

Methodological Approaches to Forming a System of Industrial Production Comprehensive Analysis Strategic Indicators

Iлона V. Yarkova
Volgograd State University
Institute of Economics and Finance
Volgograd, Russia
YarkovaIV@volsu.ru

Yekaterina P. Kucherova
Volgograd State University
Institute of Economics and Finance
Volgograd, Russia
ZemlyanskayaEP@volsu.ru

Abstract – The success of any industrial enterprise largely depends on following environmental protection factors and proper ecological safety threats management. Such management provides not only difficulties in identifying and preventing these threats and constant search for management tools, but massive costs reduction opportunities and decreasing the liability risk. The current research aims at fulfilling conceptual tasks on qualitative accounting, management, information and analytical economic entities' systems transformation. The main idea of fulfilling these tasks is to shift strategic interests in order to promote the ecological strategy on all production and management levels. The article suggests a topical process of following the ecological parameters by elaborating an algorithm of providing production enterprises ecological safety. The study suggests methodic recommendations, enabling the assessment an enterprise's ecological safety level by comparing relative quantitative indicators of activity, which are in turn the result of ecological environment's multidimensional monitoring and the average weighted ecological safety (unsafety) unified indicator. The scientific novelty and research results include elaborating a system of analytical support to business development strategy by integrating a comprehensive approach to greening the industrial production and internal control over adhering to ecological indicators in order to enhance an enterprise's economic safety level.

Keywords — *ecological management accounting, strategy, ecological risks, ecological safety, indicators of greening*

I. INTRODUCTION

The technosphere is gradually replacing the biosphere, that is why one of the businesses' main tasks is to minimize the eco-economic risks and prevent ecological crises, as they are the main reasons of damage done to the environment [1]. Such approach to viewing industry in general should be important not only for protecting the environment, initiated on the state level, but for improving the strategic effectiveness and industrial standardization. Therefore, taking into account the environment causes not only a more careful attitude to it but brings certain internal transformations. The necessity to elaborate and follow the industry's ecological strategy flows out of the sustainable development priorities, which are set by

the state in the Ecological Safety Strategy of the Russian Federation through to 2025.

The research supposes that following the regulations is not enough when ensuring an enterprise's ecological safety. However, several scholars have think the opposite [2], [3], [4], [5] and rely on the Environmental Protection Federal Law of 10.01.2002 № 7-FZ. As we can see, the priorities of ensuring ecological safety in accordance with the maximum permissible concentration and other regulative effects on the environment gradually lead to the ecological risk concentration over the last years [6]. This happens because of low efficiency and subjectivity of the normative process [7]. "In terms of the rising enterprise's environmental liability, its ecological safety for the environment and population significantly determines its competitiveness [8]. That is why the approach to elaborating a system of an industrial enterprise's ecological safety is based on the interconnection with the enterprise's competitiveness and economic efficiency growth in the strategic perspective, what goes beyond the state regulation limits. Ecological management systems have been implemented over the last 20 years in order to control ecologically oriented risks, costs and opportunities more systematically and effectively [9].

Russian enterprises are manly not adapted to environmental challenges in terms of ensuring ecological safety and decreasing possible adverse impact and thus the enterprises are unable to estimate the importance of controlling ecological safety. This aspect is disregarded by the top-managers, because they strive at achieving short-term high results and forget about the strategic importance of the timely internal ecological audit, accounting and analysis [10]. There are ecological audit norms but unfortunately they are not implemented. On the one hand, it is explained by their advisory function, but on the other hand, the enterprises' managers do not realize the goals of implementing then and are not economically interested in it. The ecological requirements are viewed not as means of overcoming pollutions consequences, but as means of preventing them. However, the enterprises' intensive ecological activity is connected not only with increased costs, but with the

decreased specific resource consumption [11], what leads to the growth of financial benefits from the ecological activity, lowering the accompanying risks and raising an enterprise's cost.

In relation to the above-mentioned, the research's goal is to elaborate the methodology and a set of recommendations on estimating the level of an industrial enterprise's ecological safety level, based on its strategic indicators production greening.

