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DETERMINATION OF THE BIOSPHERE COMPATIBLE ENVIRONMENT ATTRACTORS OF URBANIZED TERRITORIES AT THE ORGANIZATION OF MODERN CONSTRUCTION DEVELOPMENT

Abstract. *The article considers current trends in ecological construction based on the principles of biosphere compatibility. The necessity of an integrated, multi-level approach to addressing the environmental safety of urbanized areas and the renovation of the urban environment is shown. The evolution of ecological-economic systems in the organization of biosphere-compatible construction can be interpreted as a sequential transition of the system from one attractor to the second through unstable chaotic states and sharp break points (bifurcation points). The article considers the issues of defining and specifying properties, conditions, evolution of ecological-economic systems as an object of management from the level of the national economy to an investment project. Generalized indicators of the biosphere compatibility of territories and the level of implementation of city functions are proposed, a method for calculating the components of the humanitarian balance is developed on the basis of a comprehensive analysis and the accepted concept of improving the environmental safety of construction sites. Further, the presented algorithm enables monitoring to form a phase portrait of an attractor of ecological-economic systems based on an assessment of biosphere compatibility indicators.*

Keywords: ecological construction; biosphere compatibility; construction development; attractor; ecological-economic system

Introduction

It is believed that the main cause of global warming is technical progress. Techno sphere human activity leads to an increase in the content of greenhouse gases in the atmosphere due to the increasing burning of fuel, which is a factor that increases the temperature. Climatic anomalies provoke social cataclysms. The most important task at the present stage is to reduce global risks and increase people's safety.

By the way, about the relevance of creating a new branch of economics, as an ecological economy, caused by the need for practice in new methods and mechanisms that ensure the transition to sustainable development.

It should be noted that the concept of sustainable development put forward by the world community is based on the synthesis of experience mainly from countries with a developed market economy with a high level and quality of life and having a developed production, social and environmental infrastructure. Therefore, today it is only acceptable for them to limit the consumption of resources on the basis of low rates of economic growth. In the meantime, our country cannot afford the luxury of limiting itself to stabilizing the pace of economic growth in the near future, because it needs accelerated development.

The development of fundamentally new tasks in the socio-economic development of urbanized territories requires qualitatively new approaches to the organization of environmental management based on biosphere compatibility.

In the general complex of problems of greening, a special place is occupied by the greening of scientific and technological development. In other words, a radical restructuring of the economic basis is needed on the principles of the maximum possible interdependence of the links of the cycle of matter and energy.

In fact, this is a transition to environmental and economic balance, which implies significant changes in the content of methods and forms of regulation of the economic and scientific-technological basis, in which the economy, organization and management of a regional economic complex should be considered from eco-innovation positions, which are mainly not related to the disposal of harmful garbage, and with the development and execution of new technologies that do not allow these garbage [1].

Such a methodology is based on the principles of a systems approach in accordance with which "society-technology-nature" is considered as a single system. As you know, economic policy is a system of legislative, economic, social and psychological guarantees that provide all able-bodied citizens with the conditions to increase their well-being through personal labor participation, economic independence and entrepreneurship. Therefore, in the current conditions of the formation and development of a market economic system, modern regional policies should be based on the main priorities of the country's socio-economic development for the long term, when human potential and labor potential, in particular, becomes the basis of the state innovation policy [2].

Research aim and task

It must be emphasized that a comprehensive assessment of the quality of life includes the problem of analyzing the ecological situation in the region. The strategic importance of the environmental factor today no longer requires evidence because it has a comprehensive impact on all spheres of life and, above all, on health. In this regard, there is an acute problem of a comprehensive assessment of the impact of ecology on the health of the population, on the economic and urban development of the region.

The need to strengthen environmental regulation at all levels of government is predetermined by an excessively long period of ignoring the environmental factor in the process of the socio-economic development of society. It should be noted that the process of environmental regulation is particularly relevant at the regional level, since the concentration of pollution as a result of economic activity is manifested primarily in a particular area. It is unlikely that today we need special arguments to the thesis that it is the greening of economic and technological development that is the main means of preserving the natural resource potential and the ecological and economic balance.

