cycle**
Phases	**Stages**	**Steps**	
1. Design phase	1.1. Conceptual stage	1.1.1. Identifying contradictions	A contradiction between the actual (or forecasted) state of a controlled system and its desired state.
		1.1.2. Stating a problem	A control problem as the need for exerting an impact on activity (state) of a controlled system; such need must be recognized by a control subject.
		1.1.3. Defining the goal of control	Defining the goals of control as a desired state (result of activity) of a controlled system (in the narrow sense, as a way of organizing of controlled subject's activity).
		1.1.4. Choosing criteria	Criteria for describing/assessing the state (result of activity) of a controlled system. Control efficiency criteria.
	1.2. Modeling stage	1.2.1. Constructing a model	Constructing a model of a controlled system (taking into account its active property if necessary). Studying the dependence of the controlled system's state (result of controlled subject's activity) on control actions and the state of an external environment.
		1.2.2. Optimization	Solving the problem of optimal control synthesis (for the constructed model of a controlled system). Analyzing stability and adequacy of solutions.
	1.3. The stage of control	1.3.1. Decomposing	Formulating control problems as the goals for specific subproblems ensuring a definite overall goal of control (within the framework of existing constraints).

Temporal structure			**A control activity cycle**
Phases	**Stages**	**Steps**	
	planning	1.3.2. Aggregation	Coordinating the results of solution of specific control problems, assessing the feasibility of joint application of different methods, means, forms and mechanisms of control.
		1.3.3. Analyzing the conditions (available resources)	Analyzing the influence of conditions (resource constraints) on the efficiency of control activity, including resources decomposition by methods, forms, means of control, etc.
		1.3.4. Making up the program of control	Identifying the controlled system. Choosing conditions, methods, means, forms and mechanisms of control. Solving the problem of optimal control synthesis.
	1.4. The stage of technological preparations for control	1.4.1. Technological preparations	Detailed elaboration and preparation of necessary conditions, methods, means and forms of control.
2. Implementation phase	2.1. Organizing stage		Implementing conditions, methods, means, forms and mechanisms of control. Resources allocation. Distributing functions and tasks among elements of a controlled system.
	2.2. Motivating stage		Implementing the mechanisms of non-financial and financial incentives of controlled subjects.
	2.3. Monitoring stage		Organizing the system of permanent assessment of the activity performed by a controlled subject and/or an external environment.
	2.4. The stage of operational management		Well-timed correction of conditions and mechanisms of control based on monitoring results.
3. Reflexive phase	The stage of accounting and controlling		Acquiring information on the results of activity performed by a control subject and a controlled system, results assessment (comparison with posed goals).
	The stage of activity analysis (results analysis)		Reflexion as a way of control subject's recognition of his/her activity integrity, as well as of the goals, content, forms, and means of such activity. Analyzing the obtained results (taking into consideration resources consumed).
	The stage of decisions correction		In the case of cyclic (repetitive) activity, "local" modification of its content and parameters based on analysis of achieved results.
	The stage of activity improvement		Systematic reviewing of the whole organizational structure of control activity (in particular, efficiency criteria adopted, as well as methods, forms, means and mechanisms of control).

4. Philosophical Foundations of Control Methodology

A foundation is a sufficient condition of something (entity, cognition, an idea or activity). From the control theory point of view *cybernetics* and *systems analysis* are remarkable for occupying the interdisci-

plinary or overdisciplinary position and may be treated as applied dialectics. Within the framework of these approaches, control activity is a complex system intended for preparing, substantiating and implementing solutions to complex problems of different character (e.g., political, social, economic, technical problems, etc.) [6, 7, 8, 9, 10, 11]. By comparing the conceptions adopted by different scientific disciplines (*viz.*, philosophy, psychology, sociology and systems analysis or systems engineering), one would easily choose the general *structure of activity* (see Fig. 2). But the fundamental foundations for control methodology are given by philosophy.

Philosophy studies activity as a universal way of human existence. Accordingly, humans represent active creatures. Human activity covers material-practical, intelligent and spiritual operations, external and internal processes. Activity is the behavior of mind just exactly as the behavior of arms, whereas human activity makes up cognition process similarly to human behavior. Activity enables an individual to reveal his/her particular place in the world and to assert himself/herself as a social being.

Having reached a certain level of epistemological maturity, scientists perform "reflexion" by formulating general laws in corresponding scientific fields, i.e., create *metasciences*. On the other part, any "mature" science becomes the subject of philosophical research. For instance, the philosophy of physics appeared at the junction of the 19th century and the 20th century as the result of such processes [12].

