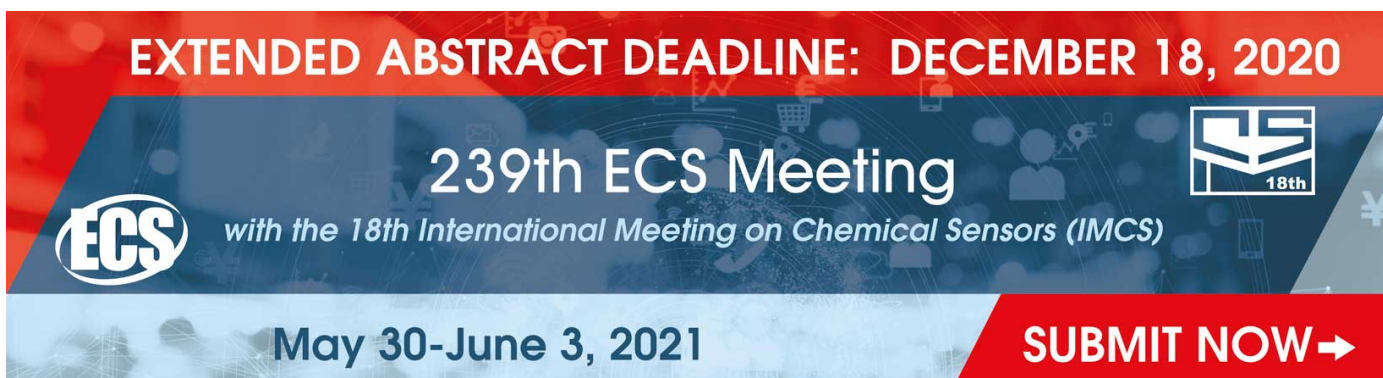


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# The conceptual framework of sustainable development and the role of environmental and technogenic safety in achieving it

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**Abstract.** The article deals with the issues related to the environmental aspects of the development of economic production performance and their impact on the sustainability of production development. Reaching a certain level of technogenic safety and the ability to influence it through a number of organizational and technical measures are the factors for improving environmental safety. The formation of the optimal direction and value of the «vector of sustainable development» (VSD) which includes the «security vector» (SV) that currently may be limited by the economic development and stability indicators, the requirements of environmental legislation and the quality of the ecological fund, the labour legislation, the level of the technological effectiveness and the environmental compatibility of production, the quality of labour potential, the health and well-being standards, the social aspects of development and protectability, the level of understanding of personal safety and personal responsibility for the safety of others were justified. The directions of risk formation and technological and environmental safety reduction for the construction industry, among which the main ones are those that are being formed at the level of the global world economic and political processes, the state, the construction industry itself, the local communities, the external organizations and contractors and a specific construction organization were outlined.

## Introduction

Throughout the ages, humanity has been constantly facing the global problems such as exhaustive resources, climate change, food and safe drinking water insecurity, overpopulation, military conflicts, as well as social problems related to unemployment, poverty, gender inequality, low levels of remuneration, the non-compliance of working conditions to the declared safety level and the social requirements for the riskogenics in everyday life. In addition to these stable risk formation factors, it should be taken into account that the modern world is changing rapidly both in everyday life and in technological processes. There are new materials, technologies, principles of human interaction with the natural environment, modern forms of employment and progressive methods of protecting humanity from negative factors of different origin.

Human being is constantly interacting with the natural environment and trying to make the living conditions more secure and protected from natural threats. However, these activities are too controversial since human beings exploit natural resources (such as forest plantations, soils, water resources, clean air, flora, fauna, mineral resources, etc.) to maintain their personal life and health, to achieve decent living conditions and economic growth in different industries in amounts that exceed the ability of natural resources to recover or the possibility of maintaining them in sufficient quantities to



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ensure humanity a comfortable life in the distant future. The threatening dynamics of human interaction with the environment reveal two major problems in this direction [1]. Firstly, there is a strong belief that all natural resources can be divided into exhaustible and inexhaustible, but it is possible to assert that owing to the pace of human impact on the environment and the irresponsible natural resource management, the inexhaustibility of resources is only a matter of time and new dangerous technologies. Secondly, a retrospective analysis of the human achievements demonstrates the geometric growth of the amounts of consumable natural resources in the way of increasing the technological effectiveness of production that can constitute a danger taking into consideration the world population growth.