However, the realization of this (in the conditions of ecological imbalance) for several decades does not give grounds for stating the existence of a modern scientific and methodological base that would allow developing an effective policy in the field of investment support for greening regional socio-economic development. By the way, the modernization of the economy in this direction may be associated with the search for technological solutions to preserve resource costs with an increase in the level of greening of the regional regulation process, aimed at strengthening the strategy of limiting consumption, which will preserve the balanced mechanism of natural systems. In fact, this is a transition to an intensive development path, which should be based on the principle of preserving the ecosystem. In other words, the basis of the concept of sustainable development of the region is the creation of economically efficient technological systems, the core of which should always be ecological and economic balance.

There are various formalizations of the notion of the *attractor* – a compact subset of the phase space of a dynamical system, all trajectories from a certain neighborhood of which tend to it at a time tending to infinity. An attractor can be an attracting fixed point (for example, in the problem of a pendulum with air friction), a periodic trajectory (for example, self-excited oscillations in a positive feedback loop), or some limited region with unstable trajectories inside (like in a strange attractor). For all definitions, the attractor is assumed to be a closed and (completely) invariant set. Since the entire phase space in any case is preserved by dynamics, the formal definition of an attractor can be given on the basis of the philosophy that "an attractor is the smallest set to which everything aspires" [3].

Modeling of the system allows you to display the functioning and development of the organization of the system of construction development with non-linear changes. It should be emphasized that the functioning of a system is usually understood as its transition from one state to another in the direction of achieving a goal with characteristics characterizing it in dynamics and not accompanied by a change in purpose.

Applied mathematical models are designed to display these phenomena in the system, describing the system as a set of interrelated elements that have these properties, a set of relationships between elements and their properties from the standpoint of some flowing process.

As the internal imbalance increases, the system approaches the bifurcation point (branch point). At this point, the evolutionary path of the system works. The system becomes very sensitive to external and internal influences. The choice of a particular path at the bifurcation point depends on the factor of randomness realized through the activities of specific people. It is a specific historical person who brings the system to a new

systemic quality. The role of chance is not only great, it is fundamental. It makes the process irreversible. The development of such systems is fundamentally unpredictable. Synergetic, by the general historical regularity, does not mean a single path of historical development, but the common principles of "walking along different historical routes." The synergetic approach focuses not only on reality, but also on opportunities, situations of choice, points of bifurcation (branching) of the historical process.

In the most general sense, the non-linearity of the system is that its response to changes in the external or internal environment is not proportional to this change. In other words, there comes a time when the system becomes "suddenly" substantially different, but the theory is not able to catch these transitions, at least at the most general level.

Proactive management of organizational development is based on an understanding of the nature of bifurcation includes a trigger that triggers a bifurcation process, interacting models of "driving forces – resistances" and "opportunities – risks"[4].

Suppose that in the process of developing an organization, a critical situation has emerged characterized by a six S:

$$S = <T_R, O_p, I, F, O_h, A_1\text{-}A_2>,$$

where: T_R- trigger, activating the bifurcation point; O_p – opportunities for development projects; I – am resistance to change; F – the driving forces of development; O_h – risks and obstacles of organizational development; A_2- – development attractor (vector); A_2- attractor (vector) of entering into a crisis.

Model S displays the connections between its main components, based on their vector representation. The trigger T_R implements its function based on feedback information about problems, challenges, risks, and opportunities that are currently concentrated at the bifurcation point. At the same time, the driving forces and resistances (obstacles) to the continuation of stable development are estimated based on the transition along the attractor A_1. In the case of transition through the attractor A_2, it is necessary to work out the project of crisis management. The model has a variable structure. The results of the simulation, as a rule, are an updated management paradigm and a development strategy, taking into account the situation at the bifurcation point.

