

# Principles of Nature-Likeness in the Creation of Technically Organized Territories

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**Abstract**— This article describes theoretical and methodological basis of the use of methods and principles of nonlinear dynamics in the development of projects for the organization of territories in the terms of nature-likeness. Based on the conclusions made, we can recommend using of the self-organization property of large systems in project management for the implementation of infrastructure projects in order to achieve a synergy effect. This article substantiates the criterial basis of project management: the level and intensity of usage of the population carrying capacity of the region. The principles for the creating of criterial basis for project management are the following: the principle of environmental acceptability taking into account population carrying capacity of territories and the principle of reasonability which is based on a dynamic model of the socio-economic potential of region. Applying of specified criteria framework provides covariance of all natural and artificial subsystems involved in the organization of territory.

**Keywords**— *Non-linear dynamics, sustainable development of territories, project management, synergy effect, population carrying capacity of territories, area planning, site grading project.*

## I. INTRODUCTION

In accordance with the concept stated by V.V. Putin, on the sustainable and long-term development of our country, the principle of nature-likeness is fundamental one. According to this principle, human social life in balance with natural environment (NE) with the priority of environmental acceptability in the development of any projects aimed at creating technically organized territories, the main criterion for project management when creating territorial organization plans, area plans, general development plans, infrastructure projects, reconstruction and renovation projects, situational plans, as well as general plans for buildings and structures of any functional purpose is the degree of intensity and the volume of usage of the population carrying capacity of the territory (PCC) as a required resource [1]. This criterion predetermines a system of limitations allowing the possibility of implementing all types of projects, taking into account forecasting of changes in PCC. The principle of nature-likeness is of particular importance in the implementation of opened and developing projects (including multiprojects) and programs. The history of project management in the USSR, in Russia and abroad has quite a few examples when the implementation of socio-economic programs led to unpredictable, often catastrophic consequences. The strategy stated by the President of the Russian Federation can be implemented under the condition of the principle of self-

organization of complex systems; this principle should be started in project management.

Modern institutional environment is advanced enough to adequately manage multiple conflicts that arise in the field of natural resources management, with various types and forms of man-induced impact on NE. Technically organized territories are complex (large) systems with many non-programmed parameters [2]. In view of this, applying the principles of nonlinear dynamics and synergetics in project management seems to be possible and effective, especially when developing progressive projects and programs. This allows you to use the property of self-organization which large systems possess. Applying of these methods within the existing regulatory framework (Constitution of the Russian Federation, law “On Environmental Protection”, Urban Development Code of the Russian Federation, law “On Sanitary Welfare of Population”, etc.) [3], in combination with the process of self-organization which actually appears in the process of natural resources management, allows the multi-parameter optimization of design decisions.

Current historical stage of human civilization is characterized as a post-industrial society; its specific characteristic is changing importance of production factors in socio-economic development. In the era of industrial development, the main factor in production activity was natural resources, or the assimilation capacity of Earth which includes all the elements of biogeocenosis and means of production, as a set of organizational and technological systems that provide the conversion of all types of resources into a socially significant result or product. Negative consequence of industrial era which was based on the extensive development and functioning of restoration systems is the imbalance between the assimilation capacity of biotic and abiotic environment and the ecological capacity of the planet. This imbalance is due to the fact that the accumulation of metabolites of different origins became avalanche-like. Society using the blessing of civilization and accustomed to relative stability and constancy has become a consumer of resources, in all aspects. Moreover, not enough attention is paid to the objectively existing possibility (threat) of quick and irrevocable changes in the biological and socio-economic conditions of our life – and it happens not only at the individual and everyday level. Social consciousness ignores objective laws, including the law of the transition of quantity into quality. Accumulation of metabolites, as well as the impact of other types of man-caused effects (fields, landscape restructuring, lithospheric effects, etc.) on natural

