THE POSSIBILITIES OF MAPPING NATURAL SYSTEMS INTO ORGANIZATIONAL SYSTEMS - PART 1

Dominika Salwa

Department of International Management, Cracow University of Economics,
dominika.salwa@uek.krakow.pl

ABSTRACT

The presented 1st part of the paper is based on a four-year-long research on two categories of living systems: natural systems and organizational systems. Natural systems - as a part of biological world - were defined as a set of living organisms and interrelations between them, organizational systems - as a part of human system - as a set of organizations and interrelations between them.

The main idea which inclined the author to the research was the assumption that organizational systems became more and more complex on one side but on the other reveal lots of weaknesses as the whole (general example: the paradoxes of globalization).

One of the nature focused futurist, K. Kelly, said that organizations are starting to take on the complexity of natural systems and at that point they become out of our control. The natural thinking is: if we want to understand the complexity of organizational system and be able to steer it, we need to understand natural systems first. They might be a great model of what organizational systems or even the whole human system is starting to be. Through the comparison of both systems we might come to final ideas of what to concentrate on. The strategic point would be the ability to model organizational and human system according to natural determination of systems construction.

Nature was always inspiring for humans, but usually in its specific parts. This research was a general and wide system analysis of the construction of nature as a whole in the context of mapping its solutions into organizational and human world.

This paper, as part 1 of the research, is concentrated on: methodological aspects of mapping process of two categories of systems, description of natural and organizational systems. Finally it presents the main outcome which is the facet for both system analysis. The facet is four dimensional, according to function, structure, process and context of each system in their four levels of emergent properties. It shows the construction of natural and organizational world and makes the simple basis for further research and analysis.

Keywords: Biology of business, complex systems, living systems, natural systems, organizational systems, the methodology of comparison of different kinds of complex systems, iterative process of inquiry.

INTRODUCTION

Treating natural systems as a pattern of organization is nothing new in science. The man have always looked at nature to inspire itself with its solutions. But never since nowadays nature was analyzed as an entire complex adaptive system (CAS), which might be as such an ideal example to improve human organizational systems. Organizational systems develop so fast and rapidly that forecasting any of its faces in the future, projecting its look, or even analyzing

it as an entire system seems to be more and more complicated. Meanwhile this system shows its disadvantages and paradoxes which, if not stopped, will continue to arise, making it less and less efficient. This is sufficient reason to look for new ideas of how to improve it.

One of the directions how to do the research was pointed by general system theorists. In the 50ties of 20th century L. von Bertalanffy, K. Boulding and others scientists have seen the similarities in different categories of systems, like human, physical, mathematical or biological. Formed later on that basis living systems theory combined natural systems with organizational systems. The widest research done by J. G. Miller pointed out similar subsystems in living systems, among which he distinguished: cell, organ, organisms, group, organization, community, society and supranational system. If the subsystems he indicated have the same functions, one of them might be a model for the other. On that basis they might be compared.

From his research can be seen that the biological systems and human once might be compared and they poses the same subsystems. This lead to further assumptions: if biological systems and human systems are comparable so there might be a possibility to map some solutions (mechanisms) that are in nature and implement to those elaborated by humans. What for? Just to improve and understand better more and more complex organizational systems (and therefore as well human system as a whole) on the basis of ideal and of great complexity biological systems[1]. Such activity have to lead as well to improve the effectiveness of organizational systems. It is worth to mention here what K. Kelly noted: "The corporations are starting to take on the complexity of biological systems. And at that point, they become out of our control"[2]. This is a reason why human needs to understand biological systems. If our system becomes a biological one, then we need to understand the biological one first to be able to understand what ours is becoming. This is the key to understand, analyze and change some unpredicted mechanisms and dysfunctions of organizational and even human systems. A kind of dysfunction might be paradoxes of globalization or the crisis that occurs. The questions like - why such things do not stop and evolve all over the system? Why the consequences might be seen far away from the source? What humans didn't predict while formulating rules of activity in its systems? – seems to be logical at that point.

