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**Proceedings of the
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**Edited by
Dr. Manuel Au-Yong-Oliveira
Professor Carlos Costa**

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System of Organizational Terms as Theoretical Foundation of a Research Methodology Aimed at Team Management Automation

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Abstract: Despite the fact that IT systems fill and automate more and more areas of human life, it is still not possible to employ an artificial manager to an organization. There is a question what are the obstacles and how to overcome them. Therefore the main scientific goal of this paper is to present the methodological concept called the system of organizational terms as theoretical foundation of a research methodology aimed at solving methodological problems of management sciences as a scientific discipline and in as the result allowing to implement team management automation. Already in 1967, P. Drucker wrote that computer systems would not only serve to collect information, but the algorithms written in them would be able to replace managers over time. However, the contradiction between the unstable nature of team management research and the opportunity coming from IT technologies creates a research problem which should be addressed before implementing team management automation: what does a team manager really do? In order to do that, it was necessary to design a methodological concept of the management science which could be comprehensive, coherent and formalized in order to allow practicing this science in a way that produces real knowledge of managers' behavior. The essence of this concept is to represent organizational reality with organizational terms, just as physical phenomena can be represented by units and their corresponding physical quantities in the SI system. This way the concept enables implementation of team management automation.

Keywords: team management automation, the system of organizational terms, management tool, organizational reality

1. Introduction

IT systems fill and automate more and more areas of human life, and thus, also managers' work. The contradiction between the unstable nature of team management and the opportunity coming from IT technologies creates a challenge for the future – is it possible to implement team management automation? However, the research problem which should be addressed before implementing team management automation seems to be: what does a team manager really do? (Sinar and Paese, 2016)

However, answering this question one can encounter many methodological problems of management sciences as a scientific discipline, indicated in the literature of the subject, such as:

- many theories created under the significant influence of the researchers' evaluation of the elements of these theories, which in the perspective of the development of science is an unfavorable phenomenon (Hicks and Goronzy, 1967),
- the phenomenon of increasing diversity of understanding the concepts (Hodge, 2003),
- the problem of incommensurability of the entire scientific discipline, especially in the field of methods of conducting research and interpretation of its results, which leads to formation of "islands of knowledge" (Gleiser, 2014).

It was worth mentioning that yet in 1961 H. Koontz stimulated the researchers' awareness of the organizational reality with the concept of "the management theory jungle" (Koontz, 1961), meaning unordered way of practicing management sciences and the ontological and epistemological controversies growing in these sciences. However, a challenge in such a state of management theories is the progressive digitization and automation of the modern world. There are more and more publications about the vision of replacing a manager with computer software and, as a result, the creation of robot managers (Fidler, 2015). However, in order to make this possible, it is necessary to unify individual areas of the organizational reality research and create a concept that plays a similar role as the SI system (Goebel, Mills and Wallard, 2006) in the case of the automation of physical phenomena.

As a result of this reason, the purpose of the author's scientific work was to obtain a solution to the following research problem: can there be a comprehensive, coherent and formalized methodological concept of management sciences, which allows to practice management sciences in a way that solves the current methodological problems and enables real team management automation?

Implementation of this goal resulted in the creation of a methodological concept of management sciences with the above-mentioned features. It is called the system of organizational terms and is used to conduct scientific research in the field of organizational reality aimed at team management automation.

The aim of the paper is to present main assumptions of the system of organizational terms as a methodological concept of management sciences (Sections 2) and a few examples of empirical research on team management with the aid of the system of organizational terms (Section 3).

2. Theoretical foundations of the system of organizational terms

2.1 Characteristics of the organizational reality

As the subject of research was chosen an organization. In the methodological concept it was assumed that the object of the organization's activity is to solve organizational problems (Kepner and Tregoe, 1965). These organizational problems can be solved by organizing methods, and each organizing method is divided into organizational techniques (Szarucki, 2013). It was also proposed that the organizing problems occur in the human community within the whole organization (many managers or many groups of organization participants) or a separate group in the organization (one manager or one group of organization participants) (Sundel, 1985). In the organization there are also interdependent social behaviors of the manager and the organization's participants (Olivier, 1993).