environment (NE) leads to M-concentration law. In accordance with this law, the accumulation of metabolites formed during the life of any biological system leads to its depopulation, mutations, and even complete extinction of species. Applied to humanity, metabolites represent the whole variety of effects on NE exceeding its assimilation capacity. In modern consumer society, the main type of metabolites is solid and colloidal municipal waste appearing everywhere where people live. Quantitative increase and morphological diversity of these metabolites occurs exponentially, i.e. there is a continuous change in the system of waste generation and man-caused negative impacts on NE caused by them, in proportion to their amount. Real threat of catastrophic changes in NE caused by waste and products of its natural decomposition determines the need to develop a waste management strategy which should include regulatory legal, theoretical, methodological and organizational and technological solutions. Implementation of this strategy is suggested in the form of specialized sector of economy which can be defined as compensatory one, i.e. having the goal of compensate and neutralize all kinds of man-caused effects on NE. The global trend of people resettlement in the modern world is urbanization which provides the specified pattern of avalanche-like growth of waste in all areas of the Earth. From the position of the general theory of systems and informatology, this phenomenon is described by the law of catastrophe due to the increase in system entropy (NE) [4].

## II. LITERATURE REVIEW

Theoretical and methodological basis of the principle of nature-likeness in the territorial organization and urban planning are described in the theory of V.I. Vernadsky on the biosphere [5]. The interaction of nature and human is possible in the case of their symbiosis. If there is human in NE, the latter is defined by V.I. Vernadsky as noosphere which is considered as a geological phenomenon. In the noosphere, human becomes a factor whose activity has a significant modifying effect on NE. The principles of changes in the world based on co-evolution of human and biosphere were developed by academician N.N. Moiseev in his works.

These principles form the basis of urban planning legislation which is in force in the Russian Federation and ensures the relative balance of environmental protection and urban planning decisions and projects for the organization of territories, area plans, general plans for settlement development. Legal framework in this case is formed by the Law of the Russian Federation "On Environmental Protection", Urban Development Code of the Russian Federation, and Land Code of the Russian Federation. Institutional basis for natural resources management in urban areas is constituted by the Constitution of the Russian Federation, Civil Code, Land Code of the Russian Federation, law No. 131 "On the Foundations of the Organization of Local Self-Government of the Russian Federation". The patterns of changes in entropy in the noosphere which is actually a complex (large) system are described in the works of G.T. Malinetsky "Nonlinear dynamics. Approaches, results, expectations", "Synergetics: the future of the world and Russia"; G. Malinetsky [6], A.B. Potapov "Nonlinear dynamics and chaos", Publisher: LIASS. 2016; I.R. Prigozhin, "Introduction to the thermodynamics of irreversible processes" Publishing House: RKS [7].; G. Nikolis, I. Prigozhin "Self-organization in nonequilibrium systems", 2000 [7,8].

## III. RESEARCH METHODOLOGY

In accordance with the basic principles of environmental design and the requirements of GOST R ISO 26000-2012 [1], the maintaining of NE is an absolute priority in the course of performing of any socially significant activity. Consequently and taking into account the initial data of this actual project, it is necessary to provide spatial positioning of noosphere objects, to develop a transport and logistics concept, to optimize land and water use solutions and, accordingly, functional zoning of territories and their landscape and visual characteristics, taking into account forecasting for territorial development on the scale of socio-economic development of the country considering its functional role in the global co-evolutionary process.

An important element of design methodology is management theory, since the design object, in the context of the problem under study, has the following features: large dimensions determined by the vast number and variety of parameters; many alternative performance parameters which determine possible rational solution; the lack of acceptable analytical dependencies and procedures for determining desired parameters; significant uncertainty in the source data. An important element of research methodology is the principles and methods of informatology, since information is a generalization essence that ensures decreasing entropy in the system, allows effective management of project risks, increases social and civil activity of the population in solving environmental and city-forming tasks, and allows implementing a preventive response strategy to reduce threats to NE. Applying the principles of self-organization in modern city formation is especially important due to the fact that urbanized territories are full of many active non-programmed elements (people) united in a particular society. In this case, the factor of self-organization should be considered as "collective unconscious" what means that the instinctive reflection of a person, groups of people and society as a whole can appear in both a socio-constructive and destructive and even antisocial form what actually determines possible scenarios of the evolution of technically organized territories. Social regulators and the forms of their institutional design and manifestations provide the socially useful and safe nature of such regulation [6,8].