**Presentation of basic material of the research.** Nowadays four fundamental laws of ecology outlined by Barry Commoner in the last century are undeniable [2]. The basic idea of these laws is as follows:

- everything is connected to everything else;
- everything must go somewhere;
- nature knows best;
- there is no such thing as a free lunch.

These postulates accurately emphasize that any kind of anthropogenic or anthropological impact on the environment will inevitably lead to certain transformations, and these changes will not cause global disaster only if appropriate and correct measures are taken. Due to the fact that in view of the capitalization of all components and using the principles of wealth accumulation by any means necessary, even if it means jeopardizing peace and security of future generations, a technologically advanced society has actually ensured the rapid growth in production and has completely disregarded the safety and health of their descendants.

The dangerous feature of imprudent environmental behavior is the ultimate impact branching that is not limited to the biological characteristics of the species, the territorial boundaries or temporal limitations. The environmental problems of certain limited territories, regions or countries impede economic growth in one way or another and require from all professionals in natural resource management to carry out their activities based on the opportunities of the natural environment to recover resources expended by them, to take measures to regulate the overwhelming impact, to limit the volume of unsustainable productions and to restrict significantly the development pressure on ecosystems. Another direction in reducing human pressure on the natural environment is to increase the quality and the rate of its recovery, to improve the existing natural conditions, to plan the activities that rely on the overuse of natural resources considering the nature of the impact of such activities in the distant future, to use the alternative resources that have not been used before with the increased benefits of all natural sources.

Therefore, the global human-nature interaction strategy should be harmonized and balanced in order to create the safe and comfortable conditions for human existence and constructive activity while maintaining the current state of the environment to the greatest possible extent and undertaking the purposeful activities necessary for its improvement. The level of harmonization and interpenetrating influence is definitely limited by a certain contour of regulation which includes the main goals of social development, the criteria for determining the achievement of a certain level of their realization and the presence of mechanisms for their achievement. Overcoming the contradictions between human and nature, which is still often considered only as a resource base, should be based on the most advanced technologies, the most effective strategies, the best available production practices and the professional labour potential. The global goal for modern society is to create the safest environment in which the high-quality objects, goods, services, infrastructure elements etc. are created with minimal impact on the environment in order to preserve the progressive vector of social development and create the preconditions for appearance, comfortable existence and progressive development of future generations based on the principles of humanism and full responsibility.

The sustainable development strategy (SDS) which is defined as an organizational principle that meets the needs of the present without compromising the ability of future generations to meet their own needs is fully consistent with these criteria.

Sustainable development combines three basic components such as environment, economy and society and this concept was proposed by the economist Rene Passet in 1979 and was further developed until it became the main strategy of social and economic development at the beginning of the XXI century. This was preceded by the adoption of a number of interstate and national documents [3-10]:

- the Declaration of the United Nations Conference on the Human Environment, or Stockholm Declaration (1972);
- the Rio Declaration on Environment and Development, or Rio Declaration (1992);
- «Agenda-21» (1992);
- the Pan-European Biological and Landscape Diversity Strategy (1995);
- the Guiding Principles for Sustainable Spatial Development of the European Continent (CEMAT) (2000);
- the Lisbon Strategy, also known as the Lisbon Agenda or Lisbon Process (2000);
- United Nations General Assembly, «The Future We Want» Resolution 66/288 (2012);
- Europe 2020 (2010 p.);
- the 2030 Agenda for Sustainable Development (2017).

The gradual development of this concept has led to the extension and receiving of the new influential emphases such as the assessment of the impact of political transformations, cultural heritage and administrative decisions on the sustainability of states, public associations, campaigns, and so on. However, what is certain is that humanity is striving for the maximum level of safety (social, political, environmental, technogenic) which can be provided only with the proper attention to all these areas rather than focusing only on one of the strategies.

The level of human development and sustainability was increasing together with the expanding of the worldview and the introduction of additional elements such as «nature», «technology», «information» in the «human-human» system and as a result it has moved from a relatively low «human-nature» level of relations to higher level, i.e. to the sustainable development.

