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ON THE DUAL NATURE OF URBAN PLANNING SYSTEM AND ITS COMPLEXITY

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ABSTRACT

This article presents an analysis of scientific ideas of the followers of the Complexity Theories of Cities and representatives of the Ukrainian urban planning school pertaining to the structure of the urban planning system, its nature and complexity. The dual nature of the urban planning system is explained on the examples using I. Newton's analog method.

Key words: urban planning system, dynamic nature, duality, complexity, demo-ecological concept, evolutionary-synergetic paradigm, city complexity theory.

1. INTRODUCTION

In this era of information society the Earth has turned into the urban type planet. According to the UNO data, almost 54% of population of the planet lived in urban areas in 2014. Polarization of settlement in favor of the large cities and the accelerated growth of population in the world give rise to the new and evermore exacerbate the existing global economic, social, political, ecological problems. Cities produce a colossal impact on the environment marked by both, demographic dynamics and by the volume of natural resources consumption. Uncontrolled expansion of developed territories at the expense of suburbs threatens the very existence of historical cities and preservation of cultural values. In the result of implementation of the policy of multiculturalism in cities the problems of segregation of urban population by social, economic, cultural and other criteria became apparent in a new way.

Ensuring sustainable development of settlements within the short time intervals requires effective planning. However, today we observe premature aging of the master plans, resulting from the disparity in the dynamic character of urban planning objects and the static forms of presenting urban planning documentation.

Urban planning today requires effective tools for computer modeling of the scenarios of urban development and this in its turn requires a clear understanding of the structure and nature of the modeled object – an urban planning system. This is why analysis of scientific ideas regarding the structure of the urban planning system, its nature and complexity, that is, the subject of research within the framework of this article remains to be a pressing scientific-methodological problem.

2. THE DUAL NATURE AND COMPLEXITY OF THE URBAN PLANNING SYSTEM

The appearance in the middle of the 20th century of the new interdisciplinary theory that has acquired several names: self-organization theory, synergetic theory, dynamical chaos theory and theory of dissipative structures compelled representatives of different sciences to reconsider their views on the nature of functioning and development of the systems of varying complexity within the frameworks of their subject areas. As a result of transformation of the world scientific picture the theory of urban planning has also experienced some essential methodological changes.

The new interdisciplinary self-organization theory was initially used to describe and study the material and complex living systems, yet physicists and mathematicians did display their interest in the city as an object for testing their mathematical models. They regarded the city not as a collection of artifacts, but as a living organism, showing all properties of the natural complex systems. Even the Nobel prizewinner I. Prigogine, author of the theory of dissipative structures, used the city in his works as a metaphor for the complexity [7]. The result of such increased scientific interests in the city as an object of the study of peculiarities of functioning and evolution of complex systems was emergence of the Universal Complexity Theories of Cities consisting of: Theory of dissipative cities, focusing on links of the city with the environment; Theory of synergetic cities, dealing with interaction between urban factors / agents; Theory of fractal cities, dealing with the fractal structures and morphology of the cities [2].

Juval Portugali, one of the researchers in the field of urban self-organization, quoting in his article [8] P. Allen, the founder of the city complexity theory, gives answer to the question what makes cities the complex systems.

In his work P. Allen noted, that once convenient for description of the motion of material objects classical mechanics can not be applied for description and prediction of urban systems behavior. For example, it is not possible to calculate in advance the trajectories of movement of motor vehicles or pedestrians in the city, since the decision to make a

turn, speed up or slow down is taken by the human who belongs to the living systems, that have "choice" and "freedom" indigenous to such systems [1, p.1].

J. Portugali explains duality and complexity of the urban planning system in his work [8] as follows. On the one hand the city is a huge, artificially created environment formed by the innumerable small artificial objects (buildings, roads, bridges, etc.), each of which is composed of still smaller artifacts, and these artifacts are mostly simple systems (Fig.1). On the other hand the city is a form and the result of development of social relations and can function only if there are people in it (Fig.2). Thus, cities by their nature appear to be the dual complex systems for they consist, on the one hand, of the material components and, on the other hand, of the "human" components. If we consider the city only as the material-spatial environment, then the city is an artifact and belongs to a simple system. If we consider the city as a system with the "human" factors, then the city is a complex system. These are the "human" factors and their interaction with each other and with the material components of the city as well as with the environment that transform the artificial object – city – into a complex urban planning system characterized by dynamic nature like any living organism.



