



## Ecological Modernization of Enterprises: Environmental Risk Management

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### ABSTRACT

**Aims** The aim was to analyze current ecological risk management systems, identify their shortcomings and implement solutions that will help avoid them, and study the ecological component when creating documents concerning the ecological modernization of enterprises.

**Information & Methods** The present study investigates ecological and civil safety using logical analysis, comparative analysis, the formal-legal method, synthesis, deduction, and the analysis method of scientific literature.

**Findings** The result of this paper is the identification of theoretical and practical foundations of ecological risk management systems, their effectiveness in preventing anthropogenic and ecological disasters, and the analysis of the regulatory framework for creating and implementing documentation to be used in the ecological modernization of enterprises.

**Conclusion** The authors developed ecological risk management systems, eliminating shortcomings in their performance, introducing methods that will improve and make such systems more effective, as well as increasing the level of the ecological component during operations with documents that are cornerstones for ecological improvement of institutions and enterprises.

**Keywords** Anthropogenic Effect; Safety Management; Natural Resources; Environment; Sustainable Development

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## Introduction

At present, an important issue in the policy of every country, including Ukraine, is ecological safety since it plays a crucial role in all spheres of government and the life of the population. For a long time, the activities of enterprises were uncontrolled and unbalanced regarding the use of natural resources; the issue of environmental protection was not a priority, which substantially affected the development and activities of such institutions and led to considerably adverse consequences. However, regardless of the area, it concerns, a current business cannot prosper or even exist, neglecting ecological problems [1]. This paper identifies ecological risks, including anthropogenic and ecological disasters on the territory of Ukraine, which consequently allows identifying approaches for their management systems at various levels, which are directly aimed at mitigating the share of adverse consequences for society. To improve the operation of such systems, it is necessary to use research methods such as observation and analysis since they allow identifying and subsequently studying exogenous and endogenous ecological risks, which in the future will prevent disasters of various types. Analyzing the state of natural and anthropogenic security in Ukraine, it can be argued that it is complex, conditioned upon several factors that only worsen as time passes. However, despite this fact, the main and cornerstone approach of enterprises in ecological management is a preventive approach, which lies in mitigating the adverse ecological impact [2]. This paper also investigates the role and place of ecological risk management in creating and implementing a development strategy for enterprises in various industries. In addition, an important element of this study is the consideration and analysis of modern approaches to assessing ecological risks that enterprises currently use, so it can be argued that the current methods are insufficiently effective since they do not consider the tasks of strategic planning for ecological modernization of the institutions mentioned above.

Ecological risk management constitutes a necessary component for the effective and safe use of ecological networks, allowing enterprises to identify threats and develop an express and high-quality ecological development strategy in the future [3]. The general theoretical concept of ecological modernization can be interpreted as the transformation of an industrial society based on the principles of environmental ethics and the use of high technologies; super-industrialization, accompanied by qualitative economic growth (considering the scarcity of resources), reorientation of technologies to restore ecological balance, the technological overcoming of adverse consequences (creation of industrial ecosystems), the

establishment of a sustainably developing technological society. Innovative green technologies will positively impact both business and the environment. An essential concept that needs to be used to improve the state of the natural environment is "green bonds" since their attraction will expand the list of opportunities for enterprises. Furthermore, it is established that the priority lies with the use of alternative sources of energy and fuel, mechanisms of ecologically friendly entrepreneurship, the use of clean technologies in agriculture, as well as a list of projects for cleaning the air, water, and soil from pollution, recycling and disposal of waste. Ecological modernization aims to harmonize the entire complex of relations in the socio-ecological system. Its sustainable, balanced development will help prevent a global ecological catastrophe and ensure the coevolution of humanity, society, and nature [4].

The questions raised in this study have partly been developed by researchers [5], but the unexplored subject considered in this paper is the development of an ecological way of managing enterprises, which affects the solution of ecological problems using data on possible ecological risks. Therefore, this study aimed to analyze current ecological risk management systems, identify their shortcomings and implement solutions that will help avoid them, and study the ecological component when creating documents concerning the ecological modernization of enterprises.