Nowadays the sustainable development principles are crucial in the issues of security of the country and they encourage the formation of national development strategies in the light of these aspects. The Sustainable Development Strategy «Ukraine 2020» has been in place since 2016 and it requires the implementation of a number of reforms and programs, including:

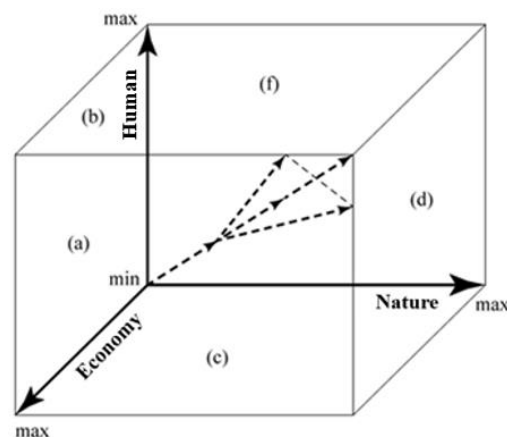
- workplace relations reform;
- welfare reform;
- environmental conservation program;
- energy efficiency program;
- a healthy lifestyle and longevity program [11].

Extremely ambitious levels of country development strategy indicators are outlined in this strategy and they are designed to double GDP per person (up to \$ 16,000), to increase the average life expectancy by three years according to the World Bank, to reduce GDP energy intensity to 0,2 toe (tonnes of oil equivalent) per \$ 1,000, and so on. However, recently updated legislative acts such as The Draft Law of Ukraine on the Strategy of Implementation of the Balanced Development Model of Ukraine by 2030 and the Draft Law of Ukraine on the Sustainable Development Strategy for Ukraine by 2030 have already been developed and are under consideration in the Verkhovna Rada of Ukraine. There are both optimistic thorough views on the subject [12] and skeptical slogans that claim that Ukraine lacks the sustainable development concept and strategy [13].

Such a range of statements is resulted from the complexity of the problem of combining the three main vectors of influence on the sustainability and the need to create a conscious responsibility for personal and financial security, personal development among the average citizens; and for economic growth, decent working conditions, preconditions for gender equality and economic justice among the entrepreneurs, leaders of the public union, party or country by shaping their activities and making administrative decisions on principles of environmental consciousness and public virtues, by promoting the preservation of biodiversity and recovering the expended natural resources on the basis of the need to preserve environmental and social conditions for future generations at present or even higher level.

Jay Forrester, Dennis Meadows, Mihajlo D Mesarovic, Eduard Pestel, William Nordhaus, Jan Tinbergen and others are the foreign scientists, innovators who drew public attention to the inevitability of the end of the human race in the condition of further development of society in the industrial paradigm without taking into account technogenic and anthropogenic impact on the environment, and who created the preconditions for the formation of the concept of sustainability and its further development [14]. Further development of the sustainability concept has been reflected in the global documents of the UN General Assembly which were mentioned above.

In her scientific work, Z A Mynhaleva suggested to present the entire range of existing approaches to sustainable development in the form of three-dimensional space with axes of coordinates as «human», «economy», «nature» [14] (Figure 1). The author claims, «The main approaches and theories of sustainable development that are grouped on the basis of qualitative and quantitative assessment as the «min» and «max» values of the main classification indices, that is, the index of the dominant (leading) element in the relation (which is the main index), the subordination index (which depends on something) and the index prevailing in the set of recommendations for policy formulation in the field of industrial and socio-economic development, nature protection with regard to sustainable development of society. The dashed lines in Figure 1 show the developmental trajectories of conceptual approaches to sustainable development in view of the importance of all sides of such triad as «human-economy-nature»: the straight arrow that points to «max» for all three elements reflects the trajectory of the sustainable development concept with equal inclusion of all elements in the relation system».



**Figure 1.** A variety of approaches to the combination of such elements as «human-economy-nature»: a) - the theory of full subordination of nature to the human and production interests; b) - the theory of equal well-being for all; c) - the theory and approaches of resource conservation, their rational management, environmental safety of production; d) - the theory of the full convergence with nature, the rejection of industrial production; e – the theory of economic growth based on the environmental principles; f - the theory of implementation of all environmental standards, healthy lifestyle.