It led to an important conclusion that if one wants to examine the organization it is necessary to know what are the behaviors of participants of the organization. Having in mind the operationalization of this research problem, following dependences were assumed (Flak, 2020):

- an organizational problem is solved by participants of the organization;
- an organizational problem is solved through the use of organizing techniques;
- an organizational problem is solved by means of a management tool used by the manager or participants of the organization.

2.2 Main characteristics of the system of organizational terms

The concept of the system of organizational terms was designed to examine the organizational reality and its issues described in Section 2.1. The author set several scientific goals which the system of organizational terms should allow to achieve, for example:

- create knowledge about the logical reality of the organization on the basis of information obtained in the scientific research;
- build full, and therefore internally consistent, theories referring to more general theories;
- fulfill by theories the criteria of accuracy, consistency, generality, simplicity and fruitfulness;
- combine a qualitative approach and a quantitative approach;
- conclude which beings exist in the organizational reality, why there exist those entities, what relations between these entities there are (causation or co-occurrence in time).

In order to achieve these scientific goals of the system of organizational terms the concept uses elements of several paradigms existing in management sciences or in the philosophy of science. In the case of general methodological issues, the concept of the system of organizational terms fits in two methodological trends – logical positivism (Heapa, Verschoorb and Zizzo, 2012) and naturalism (Brosch, Pourtois and Sander, 2010). The concept of the system of organizational terms corresponds to the concept of observing facts occurring in the organizational reality (Ducheyne, 2008), and then – based on the collected information about the facts – inductive or deductive formulation of theorems or rights included in the theory of organizational reality. This is in line with the trend of minimizing the impact of inductive reasoning and striving to use formal logic in science in general, and in management sciences in particular.

In ontological matters, elements of the resource (Peteraf, 1993) and process (Glykas, 2011) paradigms in the management sciences were used, combining both approaches. In addition, the system of organizational terms

is in line with the approach in which the determination of the causality relation is necessary to create knowledge about the organizational reality.

There are four main perspectives of the system of organizational terms: a logical construction, a contribution to management science, a content and a definition. Firstly, from the perspective of the logical construction the system of organizational terms corresponds to the definition of the system, according to which a system is a collection of elements considered as a whole separated in some respects from another set (Backlund, 2000). Additionally, the system of organizational terms possesses features of a deterministic system in the past and features of the probabilistic system in the future (Strauss, 2002). Secondly, from the perspective of the scientific contribution the system of organizational terms gives a contribution to management science gradually or revolutionarily, however, this contribution is not distinguishable due to its theoretical or practical value (Corley and Gioia, 2011). Thirdly, from the perspective of the content the system of organizational terms includes a description of ontological, epistemological, linguistic, methodical, logical and aesthetic issues existent in the practice of management science. Fourthly, from the perspective of the definition, the system of organizational terms is a set of organizational terms that have dimensions, and in them – measured values, representing the variability of organizational terms as a function of time, enhanced by a set of relations between organizational terms (Proctor, 2005).

It is necessary to claim that the persistence of a single relationship can be described probabilistically or deterministically (when the probability of occurrence is 1). The meaning of the facts and the relations was described in Section 2.3.

2.3 Ontology of the organizational reality

On the basis of the source literature the conclusion was drawn that the ontology of the organizational reality must contain an exhaustive classification of beings and universal rules on creating types of these beings and naming them (Petrov, 2010).

It was concluded that there are two classes of beings. The first class includes beings that remain unchanged over time. The second class includes beings that last for a given time interval. It was assumed that the ontology of the organizational reality is dynamic, which means that the types of beings within a given class of beings occur in the organizational reality as a function of time on the basis of universal rules (Brantingham, 2007). It was also concluded that they can exist either outside or within the human unit (manager or participant of the organization) (Azzouni, 2004). These beings are objective or subjective, respectively.

It was assumed that the evolution of the organizational reality is modal. This means that the occurrence of certain beings and relations between them implies the exclusion of other beings and relations between them, increasing the probability of occurrence of specific beings or implicating them necessarily (Pincock, 2009).

Bearing in mind also the practical perspective of the research in management science, especially the challenge of team management automation, it was assumed that the organizational reality consists of facts (Wittgenstein, 2000). A fact was defined as a result of observation of a being in the organizational reality, registered in a form of information. Facts are divided with the same logical division as beings. There are facts invariably lasting in time (facts of the class of a thing) or lasting in a given period of time (facts of the class of an event) (Brink and Rewitzky, 2002). Facts are also divided into external (objective facts) or internal (subjective facts) about the human individual (a manager or participants of the organization). It is assumed that the existence of the subjective fact is determined only by the individual, and the existence of the objective fact is shared by more than one person.