In this paper the main model of comparison will be described. In second part of it, the author will present the outcomes of comparison between the two kinds of systems

METHODOLOGY OF SYSTEMS COMPARISON

To understand better the idea of the research basic definitions needs to be defined. On the basis of general systems theory **natural system** will be understood a set of organisms and interrelations between them. The term in singular (natural system) will be used to the entire nature as a whole system, and in plural (natural systems) to indicate different types of the entire whole (certain subsystems, e.g. like: an ecosystem).

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[1] This is the pre-assumption to this paper: the human systems and therefore organizational systems are not Ideal and they need human action to be improved. But while they are so complex this is hard to analyze how and what to improve to achieve better effectiveness.

[2] K. Kelly, The new biology of business, [in:] Rethinking the future, R. Gibson (ed ed), Nicholas Breadley Publishing, London, 1997.

Organizational system is therefore a set of organizations and interrelations between them. And the same as above the term used in singular (organizational system) will be used general to the business in the global economy, and in plural (organizational systems) to point different kinds of it (subsystems, e.g. like: a branch or national business).

Organizational system as such, could be created when natural systems were in a certain stage of development. It means when homo sapiens appeared and when human developed its socio-cultural basis. Organization nowadays play an important role of every humans bio-socio-cultural life. Those times are even called civilization of organization. This point out a huge impact on the human being world which organizations poses.

While starting to think about the ways of both systems comparison researcher have to settle a path of research. This path for this research have had 4 steps:

1) Set a subject of analysis - INTUITIVE COMPARISON phase, which based on constitutive subsystems distinction in each of two kinds of systems,

2) Analyze the subjects - ANALYSIS phase,

3) Compare attributes of the subjects in isolation from its phenomenological meaning - SYNTHESIS AND ABSTRACTION,

4) Specification of the possibilities of mapping natural systems into organizational once - GENERALIZATION phase.

In the first step there had to be distinguished those parts of the entire whole which have huge impact on its behavior. Therefore on the modeling, analysis and conclusions process. M. D. Messarovic pointed it out to be able to search complex system the specification of them must be as simple as only possible. This enable to concentrate on the holistic aspect of the analysis, on holistically important subsystems and to pass over the not important parts [M. D. Messarovic, 1976, p.261].

After brief study of natural and organizational systems, and the living system science the author proposed to concentrate on those units that have the ability to self-maintaining and might be treated separately (as a system) from other subsystems in the same space (context), as well on those that are created by some kind of communication between them and are crucial to the maintenance of the oversystem (like organisms creating and living in the same ecosystem). Such distinction lead to the division of living systems on four levels of emergence (fig. 1): cellular, organismal, network and contextual. Each of them is made of the systems on the previous levels, interrelations between them and, what important, reveal different attitudes than previous ones.

The subsystems of natural system are: a cell (as a one cell organisms), an organism (multi cell organisms), an ecosystem (a set of different organisms living in the same space) and the biosphere as the entire whole of living entities. In organization system might be distinguish: a micro-organization, an organization, a network of organizations (e.g. global production network of certain industry) and biosociocultural supra-system. Those distinguished systems, located at different emergent levels, draw different kind of construction. Cellular and organismal level characterize *organizmal construction* and network and contextual level - *modal construction*.

Mapping natural into organizational systems

Natural systems	Organizational systems	Common symbol	Emergence level	Structure of system
cell (unicellular organism)	micro organisation	cell	1 – cellular	organismal
organism (multicellular)	organizations	org	2 - organismal	
ecosystems	inter- organisational relations	group or network of org	3 - network	modal
biosphere	bio-socio-cultural supra-system	supra-system (living systems)	4 - context	

Figure 1. Emergent levels of natural and organizational systems

Source: Prepared by the author

Organismal construction means that system is constituted from inside - their borders are constituted from inside. Therefore such systems obtain a subjectivity and self-identification (autonomous systems).