It is definitely a global, and perhaps even slightly utopian desire to achieve the maximum level of economic development in the most secure, healthy, equitable social environment and ecologically stable and balanced natural environment, but there is no other way, there are only prospects for expanding our focus and influence with regard to the new risks that arise with increasing economic performance and humanity's demands for comfort and safety.

Thus, it can be assumed that the optimal direction and value of the «vector of sustainable development» (VSD), which includes the «security vector» (SV) currently may be limited by the economic development and stability indicators, the requirements of environmental legislation and the quality of the ecological fund, the labour legislation, the level of the technological effectiveness and environmental compatibility of production, the quality of labour potential, the health and well-being

standards, the social aspects of development and protectability, the level of understanding of personal safety and personal responsibility for the safety of others.

From a mathematical point of view, the length of VSD  $\overrightarrow{a}$  (Figure 2) is determined by the components  $a_x, a_y, a_z$  and is calculated as follows:

$$\vec{a} = (a_x; a_y; a_z), \text{ i.e. } |\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}, \quad (1)$$

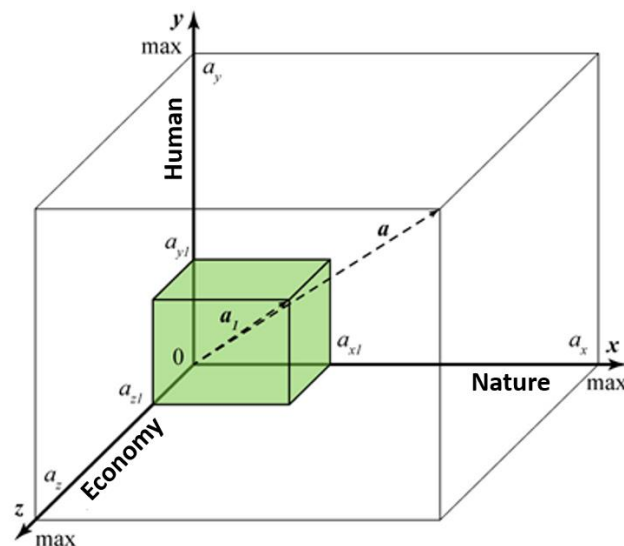
and the length of the SV  $\overrightarrow{a_1}$ , is calculated according to the formula:

$$\vec{a_1} = (a_{x1}; a_{y1}; a_{z1}), \text{ i.e. } |\vec{a_1}| = \sqrt{a_{x1}^2 + a_{y1}^2 + a_{z1}^2}, \quad (2)$$

where  $a_x$  – the level of environmental sustainability;  $a_y$  – the level of economic growth;  $a_z$  – the level of social sustainability;  $a_{x1}$  – the level of environmental safety;  $a_{y1}$  – the level of economic sustainability;  $a_{z1}$  – the level of human security in the production process and in everyday life.

In general, all these indices should be summarized considering the end result i.e. the improvement of health and the increase in the life expectancy in conditions that ensure the basic needs of humanity such as the availability of safe drinking water, clean air, food, safe accommodation and working environment, self-realization.

Undoubtedly, the environmental compatibility of relations in the system of «human-technology-nature» is the foundation for sustainable development that is focused on risk management in the national health system, which itself requires the financing of environmentally oriented services both from the state and from participants of production activities and social sphere. The environmental component of sustainability requires society to develop measures to meet human needs while maintaining the planetary life-support systems (sustainable use of natural resources and water resources, use of renewable energy, biomass and biodiversity conservation, avoidance of hazardous industrial and household emissions).



**Figure 2.** The definition of the «vector of sustainable development» and «security vector».

The precarious situation arises when natural capital is consumed faster than can be restored, and human capital suffers significant losses in the form of deterioration of living conditions, health, safety, and self-realization. Sustainable development is based on such human activity during which natural resources are used only in accordance with the natural rate of their recovery. It is theoretically possible to design the future of mankind where a strategy of destructive and negligent attitude towards the environment in which it is impossible to create the conditions for human existence and the birth of future

generations is implemented. That is to say, environmental degradation causes the destructive processes that provoke an increase in mortality among the population and make it impossible for humans to have an impact on the degraded environment when passing a critical point.