Originated in the 1850s, research in the field of *control theory*[1] led to the appearance of other metasciences, i.e., *cybernetics* [6, 7, 11] (in the 1950s) and *systems analysis* [8, 9, 10] (later). Moreover, cybernetics quickly became the subject of philosophical investigations (e.g., see [11, 13]) conducted by "fathers" of cybernetics and professional philosophers.

The 20th century was accompanied with rapid progress of *management science* [14, 15, 16] as a branch of control theory studying practical control in *organizational systems*. By the beginning of the 2000s, management science engendered *management philosophy*. Books and papers entitled "Management philosophy" appeared exactly at that times (for instance, see [13, 15, 17]); as a rule, their authors represented professional philosophers. Generally speaking, one may acknowledge the long-felt need for more precise mutual positioning of philosophy and control.

Consider Fig. 5 illustrating different connections between the categories of philosophy and control; they are treated in the maximal possible interpretation (philosophy includes ontology, epistemology, logic, axiology, ethics, aesthetics, etc.; control is viewed as a science and a type of practical activity). We believe that the three domains shaded in Fig. 5 are the major ones.

Control philosophy (as a branch of philosophy). Historically (and similarly to the subjects of most modern sciences), control problems analysis was first the prerogative of philosophy. R. Descartes was used to say, "Philosophy is like a tree whose roots are metaphysics and then the trunk is physics. The branches coming out of the trunk are all the other sciences."

Historical and philosophical analysis implies that first control theorists were exactly philosophers. Confucius, Lao-tzu, Socrates, Platon, Aristotle, N. Machiavelli, T. Hobbes, I. Kant, G. Hegel, K. Marx, M. Weber, A. Bogdanov–this is a short list of philosophers that laid down the foundations of modern control theory for the development and perfection of managerial practice.

Presently, concrete control problems are no more the subject of philosophical analysis. Philosophy (as a form of social consciousness, the theory of general principles of entity and cognition, human attitude to the reality, as the science of universe laws of natural development) studies GENERAL problems and laws separated out by experts in certain sciences.

By analogy to the notions of "historical philosophy," "cultural philosophy," "legal philosophy," etc. (see philosophical encyclopedias), one can define *control philosophy* as a branch of philosophy connected with comprehension and interpretation of control processes and control cognition, studying the essence and role of control. Such meaning of the term "control philosophy" (see the dashed-line contour in Fig. 5) has rich internal structure and covers epistemological research of control science, the analysis of logical, ontological, ethical and other foundations (both for control science and management science).

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[1] *Following the established tradition, we will occasionally call control science by control theory* (*yet, keeping in mind that the name is narrower than the subject*).

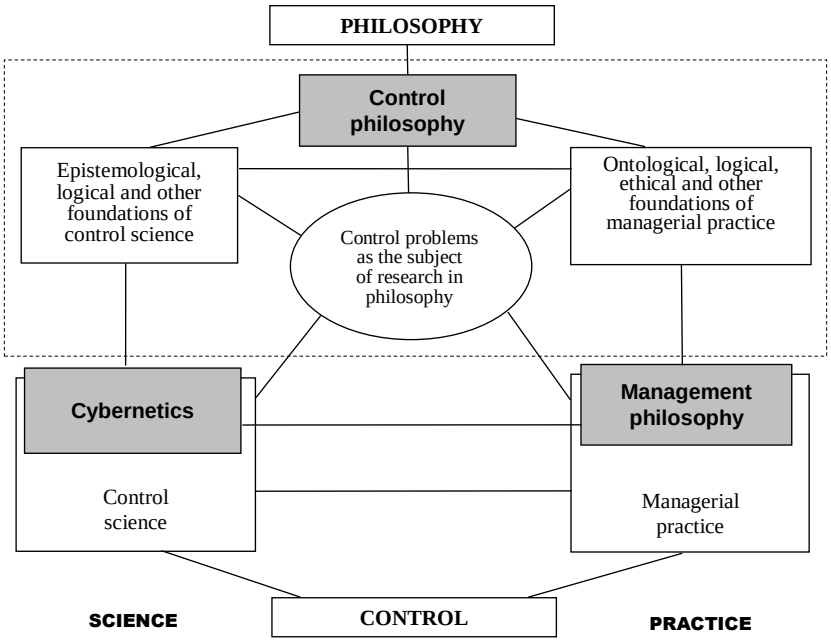

Fig. 5. Philosophy and control

The basic goals of research in control philosophy are as follows:

1. Identifying the content of control as a science and practical activity, analyzing their subject and place in the system of scientific knowledge;

2. Performing the ideological, methodological and logical-epistemological analysis of primary notions, results, techniques, functions and theories in control science;

3. Translating philosophical laws to enrich the content of control laws;

4. Involving the achievements of control theory and practice to enrich the content of philosophical categories and laws;

5. Substantiating the feasibility and conditions of using common approaches to control problems in systems of interdisciplinary nature, constructing uniform control theory;

6. Performing methodological analysis of control with application to different areas of human activity and different classes of control objects;

7. Substantiating philosophically the key directions in control theory and practice.

8. Systematizing and classifying theories of control;

9. Identifying and systematizing axiological dominants in control theory and practice;

10. Developing the integrated conceptual framework of control science (including the terminology of all embedded theories).

