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Evaluation of machinery-building enterprises activity in the concept of sustainable development

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Abstract. The global idea of sustainable development as a Trinity of economic, social and environmental development priorities confirms its relevance at the level of the country, region and enterprise. An industrial enterprise can and should be responsible for environmental performance in terms of ensuring the safety of its production technologies and for implementing social objectives for its employees as a socially responsible employer. In order to monitor the implementation of the concept of sustainable development, it is necessary to develop a system of target indicators by which to assess the degree of achievement of the goals not only at the state level, but also at the level of the enterprise - the key link of the economic system. To implement the monitoring of sustainable development, an attempt is made to ensure the "cross-cutting" nature of sustainable development indicators – the presence of similar indicators at all levels of economic development – from the enterprise to the level of the region and the state. Approbation of the author's technique is made on the example of industrial enterprises of machine-building profile. **Key words**: the concept of sustainable development, sustainable development of industrial enterprises, assessment of the level of sustainable development of industrial enterprises.

1. Relevance of the research topic

The concept of sustainable development, the essence of which is a balanced economic, environmental and social development , initiated by the Roman club in the middle of the XX century, was embodied in the form of national development programs with appropriate performance indicators. As for the Russian practice, the start of implementation can be dated back to 1996, when the Concept of transition of the Russian Federation to sustainable development was presented by the Government of the Russian Federation and approved by presidential decree No. 440 of April 1, 1996. The Concept notes that “following the recommendations and principles set out in the documents of the UN Conference on environment and development (Rio de Janeiro, 1992), guided by them, a consistent transition to sustainable development it is necessary and possible to implement in the Russian Federation, ensuring a balanced solution of socio-economic problems and problems of preserving a favorable environment and natural resource potential in order to meet the needs of current and future generations of people” [1]. Ten years later, the Order of the Government of the Russian Federation from 06.06.2017 №1170-p [2] the Federal state statistics service of the Russian Federation (Rosstat) has become the body of coordination the activities of subjects of official statistics on the formation and submission the indicators of achievement of the goals of sustainable development of the Russian Federation in accordance with international standards for the exchange of statistical data to

international organizations of official statistical information, that is, to provide information on the declared at the world level 17 sustainable development goals, which in the Russian document refracted in 87 indicators: Eradication of poverty, eliminating hunger , good health and well-being, quality education, gender equality, clean water and sanitation, missing and clean energy, decent work and economic growth, industrialization, innovation and infrastructure, reducing inequality, sustainable cities and human settlements, responsible consumption and production, the fight against climate change, conservation of marine ecosystems, conservation of terrestrial ecosystems, peace, justice and effective institutions, partnership for sustainable development. This is due to the fact that the global sustainable development goals have been decomposed into indicators with a focus on the available statistical base and the relevance of the goals for the Russian Federation. It is obvious that these goals and indicators are for the global (world) level, for the country and regions.

At the same time, for Russia, which traditionally considers itself an industrial power, it is important to consider how an industrial enterprise can participate in the implementation of sustainable development goals. Environmental and social indicators are implemented through the mechanisms of public administration – redistributive system of taxation. The industrial enterprise is held responsible for its economic performance under market conditions. Previously, in the pre-perestroika period, the industrial enterprise took over the function of implementing social and environmental goals. It is obvious that these functions can be implemented by enterprises at the present time.

The objective of our study is to shift the implementation of the sustainable development concept into the language of productive enterprise and to understand, in the performance of any of the 17 objectives in the framework of the "Agenda for sustainable development for the period till 2030" adopted by the member States of the UN on 25 September 2015 for the eradication of poverty, conservation of the resources of the planet and prosperity for all [3] , can participate in the Russian industrial enterprise.

2. Level of study and elaboration of the problem

The category of "stability" is considered by scientists in a broad, philosophical sense (for example, in articles of I Prigogine [4]), and in the applied level of indicators evaluation [5,6, etc.]. Some scientists say that sustainable development can be achieved only on a global scale, for example, G. A. Ugolnitsky emphasizes the diffusion of environmental problems: "sustainable development can be fully realized only at the global level, since the earth's biosphere is United and violation of the requirements of sustainable development in one place is quite capable of causing global consequences" [7]. Today's situation in Europe clearly demonstrates the global nature of economic and social problems: refugees from Africa and the East are seeking Europe as a more economically and socially comfortable territory. Undoubtedly, the stability of the meso-level (state and region), and the micro-level (specific enterprise, organization) system is dependent on global sustainability. At the same time, the inverse relationship is also true: global sustainability is the sum of the economic actors sustainability plus the Delta of social and environmental sustainability that cannot be achieved at the enterprise level, and which needs the institutional and financial support of the State, provided by the tax system. Therefore, we agree that in such a complex issue of planetary importance, both philosophy and concrete actions on a limited time interval are important. [8].

