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## CONCEPTUAL FOUNDATIONS OF MONITORING SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC SYSTEMS

## КОНЦЕПТУАЛЬНІ ОСНОВИ МОНІТОРИНГУ СТІЙКОГО РОЗВИТКУ СОЦІАЛЬНО-ЕКОНОМІЧНИХ СИСТЕМ

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*The article considers the issues of monitoring the sustainable development of socio-economic systems, by which we mean the process of continuous control of effective functioning and sustainable development of socio-economic systems, including the collection of data tracking the dynamics of changes in the state of the system and identifying trends in its development. Two types of monitoring of sustainable development of socio-economic systems are identified. In the static monitoring model, a comparative analysis of socio-economic systems, positioning of the system under study and determining the degree of its sustainability in comparison with others is carried out. The dynamic monitoring model analyzes the trends in the sustainable development of socio-economic systems based on the information for different periods. The proposed methodology combining elements of correlation analysis and elasticity theory allows advancing in the issue of short- and medium-term forecasting of economic crises. **Key words:** monitoring; system; surveillance; sustainable development monitoring system; monitoring models; global threats.*

*У статті розглядаються питання моніторингу сталого розвитку соціально-економічних систем. Під моніторингом сталого розвитку розумітимемо процес безперервного контролю ефективного функціонування та сталого розвитку соціально-економічних систем, що включає збирання даних, які відстежують динаміку зміни стану системи та виявлення тенденцій її розвитку. Система моніторингу сталого розвитку (СМСР) – це ефективна комплексна система спостережень, контролю та оперативного управління сталим розвитком соціально-економічної системи загалом та її окремих елементів. СМСР повинна акумулювати у собі банки даних, що містять інформацію про економічні, екологічні, соціальні та інноваційні аспекти сталого розвитку соціально-економічних систем. Вона дозволяє оперативно та своєчасно реагувати на поточну ситуацію, отримувати максимальну інформацію про стан об'єкта та прогнозувати можливі загрози, створюючи передумови для ефективного управління сталим розвитком. Виділено два види моніторингу сталого розвитку соціально-економічних систем. У статичній моделі моніторингу проводиться порівняльний аналіз соціально-економічних систем, позиціонування досліджуваної системи та визначення ступеня її стійкості порівняно з іншими. У динамічній*

моделі моніторингу проводиться аналіз, що дозволяє визначити тенденції сталого розвитку соціально-економічної системи, базуючись на інформації за різні періоди. Запропоновано методику, що поєднує в собі елементи кореляційного аналізу та теорії еластичності, дозволяє просунути у питанні короткострокового та середньострокового прогнозування економічних криз. Кореляційний аналіз використовується з метою виявлення основних тенденцій, залежностей та тимчасових лагів. Матриця коефіцієнтів еластичності дозволяє провести ідентифікацію ризиків та здійснити їхню оцінку. У цьому виявляється встановлення як можливих джерел ризику, так й ефекту впливу можливої зміни кожного вхідного параметра на динаміку вихідних параметрів. Ці дані можуть коригуватися в ході низки спостережень та використовуватися для прогнозування глобальних загроз. **Ключові слова:** моніторинг; система; нагляд; система моніторингу сталого розвитку; моделі моніторингу; глобальні загрози.

**Statement of the problem in a general form and its connection with important scientific or practical tasks.**

In modern conditions, the formation of an effective system of sustainable development of the national economy is impossible without strengthening the role of the state. On this basis, it seems necessary to consider the issues of management of sustainable development of socio-economic systems. On the international scale, such management should be carried out by international organizations, such as the UN. At the country level, the need for more effective management of economic and social processes of the society has now intensified. This also requires the development of legislative documents and mechanisms for their implementation in order to maintain the sustainability of the functioning of the economic and social sphere. At the regional level, local public authorities are called upon to manage sustainable development, taking into account the specifics of industrial, socio-cultural development of the region and its environmental features. Finally, it is necessary to manage sustainability at the micro level, as any enterprise is subject to threats from competitors, suppliers, consumers and other subjects of economic activity. In this context, these levels of sustainable development management, from the management of a specific technological process to the interaction at the level of the global community, should be closely interconnected, subordinated and harmonized.