It should also be noted that the environmental impact is closely related to technologies, modes of their use and the scale of their mass production. Therefore, the most destructive factor of global environmental degradation is definitely a narrow-minded human who concentrates only on economic component of sustainable development and strives only for financial stability without taking into account significant external impact factors, so this human will always face the risks and will need significant financial investments and the ability to respond promptly and to direct efforts in the right direction in order to avoid, localize these risks or to reduce their negative and dangerous impact that generally has a synergistic effect.

The efficiency and sustainability of individual sectors of the economy strongly depend on the risks that are developed at different levels of impact. For the Ukrainian construction industry, the main levels of medium, significant and high risks formation are:

- interstate level;
- state level;
- level of Ukrainian construction industry;
- local community level;
- level of a specific construction organization;
- level of the external organizations and contractors.

The modern strategies and ways to influence the risk have two main directions:

- reduction of probability (impossibility) of danger occurrence;
- reducing the consequences of a dangerous event that has occurred.

It will be relevant to implement certain proactive strategies for increasing the sustainability of construction industry of Ukraine since it has such extensive levels of risk formation. The main elements of these strategies are presented in Table 1.

Strategies for risk management in Ukrainian construction industry summarized in Table 1 allow to embrace the levels of medium, significant and high risk. Preventive actions at these levels range from developing strategies for the construction industry, a local community, and a specific enterprise to simple and definite solutions at the lower administrative levels. One of the current strategies for technogenic and environmental risk management in the construction industry is the introduction of modern and safe green technologies, the so-called «green construction». Reducing of risks with the introduction of green construction technologies contributes to:

- reduction of dangerous technogenic and environmental load from corporate activities and the financial portfolio for its localization;
- reduction of the budget for overcoming the effects of negative residual environmental impact from construction industry;
- reduction of waste (including hazardous one) generated at the stage of production, operation and disposal of construction materials, equipment, tools and facilities;
- improvement of working conditions;
- enhancement of occupational safety;
- reduction of long-term risks connected with the occurrence of occupational diseases among construction workers;
- increase of the social importance of the industry;
- increase of positive.

Strategies for risk management in Ukrainian construction industry summarized in Table 1 allow to embrace the levels of medium, significant and high risk. Preventive actions at these levels range from developing strategies for the construction industry, a local community, and a specific enterprise to simple and definite solutions at the lower administrative levels.

**Table 1.** Strategies for Risk Management in Construction

Level of risk formation	Strategies for risk management
Interstate level	<ul style="list-style-type: none"> <li>- Analysis of current global economic and political tendencies to the changes in the basic economic indicators of developed countries and economic sectors.</li> <li>- Investigation of impact of the changes in the national economic activity on the stability and profitability of the construction industry.</li> <li>- Analysis of existing strategies for risk and crisis management used in different economic sectors by successful enterprises of Ukraine and other countries.</li> <li>- Prediction about the level and nature of the impact of transformations in the world economy on the construction industry based on the national peculiarities and global policy aspects of influence.</li> <li>- Development of the strategies to protect the construction industry from the impact of global economic and political factors, taking into account the best global practices and national characteristics.</li> </ul>
State level	<ul style="list-style-type: none"> <li>- Development and implementation of legislation to support the risk-oriented production development strategy.</li> <li>- Implementation of effective mechanisms to control the technogenic and environmental safety of production.</li> <li>- Implementation of state programs for the development and support of economic sectors that are the driving force of economic growth.</li> <li>- Equal conditions in the market and the inevitability of punishment of offenders.</li> <li>- Encouragement of long-term cheap investments in the industry.</li> </ul>
Local community level	<ul style="list-style-type: none"> <li>- Preparation and implementation of a community development plan, taking into account the environmental, technogenic and social components.</li> <li>- Support of the construction industry as the basis to ensure sustainable community development.</li> <li>- Creation of preconditions for development of labour potential of the region.</li> <li>- Increase in the level of social standards and safety for community.</li> </ul>
Construction industry level	<ul style="list-style-type: none"> <li>- Preparation and implementation of a strategic plan for sustainable development of the construction industry.</li> <li>- Formation of request and financing of scientific research results on the current areas of industrial development.</li> <li>- Creation of the development concept of labour potential and production capacities for the construction industry.</li> <li>- Promotion of advanced technologies and their integration into the global professional community.</li> <li>- Support of small businesses and expansion of regional manufacturing complex.</li> <li>- Constructive dialogue with all players of the construction services market.</li> </ul>
Level of the external organizations and contractors	<ul style="list-style-type: none"> <li>- Employment of strategy of trusted partnerships.</li> <li>- Long-term cooperation agreements only with companies that promote the values of safety, environmental compatibility and corporate social responsibility.</li> <li>- Secure and fast logistics.</li> <li>- Regular dialogue and cooperation with contracting organizations.</li> <li>- Constant analysis of alternatives, advantages and disadvantages for existing contractors.</li> </ul>
Level of a specific construction organization	<ul style="list-style-type: none"> <li>- Risk-oriented approach is the basis of construction company organization.</li> <li>- Engagement of trusted and reliable contracting organizations.</li> <li>- Availability of own technological developments.</li> <li>- Introduction of modern and safe green technologies.</li> <li>- Accurate staff selection, their constant training and development.</li> <li>- Raising of social standards in the enterprise.</li> <li>- Security leadership.</li> </ul>