During developing this paper, theoretical basis of urban planning and architecture, urban studies, natural resources management in urban environment, environmental psychology, as well as the principles of nonlinear dynamics and synergetics that determine the adaptive and attractive properties of a settlement as a large system, was studied. This methodology allowed developing theoretical and methodological approaches based on the general theory of systems, the general theory of management and synergetics when implementing the strategy of nature-likeness in the processes of territorial planning and urban development [9, 10]. The main principles are as following:

1. Urban planning required for sustainable development of territories, i.e. creating a comfortable artificial environment for safe and favorable human living conditions, limiting negative man-caused impact on NE, and reducing the usage of PCC. Basic documents for territorial planning, including urban one, are: territorial planning schemes of the constituent entities of the Russian Federation, general plans for urban settlements projects of which are mandatory discussed at public hearings with the participation of representatives of the

population living in the place of location of these projects. Based on the projects of land surveying, urban development solutions are developed, both built-up and free territories to be built up. Information on the permitted type of development is contained in urban planning regulations. Land use rules are established by regulatory legal acts of local authorities [11, 12].

2. Functional zoning of territory: the division of territories into zones of their possible functional use registered in accordance with regulatory standards. This provides the optimal combination of different socially significant functions realized within territories, and settlements that are often incompatible or even antagonistic to each other: residential, recreational, public administrative, industrial, engineering and transport infrastructure zones, military zones, and also zones for special and compensatory purposes [13].

Evidently, it is necessary to use the properties of self-organization which is understood as an order arising from chaos in practical activities related to the design, construction and operation, as well as the elimination and disposal of all reproducing systems, and also social engineering infrastructure that provides their functional sufficiency. Compensatory industry is an element of noosphere that provides the neutralization of complex negative effect on NE, as well as on its technically organized part. Organizational and technological processes carried out by compensatory industry can be considered as a sign of the self-organization of a complex large system; in the course of such self-organization, Ashby's Law of Requisite Variety is realized which objectively ensures the homeostatic existence of all the spheres on the Earth [7]. Obviously, in the field of urban development, area planning, development of projects for the organization of territories, the emergence of a new restoration system should be taken into account by creating systems of theoretical and methodological support for its functioning and normative and technical regulation of all processes and functions of compensatory industry.

At present, the advanced regulatory framework has been created in the Russian Federation which is sufficient for organizing the functioning of compensatory industry equipped with modern innovative technologies; while taking into account the features of regulatory object such as the global nature of waste impact, the need for quantitative and qualitative accounting of PCC of the region or area where the metabolites are located, specifics of their morphological composition, as well as the motivation of business structures involved in the process of metabolites handling, and the nature of their social responsibility. In Russia, the state and international standardization system is used which provides the implementation of the United Nations guidelines, consumer protection, and social responsibility for ensuring the constitutional right of citizens of the Russian Federation to safe and favorable environment [14]. Based on the experience of design and organizational work in the field of natural resources management, the creation of NE protection systems and programs in the field of waste management in different regions of the Russian Federation, the authors presented normative and methodological approaches for optimizing projects in technically organized territories including general plans for urban and rural settlements taking into account the existing danger of the negative impact of compensatory industry on the functional zoning scheme of settlements of engineering infrastructure projects, land management

projects, as well as technological and administrative regulations for water use, subsurface use, forest use, etc. The basic methodology in this case is project management [15]. President of the Russian Federation V.V. Putin, Prime Minister D.A. Medvedev and Moscow Mayor S.S. Sobyenin [16] are constantly talking about the system of managing priority national projects and its further improvement. Examples of successful project management in Russia are obvious: construction of Crimean bridge, Moscow Renovation Program project, as well as targeted comprehensive programs which include the creation of a single federal waste management system based on the achievements of science and technology [15, 17]. Concept of project management is based on the principles and methods of multi-parameter optimization of restoration systems that include settlements of various types, as well as restoration systems included in the technically organized part of territories and settlements that perform the functions of methods of labor application and neutralizing the impact of society on these territories [17]. Moreover, these restoration systems by their nature are complex (large), dissipative, active, dynamic, self-organizing, and are created artificially to meet the real or potential needs of society or to solve a complex of socially significant problems [18]. Obviously, in the context of project management, these systems belong to open, progressive projects [18]. Target designation is fundamental in project management, i.e. the developing of the ideal image of the future state of projected system and characteristic of its system-parametric model. Due to the objective effect of uncertainty principle which is fundamental by its nature, it is necessary to take into account this principle for any type of human activity involving the creation of artificial systems in technically organized territories, and to rationally apply the "black box" methodology in managing the activity in question. This methodology a priori implements the principle of self-organization, regardless of the nature of the processes and phenomena where it is applied. In the context of the abovementioned, project goal-setting is impossible without establishing the priority requirement of maintaining the population carrying capacity of the territory, as well as reducing its usage both during project implementation and in the post-project time period [7,8].