**Analysis of the latest studies and publications, which the author relies on, which consider this problem and approaches to its solution.** First, it is necessary to define the spheres of application of the categories «management» and «monitoring». P. Drucker defines management as «a special kind of activity that transforms an unorganized crowd into an effective, purposeful and productive group. Management as such is also a stimulating element of social change» [2, p.18]. According to M. Mescon, M. Albert and F. Hedourie, «management is a process of planning, organization, motivation and control necessary to formulate and achieve the goals of the organization .... Control is the most fundamental element of the management process. Neither planning, nor the creation of organizational structures, nor motivation can be considered entirely

in isolation from control. Indeed, in fact, in fact, all of them are integral parts of the overall control system» [5, p. 38]. The closest to the concept of «control» is, in our opinion, the concept of «monitoring». The concept of monitoring, as a method of scientific research, is interpreted differently in scientific literature. «Monitoring» is a method of research of an object, implying its tracking and control of its activity (functioning) for the purpose of forecasting [1]. Alternatively, monitoring is a specially organized systematic and continuous observation of the state of the object and its operational assessment. The main structure-forming elements of the diagnostic system monitoring should include mechanisms that contribute to the information support of organizational structures regarding the normal state of the enterprise, its competitive potential and other characteristics, as well as regarding the potentially dangerous and negative [2].

Thus, monitoring includes the study of the object, its assessment, control, forecasting, as well as the development of recommendations for making managerial decisions to bring the object to an optimal state. Management, on the other hand, involves the adoption of effective to bring the object to an optimal state, as well as the implementation of this activity. The purpose of management is to ensure the sustainability of socio-economic system, maintenance of key modes of its functioning. The purpose of monitoring is to obtain information necessary for making managerial decisions.

**Highlighting previously unsolved parts of the general problem, to which the specified article is devoted.** As the analysis of world experience shows, the most important element of management of sustainable development of socio-economic systems is the organization of effective monitoring. In the leading countries of the world, starting from the 90s of the XX century, monitoring has become a real management tool in the system of sustainable development. Nevertheless, despite this, monitoring of sustainable development requires the development of conceptual foundations, methodological and organizational approaches to its implementation.

**Formulation of the goals of the article (statement of the task).** The task of managing the sustainable development of socio-economic systems

is too extensive. Therefore, in our study we focus more on the substantiation of such an important economic category as «sustainable development monitoring», which is an integral and key component of the management process. Therefore, the purpose of the article is to investigate the conceptual foundations of sustainable development monitoring.

**Presentation of the main research material.**

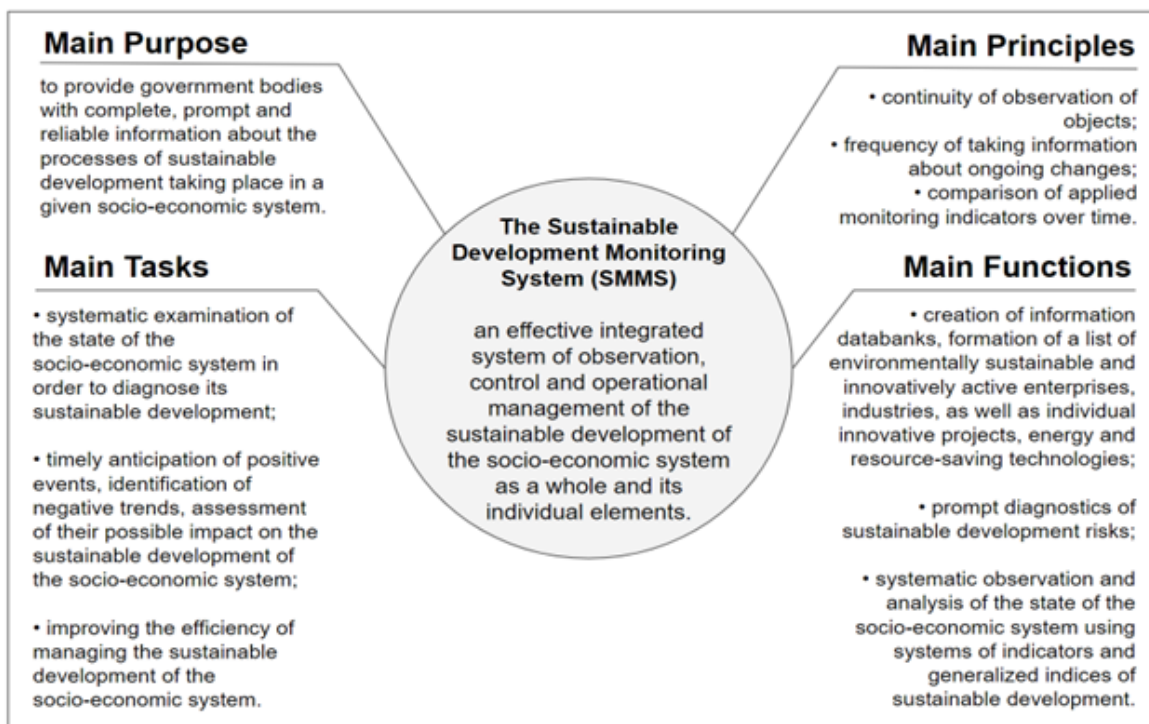
With regard to the system of sustainable development, the term «monitoring» was first used before the UN Stockholm Conference on Environment in 1972, where the necessity of creating a systemic global international environmental monitoring was justified [8]. The first domestic scientific publications on environmental monitoring appeared in the mid-1970s of the XX century. Here we can distinguish two alternative concepts of environmental monitoring as a system of observations that allows highlighting changes in the state of the biosphere under the influence of human activity. In this case, monitoring was considered separately from the management process [9]. Moreover, another concept, treating monitoring as a system of observation, control, assessment and management of the environment. In this case, the effectiveness of monitoring, not aimed at management, is low and leads to redundancy or insufficiency of information and its non-use [4].