Thus, the criterion of resource security in the region is the existing level of technological development, since it is the technology used that determines for society what is a resource and what is not. The level of social stability is determined: objectively – by the conformity of the social structure to the specifics of the functioning of the natural environment in a given territory, subjectively – by the degree of public confidence in the government. To realize the interests of society within the region, these two factors must be directly proportional – the higher the resource endowment of the region, the higher the social stability. It is the level of technological development that determines the degree of use of the region's natural potential, which ultimately means the level of social development or the efficiency of using the resource potential for social development.

Consequently, the sustainability of regional development is associated with the parameters of economic activity in the territory and the technologies used. For sustainable regional development, it is necessary to organize such a system of management and economic mechanisms that, based on a reliable assessment of the available natural resource potential, would bring the industrial and technological structure in the region into a form that ensures an adequate level of social stability and the necessary level of economic growth.

In recent decades, the population of urban agglomerations has grown rapidly throughout the world, including through the absorption of rural settlements. Half of humanity today lives in cities, which account for 75% of global energy consumption and 80% of CO_2 emissions. Faced with the rapid urbanization process and aware of these facts, people are increasingly aware that new strategies are needed to reduce emissions and energy consumption. One of the possible answers to these pressing questions was the first "active energy building". The project, developed and implemented by falkeis.architects, is the winner of an international competition for the construction of an apartment building in Vaduz, the capital of Liechtenstein [5].

The architects have successfully integrated into this house an energy production system developed on the basis of deep research specifically for a new type of building. Photoelectric tracking systems (PV-tracking systems) and so call "Climate wings" (PCM-climate wings), being part of the movable shell of a building, accumulate solar and cosmic radiation, produce energy and control the internal climate [6].

The "active energy house" also has the ability to adapt to changing spatial needs due to its effective supporting structure. As the first model of decentralized energy production in cities to be implemented, this project is designed to make an important contribution to improving people's living conditions and reducing the demand for energy.

The current stage of development of "green building" in Ukraine shows, though it is, a slow but rather confident progress, which can be demonstrated by the example of the following points:

– appraisers and certified consultants for the three leading certification systems appeared in Ukraine: BREEAM, DGNB, LEED [1; 6; 7];

– the first training for the preparation of DGNB consultants was conducted;

– the Ukrainian Council on Green Construction is registered and actively operating;

– the first objects are certified: Shell Kiev Office (LEED Gold), Billa food supermarket, Kiev (DGNB, Silver, pre-assessment);

– in the process of BREEAM certification: Rose Park shopping and recreation center in Makeyevka (Donetsk region, Immoshan Ukraine), Forum Shopping Center Lviv, Lviv;

– registered for LEED certification: NEC, USA Embassy in Ukraine (Kiev), Leski-2 Complex (Nikolaev) [5].

Building technologies are the basis of technogenic transformations of cities and settlements, which provide not only qualitative, but also quantitative development of the population, i.e. life of future generations. In this paper, we study the methodology and calculation methods for implementing one of the stages of this transformation in relation to the technological reconstruction of industrial enterprises of the city infrastructure from the standpoint of environmental safety based on the paradigm of biosphere-compatible cities that develop people.

In recent years, the Kiev National University of Construction and Architecture (Ukraine) has conducted fundamental research on the creation of interdisciplinary technologies in the field of architectural and construction activities under the common title "Biosphere-compatible cities and human development" [8]. The general trend in applied sciences related to the national economy (including construction) has become their abrupt as the requirements of the times change and the accumulation of new knowledge develops and integrates with related disciplines while preserving its specificity. Thus, the organization of construction, while preserving the traditional areas of analysis and regulation of construction processes (construction organization projects, work production projects, scheduling, preparation and construction priority, duration regulation, etc.), targeted at contracting organizations [9, 10], As the market economy developed in Ukraine, it began to include a wider range of problems – a system-technical representation of the investment process as an integral mechanism.