## Information and Methods

This study used several methods and methodological approaches for conducting research in ecological and civil safety, namely the prevention of anthropogenic and ecological disasters and the creation of documents upon making decisions on the ecological modernization of enterprises. First of all, to conduct this study, it is necessary to identify the main goals and research areas, which is possible through a functional and methodological approach. The method of logical analysis, namely the logical reasoning method, offers the required results quickly and without hindrance; in addition, it facilitates the structure of the study in becoming efficient and logical. Since the subject concerns ecological and civil safety, it is worth noting the importance of using a theoretical and methodological approach because it provides a clear insight into the meaning of each concept, its features, and the principles used in the study. The method of comparative analysis allows considering and comparing ecological risks of various types, comparing different risk management systems, and immediately identifying the main shortcomings for their further overcoming and improving the efficiency of their activities. As an object of research, this area has a legal aspect, so using the formal legal

method is essential in this paper. This allows considering certain legislative norms relating to ecological safety and affects the creation of a high-quality regulatory framework for enterprises in need of ecological modernization. The synthesis method allows combining the factors identified during the study, which affect the operation of ecological risk management systems, to obtain more accurate conclusive study results. It is necessary to focus on the deduction method since it provided an opportunity to cover this subject from the general to the particular, namely from the broad concept of ecological risks to the narrow concept of the management system of eco-networks, using the logical chain method. Thus, the following tasks have been formed:

- review and evaluate the effectiveness of environmental risk management systems;
- discover means and methods of implementing ecological modernization of enterprises;
- allocate the share of the ecological component when creating constituent documents for enterprises undergoing ecological modernization;
- investigate the advantages and disadvantages of current systems for preventing anthropogenic and ecological disasters.

The subject of this study is investigated in three stages. The first stage highlights the theoretical foundations of this subject. For this, the authors of this paper analyzed the main approaches of researchers and scientific studies of Ukrainian and world authors. A plan for conducting research analysis is drawn up, and the main goals and objectives are highlighted. The second stage compares the practices of foreign countries in the field of ecological safety and analyses all ecological risk management systems designed to prevent anthropogenic and ecological disasters. It identifies promising means and methods to improve their activities with the involvement of international standards. The third and final stage lies in developing an exact algorithm for the ecological modernization of enterprises, increasing the share of the ecological component in documents, and considering possible risks and obstacles.

## Findings

Notably, in Ukraine, the regulatory framework for establishing restoration measures and determining and regulating the cost of environmental management is insignificant. Analytical data are also scarce in terms of their quantitative and qualitative indicators. Since the number of documents relating to the risk assessment of objects of impact, the selection of technical methods and the study of the level of disaster response is small, this does not allow for an unambiguous interpretation of certain issues in this area. One of the main components of the regular performance of ecological risk management systems is human resources. The

effectiveness of implementing any changes and reforms, including ecological modernization of enterprises, depends on the qualification of employees. Thus, combining a high-quality regulatory framework with a high-level professional knowledge of employees will create a fairly clear management system, including disaster prevention and ecological risks.

Moreover, the introduction of modern and orderly documentation in the activities of enterprises, which will have an ecological component, will allow calculating all the risks and amounts of damage from situations of various types, both ecological and anthropogenic, as accurately as possible. To ensure the effective implementation of timely and relevant strategies for responding to ecological risks, it is necessary to immediately investigate the possible ecological consequences of a process or product at the initial stage of planning its activities. This gives insight into the real situation and the danger of any activity at the enterprise. Furthermore, in case of a deterioration of the situation and the occurrence of troubles, ways will be known to overcome and eliminate them, which considerably protects production and employees.

Notably, one of the main factors influencing the ecological modernization of enterprises is the stringency of ecological requirements put forward by stakeholders or parties with a legitimate interest in the organization's activities. In addition, some entrepreneurs use modern ecological concepts and are guided in their activities by the norms of international environmental law to increase the competitiveness of their institutions. The international practices of standardization of environmental management systems by enterprises and companies will improve such indicators as energy efficiency, decarbonization of the energy segment, and, most importantly — the implementation of international ecological initiatives in Ukraine. Having analyzed the prospects for introducing the latest and most relevant approaches, there is no doubt that they constitute the so-called catalysts for the modernization of enterprises in the ecological sphere. An example of such innovations can be introducing an eco-network approach in sectoral policy, the reform of the integrated environmental management system, the merger of ecological policy with other policies, and the mandatory nature of applying an ecological component upon creating applying state planning documents. It is also necessary to resolve the issue of agreeing on conclusions on the creation of a particular industry enterprise that will impact the environment; in particular, it can be solved by reducing the ecological tax rate, as well as through an established annual compensation, combined with an increase in the level of ecological properties of products. This will facilitate bringing the state of Ukrainian ecological policy to the European level.