According to the idea of V.I. Vernadsky, "humanity can survive being independent from the limitations of NE while maintaining biological productivity and assimilation capacity by developing, adopting and implementing a general strategy for human behavior in the environment" [19].

#### IV. RESULTS

Spatial and technical organization of territories in accordance with the principles of project management belongs to the category of progressive projects what makes it necessary to use project management in a modern system of natural resources management and urban formation. Based on the above studies and rationales, the following can be considered as the results of this work:

1. Urban planning system is a set of spatially organized and interconnected material objects of technologically developed territories which, together with natural components, form the environment of human social life [1, 20]. Development of urban planning system is a complex interaction of social, biological, natural and climatic and technological processes and phenomena, large part of which are non-programmed; therefore functioning and development

of a technically organized environment is a synergy process; the main reasons for this are the following:

- uncertainty of factors and conditions that determine the emergence and socio-economic development of settlements;
- objective existence of irrational phenomena that arise in the process of organizing territories, they are caused by human as an active element of the system in all its aspects;
- scientific and technological progress as a sign of human and NE co-evolution.

2. For many cities, adaptation of industrial buildings and structures characterized by a mismatch of their general planning, space-planning and structural solutions with modern building and urban planning norms and rules is actual, in order to use them for the purposes that were not established during their design. These are mainly industrial and transport-storage buildings, buildings of the late 19th and early 20th centuries, as well as objects of functional architecture. International experience in urban planning and improvement shows that the reconstruction of capital industrial buildings can produce objects of other functional purpose, in particular theaters, studios, exhibition halls, art workshops, sports, scientific and other places of “creative” space [10, 19]. Examples of the organization and modification of urban environment and of implementation of modern concepts of urbanism actually require fundamental theoretical and methodological approaches based on the theory of self-organization which allows a multi-parameter optimization of space in order to solve actual urban problems. In this context, a technically organized territory is considered as a complex self-organizing system with high level of uncertainty what determines the applying of robust methodology for its management. With regard to urban development, this is a set of management methods, the purpose of which is to create such a regulator that provides stability and functionality of a technically organized environment under the conditions of a complex negative effect of different origin. Principle of self-organization is an important tool for urban formation which allows transforming the chaotic impact that occur during the design of settlements, the antagonism of society and NE, the contradiction in functional use of the territory of settlements, transport conflicts, socio-economic limitations, extra-systemic mergers, etc. in the process of organizing general plans for settlement and balancing the interests of subjects living on this territory [21,22].

3. City is a complex dynamic system; therefore, it is reasonable to use the following principles at the stage of developing a strategy for urban formation and conceptual solutions for the organization of urban space [23, 24]:

- homeostasis which provides stability and design functionality of the settlement under the conditions of negative influences in accordance with the design hypothesis;
- hierarchy and the resulting principle of system scaling;
- nonlinearity, as a property arising from the emergence principle which represents one of the interpretations of the law about quantity to quality transition in terms of urban planning;
- attractiveness, i.e. taking into account the properties of technically organized territories to modify the characteristics and properties of natural environment, as well as of the source social and engineering infrastructure.

4. Developing of criterial basis for projects and programs aimed at achieving design results is of particular importance in the design of spatial distribution systems for socio-economic systems for various purposes. The whole amount of criteria can be divided into two categories:

- criteria for the admissibility and acceptability of projects which should include the volume and level of intensity of PCC usage; dynamics and nature of transitional processes of combining and embedding noosphere objects into NE taking into account Le Chatelier’s principle.
- criteria of reasonability which can be combined as the socio-economic potential of region (SEPr). This criterion is a functional that takes into account the specifics of the system-parametric model of designed territory: social utility, significance and effectiveness, as well as the potential and vector of functioning of territories in the global processes of mankind. In this case, it is necessary to take into account the principle of system scaling which provides maximum covariance of intra-system connections and interactions of all subsystems in noosphere that are formed as a result of a territory organization project.

