

Kateryna Tymchenko

State Organization "Institute of Market and Economic&Ecological
Researches of the National Academy of Sciences of Ukraine", Odesa, Ukraine
E-mail: tymchenkoks@gmail.com
ORCID: <https://orcid.org/0000-0002-3328-6055>
ResearcherID: ABN-2358-2022

Assessment of Industrial Safety in the Black Sea Region of Ukraine

Abstract

The paper presents theoretical and applied aspects of ensuring industrial safety in the Black Sea region of Ukraine against the background of the socio-economic turbulence and military aggression. The purpose of the paper is to provide theoretical justification and practical assessment of the industrial safety level in the Black Sea region of Ukraine under conditions of martial law using an indicator approach, as well as to identify the main threats and areas for its strengthening at the regional level. *Methodology.* The methodological basis of the study is modern scientific approaches to assess the industrial safety, with special emphasis on the regional level of analysis under the conditions of martial law. To achieve the set goal, a number of general scientific and special research methods were applied. The logical-theoretical method was used to clarify the essence of the "industrial safety" concept, determine its place in the system of economic security of the state and the region, as well as to reveal the features of the industrial sphere functioning in conditions of crisis phenomena. The analytical method was applied to systematize existing approaches to assessing industrial safety, critically analyze scientific sources and the regulatory framework. For practical measurement of the industrial safety level, an indicator approach was used, which is based on the assessment of key indicators that reflect the industrial sphere state and its ability to function stably in unstable conditions. The statistical method was applied to collect, process and analyze data from the State Statistics Service of Ukraine, as well as regional statistics departments of Odesa, Mykolaiv and Kherson regions, which allowed for an empirical assessment of the industrial safety level in the Black Sea region. The comparison method was used to identify differences in safety levels among individual regions, as well as for comparison with regulatory values. In order to visualize the study results, the identified trends and structural changes, a graphical method was applied, which contributes to a better understanding and interpretation of the results obtained. The comprehensive application of these methods provided both theoretical and applied value of the study, allowing to provide a substantiated assessment of the industrial safety of the region, taking into account modern challenges and threats. *Study results.* Based on a comprehensive analysis of industrial safety in the Black Sea region, which includes an assessment of key economic indicators, in particular, the depreciation degree of the fixed assets in industry, the share of high-tech products in the total volume of industrial products sold, the profitability of operating activities, labor intensity, as well as structural, infrastructural and personnel aspects, both positive trends and significant problems affecting the stability and efficiency of the functioning of industrial enterprises in the region were identified. A comprehensive assessment of the state of industrial safety in the Black Sea region of Ukraine has demonstrated that its level is the result of the action of interrelated economic, technical, organizational and social factors, and also deeply depends on external destabilizing influences, in particular military actions, infrastructure destruction, loss of sales markets and decrease in investment activity. Structural imbalances and threats that reduce the stability of the region's

Keywords

economic security,
industrial safety, Black
Sea region, indicator
approach, profitability,
SWOT analysis, industrial
potential

JEL: F52, R58, O18, R11



This is an Open Access article, distributed
under the terms of the Creative Commons
Attribution CC BY 4.0

production system have been identified. *Practical importance.* An adapted indicator approach to assessing industrial safety at the regional level is proposed and a SWOT analysis is conducted, which makes it possible to outline the strategic directions for restoring and strengthening production potential. The need for infrastructure modernization, supporting innovations, and developing public-private partnership to ensure the stability and safety of the production environment of the Black Sea region is substantiated.

DOI: <https://doi.org/10.30525/2500-946X/2025-3-2>

1 Introduction

The current socio-economic situation in Ukraine is characterized by a high level of instability, increased internal and external threats, as well as the prolonged impact of hostilities, which significantly affects national security. One of its key components is industrial safety, which determines the stability of the functioning of basic industries, contributes to economic growth, maintaining social well-being and forming the potential for sustainable development. The issue of assessing the industrial safety level acquires particular importance at the regional level, where the manifestation of crisis phenomena has own characteristics. The Black Sea region of Ukraine, which is of strategic importance for the national economy, has been significantly affected by the hostilities, destruction of infrastructure, logistics chains and a decline in production volumes, but this region has significant production, transport and resource potential, which requires special attention from the point of view of ensuring its economic stability and security.

The insufficient level of scientifically grounded methods for assessing industrial safety complicates the process of risk monitoring, the formation of effective management decisions and the implementation of state policy in the field of safety. In this context, scientific understanding of the mechanisms for assessing and ensuring industrial safety in the Black Sea region is extremely necessary for the development of effective measures for economic recovery, increasing regional resilience to the challenges of the war and post-war period, as well as for building an effective system of economic security for the state as a whole.

Theoretical and methodological approaches to determining the economic security level, in particular through the calculation of integral indicators, are highlighted in the papers (Mkhalitska and Tsvaih, 2017), which can serve as the basis for building a system for assessing safety at the regional level. The components of the state's economic security, including the production component, are considered in the papers (Hnatenko, 2021; Hbur, 2018; Pikhotskyi, Pikhotska, 2022), where the emphasis is on current threats to economic security and the need for a comprehensive assessment. The issues of assessing industrial safety in the context of modern challenges are the subject of research by a number of scientists

(Kulish and Liadska, 2019; Vashai and Doroshenko, 2019), who considered methodological aspects of analyzing the dynamics of industrial safety indicators and approaches to its assessment in the context of military-political instability. Scientists (Ovcharenko, 2021; Ivanova and Malovychko, 2019; Tkach, 2015) focused on approaches to assessing the economic security of regions, which is extremely important given the need to take into account regional specifics in assessing industrial safety.