We cannot afford to consider sustainability only as ensuring the stable state of the system, as a return to the initial state, as the relative immutability of the main parameters of the socio-economic system, the ability of the system to remain constant for a certain time –this may be characteristic of technical systems. Eminent authors (LI Abalkin, S.Yu. Glazyev [9,10]) associate stability with the security, stability, reliability, integrity and strength of the system, which undoubtedly implies the ability of the socio-economic system to maintain a dynamic balance. The stable state of the socio – economic system is the stability in the dynamics while ensuring the growth of economic indicators , which, in turn, are a condition for maintaining social and environmental indicators at the appropriate level.

There are also approaches to sustainability at the enterprise level, and they are very diverse.

One view ("static") is that sustainable development implies the ability of a system of interrelated elements of an enterprise to ensure the viability and growth of economic efficiency of the enterprise, despite the impact of various environmental factors: T.V. Kolosova [11], M.A. Mikitas [12], etc .A number of authors understand the "sustainability" as the ability to long-term implementation of the activities of the industrial enterprise, the ability of the system to function stably, to develop, to maintain the movement along the planned trajectory, to increase the potential of the enterprise (O.V. Shalamov [13], S.V. Orekhova [14], etc.).The above approaches focus on economic evaluation.

The representatives of the "noospheric model of sustainability" interpret it as a prevention of threat of infringement of an ecosystem. Their theses carefully substantiate the economically acceptable rates of development, are aimed at regulating the economic burden on the environment, insist on such rates of economic development that will not violate the rates of self-representation of the ecological environment [15, etc.]

The classics of "sustainable development" require consideration of all the three components: economic, environmental and social. This is a systematic, triune approach reflected in the works of modern authors, such as N.A. Khomyachenkova [6], T.V. Alferov and E.A. Tretyakov [16], etc. The Company can and should ensure the achievement of environmental goals in the framework of ensuring the safety of its technology for the external environment and the payment for pollution . Also, the company can and should provide social goals for its employees , considering them as motivational investments.

A large number of works of both foreign and domestic authors are devoted to the problems of developing tools for assessing sustainable development. Among the works in the field of studying the theoretical and practical conditions for assessing sustainable development and developing indicators of sustainable development, it is necessary to highlight the report "On measuring economic development and social progress" of two Nobel prize laureates in Economics: Stiglitz and A. Sena[17]. Sala [18] in its work analyzes the main methodologies for assessing sustainable development , the most popular in practice (environmental impact assessment (EIA); strategic environmental assessment (SEA); economic and environmental accounting system (SEEA); life cycle assessment (LCA); life cycle cost (LCC); benefit and cost analysis (CBA), etc. Nuri Jihat Onat [19] analyzes the possibility of using a promising method for assessing the sustainability of the life cycle (LCSA), which is one of the most popular in monitoring the environmental effects of production, poorly reflects the economic and social component of sustainable development.

Currently, there are two main directions in the development of methods for assessing sustainable development:

- formation of a system of indicators, each of which reflects certain aspects of sustainable development ;
- the formation of an integral (aggregated) indicator, which can be used to track the stability of development as a whole.

The second direction to the development of methods for assessing sustainable development involves the use of an integral (aggregated) indicator representing a set of weighted indicators. The integrated indicator can be positioned as a comprehensive indicator of sustainable development, a kind of analogue of GDP of the selected object of management (territory, region, industrial enterprise). From this point of view, the approach to the assessment of sustainable development in the form of an integrated indicator is more convenient for decision makers, as it virtually eliminates the need to predict the consequences of the mutual influence of indicators and allows for more rapid conclusions in the field of management: the growth of the integrated indicator means the sustainable development of the object of management, respectively, the reduction of the integral indicator indicates the instability of development. Sustainable economic well-being index (ISEW), Human development index (up to 2013 – human development index) [21]. The complex nature of the integral indicator, despite the factor of subjectivity in the process of determining the weight coefficients, justifies, in the authors ' opinion, wider prospects of using this approach for assessing sustainable development compared to the approach using the principle of the indicator system.