The organization of construction now solves a number of new methodological issues:

– expanding the scale of designing a construction organization for an investment process in general, covering all stages and stages of investment: pre-project studies, land acquisition, design and construction stages, implementation or operation [3];

– structuring the system of regulatory requirements for the organization of construction, composition, content and form of organizational and technological documents for mandatory federal requirements that ensure the safety of buildings, buildings and structures, the processes of their construction, operation, implementation in accordance with technical regulations; recommendatory norms (ensuring high consumer properties of building products); intra-company rules of planning, management and organization of production (which include most of the traditional issues of construction organization: the development of flow methods, network and other models of organization construction; justification of rational organizational structures; production definition power; increase of organizational and technological reliability and product quality, etc.) [4];

Table – ***The main factors constraining ecological construction in Ukraine***

At the national level	At the level of a specific object
– lack of a clear understanding of the cost structure for the implementation of a "green" project, as well as of the advantages that such a project will have at all stages of its implementation: from construction to possible sale; – Lack of incentives for green building at the state level. In particular, since 2012, the Law on the Energy Efficiency of Residential and Public Buildings has not been adopted; – lack of sufficient experience of Ukrainian appraisers, in view of the few certified projects. At the same time, attracting an appraiser with international experience may cause additional costs; – implementation of "green" projects is associated with a high level of training from all its participants: the project office, the general contractor, etc.; – the difficult process of harmonizing the use of Ukrainian building codes for project certification, as a result, the need to work according to European standards	– lack of understanding of the essence and necessity of following the requirements of the certification standard on the part of contractors at the initial stages of the project implementation; – difficulties in obtaining so-called evidence used in the preparation of the report by the city administration; – the need to import some equipment; – compliance with European standards; – Difficulties in finding competent contractors, however, both the general contractor and the general designer of the project paid special attention to the requirements from the customer, in particular, both companies have BREEAM standard specialists. – the continued participation of the client's certification coordinator in the process is mandatory

– orientation of construction organization with predominantly state capital investments (gratuitous, interest-free) to private investors: commercial firms, banks, individuals, taking into account credit systems and inflation [5];

– consideration of the exclusive role of land use in a market economy, since the location of the site in the urban environment or in the system of agglomeration determines the value of real estate (besides, the land plot largely determines not only the operating conditions of the constructed on it the object, but also the conditions of construction) [6];

– change the criterion base for making decisions on the organization of construction depending on final interests of the owner, using the estimated return on invested capital, which should take into account all the costs of the investor (price of land; costs of pre-project development, design, construction; advertising; operating costs; taxes; inflation; lost profit on invested capital) and the cumulative investment results taking into account the time factor throughout the life cycle [7].

The modern trend of ecological construction is a large-scale transition from a separate building with an adjacent land plot to whole “green” quarters and cities built on the principles of sustainable development. From the elementary green technologies of the present (passive houses and zero energy consumption) city planners are moving to the cities of the future. At the level of quarters and houses, this is expressed in the principle of “triple zero” – zero external energy consumption, lack of greenhouse gas emissions and complete waste-free activity.

A more comprehensive development was the theory of protecting the planet and humanity in the 80s and 90s in the form of the concept of sustainable development, which is to ensure the safety and favorable conditions of human activity in the implementation of urban planning activities, to limit the negative impact of economic and other activities on the environment and ensuring the protection and rational use of natural resources in the interests of present and future generations. This concept is currently the only one adopted in the Ukrainian legislation in the field of green building and "green" standards. The concept of sustainable development has three components: economic, social and environmental, or 3P in English – Profit, People, Planet [10].

Green, green building:

– reducing the cost of operating the building by saving energy and water;

– increase in efficiency and the absence of harm to people's health by improving the microclimate in the building;

– reducing the negative impact of the building on the environment.

Ecological construction uses renewable energy sources (sun, wind, heat and cold of the earth and water), collects rainwater, uses environmental and secondary materials, handles garbage, reduces emissions and pollution, cares about the health and well-being of building users.