The fact of the class of a thing was defined either as a real object or an intentional object. The fact of the class of a thing is an organizational resource in the resource approach in management science (Eaton and Bawden, 1991). It was assumed that the fact of the class of a thing is named by a noun. The fact of the class of the event is when two states of things describing the same fact of the class of the thing differ from each other in a different way than only resulting from the passage of time, which means that the fact of the class of the thing at the moment t_1 showed a certain feature whereas at the moment t_2 no longer showed this feature or vice versa. The fact of the class of the event is an organizational process in the process approach in management sciences (Glykas, 2011). It was assumed that the fact of the class of the event is named by a verb.

2.4 Epistemology of the organizational reality

After the ontological assumptions presented in Section 2.3, the next question to answer is how to build knowledge about the organizational reality. In this field the system of organizational terms refers to the concept of convention, which enables the creation of knowledge about organizational reality in language. It was assumed that a natural language is necessary to create statements about facts in the organizational reality (Wang, Ali and Srimani, 2010). From this assumption it is possible to draw a conclusion that the source of cognition is an observation of the organizational reality (Midgley, 2003). On the basis of the literature on the subject, the conclusion was drawn that the process of cognition is a reflection of the organizational reality in the concepts of facts and the cognition is neutral in relation to the organizational reality (Storozhuk, 2007).

In order to answer the question how to build knowledge about the organizational reality there were two assumptions. Firstly, the condition for knowing the organizational reality is to receive information about facts in the organizational reality. Secondly, the cognition must begin with a question (Cheung, 2006). It was assumed that information about the organizational reality is expressed in the form of elementary sentences corresponding to the existing facts (Kuukkanen, 2010). In this perspective each elementary sentence presents in language the occurrence of one fact or a state of affairs of one fact, and a logical form of elementary sentences and sentence functions reflects the structure of facts described by these sentences (Wray, 2010).

However, the use of the natural language in building elementary sentences is not enough to build sophisticated knowledge about the organizational reality. There is needed a mechanism of the sentence transformation. Therefore, on the basis of the literature, such a mechanism is a formal logic which enables capturing phenomena occurring in the organizational reality, describing them by means of language and reasoning about them (Luschei, 1962).

It is worth adding that an important theory included in the concept of the system of organizational terms is the information theory (Shannon, 1948). An analysis based on it allowed for the assumption that the transformation of the organizational reality from beings to facts occurs through information received by the manager or participants of the organization. Additionally, it was assumed that the infrastructure for gaining knowledge must be separated from the knowledge itself. This assumption has an impact on the operationalization of organizational terms described in Section 2.6. Before that it is necessary to go back to the organizational term in Section 2.5.

2.5 Organizational term

An organizational term is the central concept of the system of organizational terms. According to the main assumption regarding this concept, any fact appearing in the organizational reality can be presented by the organizational term, which is a symbolic element of the organizational reality model (Middendorp, 1991). It should be added here that the organizational term is a close analogy of the physical quantity in the SI system (Goebel, Mills and Wallard, 2006). However, the fact in the organizational reality becomes an organizational term, when there is a relation of causality between this fact and another one or in relation to changes within the same fact (Fraassen, 1989). It was concluded that organizational terms do not exist in the organizational reality, but they are abstractions, which exist only in language and are used to represent information about the existing facts.

Going back to the relations between facts, mentioned in Section 2.3, it was assumed that the organizational term has properties, some of which stem from its own definition, and some result from the relation of causality or the relationship of coexistence with other organizational terms. When organizational terms arise, quantitative, qualitative, mereological, or substantial changes occur as a function of time (Ujvari, 2014).

As it was mentioned in Section 2.3, there are facts invariably lasting in time (facts of the class of a thing) or lasting in a given period of time (facts of the class of an event). According to this logical division of facts, organizational terms are divided also into two classes – primary organizational terms and derivative organizational terms. Primary organizational terms correspond to the facts of the class of the thing. Derivative organizational terms correspond to the facts of the class of the event. The next logical division of primary and derivative organizational terms is their division into types. Types of organizational terms in individual classes arise as a function of time and their number is not predetermined. It is assumed that the logical division of organizational terms is adequate and disjointed. The combination of a primary and a derivative organizational term is called the managerial action

(Yang, Flak, and Grzegorzek, 2018). Figure 1 presents the pattern of organizational terms over time combined in managerial actions.