Important sources for applied analysis were official statistical data (State Statistics Service of Ukraine; Principal Departments of Statistics in Odesa, Mykolaiv, Kherson regions).

However, given the existing theoretical developments and individual examples of assessing the state of industrial safety in Ukraine, there remains a need for a more in-depth study of regional aspects, in particular, assessing the industrial safety of the strategically important Black Sea region against the background of martial law and post-crisis economic recovery.

The purpose of the paper is a theoretical justification and practical assessment of the industrial safety level of the Black Sea region of Ukraine under martial law using an indicator approach, as well as identifying the main threats and areas for its strengthening at the regional level.

Research objectives:

- to analyze theoretical approaches to interpreting the essence of industrial safety and the features of its assessment in modern conditions;
- to systematize approaches to assessing the industrial safety of regions;
- to assess the industrial safety level of the Black Sea region of Ukraine based on the indicator approach;
- to identify the main threats affecting the state of industrial safety of the region;
- to formulate proposals for increasing the industrial safety level in the Black Sea region, taking into account modern challenges.

2 Theoretical Aspects of Assessing Industrial Safety of the Black Sea Region of Ukraine

In the structure of economic security of the state and its regions, industrial safety has a special place,

which, according to the systemic approach logic, is one of the components of economic security along with financial, investment and innovation, energy, social, foreign economic, macroeconomic, demographic and food subsystems.

Industrial safety is one of the key elements of the economic and national security system, as it ensures the continuity and stability of the functioning of the national production fundamental sectors forming the basis of economic growth, contribute to increasing the social well-being of the population and provide conditions for sustainable development of the state. The level of industrial safety serves as a criterion for the resilience of the production system to various internal and external threats, and also determines the ability of industrial sectors to quickly recover and adapt in conditions of dynamic economic and social challenges. In this context, the state of the production sector directly correlates with the quality of the main macroeconomic indicators, affecting the overall level of protection of the national economy from potential crisis phenomena.

The regional aspect of ensuring industrial safety is of particular importance, which is of strategic importance for territories with important economic and geopolitical potential. The formation of theoretical foundations for assessing industrial safety requires a comprehensive, interdisciplinary approach that integrates economic, technical and social factors and is a necessary condition for the development of effective mechanisms for increasing the stability, adaptability and competitiveness of the production system of the region in the face of modern challenges and threats.

The scientific literature has not yet formed a unified interpretation for the “region industrial safety” concept, which indicates the complexity and multifaceted nature of this phenomenon. Depending on the research approach, industrial safety can be considered as a state of protection of the production environment, personnel, material and technical base and infrastructure of the region from potential threats of a technogenic, technological, organizational or natural nature. In a broader context, it is defined as the ability of a regional system to ensure stable, safe functioning of enterprises within an acceptable level of risk, taking into account the local industrial structure, employment specifics and the level of development of occupational safety management institutions (Kulish and Liadska, 2019; Vashai and Doroshenko, 2019). The lack of a unified approach to its definition complicates the formation of an effective assessment and management system, which necessitates the development of scientifically sound methodological approaches at the regional level.

Region industrial safety is the state of protection of the region's production potential from internal and external threats, which ensures stable, effective and continuous functioning of enterprises, preservation of labor resources, infrastructure, technological

equipment and logistics chains in conditions of normal activity, crises or emergencies. Industrial safety at the regional level is a set of organizational, technical and regulatory measures aimed at preventing accidents, incidents and minimizing their consequences at production facilities and within the region, which is implemented through the local management system for occupational health and industrial safety (Bohma, 2016; Hnatenko, 2021).

Therefore, industrial safety of the region is a dynamic state of the regional production environment system, characterized by the ability to ensure continuous and effective functioning of all elements of the production and logistics chain, preservation of labor and material resources through the regular application of the indicators, implementation of organizational, technical, regulatory and administrative measures built on the basis of systemic and integrative approaches to risk assessment and management.

Industrial safety assessment is a complex process that involves a regular analysis of factors that affect the stability and uninterrupted functioning of production facilities. The assessment of industrial safety includes the identification and quantification of potential risks and threats, assessment of the state of major production assets, technological level, human resources, as well as the level of organizational and regulatory support for safety. An effective assessment allows you to identify key problem areas, contributes to the formation of strategic management decisions and the development of measures aimed at preventing emergencies, incidents and environmental incidents. In the regional context, the industrial safety assessment is of particular importance, as it takes into account the specifics of the regional economy, infrastructure features and socio-economic conditions, which ensures the adaptability of the safety management system to dynamic environmental changes.

The purpose of the industrial safety assessment in the region is to determine the current state of industrial safety, identify key risks and factors affecting the stability of the functioning of production systems, as well as develop recommendations for increasing the level of safety and sustainability of industrial enterprises, taking into account regional characteristics.

The main tasks of the regional industrial safety assessment are as follows:

- identification, assessment and regular monitoring of potential production risks and threats that may negatively affect the safety of enterprises in the region;
- development and implementation of organizational, technical, regulatory and preventive measures aimed at preventing accidents, breakdowns and environmental incidents;
- ensuring coordination of the activities of enterprises, local authorities and response services for the prompt prevention and localization of emergency situations;

- formation of a system for monitoring compliance with occupational health and safety requirements in the region;
- conducting training, advanced training and forming a safety culture among employees and managers of enterprises;
- ensuring stability and resilience of production processes in crisis conditions by adapting management decisions to changes in the socio-economic environment;
- identification and application of the key indicators of production safety for a regular assessment of its status and management effectiveness at the regional level.