Fig.1. Venice, Grand Canal. Source: Photo by Pavel Suprun.



Fig.2. Public space near Latin Cathedral in Lviv. Source: Photo by Pavel Suprun.

Despite the fact that at present time the relatively new Complexity Theories of Cities and their followers of today claim to be able to describe fully all the peculiarities of functioning and evolution of cities as the complex dynamic systems, we can not but make a note of the great contribution made by other researchers, such as the founder of the system

dynamics theory J. Forrester and his work [4] dedicated to the study of the dynamic nature of an urbanized territory. It was in this work that the author showed that the city is a complex system in which dependences between its elements can not be described by linear functions. J. Forrester views the urban planning system through the prism of integration of the following subsystems - business (entrepreneurial) sphere, housing and population, for they make up the dynamic framework of the city structure [4, p.26]. Changes in the proportions of housing, population and business activity are the main regulators of the growth and stagnation processes of the city. Such view of J. Forrester on the essence of the urban planning system does not contradict the views of J. Portugali on the city as a dual system that are set out in his work [8].

Duality of the urban planning system can be easily explained applying the analog method used in their time by such great scientists as Isaac Newton, Charles Coulomb, Andre-Marie Ampere and others.

We can take a metal conductor as a remote analog of such urban planning system, that is a unity of dynamic and static components. The static component in such a physical dual system is the atomic lattice, and the electrons in their eternal motion are the dynamic component. The atomic lattice mass is by several times (2000 - 200000 times) greater than the mass of electrons. Inertial atomic lattice by analogy with the city plays the role of the urban planning system framework and electrons can be compared to the city residents respectively. Obviously the electrons are a very far-fetched analog of the human nature considering at least the fact that the electron is a carrier of one charge, one sign while the human being is a carrier of many charges in the form of images formed by the external multidimensional world and social relations and, therefore, is a multidimensional dynamic object.

3. THE NOTION OF THE URBAN PLANNING SYSTEM IN THE WORKS OF THE UKRAINIAN URBANISTS

The following definition of the urban planning system prevailed for a long time in the domestic urban planning theory [10 p.14]: the term "urban planning system" implies an array of spatially organized and interrelated material elements of technically developed territories, buildings and structures, roads and utility networks, that together with natural components form the environment of public life at various territorial levels".

However, aside from the material-spatial environment of the society life the object and the subject area of urban planning activity is also population and its economic activity intending, first of all, to satisfy the needs of city residents. It is owing to synergy of the groups of various factors ("human" with physical factors of the environment) that the material-spatial environment or artifact transforms into a city functioning as a living organism.

A considerable contribution to the revision of the concept of urban planning systems in domestic urban studies was made by professor M. Dyomin, one of the first to point out that the city should be considered not only as a "material-spatial environment" or a system of the orderly and interrelated artifacts, but within the framework of demo-ecological concept: "it is the population interacting with the environment in the process of labor and social-cultural activity, that determines behavior of architectural-urban planning system" [3, p.10].

According to this concept "the subject of urban planning studies and design is not the "technical" system as the material environment of the processes of the society life and industrial-technological processes, but the socio-economic, territorial-industrial and demo-ecological system "population - environment - activity" [3, p.10]. That is, the city, being an integral object in terms of its structure and function, is regarded as a system in the form of interrelated groups of elements - "population", "environment", "activity".

In his work M. Dyomin operates with the notion of a regional urban planning system. From the standpoint of the system approach the city can not be considered separately from the entire regional economic complex and the formed pattern of settlement. First of all this is an open system that carries on an active energy exchange with the outside environment.

Owing to such perception of the city as a system and to the proposed information model it has become possible to describe both, quantitatively (in the form of indices) and qualitatively all objects and phenomena of the city. Such is the approach that permits to see dynamics of the changes in urban planning space, fix stages of the development of urban planning system in various space-time intervals in the form of information snapshots.

Views of M. Dyomin on the problem of the urban planning system structure determination taking into account its dual nature were further continued and developed in the works of M. Habrel, A. Ositnyanko, O. Synhaivska.