It is necessary to use a systematic approach to modernize the entire nature management mechanism, including enterprises. It allows identifying the main problems and shortcomings first and then, based on their elimination, developing an optimal model of nature management. The creation of such a clear structure will enable:

- improvement of the efficiency of using and restoring natural resources, greening businesses;
- revenues to the state budget;
- mitigation of the risks of ecological disasters and losses from them and elimination of their consequences;
- replenishment of the personnel of the environmental protection industry by highly qualified ecological specialists;
- solution to the most pressing issues of modern ecological science and education in Ukraine;
- implementation of the strategy of the national environmental policy of Ukraine for the period up to 2030 [4]. Thus, the authors of the present study offer an algorithm for improving ecological risk management systems: determining the object of management, system analysis of management methods, identifying the characteristics of the model, planning experiments, studying management processes, implementing an optimal management system created considering all standards and corresponding to a particular area of activity.

To create an effective environmental risk management system and prevent possible disasters in the future, it is necessary to analyze the current state of the systems. When developing new ones, it is necessary to consider all the shortcomings of the previous ones. In particular, at the current stage, the approach to the components of the ecological structure remains the main problem. This approach is a cornerstone in the performance of the system of ecological permits since it is differentiated, does not factor in and does not apply the necessary number and volume of international standards and innovations, including the legislative framework of the European Union. Therefore, the need for its reform is a priority. The system can be reformed by introducing separate permits for enterprises if the products they put out pollute the atmosphere and water world. Such permits should be justified based on sanitary and hygienic indicators to establish particular indicators for maximum permissible concentrations and optimally safe levels of exposure to harmful elements in the natural environment. Notably, in these changes, the expected result is not the prevention of disasters and pollution but the greening of each production stage. At present, the concept of ecological modernization of enterprises is largely widespread. It is based on the creation of sectors for the collection, storage and processing of hazardous waste yielded during production in a particular industry, as well as lamps containing mercury, packaging materials and containers, used

oils, worn tires, rubber products and waste of rubber production, disposal of unusable vehicles, electrical and electronic equipment (including transformers, stabilizers, and batteries), medical waste.

Important components in ecological risk management, which will immediately positively impact reducing the percentage of possible disasters, are ecological audit, certification of ecological facilities, ecological insurance, certification, and standardization according to current standards. Methods of research and consideration of this issue are as follows: implementation of forecast and analytical operations with subsequent use of the results obtained; creation of regulatory and methodological support for the development and implementation of the State Register of Ecological Passports of Enterprises; creation of the State Register of Ecological Passports of Enterprises; launch of a test project for certification of 5–10 of the most ecologically dangerous enterprises and institutions [6]. Ecological insurance is interpreted as a procedure for developing and applying civil liability insurance for stakeholders or users of products of high ecological hazard in case of their possible adverse environmental impact and damage to the interests of various entities, including the state. The purpose of ecological insurance is to create and develop a safe state of the natural environment for human health; to protect the property interests of owners and users of products of increased ecological danger in case of possible ecological pollution; to compensation for a certain percentage of losses caused to the country and other persons as a result of environmental pollution; to reduce the number of ecological risks and ecological losses. The key element of solving this issue is scientific and analytical research data and the creation of regulatory and methodological support for the ecological insurance system. In the future, such an innovation as ecological insurance should be expected to provide enterprises — foci of ecological danger — with material resources to compensate for ecological losses caused to Ukraine and other persons [7].

## Discussion

Many researchers from different countries have been investigating this issue mainly in the theoretical aspect for several decades. The ecological modernization theory formed the basis for developing national policy in many countries, including the Netherlands, Japan, Germany, and other highly developed countries. In them, the eco-modernization transformation reached the highest level of development and use. Analyzing the scientific achievements of researchers in this field, it is possible to interpret eco-modernization as a socio-ecological concept that eventually connects

the environment with constant societal changes. An essential element for the study of this industry is also a list of works concerning the economic component in ecological policy, technologies, and mechanisms of green and safe entrepreneurship and the ecological development of industrial production in the context of post-industrial development of society [8].