In parallel with environmental monitoring, there was a development of economic monitoring systems, significantly including elements of economic security. The analysis of theoretical developments and approaches to the creation of sustainable development monitoring systems has shown that they

are incomplete. The existing monitoring systems, as a rule, carry out diagnostics of only certain aspects of sustainable development, which, moreover, is carried out irregularly. Despite the diversity and availability of information, there are problems with its collection, storage, processing and, especially, provision by various economic entities. Incompleteness of information on sustainable development indicators or its redundancy, late receipt of information, imperfect methodological support of monitoring and other negative factors complicate the comprehensive assessment of sustainable development of socio-economic systems.

To solve these and other problems, it is necessary to develop concepts for monitoring the sustainable development of socio-economic systems, including goals, objectives, principles and stages of building a monitoring system, a methodology for calculating a generalized index of sustainable development, a methodology for operational forecasting of global threats [5].

By monitoring sustainable development, we will understand the process of continuous control over the effective functioning and sustainable development of socio-economic systems, including the collection of data tracking the dynamics of changes in the state of the system and identifying trends in its development. It is based on the scientific methodology of achieving efficiency within the framework of economic control, complex-system analysis, planning and forecasting, management, marketing, information technology. Figure 1 presents the goals, objectives, principles and functions of the sustainable development monitoring system.



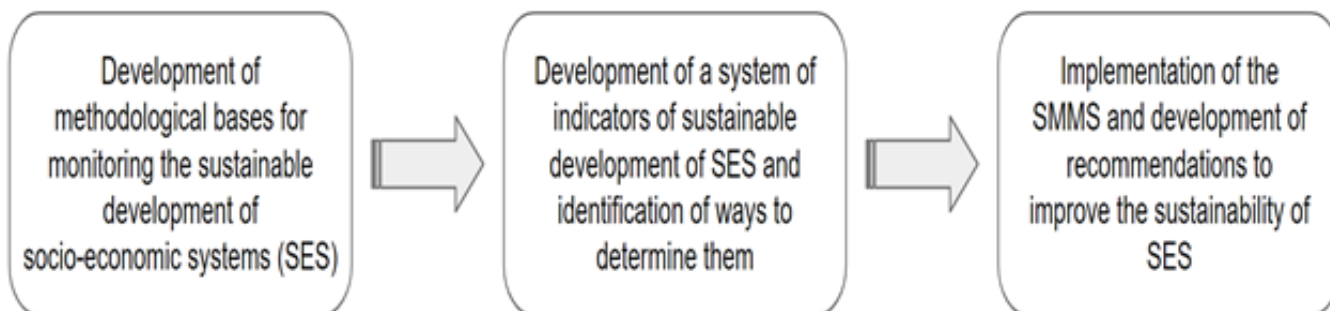
**Fig. 1. Goals, objectives, principles and functions of the sustainable development monitoring system**

Source: own research

Figure 2 shows the stages of development of the sustainable development monitoring system.

At the first stage of the SDMS development, it is necessary to select specific methods and types of monitoring necessary to analyze the sustainable development of the economic system. It is proposed to use two approaches when developing methodologies. The first one is associated with a comprehensive analysis of various aspects of socio-economic system functioning. The main criterion here is the completeness of information, which allows

us to judge the balance and proportionality of the development of socio-economic systems. Dynamic analysis of individual indicators and generalized indices of sustainable development allows us to assess the prospects of strategic development of the system and identify the main problems. The second approach is used for operational control and forecasting of threats. Here, to a lesser extent, the use of all sustainable development indicators is required. The main criterion is the promptness of information receipt, processing and analysis.



**Fig. 2 Stages of development of the sustainable development monitoring system**

*Source: own research*

At the second stage of the development of the SDMS, a specific set of sustainable development indicators is defined, they are normalized, and generalized sustainable development indices are defined. The main attention here is paid to the information support of monitoring. It includes the search for information sources, collection, accumulation, storage, processing, protection and analysis of information using specially developed information systems and databases.