Systems of modal construction (modality) means that it is constructed by observer-participant, its borders stand out as a consequence of communication between participants of different systems. Modality does not eliminate the autonomy of the systems, but define its interrelations. Modality is not over system but a space in which communication exist [J. Hausner, 2004, p. 38-39].

Such distinction of organizmal and modal systems indicate different behavior of those systems and need different investigation, because systems of organizmal construction are cybernetic systems in which impulse-reaction is a main area of research. Meanwhile in systems of modal construction the focus is on the rules of participants interactions.

The further steps of research needed common methodological basic. J Gharajedaghi, to manage chaos and complexity, proposed a simple method in form of iterative process of inquiry (see fig. 2) [J. Gharajedaghi, 2006]. This seemed to be the common basic for natural and organizational systems comparison. According to that model every complex system have a certain structure, process and functions, and operate in a wider context.

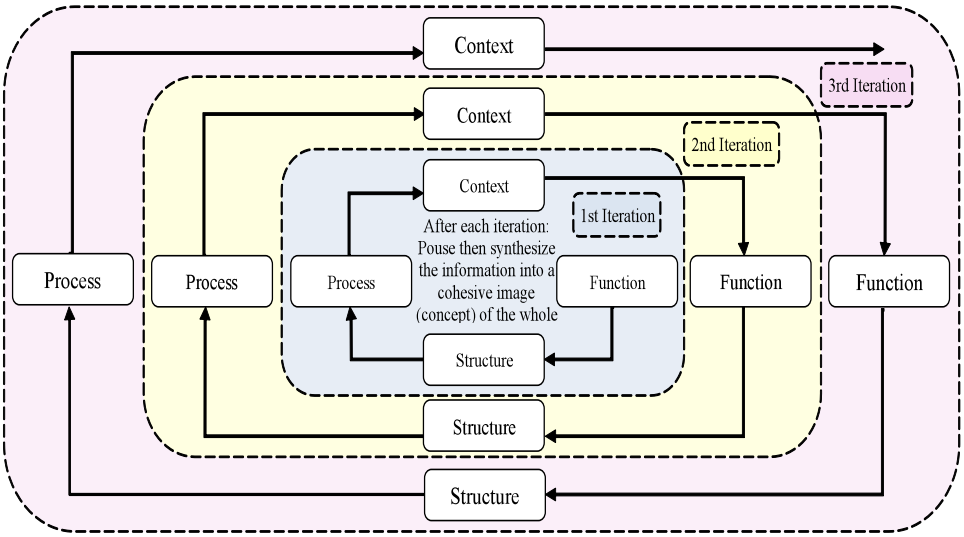


Figure 2. Iterative Process of Inquiry for Understanding Complexity

Source: J. Gharajedaghi (2006), *Systems Thinking. Managing Chaos and Complexity: A Platform for Designing Business Architecture*, Elsevier, p. 112.

Basing on the iterative process of inquiry each level of emergence was analyzed according to structure, function, process and context. And that was a platform for further phases: analysis of a certain systems, synthesis, abstraction and generalization.

INTRODUCTORY ANALYSIS OF NATURAL SYSTEMS

Biological determination of humans and all natural systems means the coherent system of rules and principles which rule the nature world. On the basis of that are physicochemical fixation principles of biophile elements (hydrogen, oxygen, carbon, nitrogen, sulphur and phosphorus). Those chemical elements, only in very tight bounds of earth biosphere, found an opportune terms to connect and form basic structures of living world - organic compounds (nucleic acid, proteins, lipids and carbohydrates). Those four kinds of compounds determines the construction of the whole diversity of nature.

The physicochemical principles could be seen as the basic principles of universe construction. But biological organisms are determined by another kinds of rules: instructions in genetic material. Those instructions determine the structure and functions of the first emergent level of natural systems: one cell and multi cell organisms. Complicated and well preserved process of passing on the genetic information is realized on the lowest possible level - cell level. They are the smallest organisms in nature. Once they meet the top-perimeter size they divide, combine and specialize building multi cell organisms.

The most extraordinary multi-cellular organisms is undeniably human being. His constitution indicates extremely stage of harmony and integration of separated functionally structures and complementary to each other subsystems.