II. MATERIALS AND METHODS (MODEL)

The systems of managing the industrial enterprises' ecological safety have been analyzed by the Russian scholars [12], [13], [14] from the point of view of timely finding and processing the information on the pollution parameters and their influence on the environment as well as estimating and forecasting future ecological situation. Some studies [15], [16] are based on standard indicators and various maximum permissible discharges, the others base on using multiple quantitative (absolute and relative) and qualitative indicators. This complicates making universal conclusions. At the same time the above-mentioned studies tell almost nothing about the ecological measures' influence on the financial result, as well as there's very little information on the identification and estimation of the ecological safety components.

This investigation is based on a comprehensive approach to estimating the ecological safety level and processes of collecting the data in terms of the environment's multi-dimensional monitoring. In return, the data is correlated with the weighted indicators calculation mechanism, based on the management (ecological) accounting. Moreover, the article presents a model of defining basic components, the algorithms of an industrial enterprise's ecological safety by means of the coefficient method and expert estimate method. The system analysis methodology has been chosen as the core for solving the issues of ecological safety level estimation, what enables to discover the structure and cause-effect relations of building ecological management systems.

III. RESULTS AND DISCUSSION

The industrial enterprises' eco-economic risks are certain economic losses risks, which are caused by environmental disruptions and directly relate to accidents, excessive pollutants emissions, incompliance with the environmental legislation requirements, including the differences in their nature and consequences (fig. 1). The first block is connected with the industrial enterprises functioning conditions and is based on regulative documents analysis. The second block implies basic components of the industrial enterprises ecological safety, i.e. the formation of a total of the strategic indicators of production greening complex analysis and elaboration of strategic methodic recommendations. The third block is a target one, because here each management level is evaluated, basing on the target indicators. The fourth block presents the industrial ecological safety's tasks. The most complicated part of the whole algorithm is the second block.