Considering environmental risk management issues, it is worth investigating the list of methods that can be used to assess ecological safety at enterprises of various industries. In particular, one of such assessment methods allows investigating the system of costs for ecological safety of production, factoring in its mandatory and structured nature. In general, it can be used in planning activities in the ecological risk management sector compared to its direct analysis and evaluation [9]. Another method allows comparing the dangerous ecological impact by enterprises of different industries, thus immediately identifying the most dangerous among them to apply certain restrictions. This method is based on indicators and data that correspond to the characteristics of particular individual industries. Thus, the process of studying the assessment of enterprises occurs in several stages, the main of which is the examination of statistical data in points with the calculation of weight coefficients; the final stage is the analysis of the dynamics of indicators as a percentage, subtracting the actual value of the total amount of points for quantifying the characteristics of production to the application of methods of socio-ecological safety. In addition, an integral index of prospects of enterprises of various industries to the application of socio-ecological responsibility as the optimal value of financial and non-financial indicators has been developed. Undoubtedly, the advantage of this method is the correlation analysis of current indicators at the enterprise with the main European ecological indices [10].

It can be argued that the integral structure of the mechanism for implementing ecological development of enterprises is a necessary element for preventing and eliminating possible threats of violation of regulatory ecological standards and requirements, which as a result, helps establish ecological responsibilities for industrial production. To develop and implement an enterprise development strategy, and most importantly, to meet the interests of stakeholders and users, it is necessary to use the principle of duality. This principle lies in combining the interests of both parties and is aimed at a rational solution to the problem [11]. Ecological risk management of enterprises is a fairly new scientific area based on practical aspects. It allows identifying the additional advantages for enterprises and mitigating the adverse environmental impact of a particular production. The effectiveness of the enterprise in the development and modernization of ecological

policy serves as the main guarantee of ecological safety and the ability to monitor and manage ecological risks during economic production. The concept of environmental risk management is becoming increasingly popular worldwide. It has received the greatest publicity in countries that actively promote the policy of green entrepreneurship, including Switzerland, Belgium, Austria, Finland, and others. The purpose of green entrepreneurship is to comply with and implement the approved established sustainable development standards to reduce the eco-destructive ecological impact, but without changing the pace of development of production activities. It is inherent in such entrepreneurship to reduce the adverse ecological impact, providing rational economic and social development [12].

Thus, green production covers three elements at once: ecological, social, and economic, instead of conventional entrepreneurship, which is aimed only at social and economic elements. A precondition for such modernization of Ukrainian enterprises is acquiring new and high-quality knowledge, approaches, and methods to develop new, modern, and, most importantly, green organizational structures for full compliance with the principles of sustainable development [13]. Admittedly, it is worth paying attention to such a financial element as green bonds, a debt obligation; the funds received during the sale are sent in full to finance green entrepreneurship and innovative eco-projects. This tool will help accelerate the development and modernization of most enterprises operating in Ukraine to a certain extent. This concept was introduced in 2007, and the first to support it were the World Bank and the European Investment Bank. However, the highest peak in the prevalence of bonds was obtained in 2016 in Luxembourg, as it was there that the first international green bond exchange was established. One of the main advantages of implementing this trend in Ukraine is the possibility of capitalization of enterprises, which will increase the level of their competitiveness and, most importantly, these institutions will become investment-attractive. As for the subjects in such relations, the main ones are European investors who act on the part of buyers. The financing of such green projects and support for enterprises reflects their socially responsible investment policy [14].

Analysis of the introduction of "green entrepreneurship" in Ukraine leads to positive changes in all sectors of the economy. First of all, the primary sector covering agriculture, fishing, forestry, and extractive industries will be able to improve the main priority processes in the output of products to meet the primary needs of the population. Therefore, changes will occur at the initial stage, allowing the entire mechanism and production system to change. When it comes to the secondary sector, which includes industry and

construction, it is safe to say that it needs modernization and investment the most since the basis of processes in this sector is the use of energy resources, which then form those hazardous elements and residues that enter the environment. This sector needs to be completely modified in technical terms since production characteristics serve as the basis for creating the main mechanism for all production and machinery and equipment. As a result, this will free the environment from the harmful effects of enterprises and allow using limited resources and control their balance effectively and efficiently. The tertiary sector is directly an image of a green economy since it provides services to both the population and businesses and represents the integral structure of various branches of entrepreneurship. It is precisely this structure that includes complex research and development processes.

Furthermore, it includes developing and implementing business plans and methods and energy-efficient technologies directly aimed at ecological modernization of the primary and secondary sectors. The use of innovations in the ecological sphere will allow increasing the efficiency of production processes, focusing on saving exhaustive critical resources for the planet, increasing commercialization, and introducing as many eco-technologies as possible into the daily work of enterprises. Thus, the main prospects for the introduction of "green bonds" are to improve the ecological state of Ukraine, accelerate the ecological modernization of enterprises, and ensure optimal use of natural resources [15].