## V. DISCUSSION OF RESULTS

Growth of urban population in Russia reached 73% (rapid process of urbanization actually leads to the problem of poor quality urban environment, aggravation of environmental situation and social contradictions). An urgent scientific and socio-economic problem is the development of a theoretical and methodological basis for the practical solution of the problems of urbanized settlements. Ecological approach in urbanization considers the urban settlement as an existential environment where the conditions for all types of biological and social life of people are combined and well-balanced; this is achieved by rationalizing urban planning solutions that ensure the multifunctionality of all objects of urban environment (multifunctional buildings, street adaptability not only for traffic flows or human flows, but also for recreation purposes, as the place for creativity, innovation and other forms of activity (boulevards, squares and so on.)). In accordance with the current conditions of social life, in the post-industrial era, the main trends in creative urbanism are overcoming industrial survivals, social exclusion of people, as well as the restoration of sparsely populated suburban and rural settlements that are in socio-economic decline. Modern trends of urbanism which appeared in Renovation Program [9] in Moscow are the example of creating an environment in settlement space which provides a favorable social climate and communication, contributes to the realization of creative and intellectual potential of its residents, and the improves their quality of life [25]. Signs of socio-ecological adaptation and the formation of order from chaos in modern city formation are among the following trends:

- maintaining of traditional types of buildings and architectural forms that have been modified over many decades, as well as of landscape-visual environment which was historically created and provided a certain balance for NE and man-caused transformed artificial urban environment. These are, as a rule, areas of historical development with the signs of architectural styles which appeared during the formation of urban environment.
- using new creative methods for the formation and development of urban space, where, as a rule, the activities of the “creative part of society”, financial centers, service

industry, residential buildings of increased “exclusive” comfort are functionally concentrated. Fundamental principles for the formation of these urban areas are: technology, tolerance, innovation. It is in such territories that objects are designed and built using innovative technologies (“smart city”) that demonstrate the evolution of noosphere. The cornerstone of such an urban concept is the idea of a comprehensive and complete satisfaction of all human needs [23, 26].

The principle of nature-likeness in projects for the technical organization of territories allows the creation of artificial large “non-linear” reproducing systems located in man-caused modified NE which are characterized by the ability to self-organization that determines the level of their stability and functional sufficiency, as well as attractiveness; the latter is visible in the different nature of the involvement of NE in urban process. Consideration and use of these principles in the organization of territories allows implementing the principle of nature-likeness and minimizing the usage of PCC what is a prerequisite for stable, long-term and sustainable development of the territory and the country as a whole [13]. NE in accordance with the principle of general theory of systems should be considered in the context of its impact on human. Development of the projects for organization of territories should be based on the postulate of permanent interaction between NE and human. A certain type of human behavior in NE determines the type of natural resources management and the volume of PCC usage. This is especially important in the implementation of ongoing, open infrastructure projects that corresponds to the concept stated by the President of the Russian Federation.

In the context of the implementation of the May 2018 Decree of the President of the Russian Federation, among the main requirements of which is to resolve the issue of destroying the metabolites that were formed during the life of modern society, it is obvious that a compensatory industry should be created within the country’s economic complex that has a sufficient degree of adaptability and diversification to neutralize man-caused negative impact on NE and to reduce its assimilation capacity.

## VI. CONCLUSIONS

1. Quantitative and qualitative changes in the noosphere that are characteristic of the sixth technological structure predetermine the need to create a single theoretical base that provides maximum balance of NE with man-caused effects formed during the creation of technically organized territories based on the works of V.I. Vernadsky and N.N. Moiseev;

2. The need for implementation of the principle of nature-likeness as a fundamental one in survey, design and urban forming activities is obvious; popularization of positive effects arising from the self-organization during activities for forming an urbanized environment is also necessary;

3. Principles of self-organization and synergetics are the consequence of the process of multi-parameter optimization of the functioning of technically organized territories, and they should be taken into account during project management;

4. Project management objectively becomes the most important tool to practically implement the principle of nature-likeness in the development of technically organized territories of various socio-economic and functional purposes;

5. Criterial basis of the principle of nature-likeness in project activities is the population carrying capacity of territories, as well as the size and intensity of its usage.

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