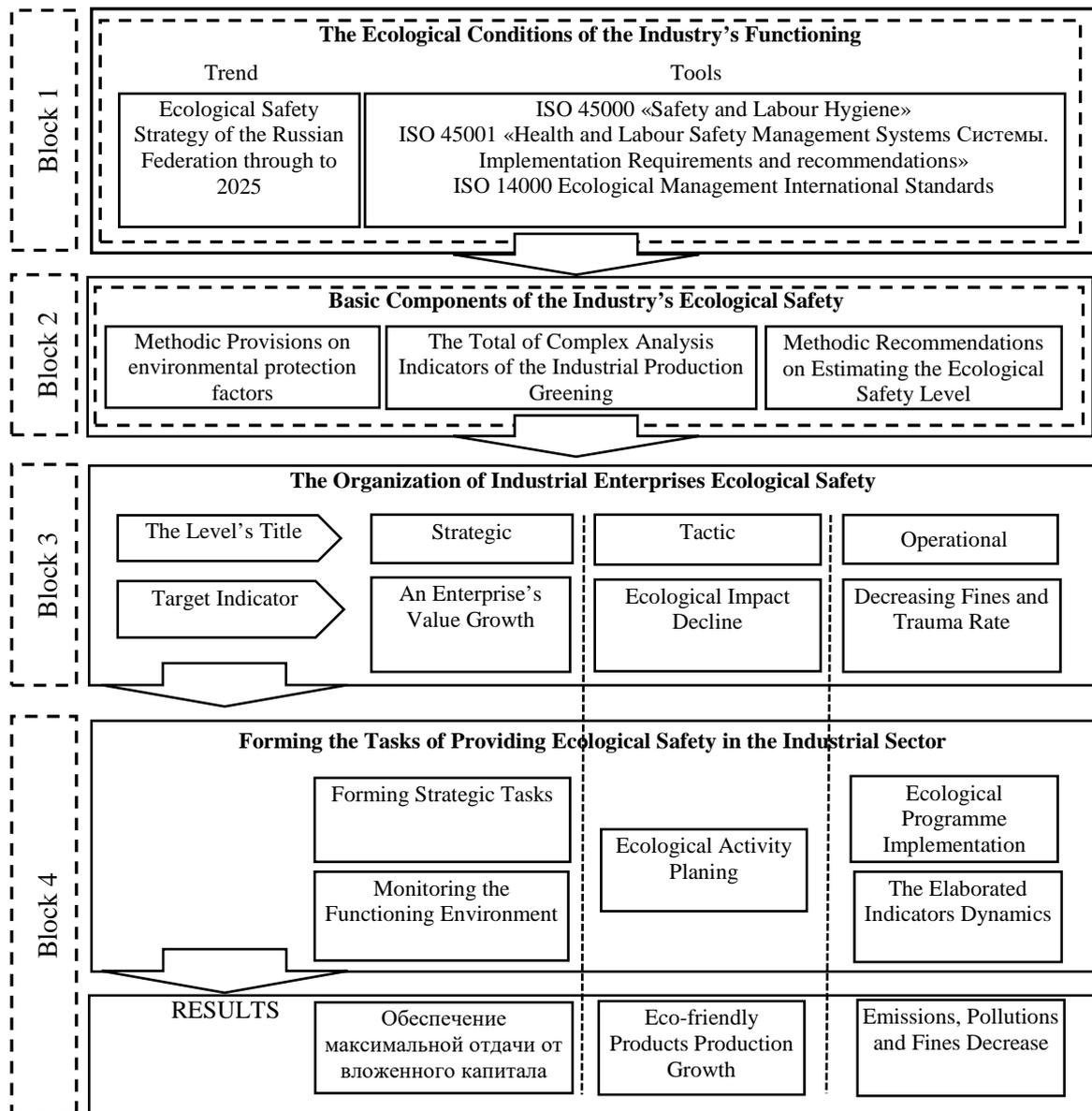


Fig. 1. The Strategic Algorithm of Providing Industrial Enterprises Ecological Safety

The study suggests a comprehensive set of stages of providing ecological safety and forming corresponding indicators for making managerial decisions (fig. 2). This process is supposed to start from collecting primary information on the condition and perspectives of an enterprise's environment, which contains macro-, meso- and micro environments. The macro-environment's factors include a system of the ecological safety state regulation, science-technical, informational, economic and legal, socio-demographic and natural environment. The meso-environment factors consist of environmental protection bodies, the mass-media, specialized educational institutions, audit companies. The micro-environment includes external factors (such as clients, contact audience, material, machines and equipment suppliers, investors, etc.) and internal (labour, financial and informational resources, ecological production

technologies, a company's image, production management system and so on).

Further, the system of providing ecological safety's basic components implies the stage where the information on an industrial enterprise's ecological environment is transformed. This stage is supposed to be implemented, basing on a complex monitoring with the following presentation of results in a form of indicators totals necessary for making managerial decisions. Moreover, the study shows the structure of indicators, which could facilitate the estimation of industrial enterprises ecological safety. They are distributed by the environment's complex monitoring directions (Table I).