At the third stage of the SDMS development, a monitoring system is implemented to manage the sustainable development of a specific socio-economic system. Based on the analysis of the main trends of sustainable development, recommendations are developed for public administration bodies aimed at improving the sustainability of the socio-economic system.

Within the framework of this concept, it is also advisable to consider different types (models) of monitoring the sustainable development of socio-economic systems. One of such models is a static monitoring model, which provides a comparative analysis of socio-economic systems by various criteria of sustainable development. In the course of this monitoring, the positioning of the socio-economic system under study can be carried out, the degree of its sustainability in comparison with others can be determined. The dynamic model of monitoring the sustainable development of socio-economic systems uses the information of

the base and current periods. In such a model, dynamic analysis is performed, which allows to determine the trends of sustainable development of socio-economic system, based on its internal capabilities, to make a forecast of its sustainable development using the methods of mathematical statistics. This forecast, however, will be reliable in a stable economy.

In conditions of socio-economic instability (for example, during the emergence and deepening of the global economic crisis), the above models of sustainable development monitoring require supplementation and improvement. In these periods, operational diagnostics of global threats that have the most negative impact on the sustainable development of socio-economic systems acquires significant relevance. The literature describes various methods of operational diagnostics and forecasting of global risks. Geophysical methods of forecasting earthquakes, tsunamis and other natural and man-made disasters are widely known [326]. The UN Food Organization has a system of early warning of crisis in the world grain and food supply to prevent mass starvation.

At the same time, monetary indicators alone do not always adequately reflect the dynamics of the global crisis. In this regard, in order to assess global risks and their early diagnosis, we propose a methodology combining elements of correlation analysis and elasticity theory, the essence of which is presented in Table 1.

**Characteristic of the global risk assessment methodology**

Parameters	Characteristic
Definition of the object of analysis	It is necessary to precisely define the boundaries of the analyzed system (for example, the economy of Ukraine).
Formation of a set of exogenous and endogenous parameters	Parameters to be surveyed, selection of reliable sources of information, taking into account the infrequency of its provision.
Correlation analysis of the data	In order to identify key trends, dependencies and time lags.
Calculation of the matrix of output elasticity coefficients	The elasticity coefficient of the output indicator B for the input parameter A is defined as the modulus of change in the value of the indicator B, caused by a given change in the input parameter A, with all other input parameters affecting the value of B unchanged. After finding the elasticity coefficients of the parameters, taking into account time lags, a matrix containing the elasticity coefficients of the output indicators for a finite set of input parameters is constructed. Values of elasticity coefficients can serve as a measure of global risk, determining the level of connection between input and output parameters. The stronger the relationship, the higher the probability of a crisis.
Analysis of the results	The matrix of elasticity coefficients makes it possible to identify risks and their assessment, while determining not only the possible sources of risk, but also the effect of the impact of a possible change in each input parameter on the dynamics of output parameters. These data can be adjusted in the course of a number of observations and used to forecast global threats.

Source: own research

**Conclusions from this study and prospects for further research in this direction.** Summarizing the above, the following conclusions can be drawn.

1. By monitoring sustainable development, we will understand the process of continuous control over the effective functioning and sustainable development of socio-economic systems, including the collection of data tracking the dynamics of changes in the state of the system and the identification of trends in its development.

2. The Sustainable Development Monitoring System (SDMS) is an effective integrated system of observation, control and operational management of sustainable development of the socio-economic system as a whole and its individual elements. The SDSM should accumulate data banks containing information on economic, environmental, social and innovative aspects of sustainable development of socio-economic systems. It allows responding promptly and timely to the current situation, obtaining maximum information about the state of the object and forecasting possible threats, creating prerequisites for effective management of sustainable development.

3. Two types of monitoring of sustainable development of socio-economic systems are identified. In the static model of monitoring the comparative analysis of socio-economic systems, positioning of the system under study and determination of the degree of its sustainability in comparison with others is carried out. The dynamic monitoring model analyzes the trends in the sustainable development of socio-economic systems based on the information for different periods.

4. The proposed methodology, combining elements of correlation analysis and elasticity theory, allows us to advance in the issue of short- and medium-term forecasting of economic crises. Correlation analysis is used to identify the main trends, dependencies and time lags. The matrix of elasticity coefficients allows to carry out identification of risks and their assessment. In this, case the definition of not only possible sources of risk, but also the effect of the impact of a possible change in each input parameter on the dynamics of output parameters. These data can be corrected in the course of a number of observations and used to forecast global threats.

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