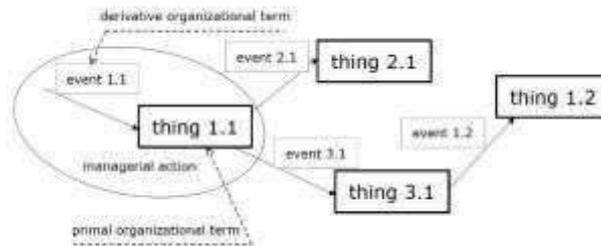


Figure 1: Pattern of primary and derivative organizational terms

In addition to the concept of an organizational term two key concepts have also been defined – the dimension of the organizational term and the measured unit. The dimension of an organizational term is a homogeneous feature of a fact, which is represented by the organizational term (Friedman, 1966). It was deduced that any organizational term can have any number of dimensions. It was concluded that the measured unit indicates how the measurable feature of two facts differ from each other or how the measurable feature of one fact differ from each other as a function of time (Lee and Hubona, 2009). Regarding the relation of the dimension of the organizational term and the measured unit, it was concluded that the assignment of the measured unit to a dimension of an organizational term may take the form of equivalence or probabilistic dependence (Watson, 1982). The measured unit can be observed or controlled (Bhattacharjee, 2012).

It is worth adding that the method of constructing organizational terms consists in giving the fact a name that has a scope and a content. It is also assumed that the organizational term is represented in a language by the name being a set of symbols. To build names of organizational terms it was used a hierarchical model of associative memory presented by A. Collins and M. Quillian (Collins and Quillian, 1969) as well as the principle of the so-called cognitive economics (Collins and Loftus, 1975).

Despite the theoretical foundations of the organizational term inevitably there comes a question: how to get information about measured units of organizational terms. The solution to this problem is presented in Section 2.6.

2.6 Operationalization of the organizational term

If one wants to meet the epistemological assumptions mentioned in Section 2.4, there is a need to establish adequate research method. It was assumed that the research method should be an observation, because it meets the assumptions:

- it is as much as possible detached from the subjectivism of the scientist (Ducheyne, 2008);
- it is complicated only to the least extent necessary, which enables efficient use of it (Bryman, 2008);
- it may not interfere with the activities provided for in it (Little, 1993).

The next important assumption allows achieving the goals set for this methodological concept described in Section 2.2, is that this research adopts a mixed method (Symonds and Gorard, 2010). In this perspective the measurement of the organizational term was defined as the assignment of the organizational term of a specific set of values in such a way that the relations occurring between these values are isomorphic to the relations between the characteristics of the fact to which this organizational term corresponds (Mari, 2005). It was assumed that each measured unit (describing a certain organizational term) can have a unit of measurement (Friedman, 1966). It was assumed that the measurement of organizational terms is made using a measuring tool by measurement of measured units (Hatchuel, 2001).

From the practical point of view the following assumptions are also important:

- the measuring tool records information on the primary organizational term;
- only one primary organizational term is measured by one measuring tool;
- the measuring tool is a management tool.

Going back to Figure 1 in Section 2.5, it means that there are measuring tools which can record information on primary organizational things called “thing 1.n”, “thing 2.n”, “thing 3.n”, where n means the next versions of the fact in the matter of time. While the management tool was defined as an instrument that, through organizing technique, is used to solve an organizational problem (Leedy, 2005), it is a connection to assumption presented in Section 2.1 about the way how the organizations operate. It means that the main subject of the research, which is the organization, can be examine using management tools recording information on managerial actions which consist of primary and derivative organizational terms.

It is necessary to claim that a management tool is an instrument created on the basis of the well-known concept of the unit of behavior and registers information on how to solve the organizational problem by the manager or participants of the organization (Hatfield and Weider-Hatfield, 1978). The inseparable connection between theory and practice in management sciences simultaneously results in the assumption that the measurement method used in the management tool is the research method. In the context of the aforementioned combination of resource and process paradigm in management sciences, it was assumed that the management tool has the following features:

- in the management tool, information about resources resulting from processes is recorded;
- it is possible to infer something about the processes on the basis of registered information about resources.