A high level of industrial safety ensures not only the effective functioning of individual enterprises, but also the overall resilience of the regional economy to destructive influences. In this context, it can be considered as a system-forming element of economic security, which integrates technical, personnel, infrastructure and environmental components directly related to the production process. That is why the formation of an effective system of assessment and management of industrial safety at the regional level is an important prerequisite for balanced socio-economic development.

In the context of the spatial organization of the state's economic security, industrial safety at the regional level is a critically important component that ensures the stability of local economic systems, their ability to self-recover and adapt to destructive influences. This becomes especially relevant in conditions of external aggression, disruption of production and logistics chains, damage to critical infrastructure and resource shortages, which is typical for individual regions of Ukraine during martial law.

3 Assessment of the Industrial Safety Level in the Black Sea Region of Ukraine Based on the Indicator Approach

The Black Sea region of Ukraine holds an exceptional place in the structure of the national economic complex, since its significance for the formation and maintenance of the economic and industrial security of the state is systemically important. The region includes Odesa, Mykolaiv and Kherson regions, which are integrated into a single geo-economic system with developed industrial, agricultural, transport and logistics and port transit potential. The determining factor of the strategic importance of the region is its geographical location, direct access to the Black Sea, integration into the network of international transport corridors, border neighborhood with the countries of the European Union and the countries of the Black Sea basin. The combination of these characteristics determines the role of the region as a key hub for the transit of commodity flows and

spatial concentration of industrial and economic activity. The economic profile of the Black Sea region is characterized by a high level of diversification, with shipbuilding, machine-building, chemical, food and agro-processing enterprises operating within its borders, which form a significant share of Ukraine's industrial potential. The region is notable for significant agricultural specialization with a pronounced export orientation, providing a significant share of the national production of grain, oilseeds and vegetable products. An important role is played by the port infrastructure, which serves more than half of the state's foreign trade operations. At the same time, the geo-economic position of the region determines increased sensitivity to risks and threats of various nature. These include: military-political risks caused by the ongoing armed aggression of the Russian Federation; environmental threats associated with the progressive processes of climate change, water resource shortages and degradation of natural ecosystems; man-made risks arising from the high concentration of critical infrastructure and industrial production facilities. The combination of these factors highlights the need for a comprehensive assessment of industrial safety in the Black Sea region, as well as the formation of multi-level mechanisms for its provision, integrated into the national security system of Ukraine.

Assessment of industrial safety at the regional level involves the application of systematized and representative information base, which covers both quantitative and qualitative parameters of the industrial complex functioning. To conduct a substantiated analysis of industrial safety in the Black Sea region (Odesa, Mykolaiv and Kherson regions), it is advisable to use not only national, but also regionally relevant indicators.

Prior to the invalidation, the Methodical recommendations for calculating the level of economic security of Ukraine approved by the Order of the Ministry of Economy Development and Trade of Ukraine dated October 29, 2013 No. 1277, served as a methodological basis for assessing integral indicators of the economic security, in particular in the field of industrial safety. However, the application of the indicators specified in the recommendations at the regional level was accompanied by a number of methodological and informational limitations, a significant part of the indicators had a macroeconomic nature and did not take into account the specifics of the functioning of individual territorial and economic systems, such as the Black Sea region. In addition, the insufficient statistical coverage of individual indicators at the level of administrative and territorial units significantly limited their analytical capacity for studying the industrial safety of the region. The aforementioned Methodological Recommendations had a number of shortcomings, in particular, insufficient adaptability to regional conditions and limited analytical capacity

due to methodological and information gaps, which significantly affected their effectiveness in practical application. This regulatory document has become invalid since August 11, 2025, which necessitates the development of updated methodological approaches that can adequately reflect modern challenges and regional features of economic security.

Also was conducted a comprehensive assessment of industrial safety in the Black Sea region (Odesa, Mykolaiv and Kherson regions) based on the following indicators.

The degree of depreciation of fixed assets in industry is one of the key indicators of the technical and technological component of the regional economic security, this indicator reflects the share of morally and physically obsolete elements of fixed capital, such as machinery, equipment, buildings and structures, in the total cost of fixed assets. In the context of assessing the industrial safety of the Black Sea region (Odesa, Mykolaiv and Kherson regions), this indicator acquires particular significance due to the concentration of industrial enterprises in the shipbuilding, food and chemical industries, the activities of which directly depend on the technical condition of the equipment. The dynamics of the degree of depreciation of fixed assets in the industry of the Black Sea region (Odesa, Mykolaiv, Kherson regions) is presented in Fig. 1.

Analysis of the dynamics of the degree of depreciation of fixed assets in the Ukrainian industry indicates a consistently high level of physical aging of the production equipment. During 2019–2023, this indicator fluctuated within 54.8%–63.5%, which indicates the depreciation of more than half of the fixed assets of the country's industrial sector and emphasizes the need to modernize the production capacities. Significant interregional differences are observed within the Black Sea region. In the Mykolaiv

region, the degree of depreciation of fixed assets remained relatively stable at 45–49%, which indicates a relatively better technical condition of industrial equipment. Odesa region demonstrates a trend of decreasing depreciation from 57.2% in 2019 to 45.6% in 2022, with a slight increase to 50.5% in 2023. Such dynamics are associated with the renewal of fixed assets or structural changes in industrial production. During 2019–2021, the degree of depreciation of fixed assets in the industry of Kherson region remained extremely high, exceeding 96%, which indicated a critical level of depreciation of fixed assets and insufficient financing for the modernization of industrial capacities. In 2022, the indicator decreased sharply to 42.75%, which probably does not reflect a real improvement in the technical condition of enterprises, but is a consequence of methodological changes in statistical accounting caused by hostilities, temporary occupation of the territory and partial loss of control over production assets. The return to an ultra-high level of depreciation in 2023 (98.36%) reflects the resumption of accounting and a more accurate assessment of the state of industrial infrastructure.