Human being, as well as any other multi-cellular organisms might be classified as an autonomous system. This means it is self reliant, has the capability to self-steerage and may counteract the loss of this capability. Such autonomous system has to have six subsystems:

receptors, alimentators, corelators, homeostat, acumulators and efectors [M. Mazur]. Self-reliant system keep functional balance which enable proper realization of life functions, and adaptation to changeable external conditions.

Each biological organisms goes through characteristic phases of birth, growth, maturity and death. Therefore the key function of each organisms in its over system is to give genetic information further. This enable to last the system over time.

The above mentioned fact shows that not a specimen is the main basis for life lasting but a population - which is a set of inter-breeding organisms of a particular species. Populations and species are on the third level of emergence - network level (see fig. 1). This level shows different kind of its constitution - as a result of interaction of the subsystems (specimens). Such system was named as a system of modal construction in the contrary to the autonomic systems of organizmal construction.

In nature the organisms are to some extent connected to the place (area) in which they life - ecosystem. Together they realize biogeochemical cycle, which is the basis for the stability of ecosystem. While realizing the biogeochemical cycle organisms arrange into trophic dependence of producers, consumers or destructors and they go into many kinds of interactions. In such metter they complete a certain roles (niche), which are available in the ecosystem.

As a consequence of huge diversity of natural world, characteristic for each level of its construction, organisms usually fulfill a part of its potential possibilities. Nevertheless this is the necessary condition to keep the stability of the whole, in which they are a part. The tendency to rise of diversity is built-in in the process of genetic information transferring - rank and file, particularly through sexual reproduction.

INTRODUCTORY ANALYSIS OF ORGANIZATIONAL SYSTEMS

Organizations began to be treated as living systems more or less in the mid 20th century. Since then, organization has become an object of research focused on the criterion of its *vitality*. There have been also numerous metaphorical references between organizations and organisms. Science searched for *genetic* sources of organization, and analysed its behaviour in *the jungle* of organizational system. At that time it was noted that the essence of existence of an organization lies in its survival and self-improvement, and not in profit, which should constitute a need, not the aim.

Organizations execute their character in different ways, engaging in sets of various dependencies, and filling in particular niches in the biosociocultural supra-system. However, despite the fact that the organizational system consists of hierarchical units (human, organizational cell, organizational division, organization, a network of organizations), in the context of the biosociocultural super-system, autonomous systems, as already mentioned, creating these units are the most important. Autonomous systems show functional independence, they have - like natural organisms - control capacity and ability to counteract loss of this capacity. Autonomous systems of organizational system include: micro-organizations, autonomous organizations, networks of autonomous organizations (sets of various autonomous organizations operating in a given field), and autonomous networks of organizations (set of organizations that cooperate with each other, and form an autonomous organism, like certain global productions system). Organizations themselves can decide which kind of autonomous system they shall become through their adopted strategy of development.

Functioning of an organization is possible only thanks to the system of management. Its main function is maintenance of capacity to control the system, and counteracting its loss. Performance of this function derives from interaction of subsystems: management, executive, and the process of interaction. Micro-organizations and autonomous organizations constitute the whole management system within own borders. Autonomous networks of organizations must additionally develop a system of management outside the borders of own systems (performing the role of subsystems) with other organizations belonging to a given network (e.g.: in accordance with JIT, or x-engineering concepts). They all perform the functions of critical subsystems of autonomous network of organizations. Their autonomy is restricted for the good of a given network, and thus one may say that only the whole created by them presents both, autonomous, as well as slightly egoistic behaviour.

The last level of hierarchy of organizational system, and, at the same time, of its emergence, is the biosociocultural supra-system, which is a set of various autonomous systems, and offers various *environmental* conditions. The biosociocultural supra-system may be considered in regional or global scale as the context for functioning of an organisation. In the regional scale, the biosociocultural supra-system refers to similar political, legal, social, cultural, technological, and environmental conditions for an organization. Globally, it is a set of various biosociocultural contexts that may be regionally distinguished.