One of the current strategies for technogenic and environmental risk management in the construction industry is the introduction of modern and safe green technologies, the so-called «green construction». Reducing of risks with the introduction of green construction technologies contributes to:



- reduction of dangerous technogenic and environmental load from corporate activities and the financial portfolio for its localization;
- reduction of the budget for overcoming the effects of negative residual environmental impact from construction industry;
- reduction of waste (including hazardous one) generated at the stage of production, operation and disposal of construction materials, equipment, tools and facilities;
- improvement of working conditions;
- enhancement of occupational safety;
- reduction of long-term risks connected with the occurrence of occupational diseases among construction workers;
- increase of the social importance of the industry;
- increase of positive public attitude to the industry.

This approach provides more opportunities for sustainability of the construction industry due to reduction of production risks for workers by using environmentally-friendly materials and their processing and production techniques, reducing the costs on recycling of environmentally hazardous packaging materials and waste generated at the stage of production, employment and further recycling of materials, increasing the competitive position of industry and the incomes of a specific construction organization as a result of the higher demand for environmental compatibility of buildings and social facilities and the constant growth in such demand from society, changing attitudes to the labour potential of the state and caring attitudes towards the health of the population of the state.

**Conclusions.** Thus, it would be efficient to create a specific behavioral strategy both for individuals in everyday life and for businesses in all sectors of the economy in order to reduce the negative impact of the above-listed range of risks on the environment and to preserve the natural potential of the planet through the introduction of environmental technologies and the restriction on the direct use of natural resources with low growth rate. If the aim of the society in the XX century was to form various forms of activity and consumption, then the aim of the XXI century is to optimize these forms through an exclusively ecological worldview.

The impact on the natural environment is the the most significant within the production environment since it has the dangerous consequences for the health condition and human reproduction both in terms of production itself and as a secondary factor outside the enterprise (toxic emissions, pollution of drinking water sources, hydrological phenomena, changes in biodiversity, etc.). Direct and indirect (secondary) environmental production factors create a synergistic effect and require equal attention and a comprehensive solution to this problem. Human also needs as much attention as the natural environment, being an element in the «human-technology-nature» system and having certain limits in stability and adequacy of actions in stressful and dangerous situations. Human often causes hazardous or emergency situations even with high equipment safety and controlled minimal environmental impact, and therefore leads to the large-scale environmental disasters with significant financial losses, human casualties or land use restrictions for indeterminate or limited period. These strategies for risk management in the construction industry of Ukraine are created on the basis of the main directions of promoting the sustainable development of a state and they allow to increase the stability of the construction industry of Ukraine and to improve its economic indicators through a number of precautionary measures. The introduction of green construction techniques is a success strategy for the construction industry that will provide an organic transition from a state of danger to a state of security, and from indifference to interest and responsibility.

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