Russian scientists also contributed to the development of the theoretical apparatus for assessing the sustainable development of industrial enterprises. E.A. Tretyakova, T.V. Alferova, Yu.I. Pukhova [16] analyzed the methods of sustainable development of industrial enterprises developed by domestic scientists, satisfying the definition of sustainable development as a set of processes of positive changes that embody their technologies aimed at harmonizing relations between the economic, environmental and social spheres. According to the authors, the methods should allow to evaluate the processes of positive changes occurring in the development process, while taking into account the balance of social, economic and environmental activities that allow systems to exist indefinitely.

Methods of sustainable development assessment, using additive functions as calculation ones, have a sufficient degree of subjectivity due to obtaining weight coefficients by expert means. The method of evaluation of sustainable development , based on the use of geometric average[22,6], determines the limitations to the nature of the components used in the calculation (non-application of relative changes in parameters). The most optimal, taking into account these restrictions, is the use of a combined (mixed) calculation mechanism, including both the geometric average method and the additive function method. The author's methodology for assessing sustainable development, presented below, is based on the use of a mixed calculation mechanism.

The main conclusions obtained from the analysis of indicators and methods of assessing the level of sustainable development, presented in the policy documents and publications of key scientists and practitioners relating to a particular production enterprise, include:

- the complexity of most of the analyzed techniques;
- the greatest preference for the economic factor. Environmental and social indicators are underrepresented in sustainable development assessment methodologies ;
- the need to combine a static and dynamic approach in the process of developing a methodology for assessing sustainable development. Static indicators characterizing the state of the system at a particular time will reflect its stability, and dynamic indicators, for example, growth rates, will characterize the degree of development of the enterprise for a certain period of time.

3. Method of assessment of sustainable development of industrial enterprise

The analysis of the existing directions of monitoring of sustainable development (system of indicators, integrated indicators) showed:

- the use of a methodology for monitoring of sustainable development, developed on the basis of a system of indicators, provides a good statistical base for all factors of industrial enterprises. At the same time, the availability of a large amount of information presents certain difficulties for policy makers in the decision-making process;
- monitoring with integrated indicators has an advantage in decision-making. The disadvantage of this method is the difficulty of determining the weights of the initial indicators without losing significance and without excessive subjectivity.

Thus, the current methodologies for assessing of sustainable development do not fully address the challenges of monitoring the assessment of sustainable development. According to the authors, the integrated indicator, due to its complex nature, justifies the priority nature of the use of this approach to assess sustainable development.

Analysis of indicators of sustainable development approved by the Government of the Russian Federation for the implementation of the "Agenda 2030" (87 indicators), program documents of socio-economic development of the Russian Federation indicates the insufficiency of the selected list of indicators to ensure full monitoring of the assessment of sustainable development , the lack of "cross-cutting" nature of indicators (parameters, indicators), which does not allow for a phased (consistently at all levels) assessment of sustainable development[23]. A large number of indicators approved at the official level to monitor the achievement of the sustainable development goals of the Russian Federation, causes a high complexity in the process of collecting information and its statistical processing to obtain an assessment of sustainable development .

The main requirements for building a sustainable development monitoring system are:

- reflection of key indicators of all factors of activity of the industrial enterprise (economic, ecological and social);
- "cross-cutting" nature of the indicator, allowing to assess sustainable development at all levels of activity (national; sectoral/regional; industrial enterprise);
- quantitative measurability;
- dynamic nature.

Analysis of the proposed indicators of sustainable development of industrial enterprises and indicators of sustainable development goals of the Russian Federation shows that to monitor the assessment of sustainable development of objects of the national economy at any level, it is necessary to introduce additional indicators of sustainable development at both national and regional (sectoral) levels. It should be noted that the indicators of sustainable development in static mode are not informative in themselves. To assess the degree of achievement of the sustainable development goals of an industrial enterprise, it is necessary to develop a methodology for assessing the level of sustainable development , based on the use of indicators for monitoring sustainable development (table 1). It presents indicators of monitoring the sustainable development of industrial enterprises that meet the specified requirements, as well as corresponding analogues of indicators of sustainable development goals of the Russian Federation. The achievement of the sustainable development goals in the framework of the "Agenda 2030" is planned to be assessed with the help of 244 indicators, which have been developed since 2015 within the framework of the Inter-Agency and expert group on indicators of achievement of the sustainable development goals (IAEG-SDG). Monitoring the achievement of one goal can be described by several indicators. Taking into account this fact and the fact that it is necessary to minimize the indicators used, the most key sustainable development goals of the Russian Federation are selected from the total number of goals described by indicators reflecting the main components of sustainable development (economic, social and environmental component):

- clean water and sanitation;
- missing and clean energy;
- decent work and economic growth;
- industrialization, innovation and infrastructure;
- reducing inequality.