The contemporary form of operation of organizational system contributes to integration and mutual dependence of different regions of the world. This is due to, first for all, autonomous networks of organizations - through their implemented, and unlimited - in the scope of place and time - share of production. Thereby, the image of organizational system is changed, and it assumes the form of a complex network of dependencies, which starts to be governed by laws similar to those which regulate natural systems.

COMPARISON OF ATTRIBUTES OF THE ANALYZED SYSTEMS

of natural and organizational systems should have started from finding common and different mechanisms of their operation with breakdown into a system structure. The main goal of organismal systems seems to be protection of duration of information which is constitutive for them (DNA in the case of organisms, behavioural experiences in organizations). In the case of modal systems, whose the previously mentioned systems are a part of, it is difficult to speak about the purpose of their actions. They constitute the area of boundary conditions for functioning of the former, to which conditions they must adjust. A supra-system thus creates the functioning principles in a given space to which autonomous systems must adapt.

In the case of organismal systems, the character of *vitality* is determined through system condition, namely its efficiency which affects its functioning and results. Each natural organism aims at preservation of internal balance (homeostasis) within precisely specified and quite inflexible borders. Only such condition ensures optimum execution of internal processes. Therefore, organisms shall aim at maintenance of such conditions by means of a system of control and regulation (referred to further on).

Homeostasis seems to be equally important for organizations, though not always as automatically regulated as in the case of organisms. Internal environment analysis in an organization is important, as without it there arises a risk of sanctioning a dysfunction in the system, and, as a consequence, of permanent reduction of its efficiency. In the case of organizations, pathology analysis is too often omitted. Testing organization in terms of

pathology could also be related to development analysis. Similarly as in organisms, particular dysfunctions are characteristic for different stages of their development.

Both, organisms and organizations pass through the life cycle essentially including: birth, development, maturity, decline. The qualitative dimension of last stage of life is, however, different in the case of organs. Different organisms finish their life breaking into basic units of the natural world - elements and simple chemical compounds. Their primary goal in the living process is to convey genetic information. In this way *the vital information* materializes again in another organism.

The decline of organizational systems has a slightly different shape. First, the disintegration is not total, but partial - to the previous levels. Secondly, the decline may occur by reduction of useless behavioural experiences (a kind of organizational DNA), and creation of useful ones (e.g. new technologies). In this way, organizations may in a way *jump over* the process of *natural death*. The impact of an organization on the process of *self-reduction* is too great, therefore organization rather protects itself against this stage than *co-operates* with it. In biology, in the case of decline one may observe strong determinism encoded in genes that an organism cannot counteract. Whereas many organizations last despite a number of internal pathologies. This condition is costly for the super-system, which must maintain this unnecessary organizational *adipose tissue*.

Control and regulation are the main processes maintaining homeostasis in organs. The higher the degree of a system's organic component, the greater the link between control and regulation. The human nervous system performs both, the functions of control and regulation, depending on life functions it applies to: higher or autonomous. In organizations, though depending on the degree of organic component, one may usually distinguish a subsystem of control and regulation. It is worth noting that it is *the structure* of management system that to a large extent constitutes an organization as mechanical or organic. If, however, one assumes that the level of development of a system is determined by the degree of dependence between system of control and regulation, organizations should aim at such application of management systems, which shall enable this dependence on each level. Then they will reach the character of a self-determined system.

The basis for the processed of control and regulation consists in the mechanism of feedback: positive and negative. Control operates on the basis of positive feedback, directing the system, and regulation on the basis of negative feedback - counteracting deviations from the adopted condition.

In order for an organism to function properly, it is necessary to fulfill five basic conditions of efficient control and regulation, namely: existence of a pattern, internal hierarchy, relations between the elements, embedded mechanisms of functioning, capacity for capturing information from the environment. These basic capacities secure functioning of both, autonomous natural systems, and organizational systems.