In Section 3 there is an example how the system of organizational terms was used to measure managerial actions in one of the research project.

3. Example of use of the system of organizational terms in team management research

There were a few research projects in which the system of organizational terms was used as the theoretical background to acquire knowledge about team management. One of them was conducted in 2019 and concerned the trajectory of managerial actions taken by managers in a given project among students of Human Relations Management at the Faculty of Psychology at the University of Silesia in Katowice. They had to carry out a given project from an idea to a final presentation, which concerned organizational solutions in one of Polish universities aimed at development in scientific achievements of academics. The problem to be solved by the students: one of the main Polish universities planned to be a research university from 2020.

The participants of the research were working in teams consisting 4-5 members. Both a manager and team members were using the online management tools in Transistorshead.com, a research platform available by an Internet browser (on laptops or mobiles). The research tools implemented in the TransistorsHead.com research platform were designed and implemented by the author in 2017 and since that time have been used in many research project on team management automation. The management tools are at the same time research tools. The tools were recording participants’ behavior, which made it possible to know what types of managerial action they took, in which order and what the features of the managerial actions were.

Table 1 contains the names of online managerial tools, their numbers (which are necessary to read Figure 2), names of primal and derivative organizational terms and names of managerial actions. In the Table 2 there are functions of the online management tools.

Table 1: Names of online management tools, their numbers, names of primal and derivative organizational terms and names of managerial actions

Name of management tools in TransistorsHead.com	Number of managerial actions	Name of managerial actions	Primal organizational term	Derivative organizational term
set goals	1	set goals	goal	set
describe tasks	2	describe tasks	task	describe
generate ideas	3	generate ideas	idea	generate
specify ideas	4	specify ideas	specification	specify
create options	5	create options	option	create
choose options	6	choose options	choice	choose
check motivation	7	check motivation	check-up	check
solve conflicts	8	solve conflicts	solution	solve
prepare meetings	9	prepare meetings	agenda	prepare
explain problems	10	explain problems	explanation	explain

Table 2: Functions of the online management tools

Tool	Application of the tool during the process of working
Set goals	Agreeing on the goals of the project, actions to be taken, etc. (what is the overall goal of the project?).
Describe tasks	Describing tasks that will have to be performed in order to achieve the overall goals.
Generate ideas	Generating ideas (brainstorming) about performing the tasks (who, how, when, where) and solving potential problems.
Specify ideas	Describing in detail the ideas and solutions.
Create options	Creating options for decision making (deciding which options are the best and which options the team will choose as the final ones).
Choose options	Selecting and deciding which options will be chosen as the most beneficial for the participants according to criteria that determine this.
Check motivation	Checking the level of motivation of the team members according to Maslow's theory of basic needs.
Solve conflicts	Analyzing reasons for potential conflicts among the team members, coming up with possible solutions to these conflicts.
Prepare meetings	Preparing agenda for a meeting based on the law of demand and supply, known in economics. The agenda allows for using the potential in the team and knowledge of participants.
Explain problems	Explaining business problems or tasks by an analysis of keywords in sentences.

The example of the recorded trajectory of team management done by one of the managers in the research is shown in Figure 2. This manager took 232 managerial actions (which means the combination of primal and derivative organizational terms), started his work on 14th May 2019 at 10:58 and finished on 28th May 2019 at 11:56 and his real team work took 1213107 seconds. As can be seen in Figure 2 the trajectory of team management started from setting goals (managerial action no. 1) repeated twice, then the manager skipped to describing tasks (managerial action no. 2) and later to generating ideas (managerial action no. 3) etc. The numbers of the created primary organizational terms and their versions (edited and corrected) is shown in Table 3.