The main purpose of assessing and monitoring the environmental risk management system is to apply minimal costs to achieve high results. Furthermore, to increase the efficiency of the management sector at the enterprise, it is necessary to search for and apply optimal and reasonable decision-making methods and solve issues [16-18]. The basis of greening production facilities and enterprises is the potential to increase production size in the context of maintenance and transition to the accelerated improvement of quality indicators and statistics of the ecological state of the natural environment. The structure of such high-quality integral ecological and economic marks and elements should include resource return, resource recovery, preservation, waste-free, ecological efficiency of the economy, which will serve as the basis for creating and producing important innovative concepts in the implementation of the greening policy. Such urgent actions for ecological modernization should be performed in the production facilities of industrial enterprises that most pollute the environment, for which innovative technologies and ideas for greening their production are extremely prioritized [5]. Ukraine's course toward European integration processes certainly has a positive impact on the

overall ecological state of the country. It is reflected in creating an innovative sector for modernizing ecological entrepreneurship by the current standards of the European Union, its competitiveness, profitability, and improving living conditions for the population. Maintaining ecological growth and development allows natural assets to continue to provide resources and ecological services that shape the well-being of social businesses. For this purpose, it serves as a catalyst for investments and technologies to be used as the basis for sustainable development and gives a list of new financial opportunities [19-21].

A characteristic difference from the current economy is that it is endowed with the properties of an ecological economy. The main goal of the ecological economy lies in reaching optimal development when comparing the concepts of ecology and economy as the basis for applying the ideas of sustainable development and putting forward proposals to the governments of countries for the transition to rational activity and production, which concerns supporting investments in national natural capital, solving energy issues and providing the population with ecological food products, optimal use of land resources and constant monitoring of their number, the development of more effective ecological and resource-saving innovations and mechanisms that will work to reduce the number of emissions of hazardous elements, resource creation, timely response to the results of climate change, the creation and implementation of technologies and mechanisms based on waste-free production [22]. The European Ecological Agency interprets the ecological economy as a current policy that allows the population to extract more resources every year while preserving the natural ecosystems. Studying all the definitions of the concept of ecological economics, it is worth concluding that its tendentious conceptual feature is greening. In turn, greening is an innovative process of consistent introduction of new equipment and technology, new forms of production organization, implementation of management and other decisions that allow increasing the efficiency of using natural resources while preserving the natural environment, improving it at various levels and ensuring overall well-being [23]. Ecological production provides a list of benefits to the enterprise because, after reducing operating costs as a result of stopping the unnecessary use of raw materials and energy, which is vital, it provides significant ecological benefits and creates added value [24]. Waste management is an appropriate example of ecological services that are extremely valuable for the ecology and the environment. Thus, processed raw materials that have lost their use for production can become valuable for a third party, which will be able to use them as raw materials for another product or restore them for reuse; it is for this process that it is

necessary to attract the latest eco-technologies and innovative developments [25].

## Conclusion

Consideration of the ecological component and ecological risks in the development and approval of documents related to the choice of an ecological strategy for the development of industrial enterprises allows for identifying ecologically optimal alternatives to activities, predicting the possible result in the ecological aspect of economic activities factoring in the current ecological state in a particular territory. The use of ecological risks management elements such as environmental impact assessment and internal and external ecological audits will allow combining ecological standards, including European ones, with the economic plans of industrial enterprises. This study can be used as a basis for the future development of the methodology for assessing ecological risks of industrial enterprises, as well as its application in the ecological risk management system during production at the enterprise. In addition, the study identified the importance and necessity of transitioning from the current concept of classical economics, which focuses only on the economic growth of the enterprise with ignoring the main ecological responsibilities, towards a new "green economy". It will considerably improve the well-being of humanity and the environment, while entrepreneurs will manage to combine two components: material and ecological. It is possible to identify numerous advantages after applying the concept of greening in Ukraine, among them: production of ecologically friendly products; rational use of resources; optimization of production costs; processing and waste-free production; increasing investment attractiveness and motivation to introduce innovations; better, ecologically safe working conditions and quality of life of personnel; increasing consumer confidence; reducing ecological risks; improving business reputation and image; positive impact on the environment, ensuring its restoration. As a result of the implementation of ecological modernization of enterprises, the issue of excess solid waste generation from production will be solved by changing the main production algorithm and minimizing them, ensuring the maximum possible use of resource-intensive waste and the issue of harmful waste disposal will be solved through the change and development of technological processes and the development of innovative complexes for their processing and use in the future.

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