GENERALIZATION OF COMPARISON PHASE OF NATURAL AND ORGANIZATIONAL SYSTEMS

Mapping natural systems in organizational systems, based on iterative process of inquiry (fig. 2), made possible to develop a model that constitutes a basis for further analyses. As might be seen on fig. 3 the first and the second levels of the model cover authonomous organismal systems, constituted from the inside: cells and micro-organisations, multi-cellular organisms,

and greater organizations. The third and the fourth levels include modal systems, constituted as a result of interactions between their elements: autonomous organizational networks, and various types of inter-organizational compounds: trade dependencies, and connections between organizations in the same environment.

Mapping of the natural world and the organizational world suggests quite a large degree of their convergence. Similar functions and processes, and the role towards the context indicate a high degree of convergence of the organizational world structure and the structure of the natural world.

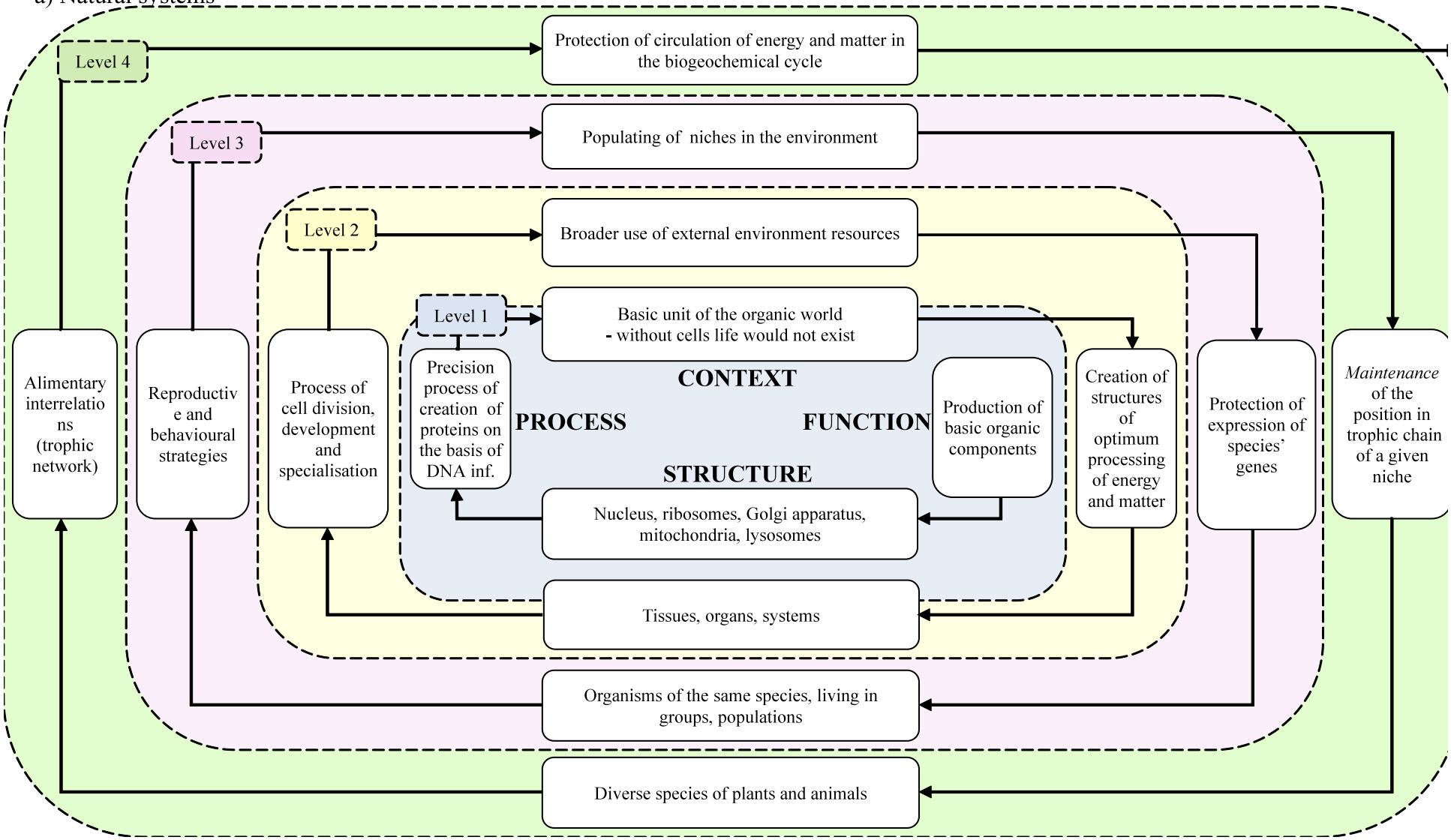
Micro-organisations, and greater organisations may be presented in analogy to the processes conducted by a cell. This microcosm may constitute a perfect example for analysis of companies, regardless of their size, and even the number of executed processes. This in turn simplifies the outlook on organizations, making them more conspicuous.