As part of assessing the innovative potential of regional industry, an important indicator is the share of high-tech products in the total volume of industrial products sold. According to the methodological approach, which is based on the structure of the KVED-2010, high-tech industries include: production of basic pharmaceutical products and pharmaceutical preparations (code 21), computers, electronic and optical products (code 26), electrical distribution and control equipment (code 27.12), as well as other vehicles (code 30), excluding railway engineering (30.2). The dynamics of the share of high-tech products in the total volume of industrial products sold in the Black Sea region is presented in Fig. 2.

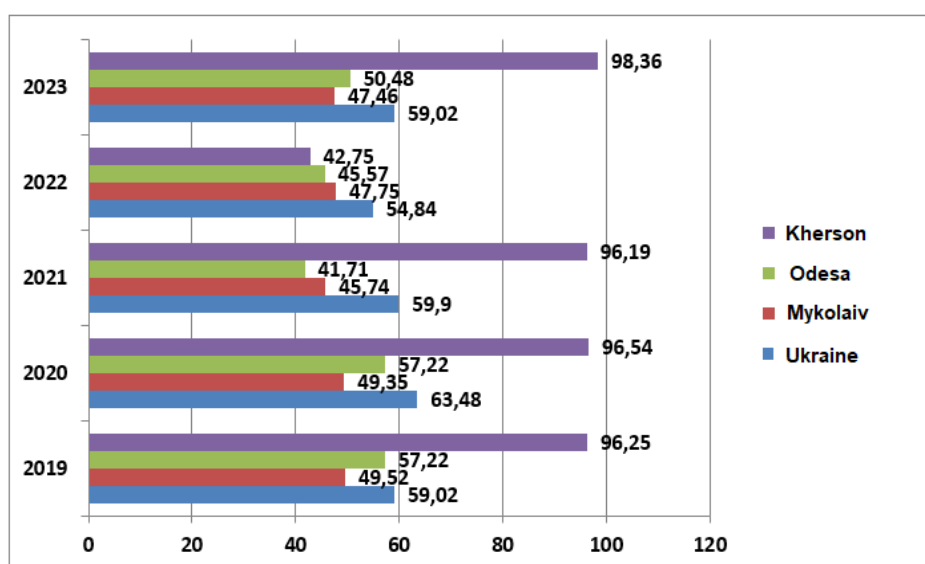


FIGURE 1 Dynamics of the degree of depreciation of fixed assets in the industry of the Black Sea region (Odesa, Mykolaiv, Kherson regions), %
Source: calculated based on data from the state and regional statistics services of Ukraine

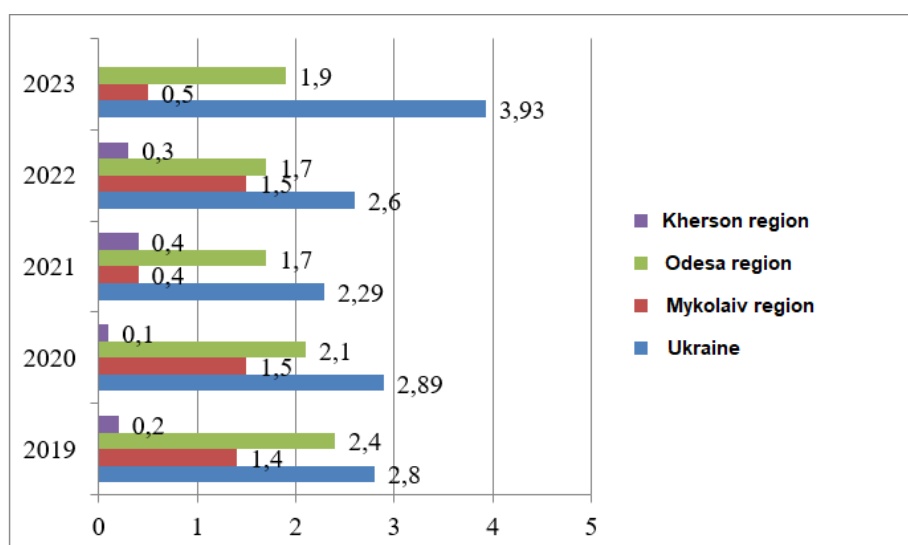


FIGURE 2 Dynamics of the share of high-tech products in the total volume of sold industrial products in the Black Sea region (Odesa, Mykolaiv, Kherson regions) for 2019–2023, %

Source: compiled by the author based on data from the state and regional statistics services of Ukraine

Analysis of the dynamics of the share of high-tech products in the total volume of sold industrial products in the Black Sea region, which includes Odesa, Mykolaiv and Kherson regions, for the period 2019–2023 revealed significant spatial and temporal differences in the level of technological complexity of industrial production; the regions demonstrate a rather low level of concentration of high-tech industries, which is an indicator of the limited innovation potential of the industry of the region as a whole. Among three regions studied, the most favorable conditions are observed in Odesa region, where the share of high-tech products remained at a relatively stable level during the studied period, although without clear positive dynamics. The presence of computer, electronic and optical production indicates the potential for the formation of specialized high-tech clusters, on condition that appropriate institutional support is provided. In contrast, Mykolaiv region demonstrates high volatility of the indicator, which indicates the instability of production processes in the high-tech segment, as well as sensitivity to external shocks, in particular armed aggression and disruptions of logistics chains. Kherson region turned out to be the most vulnerable, with a systemically low level of the share of high-tech production throughout the period, which indicates the absence of a critical mass of enterprises capable of generating innovative development in the industrial sector.