In his work M. Habrel studies regional urban planning systems and understands this term as a complex dynamic system that appears to be a composition of settlements, their connections and relations in the multidimensional natural and socio-economic space [5, p. 16]. The author presents the structure of a regional urban planning system in the form of the social-natural-functional complex. Such approach to understanding the complex of interacting components of the urban planning system is concordant with the views of M. Dyomin, in whose work this study object is presented as the three interacting subsystems: social-economic, territorial-manufacturing and demo-ecological.

M. Habrel describes the dynamic nature of urban planning system using the notion he has introduced, "Life cycle of the urban planning system", which the author understands as the stages of existence of the urban planning system: design, implementation, use, liquidation and re-cultivation of space [5, p.16]. The author operates with such a notion as dynamism of space that he understands as the generalized property characterizing the change of parameters and conditions of space in time.

In his work, A. Ositnyanko examines the urban planning system from the standpoint of its four interacting subsystems: economic; natural-anthropogenic; spatial; social-demographic. The process of evolution of the urban planning system is presented in the work of A. Ositnyanko as a sequence of the four stages: stage of the city development, stage of the city growth, stage of stagnation, stage of decline of the city [6, pp. 20-21].

The idea of describing the life cycle of an urban planning system in the form of the above said stages is not new. Earlier such an approach to the study of city development dynamics was realized in the city simulation model developed by J. Forrester. However, in the American cities studied by J. Forrester that were developing under the conditions of the capitalist and not planned, strictly determined economy, the stage of stagnation of the city began when the number of housing units exceeded the number of jobs and the resulting appearance of the great number of unemployed people. According to A. Ositnyanko the stage of "stagnation" begins when the gap widens between the number of jobs, the number of housing units and the scope of public benefits, resulting in the population growth approaching to zero.

O. Synhaivska in her work dealing with the problem of information support of the processes of urban planning systems management also points out on the dual nature of the object of urban planning studies and design: "on the one hand this is the material environment and its elements - objects of direct action of city - physical objects – various buildings, on the other hand - human society that fulfilling its various needs fills up with content functional elements of the environment and urban planning activity in general» [9, p.61]. The author attributes the urban planning system to the class of socioecological systems or "socioekosystems".

4. CONCLUSION

A more precise definition of the key notions of urban planning theory is a pressing problem that has not yet been resolved to the end, for the effectiveness of computer tools for modeling behavior of urban planning systems depends on the scientific notions of the structure of such systems, the structure's nature, peculiarities of its functioning. Urban planning objects are characterized by their dynamic nature that can be exposed provided only that the settlements are considered as dual complex systems, that is, as a "conglomerate" of the natural-anthropogenic and sociological systems. The essence of the urban planning objects as dynamic non-linear dual systems is most fully presented by definition proposed by M. Dyomin within the framework of demo-ecological concept.

BIBLIOGRAPHY

- [1] Allen P. *Cities and Regions as Self-organizing Systems: Models of Complexity*, Routledge, 1997.
- [2] Batty M. *Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals*, Cambridge, MA: MIT Press, 2005.
- [3] Dyomin M., *Upravlenie razvitiem gradostroitelnykh sistem [Management of development of urban systems]*, Kyiv, Budivelnyk, 1991.
- [4] Forrester Jay W., *Urban dynamics*, M.I.T. Press, Cambridge, Mass., 1969.
- [5] Habrel M., *Prostorova organizatsiya mistobudivnykh system [Spatial organization of urban systems]*, Kyiv, A.C.C., 2004.
- [6] Ositnyanko A. *Planuvannya rozvytku mista [Planning of city development]*, Kyiv, Kyiv National University of Construction and Architecture, 2005.
- [7] Prigogine I. Time, Structure, and Fluctuations, in: *Science*, No. 4358, v. 201, 1978, 777 – 785 p.
- [8] Portugali J. *What makes cities complex?*
<http://www.spatialcomplexity.info/files/2013/10/Portugali.pdf> Synhaviska O. *Informatsiyne zabezpechennya protsesiv upravlinnya rozvytkom mistobudivnykh system [Information support of management processes of urban systems development]*, Kyiv, Kyiv National University of Construction and Architecture, 2013.
- [10] Yargina Z., Kositskiy Ya., Vladimirov V., Gutnov A., Mikulina Ye., Sosnovskiy V. *Osnovy teorii gradostroitel'stva [Fundamentals of urban planning theory]*, Moscow, Stroyizdat, 1986.

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