Let us formulate a series of "questions" determining perspective directions of research in control philosophy (according to experts in control theory, these issues lie "in the plane" of control philosophy).

- What would general laws and regularities studied by philosophy gain for control theory and practice? Which modern directions of philosophical research can find (alternatively, have already found) applications in control science (structuralism, post-structuralism, hermeneutics, etc.)? What are the manifestation and influence of general scientific meaningfulness and interdependency of adopted terminology?
- What are the epistemological specifics of control science? Are there general approaches to the statement and solution of control problems? How does control science position itself in the general system of sciences? What is the epistemological status of a researcher in control theory and practice?
- How are basic categories of philosophy (a language, ordinary consciousness, ethics, a law, philosophy, a science, art, a religion, a political ideology, etc.) correlated with that of control science (control, an activity, an organization, decision making)? How is the latter group of categories correlated with other categories (such as a human being, nature, a society, production)?

• Which laws (features) of control science formation as a metascience can be identified in historical retrospective and at the modern stage of its development? What is the connection between control theory and practice (again, in historical retrospective and in future perspective)?

• How does philosophy (as the "quintessence of culture") affect the formation of "organizational culture" in control theory and practice? What is the interrelation between universal principles, laws and features of development of particular organizational, social and cultural formations in control theory and practice?

Cybernetics (as a branch of control science, studying its most general theoretical laws). For many scientific disciplines, there exists a range of problems related to their foundations and traditionally referred to as the philosophy of a corresponding science. Control science follows this tradition, as well. Foundations of control science also include general laws of efficient control (representing the subject of cybernetics).

Nowadays, one often faces the opinion that cybernetics has become old-fashioned as a scientific discipline and no more pretends to the role of certain universal control science. This is true, but only in part. As a matter of fact, in the middle of the 1940s cybernetics appeared the theory of "control and communication in the animal and the machine" (see the pioneering monograph [11]). Furthermore, it originated even as the theory of GENERAL laws of control. Triumphal advancements of cybernetics during the 1950–1960s (e.g., technical cybernetics, economic cybernetics, biological cybernetics, etc., and well as their close connections to operations research, mathematical theory of control; plus intensive implementation of results in designing new and upgrading existing technical and information systems) created the illusion of the universal character of cybernetics and inevitability of its rapid development in future. However, the evolvement of cybernetics slowed down in the early 1970s. This "integral" science branched out into a set of partial directions and "mingled with details"; indeed, the number of subbranches grew and all of them showed independent development (almost without identification and systematization of general laws). Curiously enough, the only bearers of canonical cybernetic traditions were philosophers, whereas experts in control theory lost their confidence in ample opportunities of cybernetics.

Things can't carry on as they are. On the one hand, philosophers vitally need knowledge of the subject (actually, the generalized knowledge). In this context, V. Il'in mentioned that "philosophy represents second-rank reflexion; it provides theoretical grounds to other ways of spiritual production. The empirical base of philosophy consists in specific reflections of different types of cognition; philosophy covers not the reality itself, but the treatment of reality in figurative and category-logical forms" (see references in [18]).

On the other hand, experts in control theory need "to see the wood for the trees." Hence, one can hypothesize that cybernetics must and would play the role of control philosophy in its second meaning (as a branch of control theory, studying its most general laws). Here the emphasis should be made on constructive development of control philosophy, i.e., on formation of its content through obtaining concrete results (probably, first partial results and then general ones).

Management "philosophy." A detailed analysis of modern textbooks on management science, sociology and psychology of management separates out the following categories[1] used to describe managerial practice (see Fig. 6).

Management "philosophy" tops the pyramid demonstrated in Fig. 6. It reflects the maximally abstracted level of description and consideration of solving the problems of managerial practice.

There are intensive discussions regarding the comprehension of management "philosophy," its subject and main content. For instance, the following opinions are quoted in [18]:

– "Possibly, management philosophy is the pragmatism, where an essential characteristic of a human being lies in actions, purposeful activity. Cognizing exactly the laws of human activity must form the object of management philosophy" (L. Bessonova);

– "Management philosophy considers axiological, epistemological, and methodological foundations of human activity in control processes" (V. Diev), and so on.