A comparative analysis of the dynamics of the share of high-tech products in the structure of sold industrial products demonstrates discrepancies between national trends and the situation in the Black Sea region. While at the level of Ukraine in 2019–2023 there is a gradual increase in the technological complexity of industrial production (from 2.8% to 3.93%), due, in particular,

to the redistribution of production capacities, the development of dual-use products and the growth of the pharmaceutical sector in wartime conditions, then in the regional context such positive changes have not been recorded. The assessment results confirm that the Black Sea region generally demonstrates lower than the average Ukrainian share of high-tech products, with a clear dominance of Odesa region.

The labor intensity of industrial production is an important indicator of the efficiency of the use of labor resources in industry, which allows us to assess the level of labor intensity and conduct a comparative analysis among the regions. To ensure methodological consistency and the possibility of correct comparison between regions and national indicators, this report applies total personnel costs both for Ukraine as a whole and for regions, without distribution by enterprise category. The dynamics of industrial production labor intensity in the Black Sea region is presented in Fig. 3.

In 2019–2023, a general trend towards a decrease in labor intensity of industrial production was recorded in Ukraine, which indicates an increase in the efficiency of the use of labor resources. Against this background, the Odesa region demonstrates the most stable and effective indicators, which generally correspond to the average Ukrainian level. The Mykolaiv region is characterized by a consistently high labor intensity, which may indicate lower labor productivity or structural features of the industry. The most contrasting dynamics are observed in the Kherson region, against the background of a sharp reduction in production volumes in 2023, labor intensity increased to its maximum value, which indicates a deep crisis in the regional industrial sector. The results obtained emphasize the significant regional differences in the

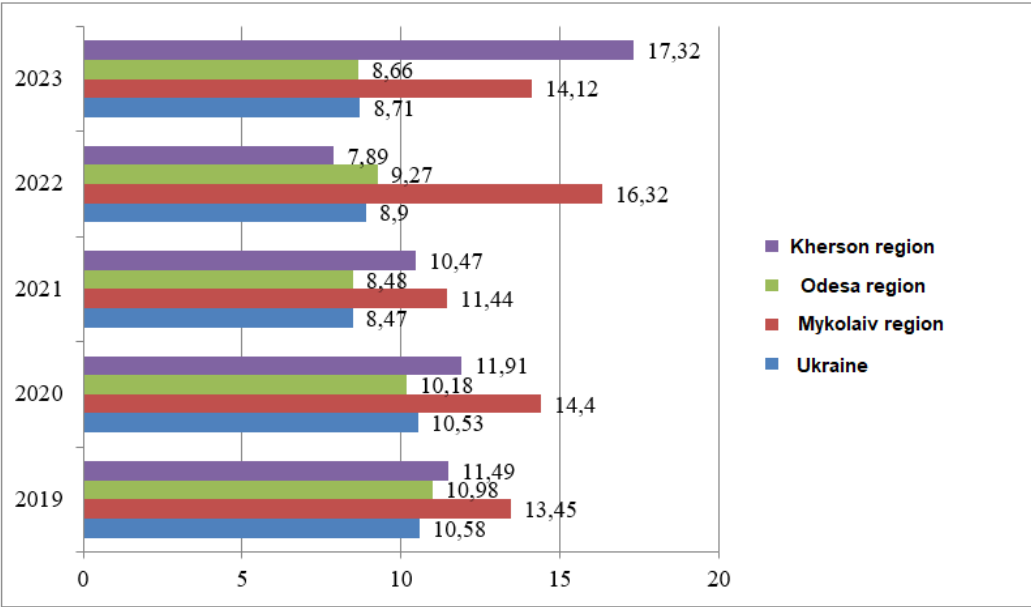


FIGURE 3 Dynamics of industrial production labor intensity in the Black Sea region (Odesa, Mykolaiv, Kherson regions) for 2019–2023

Source: compiled by the author based on data from the state and regional statistics services of Ukraine

use of labor resources and the need for an adapted policy of supporting industry, taking into account local conditions.

Further, in the paper the indicators of operating activities profitability is calculated based on the official data of regional statistics of Odesa, Mykolaiv and Kherson regions, which will allow for a comprehensive analysis of the industrial safety state in the Black Sea region. The indicator “Profitability of operating activities of industrial enterprises” characterizes the efficiency of production processes in the industry of the region and determines the ratio of operating

profit to operating expenses, reflecting the ability of industrial enterprises to ensure profitability even under conditions of economic fluctuations and external risks (Fig. 4).