An organism is, on the other hand, a perfect example of integration of subsystems into a harmonious whole. The postulates of *embedding the whole in a part*, decentralization, and self-organization perfectly complement the structure of natural organisms, in particular the human body. They create at the same time a tangible example conducive to understanding of what an organization should be, and how it should operate to achieve the result of an organic synergy of its subsystems.

The organizational system differs, however, from the idea of the natural world on the third and the fourth level of emergence, with regard to the role that it performs in the environment. There seems to exist a world dominated by organiations aiming at implementation of their own *ambitions*, regardless of the good of the entire supra-system – the biosociocultural context. If *an organization* (in the sense of an attribute) *is such a whole, the components of which contribute to the success of the whole* [T. Kotarbiński, 1975, p.74], one may even declare that in the biosociocultural context the organizational system is characterized by lack of organization. The relation between the organisational system and the biosociocultural context is far from organic. The reasons for such condition consist in still insignificant diversity of the organizational system, as well as in the lack of *the mosaic character* of the organizational system in the biosociocultural context. *The mosaic character* shall be understood analogically to the existence of ecosystems in the nature. Ecosystems exist thanks to organic borders - not barriers, but borders - well-developed by the participants of a given ecosystem.

Mapping natural into organizational systems

a) Natural systems



b) Organisational systems

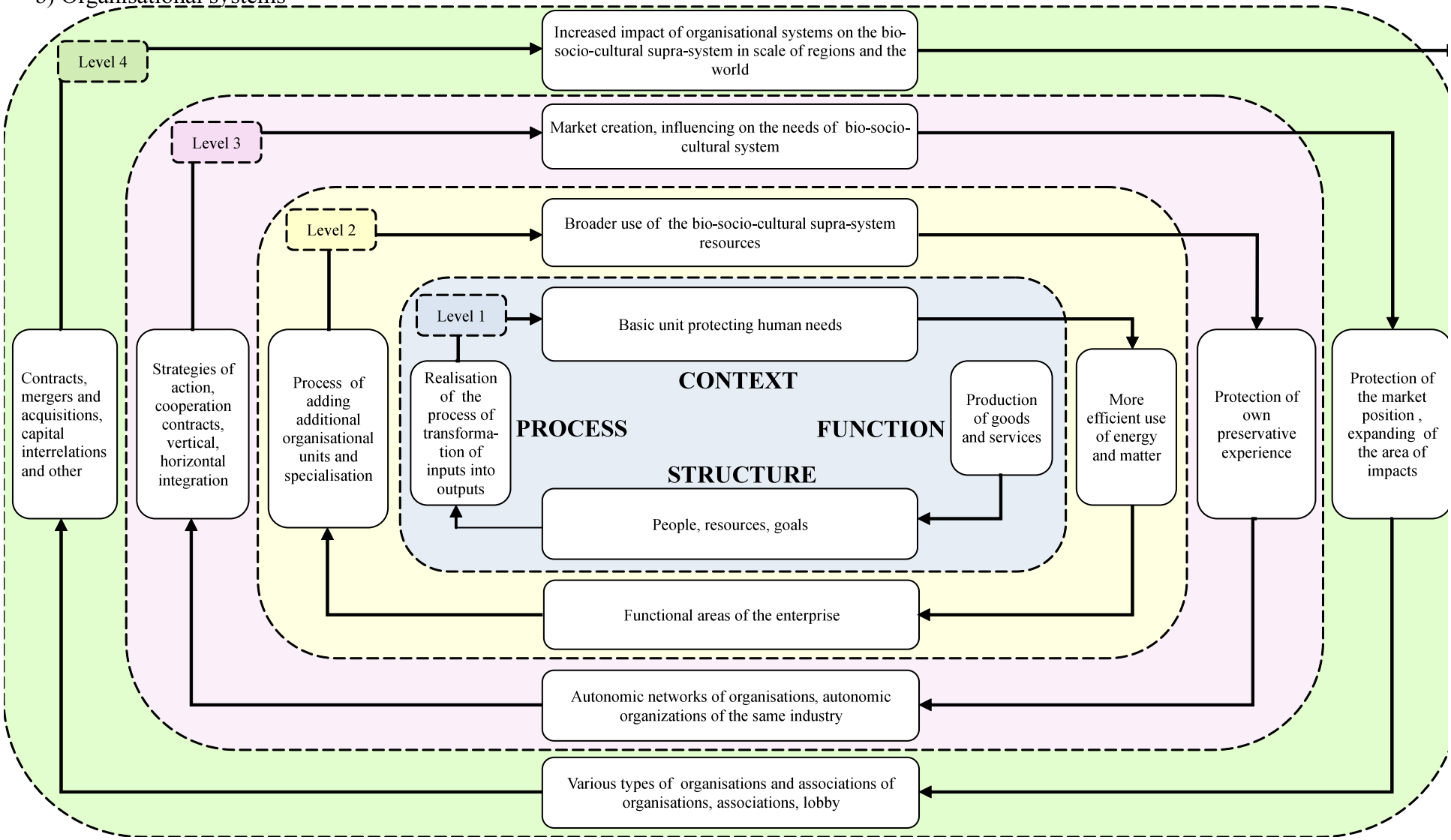


Figure 3. Iterative inquiry model with regard to natural systems (a), and organizational systems (b)

Source: Prepared by the author.

However, what is the most important, the diversity of such participants is unlimited – none of them fills in the potential niche, which it would be able to fill; each must agree to fill such niche, which is assigned to it in a given environment. Such forced limitation determines the organic co-existence, which is not yet comprehended by the organizational system. The reasons for it should be understood as consisting in small diversity reflected in competitiveness, which would constitute a limiting element, stimulated by other players in the systems, so to some degree - externally. In the natural systems the limitation, and in fact self-limitation is inherently embedded.