The main requirements for the development of the proposed methodology for assessing the sustainable development of an industrial enterprise are defined:

- use of the integral indicator principle for the calculation of sustainable development assessment;
- balanced assessment of sustainable development, ensuring integrated consideration of economic, environmental and social factors of sustainable development ;
- to interpret the level of sustainable development, it is necessary to develop a scale of assessments with the characteristics of the established ranges.

The calculation of the indicator for assessing the sustainable development of the industrial enterprise D is performed as a calculation of the average geometric components of its components by the formula

$$D= (Kecon.* Kecol.* Ksoc)^{1/3} \quad (1)$$

where Kecon., Kecol., Ksoc. – accordingly, an integrated assessment of the economic, environmental and social factors of sustainable development .

The indicators of sustainable development of industrial enterprises are used for calculation the factors of sustainable development (Table2).

The calculation of the economic factor of sustainable development of Kecon is carried out using the additive function according to the formula

$$Kecon.= [\sum_{i=1}^{n} \alpha i * Liecon] = [\sum_{i=1}^{n} \alpha i * \sum_{j=1}^{k} (\alpha j * F_{jecon})] \quad (2)$$

where $\alpha i -$ the specific weight of the components of the economic factor L_{iecon}, $L_{iecon} - i -$ component of the economic factor.

Table 1. Indicators of monitoring of sustainable development of industrial enterprise

	The SDG indicators of the Russian Federation, IAEG-SDG	Indicators for monitoring sustainable development	The formula for calculating
		Environmental component	
1	Average annual level of fine particulate matter (e.g. PM2.5 and PM10) in the atmosphere of cities (in terms of population)*	The concentration of substances polluting atmospheric К1env.	$\sum_{i=1}^{k}(a_i * c_{ia}/c_{in})$, где c_{ia} , c_{in} - actual and normative concentration of the i-th pollutant, a_i – weight coefficients of pollutants
2	CO_2 emissions per unit of value added	Emission index CO_2 К2env.	CO_2 concentration / MAC (maximum permissible concentration) /ПДК
3	Share of safely treated wastewater	The degree of purification of water К3env.	Ratio of the volume of wastewater, treated and usable as process water, to the volume of water consumed by the industrial enterprise
4	Proportion of municipal solid waste that is regularly collected and properly disposed of in the total urban waste*	Disposal of solid waste (SW) К4env.	The ratio of the volume of SW disposed in accordance with the requirements of environmental standards to the total volume of SW produced by the enterprise
5	Energy intensity calculated as the ratio of primary energy consumption to GDP	Energy intensity index К5env.	The ratio of the amount of energy consumed to the gross income of the enterprise to the same value of the world's best practices
		Social component	
6	Manufacturing employment as a percentage of total employment *	The coefficient of stability of staff К1soc.	К1soc=1-P_{left}/(P_{av}+P_{hi}), where P_{left} - the number of employees who left the enterprise at own will and because of violation of labor discipline for the reporting period, number of persons; P_{av} - the average number of employees in this enterprise in the period preceding the reporting, number of persons ; P_{hi} - the number of newly hired employees for the reporting period, number of persons
7		Salary level К2soc.	The ratio of the average salary in the enterprise to the average salary in the industry
8	Occupational injuries, fatal and non-fatal, by sex and migration status	Ensuring safe working conditions К3soc.	The ratio of the total number of occupational injuries to the number of staff N
9	Level of participation of adults and young people in formal and non-formal education and training in the last 12 months, by sex*	Advanced training К4soc.	Ratio of total training costs to gross income