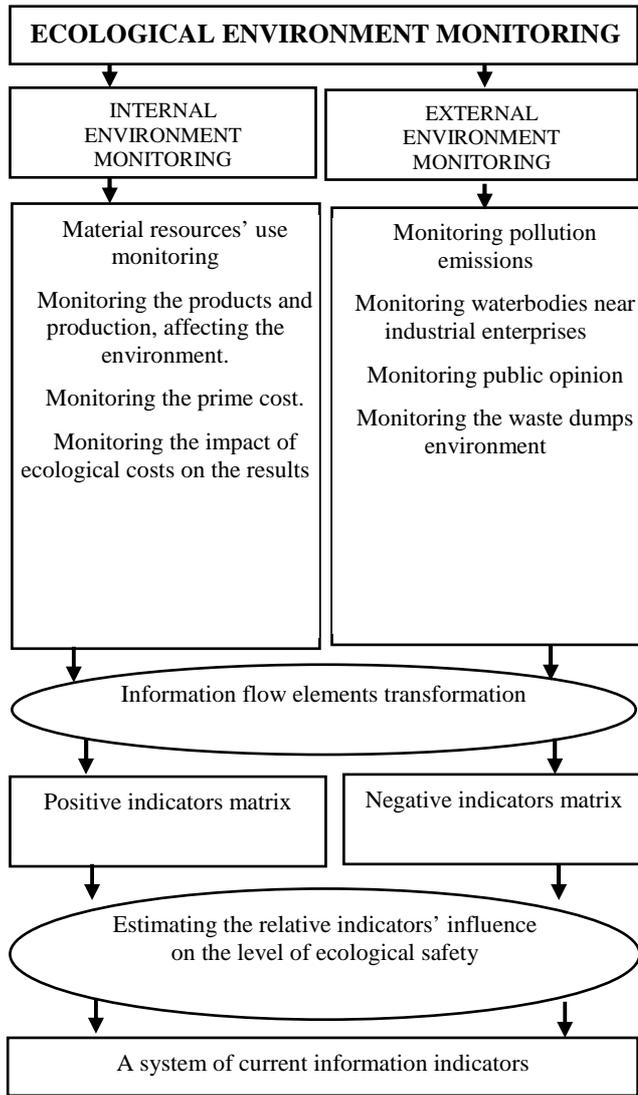


Fig. 2. Industrial ecological safety indicators basic components determination model

After that comes the elaboration of methodic recommendations, which allow estimating an enterprise's ecological safety level (the third stage of the algorithm). Thus, after calculating the quantitative relative indicators, listed in Table 1, it is necessary to standardize them.

The process of defining optimal (normal) indicators is always subjective and is conducted by experts mostly. From the research authors' point of views, one of an enterprise's managers should be responsible for setting such optimal indicators. Such manager would rate the stated below directions by their importance (it is suggested to rate them from 1 to 3). Each rate would receive a certain ration, so that overall ratios total would equal 1. Then the expertise will submit the expected figures for each monitoring indicator, which are compared to the fact figures.

TABLE I. Industrial enterprises ecological environment monitoring indicators

Monitoring stage	Indicators
Internal environment monitoring	
Material resources' use monitoring	The share of recycled materials, environmental capacity and environmental return of production, the share of natural resources costs in the products' prime cost; the share of natural resources in an industrial enterprise's ecological expenses; natural resources use coefficient; production's fuel, energy and water capacity.
Production monitoring	Production environmental friendliness, products environmental friendliness, the extent of wastes recycling, chemical concentration level in the working area air.
Prime cost monitoring	Ecological costs structure per production unit, the share of ecological expenses in the productions prime cost, ecological costs limit.
Monitoring the impact of ecological costs on the results	Ecological profitability (environmental protection profitability); ecological efficiency of an enterprise.
External environment monitoring	
Monitoring public opinion	The number of investigations or remarks on ecological cases, the number mass-media releases on an enterprise's ecological efficiency.
Pollution emissions monitoring	The degree of gas or water purification in case of emissions into the environment, the volume of emissions, releases and collecting wastes; payment for environmental pollution; production wastes dumping.
Monitoring waterbodies near industrial enterprises	The degree of affecting water bodies (soil), water bodies pollutants background concentration, maximum permissible concentrations of substances and sewage, water resources use limit.
Monitoring the waste dumps environment	Waste capacity of an enterprise, technological processes purity coefficient (eco-friendliness), the volumes (limits) of wastes, dumping permits.

Basing on the calculated indicators, the researchers suggest developing two matrixes. The first matrix will comprise normal indicators (within the expected limits) and the second matrix will comprise deviant indicators. Thus, it is possible to form a weighted figure of an enterprise's ecological safety level in all groups of positive (E^+) and negative (E^-) indicators for all monitoring directions. After that, it is necessary to compare the weighted figures: $WE^+ > WE^-$, and finally you will get an industrial enterprise's ecological safety or unsafety level in case $WE^+ < WE^-$.