[1] *Note that the corresponding terms are generally not defined explicitly and addressed somewhat inadvertently (in management science).*

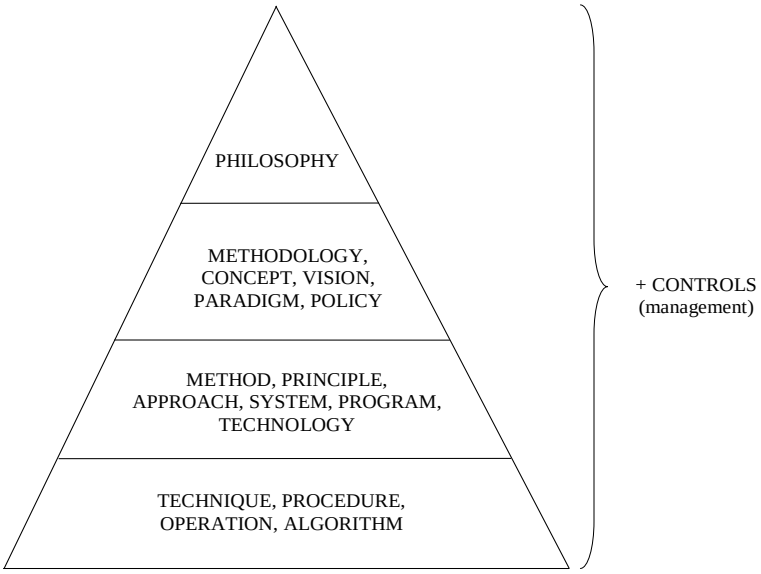

Fig. 6. Levels and categories of managerial practice description

The examples of inhomogeneous definitions could be continued. Many authors of textbooks on management science adopt the term "personal management philosophy" (similarly to the existence of numerous opinions regarding necessary qualities of a good leader, there are many different management philosophies). In other words, sometimes management "philosophy" is commonly treated as analyzing the set of qualities of an efficient manager and his/her decisions leading to a success.

Almost all authors agree with the following. Management "philosophy" is a system of ideas, views and beliefs of managers about human nature and society, control problems and ethical principles of their behavior (this system forms mostly empirically). Yet, we believe such definition appears eclectic and not operational. Our approach is to understand management "philosophy" ("the top of management") as a branch of control science dealing with generalization of laws of successful managerial practice.

We have briefly analyzed the correlation of control philosophy (as a branch of philosophy studying general problems of control theory and practice), cybernetics (as a branch of control science generalizing the methods and results of solving theoretical problems of control) and management (as a branch of control science generalizing the experience of successful managerial practice), see Fig. 7.

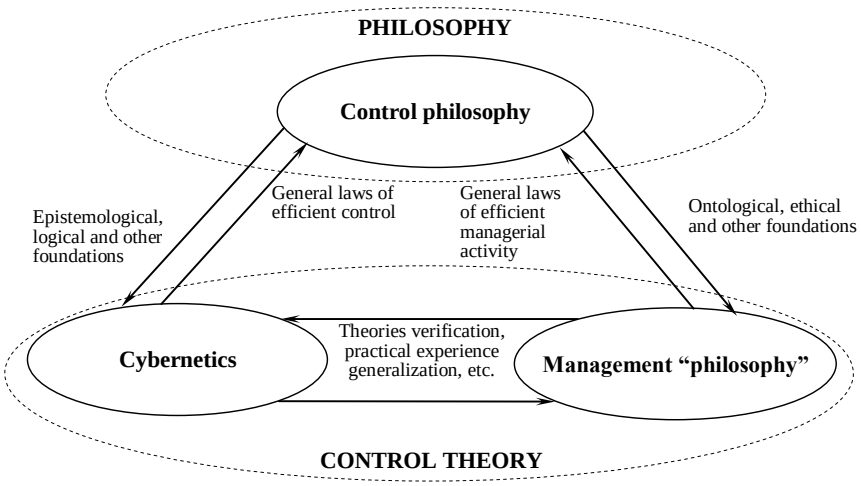

Fig. 7. Control philosophy, cybernetics and management "philosophy"

5. Conclusion

The paper has endeavored to systematize control methodology (as the theory of organizing of control activity). Philosophical foundations of the methodology of control activity, its characteristics, as well as the logical and temporal structures were described. A series of "questions" determining perspective directions of research in control philosophy were posed. Authors hope that a unified approach (based on control methodology) to the consideration and research of control activity will help to interconnect and develop parallely mathematical control theory and control philosophy.

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