Analysis of profitability of operating activities of the industrial enterprises in 2019-2023 indicates high volatility of indicators both at the national and regional levels, which is primarily due to military events and internal economic fluctuations. Among three regions of the Black Sea region, the most stable and adaptive dynamics is demonstrated by the Odesa region, while the Mykolaiv and especially the Kherson regions have

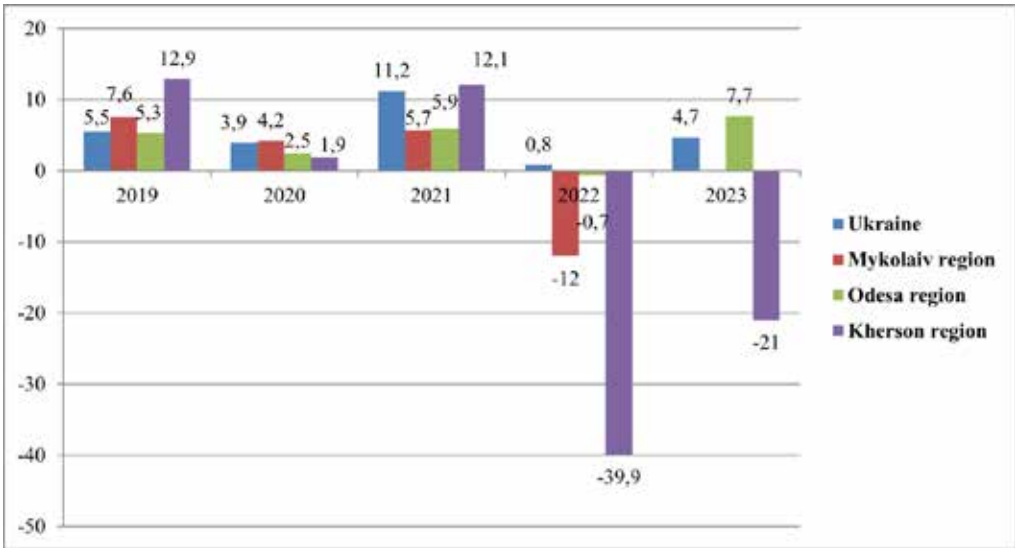


FIGURE 4 Dynamics of profitability of operating activities of the industrial enterprises in the Black Sea region (Odesa, Mykolaiv, Kherson regions) for 2019–2023, %

Source: compiled by the author based on data from the state and regional statistics services of Ukraine

experienced a significant drop in profitability, including reaching deeply negative values, which indicates a critical level of production activities destabilization in certain regions, which threatens the overall production safety of the Black Sea region.

The indicator "Profitability of operating activities of construction enterprises" reflects the efficiency of construction enterprises, which play an important role in the development of regional infrastructure. Profitability in the construction industry affects the ability to attract investments, implement large-scale projects and maintain the safety of production processes through technological updates and compliance with regulatory requirements. The dynamics of the profitability of operating activities of construction enterprises in the Black Sea region are presented in Fig. 5.

The dynamics of profitability of operating activities of the Ukrainian construction enterprises in 2019–2023 demonstrates the high sensitivity of the industry to changes in the economic environment and external influences. All-Ukrainian indicators reflect a transition from relative stability to a decrease in efficiency during the pandemic, subsequent partial recovery, a sharp drop due to a full-scale war and signs of gradual stabilization in 2023. In the regional context, the most stable results were demonstrated by Odesa region, which maintained moderately positive profitability values even in conditions of political and economic crises. The Mykolaiv region is characterized by noticeable fluctuations in the indicator, but overall, it maintained operational efficiency. The most critical situation was observed in the Kherson region, where profitability in 2022 reached its lowest values due to large-scale destruction of infrastructure and

a decrease in business activity. The results obtained indicate significant regional differences due to a combination of general economic factors, the security situation and the degree of preservation of production potential. Thus, the construction sector of the Black Sea region experienced serious negative impacts due to socio-economic and military factors, which significantly affected the profitability of construction enterprises. The most important task is to maintain stability and gradually restore construction activities, which is of key importance for the production security of the region, as well as for ensuring the housing and industrial infrastructure necessary for further socio-economic development.

The indicator "Profitability of operating activities of transport and communication enterprises in the transport and communication sector" reflects the effectiveness of the organization of logistics and communication processes, which are critically important for the continuous functioning of production chains. High profitability indicates the stability of the transport infrastructure, which ensures the timely delivery of resources and products, as well as supports the overall production safety of the region.

The dynamics of the profitability of the operating activities of transport and communication enterprises in the Black Sea region is presented in Fig. 6.

The profitability of operating activities of the transport and communication enterprises in Ukraine in 2019-2023 demonstrates generally positive dynamics, indicating an increase in the efficiency of the industry's functioning despite periods of external pressure. After a decline in 2022, associated with a full-scale war, the sector demonstrated the ability to