CONCLUSIONS

The primary purpose of the research presented in this article was presentation of possibilities of mapping of the natural systems in the organizational systems by means of a developed methodology.

In the course of the research analysis it was declared that repeatedly in the development of science and management, people have referred to the nature and its processes, looking for inspiration to explain or describe phenomena present in the corporate world. However, observation of nature has never been so significant in explanation of the trajectory of development of the entire organizational system. The unrestrained desire to understand the organizational world at the turn of the 20th and 21st centuries directed research towards other dynamic and complex living systems - so that one can better understand and possibly transfer the model solutions system to the system created by human. The development of this trend led to creation of the concept of the biology of business at the beginning of the 21st century, one aspect of which consists in the presented methodology of referring biology in its different scopes to business.

The applied research methodology allowed, in a simple and understandable manner, arrangement of the natural and organizational systems on different levels of emergence. In this way two models have been created based on one model. The first applied to distribution of function, structures, processes and context of the natural systems on four levels of emergence, and the second one distribution of the same categories for both system classes.

On the basis of the iterative process of inquiry applied to the natural and organizational systems one may seek potential representations of the natural world in the organizational world, and determine the special character of the former with regard to the latter. A researcher may benefit from the specific perspective based on the model. This range will be presented in an article that shall continue the discussion commenced herein.

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