TABLE II. The algorithm of defining an enterprise's ecological safety level

The stage and what has to be done	Result
1. Processing the data on the indicators system, environmental protection bodies' information and the data from open sources	Industrial enterprises relative indicators quantitative figures
2. Comparing all relative indicators to their expected figures	The total number of positive (E^+) and negative (E^-) indicators of ecological safety
3. Assessing the influence degree of an industrial enterprise's environment complex activity directions monitoring on its ecological safety level	The probability of an industrial enterprise's activity environment monitoring directions influence (π_i) on its ecological safety level
4. Defining the level of a weighted industrial enterprise's safety level separately by all groups of positive and negative indicators	Weighted figure: $WE^+ = \pi_i * E^+$ $WE^- = \pi_i * E^-$
5. Comparing weighted figures: $\Sigma WE^+ > \Sigma WE^-$	The accepted or unaccepted level of ecological safety
6. The analysis of the achieved level of ecological safety (unsafety) of an industrial enterprise	Deciding whether it is necessary to take measures in order to enhance the ecological safety level

The sequence of actions on assessing the level of ecological safety is given in Table 2.

After calculating the level of ecological or unsafety of an enterprise, it is essential to analyze the results and elaborate possible improvement measures.

IV. CONCLUSION

Providing ecological safety is one of the key factors of Russia's science-technological development. However, the process of providing ecological safety is complicated by the absence of unified methodological approaches to defining enterprises' ecological safety levels. The current study shows an attempt to present not only the totals of relative indicators, which allow comparing and assessing the ecological safety level, but it instructively describes the whole process of defining the ecological safety level from analyzing the

primary data to interpreting the results. Taking into account the information sources, used for calculating the figures, the research authors have chosen those, which require minimum labour and time costs and allow the managers to get the maximum of information on the ecological safety level. At the same time, the list of these information sources is flexible, depending on the industrial sector.

The final enterprises' ecological environments' relative quantitative indicators determine the information representativity and enable accurate assessment of enterprises' ecological safety levels and making reasonable managerial decisions. Therefore, the final assessment of ecological safety (unsafety) is a weighted figure, which is received as a result of applying expert evaluations method, based on the management (ecological) accounts, environmental protection bodies' data and other information, submitted by open sources.

Acknowledgment

The research is conducted with the financial support from the Russian Foundation for Basic Research and Volgograd Oblast Administration under the project № 18-410-343002/18.

References

- [1] Glushchenko, A.V., Yarkova I.V., Kucherova Y.P. The Role of the Ecologically-Oriented Accounting Systems from the Perspective of Minimizing the Strategic Risks in terms of Ecologizing the Production. *Advances in Intelligent Systems and Computing*. Series editor Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland, 2018, pp. 741-748.
- [2] Alimov, A. A. Ekologicheskaja bezopasnost' i mirovaja politika: chto proishodit, kto vinovat i chto delat'? [Environmental safety and world politics: what is happening, who is to blame and what to do?]. *Vestnik MGIMO-Universiteta*, 2011, №4, pp. 226-232.
- [3] Sarkisov, O.R. Ekologicheskaya bezopasnost' i ekologo-pravovye problemy v oblasti zagryazneniya okruzhayushchej sredy [Environmental safety and environmental and legal problems in the field of environmental pollution]. Moscow: YUNITI-DANA, 2013. 231 p.
- [4] Badaguev, B.T. Ekologicheskaya bezopasnost' predpriyatiya: Prikazy, akty, instrukcii, zhurnaly, polozheniya, plany [Environmental safety of the enterprise: Orders, acts, instructions, journals, regulations, plans]. Moscow: Alpha Press, 2012. 568 p.
- [5] Borshchev, V. YA. Ekologicheskaya bezopasnost' promyshlennykh ob'ektov [Environmental safety of industrial facilities]. Tambov: Publishing house FGBOU VO "TSTU", 2016. – 1 electron. wholesale. disk.
- [6] SHERstnev, A.V. Ekonomicheskaya ocenka riskov v sisteme upravleniya ehkologicheskoy bezopasnost'yu na proizvodstvennykh ob"ektah. Diss. kand. econ. nauk [Economic risk assessment in the environmental safety management system at production facilities]. Saratov, 2012. 183 p.
- [7] Glushchenko, M.E. Ekologicheskaya bezopasnost' predpriyatiya: kompleksnaya metodika ocenki [Environmental safety of the enterprise: a comprehensive method of assessment]. *Nauka o cheloveke: gumanitarnye issledovaniya* [The science of man: humanitarian research], 2015, №5, pp. 166-174.
- [8] Mongush, A.D. Ekologicheskij uchet na mikrourovne [Environmental accounting at the micro level]. *Science Time*, 2014, № 7 (7), pp. 272-278.
- [9] Khmelev, S.A., Suglobov A. Ye. Metodicheskie aspekty ekologoorientirovannogo ucheta i audita v celyah obespecheniya ekonomicheskoy bezopasnosti predpriyatij promyshlennosti [Methodological aspects of ecologically oriented accounting and audit in