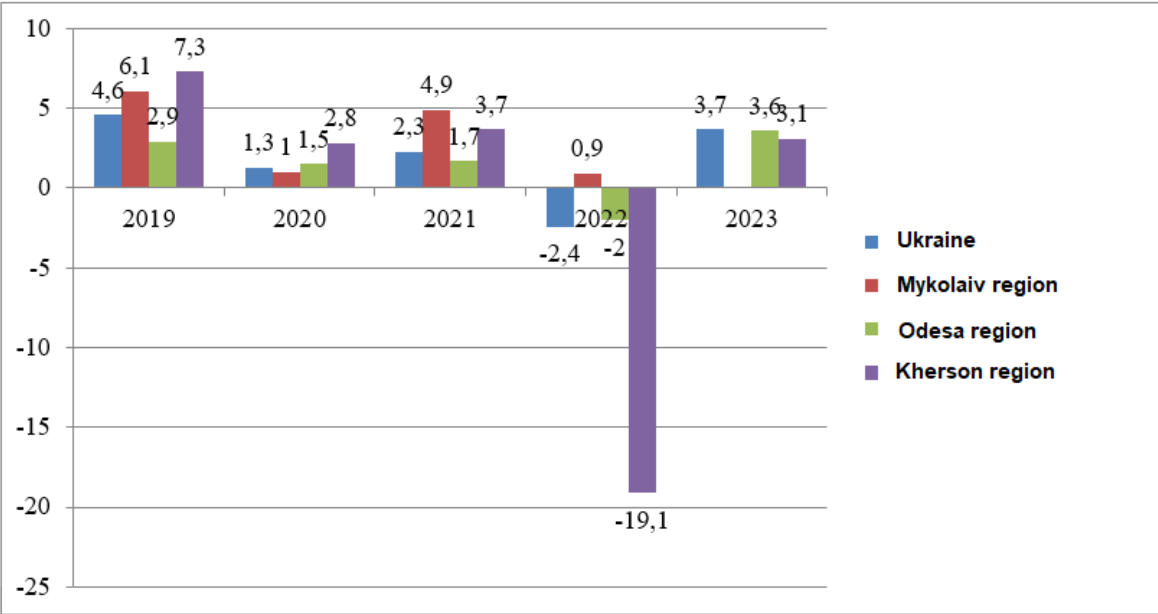


FIGURE 5. Dynamics of profitability of operating activities of construction enterprises of the Black Sea region (Odesa, Mykolaiv, Kherson regions) for 2019–2023, %
Source: compiled by the author based on data from the state and regional statistics services of Ukraine

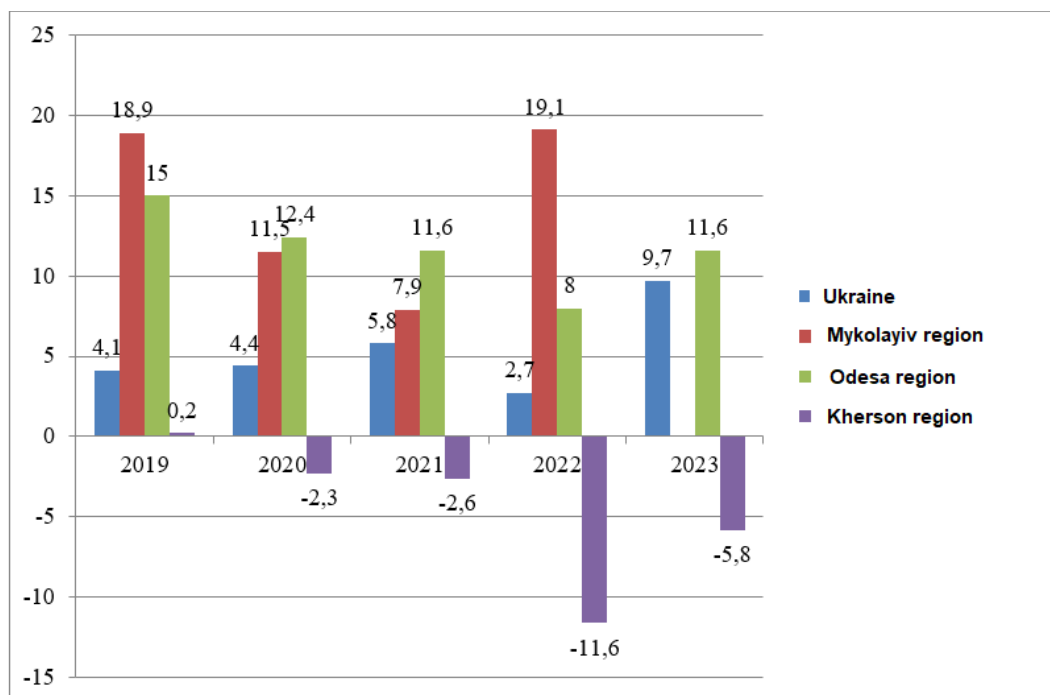


FIGURE 6 Dynamics of profitability of operating activities of the transport and communication enterprises in the Black Sea region (Odesa, Mykolaiv, Kherson regions) for 2019 – 2023, %

Source: compiled by the author based on data from the state and regional statistics services of Ukraine

recover, which is reflected in an increase in profitability to 9.7% in 2023. There is significant differentiation in the regional breakdown of the Black Sea region. The Odesa region is characterized by stable profitability, which indicates its important role in maintaining the logistical stability and operational efficiency of the industry. Mykolaiv region demonstrates unstable, but mostly positive results with signs of recovery in 2022. At the same time, Kherson region is in a state of crisis, persistent negative profitability values indicate significant challenges due to the destruction of transport infrastructure and restrictions on business activity.

Based on a comprehensive analysis of industrial safety in the Black Sea region, which includes an assessment of key economic indicators, in particular, the degree of depreciation of fixed assets in industry, the share of high-tech products in the total volume of industrial products sold, the profitability of operating activities, labor intensity, as well as structural, infrastructure and personnel aspects, both positive trends and significant problems affecting the stability and efficiency of the functioning of industrial enterprises in the region were identified. Given the multifaceted nature of the studied factors and their interdependence, it is advisable to apply SWOT analysis (Table 1) to systematize and more deeply understand the current state of industrial safety and determine the priority areas for the development of the region. This approach allows for a structured identification of internal strengths and weaknesses,

as well as external opportunities and threats that are critical for the formation of strategic decisions in the field of industrial safety.