Conclusions

A prerequisite for the greening of technological development is the formation of an environmentally oriented technological culture based on the synthesis of technological and humanitarian knowledge. The core of such a culture becomes the awareness of the fact that man is not the king of nature, but an organic component of the biosphere, and therefore its nature-transforming technological activity is limited to its limits. Thus, biospheric compatibility of technological development and eco-technological regulation is the core of the concept of sustainable eco-innovative development of the region. This process requires conscious state regulation and should be considered as one of the long-term strategic goals of scientific, technical, economic, environmental, and structural policy, including at the regional level.

References

1. European Commission – Environment. – Sustainable Buildings [Electronic resource]. – Mode of access: http://ec.europa.eu/environment/eussd/ buildings.htm

2. Chernyshev, D.O. (2017). Methodology, analytic tools and practice of biosphere-compatible construction:Monograph. Kyiv, KNUKA, 294.

3. Ryzhakova, G. (2017). Identification of the basic elements of the innovation-analytical platform for energy efficiency in project financing/ G. Ryzhakova, D. Ryzhakov, S. Stetsenko // Investment Management and Financial Innovations. LLC “Consulting Publishing Company “Business Perspectives”, Sumy, (4), 112 – 123.

4. Bushuev, S.D., Yaroshenko R.F. (2012). Vector model of bifurcation points in the programs of organization development. Management of development of complex systems, 12, 26 – 29.

5. Chernyshev, D. (2018). The organization of biosphere compatibility construction: justification of the predictors of building development and the implementation prospects/ D. Chernyshev, I. Ivakhnenko, M. Klymchuk//International Journal of Engineering & Technology. UAE: Science Publishing Corporation, 7, 3.2: 2, 584 – 586.

6. Web page of certification system in th construction sphere BREEAM [Electronic source]. – Access mode http://www.breeam.com/

7. Web page of certification system in th construction sphere LEED [Electronic source]. – Access mode http://www.leed.net/

8. Chernyshev, D.O. (2017). Conceptual basis of organizational-technological re-engineering of the projects on the principles of biosphere-compatible construction. Management of development of complex systems, 30, 205 – 209.

9. Pocolenko, V.O. (2017). Innovative technology of quality control of management of construction facilities. / V.O. Pokolenko, O.M. Malykhina, Yu. A. Chupryna, M.V. Gorbach // Management of development of complex systems, 32, 146 – 152.

10. Chernyshev, D.O. e.t.c. (2017). Application of artificial intellect systems for evaluation of economical efficiency of project solutions. Economical tools for management of financial safety of construction facilities. Edited by L.V. Sorokina. Kyiv, Ukraine: KNUCA, 58 – 68.

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ВИЗНАЧЕННЯ АТРАКТОРІВ БІОСФЕРОСУМІСНОГО СЕРЕДОВИЩА УРБАНІЗОВАНИХ ТЕРИТОРІЙ ПРИ ОРГАНІЗАЦІЇ СУЧАСНОГО БУДІВЕЛЬНОГО ДЕВЕЛОПМЕНТУ

Анотація. *Розглянуто сучасні тенденції екологічного будівництва на основі принципів біосферної сумісності. Показано необхідність комплексного, багаторівневого підходу до вирішення питань екологічної безпеки урбанізованих територій, реновації міського довкілля. Еволюцію еколого-економічних систем при організації біосферосумісного будівництва можна трактувати як послідовний перехід системи від одного атрактора до другого через нестійкі хаотичні стани і точки різкого переламу (точки біфуркації). Розглянуто питання визначення і особливості властивостей, умов, еволюції еколого-економічних систем як об'єкта управління від рівня національної економіки до інвестиційного проекту. Запропоновано узагальнені показники біосферосумісності територій і рівня реалізації функцій міста. Надалі, представлений алгоритм надає можливість на основі моніторингу сформувати фазовий портрет атрактора еколого-економічних систем урбанізованих територій на основі оцінки показників біосферосумісності.*

Ключові слова: екологічне будівництво; біосферна сумісність; будівельний девелопмент; атрактор; еколого-економічна система

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