		Economic component	
		Production component	
10		The index of labor productivity K1econ.	The ratio of labor productivity in the enterprise to the average value of the parameter in the industry
11		Renewal of fixed assets K2 econ.	Ratio of the total value of newly introduced fixed assets to the total value of fixed assets at the end of the reporting period
		Marketing component	
12	The annual growth rate of real GDP per capita*	Sales volume index K3 econ .	Sales growth rate in the reporting and previous period
13		Market share K4 econ.	Ratio of the market share occupied by the enterprise at the end of the reporting and previous period
		The operating component	
14	Value added of manufacturing to GDP and per capita	Profitability of sales K5 econ.	Net profit to sales ratio
15	Share of workers ' income in GDP, including wages and social security payments	Share of employee income in gross income K6 econ.	The ratio of the total wage and social protection costs to gross income
		Investment component	
16	Investments in energy efficiency as a share of GDP and the amount of foreign direct investment in financing for sustainable development in the service industries to expand their infrastructure and upgrade their technology*	Investment activity K7 econ.	Ratio of investment expenditure to gross income
		Innovative component	
17	R & D expenditure as a percentage of GDP	Innovative potential K8 econ.	The ratio of the cost of innovation to gross income
18	Share of added value of products of medium-tech and high-tech industries in the total value added*	Innovative productivity K9 econ.	Ratio of gross income from the sale of innovative products and services to the total gross income of the enterprise
		Financial component	
19	Financial stability indicators *	Current liquidity ratio K10 econ.	Ratio of short-term liabilities to current assets
20	Financial stability indicators *	The coefficient of autonomy of own funds K11 econ.	Equity to assets ratio

* - IAEG-SDG indicators

The calculation of the values of the components of the factors is performed by the formula:

$$L_{iecon} = \sum_{j=1}^{k}(\alpha j * F_{jecon})] \quad (3)$$

where αj – the share of the indicator of the economic factor F_{jecon} ,

$F_{\text{экон}}$ – indicators components of the economic factor L_{iecon}.

The calculation of environmental and social factors is similar.

4. The practical significance of the results of the method

Practical approbation of the developed technique is carried out at three machine-building enterprises of Sverdlovsk region. The results of the evaluation of sustainable development, is calculated according to the methodology and techniques by A.V.Ilyicheva [26], N.A.Khomachenko [6] , the results for one of the large enterprises are given in Table 2 .

To compare the author's indicators of sustainable development, the indicators of IAEG-SDG and the SDG are presented. In the case of a direct analogue of the indicators of the SDG list of the Russian Federation. If analog indicators are not in the list of indicators of the SDG of the Russian Federation, the indicators from the list of the IAEG-SDG are used.

The dynamics of the indicators of sustainable development changes , calculated using different methods, show similar trends. The author's method is characterized by a simpler calculation mechanism, as well as a smaller number of indicators used.

The author's methodology is of interest to the Executive authorities in the process of developing a set of measures to support the enterprises of the industrial sector, which can be provided in the form of public-private partnership, preferential taxation mechanisms, participation of enterprises in Federal and sectoral programs of modernization, development and technical re-equipment.

Table 2. Dynamics of the indicator of sustainable development for "Machine-building plant" for the period 2014-2016

method	Period		
	2014	2015	2016
Author's method	0,191	0,138	0,228
Method by A.V. Ilyicheva	0,514	0,278	0,451
Method by Khomachenko	0,208	0,171	0,197

The methodology may be of interest to industrial enterprises, which will be able to develop corrective actions in the field of management with the help of an integrated indicator of sustainable development, as well as to assess their investment attractiveness in the domestic and foreign markets.

The author's condition for the development of the method is the equality of the weight coefficients of the components of sustainable development. If this condition is met, a balance (Trinity) of sustainable development of the industrial enterprise is ensured. In practice, industrial enterprises have the opportunity to independently determine the values of the weight coefficients, based on the selected strategic development priorities.For assessment of sustainable development at the national and regional levels, the weights of the components should be equal. Otherwise, it will not be possible to integrate the indicators of individual enterprises.

5. Main conclusions

The scientific novelty of the proposed methodology for assessing sustainable development is determined by the following results::

- indicators of monitoring of sustainable development are used , describing the behavior of economic objects at the national, regional and local level of activity (enterprise level) and compatible with indicators of achievement of global sustainable development goals;
- the set of indicators for monitoring sustainable development is compact, necessary and sufficient to ensure compliance with the global sustainable development goals;
- the developed mathematical mechanism for calculating the assessment of sustainable development to the maximum extent takes into account the differences in the indicators of monitoring the sustainable development of industrial enterprises associated with different functional activities (economic, environmental and social).

Of course, the enterprises can't solve all the problems of implementing all sustainable development goals. But those goals that support the safety of technology and the density of resources used in the production , as well as support the implementation of social priorities of employees of the enterprise, can make a worthy contribution to the implementation of the overall goals of sustainable development of the state.

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