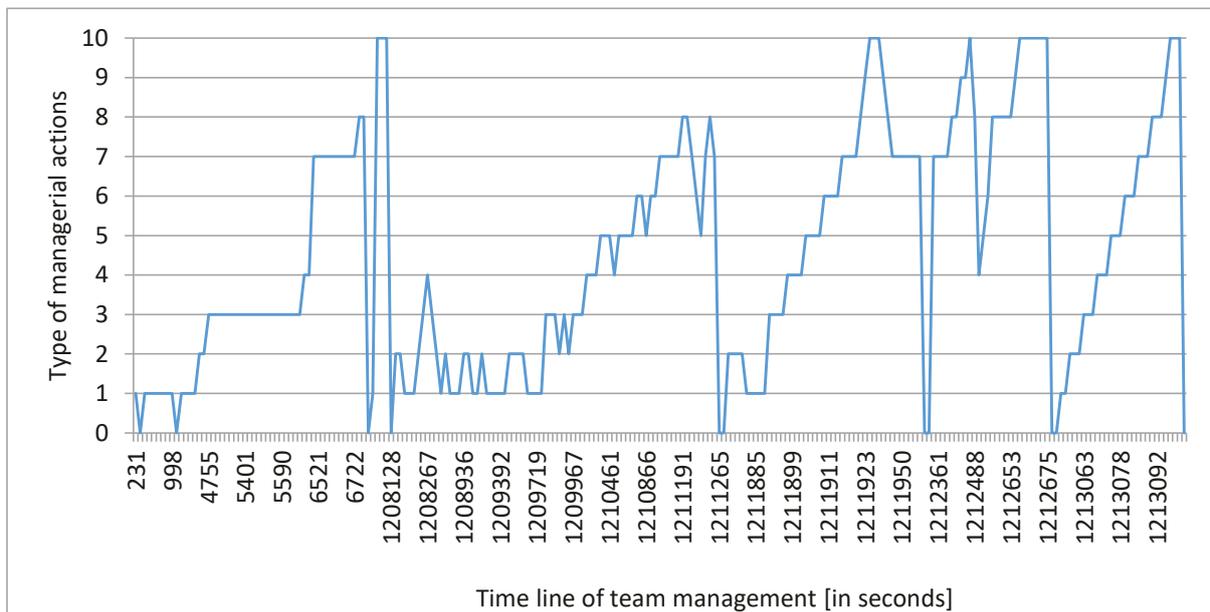


Figure 2: Trajectory in team management done by one of the managers

Table 3: Numbers of created primary organizational terms and their versions created by a manager

Name of a managerial action (and the online managerial tool)	Name of a primal organizational term recorded by the online managerial tool	Quantities of primal organizational terms	Numbers of versions of these primal organizational terms
set goals	goal	6	11
describe tasks	task	2	0
generate ideas	idea	3	8

Name of a managerial action (and the online managerial tool)	Name of a primal organizational term recorded by the online managerial tool	Quantities of primal organizational terms	Numbers of versions of these primal organizational terms
specify ideas	specification	4	9
create options	option	5	13
choose options	choice	1	7
check motivation	check-up	2	15
solve conflicts	solution	0	6
prepare meetings	agenda	6	5
explain problems	explanation	2	6

As can be seen in Figure 2, the system of organizational terms as a research methodology allows building real knowledge about team management consisting of the types and sequence of managerial actions taken by a manager with their team members. This way it is possible to answer the main question presented in Section 1 and which is the essential condition in team management automation: what does a team manager really do? This is a novel approach to the research on team management and enables imitating a human manager with a machine which could perform the same managerial actions automatically.

4. Conclusions

The presented system of organizational terms makes it possible to conduct research, which is the first step for team management automation. Knowing what a manager really does, it will be possible to imitate them or predict their behavior on the basis of pattern recognition techniques. A few research projects of the author confirmed that the system of the organizational terms has a potential to be a novel and innovative approach to research on managerial actions (Yang, Flak and Grzegorzek, 2018; Flak, Hoffmann-Burdzińska and Yang, 2018; Flak, 2018).

At this point, three main conditions for the methodological concept were fulfilled in the system of organizational terms. First of all, the concept is comprehensive, which means that it covers all or most of the issues necessary for practicing science, such as ontological and epistemological assumptions, organized elements of science, ways of using the language, methods of inference etc. Secondly, the system of organizational terms is coherent, and therefore internally consistent and internally complementary. Thirdly, the concept is formalized, so there are strictly defined rules on how to apply individual elements of the concept, defined either in detail or in the form of universal and scaled principles.

Using the system of organizational terms may develop the present management systems in organizations into a semi-automatic management system. This will allow the creation of more human-independent organization management systems that will be able to replace human managers with more efficient robot managers in certain situations.

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