- order to ensure economic safety of industrial enterprises]. Vektor nauki TGU [Vector of science TSU], 2011, №3, pp. 95-101.
- [10] Mochalova, L.A. Mekhanizm formirovaniya ekologicheskoy strategii i politiki promyshlennogo predpriyatiya [The mechanism of formation of environmental strategy and industrial enterprise policy]. Mekhanizm regulirovaniya ekonomiki [Mechanism of economic regulation], 2008, №. 3 (Vol. 2), pp. 206-215.
- [11] Strakhova, N.A., Bobarykina Yu. E., Smorgunova M.V. Metodologicheskie podhody prinyatiya ekologo-ekonomicheskikh reshenij pri provedenii ekologicheskogo audita [Methodological approaches to the adoption of environmental and economic decisions in the conduct of environmental audit]. Novye tekhnologii [New technologies], 2012, №3. Available at: <http://cyberleninka.ru>. Reference date: 28.02.2019
- [12] Dolzhenko E. N. Analiticheskaya sistema kompleksnoj ocenki ekologicheskoy bezopasnosti promyshlennyh predpriyatij: na primere predpriyatij g. Noril'ska. Diss. kand. econ. nauk [Analytical system of integrated assessment of environmental safety of industrial enterprises: on the example of enterprises of Noril'sk]. Noril'sk, 2007. 133 p.
- [13] Agafonov, A.V. Teoreticheskie i metodicheskie osnovy ocenki stimulirovaniya ekologo-orientirovannoj deyatel'nosti predpriyatij RF v usloviyah reformirovaniya ekologicheskogo zakonodatel'stva [Theoretical and methodological bases of the assessment of stimulation of ecological-oriented activity of the enterprises of the Russian Federation in the conditions of reforming of the ecological legislation]. Vestnik universiteta [Vestnik universiteta], 2017, №2, pp. 162-167.
- [14] Nikitina, YU. A. Ekonomicheskie aspekty ekologicheskoy bezopasnosti v neftegazovoj otrasli: mezhdunarodnyj opyt i rossijskaya praktika. Diss. kand. econ. nauk [Economic aspects of environmental safety in the oil and gas industry: international experience and Russian practice]. Moscow, 2012. 206 p.
- [15] Nikitenko, YU.V. Kriterii i pokazateli ocenki ekologicheskoy bezopasnosti predpriyatiya // Modelirovanie, optimizaciya i informacionnye tekhnologii [Criteria and indicators of an estimation of ecological safety of enterprise Modeling, optimization and information technology] Nauchnyj zhurnal [Scientific journal], 2014, №1(4). Available at: <http://moit.vivt.ru>. Reference date: 28.02.2019.
- [16] Kiseleva, S.P. Ekologicheskaya bezopasnost' innovacionnogo razvitiya: monografiya [Ecological safety of innovative development]. Tambov: Publishing house Pershin, M. V., 2013. 312 p.