Taking into account quantitative indicators of production activity and qualitative characteristics of the functioning in the Black Sea region, a comprehensive SWOT analysis indicates the significant potential for ensuring industrial safety. The region's strengths are its advantageous geographical location, which provides access to the Black Sea and international transport corridors, as well as developed port, railway and road infrastructure. High agro-industrial and industrial potential, availability educational and human resource capacities, as well as significant export potential contribute to strengthening the region's position in the national economy.

At the same time, an analysis of the dynamics of production indicators demonstrates significant unevenness in the levels of profitability, technological development and labor intensity in different sectors of the economy, which is a weakness. In particular, high depreciation of fixed assets, low level of investment in modernization and innovation, dependence on maritime logistics, as well as problems with maintaining and renewing qualified personnel significantly complicate ensuring the stable functioning of production facilities. External threats, primarily related to military operations, occupation of territories and destruction of critical infrastructure, have significantly affected the dynamics of production activities, especially in the industrial and construction sectors.

TABLE 1 SWOT analysis of the industrial safety in the Black Sea region in Ukraine

Strengths	Weaknesses
Geostrategic location (access to the Black Sea, international transport corridors)	High level of depreciation of production assets, especially in the agricultural and processing sectors
Developed port, railway and road infrastructure (Odesa, Mykolaiv, Chornomorsk, Yuzhne, etc.)	Insufficient level of diversification of production, dependence on maritime logistics
Powerful agro-industrial and industrial potential (grain farming, shipbuilding, food processing)	Low level of investment in modernization of production infrastructure and innovation
Availability of educational and human resources base (universities, technical schools, research institutions)	Problems with retaining and renewing qualified personnel (due to migration and mobilization)
High export potential, availability of customs and logistics infrastructure	Significant volatility of profitability in the industrial and construction sectors
Positive dynamics of profitability in the transport and communications sector, which indicates the adaptability and efficiency of the industry, support for the development of multimodal transport infrastructure	High labor intensity and low level of technological development in certain industries, which reduces productivity
Opportunities	Threats
Restoration and modernization of infrastructure after war damage with the support of international donors	Military actions, occupation of part of the territories, destruction of critical infrastructure
Reorientation of logistics routes, development of land infrastructure and multimodal transport	Blockage of ports and sea routes, disruption of international supply chains
Expanding agricultural exports through alternative corridors (e.g., the Danube cluster)	High level of risk for investors, capital outflow and curtailment of industrial projects
Possibility of creating industrial and logistics hubs in port cities	Increasing environmental threats and man-made risks due to hostilities and disruptions of technical operation
Attracting public-private partnerships for the development of regional production infrastructure	Destabilization of the personnel market and loss of human capital

Source: developed by the author

The SWOT analysis of industrial safety in the Black Sea region of Ukraine allowed to identify a number of key opportunities for its post-war recovery and strategic development, which form the basis for increasing the economic stability and industrial security of the region in the face of new geopolitical challenges. Taking into account the identified strengths and weaknesses, as well as opportunities and threats, it is important to implement a set of measures aimed at modernizing fixed assets, diversifying logistics routes, introducing innovative technologies and increasing the efficiency of labor resources. Only an integrated approach covering technical, economic, social and environmental aspects will ensure the sustainable and safe functioning of production enterprises in the Black Sea region, which is a necessary condition for the sustainable development of the region and strengthening the national security of Ukraine.

4 Conclusion

A comprehensive assessment of the industrial safety state in the Black Sea region of Ukraine demonstrated that its level is the result of the action of interrelated economic, technical, organizational and social factors, and also deeply depends on external destabilizing influences, in particular hostilities, destruction of infrastructure, loss of sales markets and reduction in investment activity. The analysis took

into account the dynamics of profitability of operating activities, labor intensity, degree of depreciation of fixed assets, the share of high-tech production, as well as indicators of human resource potential, which allowed to form a multidimensional picture of the industrial safety of the region.

The results of the study indicate the presence of both internal strengths (favorable geostrategic position, availability of logistics and port infrastructure, potential of the agro-industrial and transport sectors, educational and scientific capacities), and a number of deep systemic problems. Key weaknesses include the wear and tear of fixed assets, a critical imbalance in the technological level of enterprises, a low share of innovative products, a shortage of personnel, as well as a high dependence on maritime logistics, which makes the region's production system vulnerable to external threats. Given this, industrial safety is considered not only as the ability to maintain the continuity and stability of production processes, but also as an integral characteristic of the ability of the region's economy to adapt, recover and develop in conditions of multi-level risks.

In order to increase the efficiency of the system for ensuring and assessing industrial safety in the region, it is advisable to implement the following strategic directions:

- formation of a single indicative environment for monitoring industrial safety, which will cover economic, technical and technological, social and

personnel and infrastructure parameters, taking into account regional specifics;

- improvement of approaches to assessing industrial safety based on multifactor analysis, including integral indicators of wear, produceability, profitability, innovation and environmental sustainability;

- institutional consolidation of industrial safety management in the regional development system through the creation of coordination centers that will unite the state, municipal and business sectors;

- priority financing for the modernization of critical production infrastructure and the renewal of fixed assets with an orientation towards energy-efficient and environmentally friendly technologies;

- development of a system for training and retaining human resources, which involves stimulating vocational education, retraining of personnel and introduction of mechanisms to prevent labor migration;

- activation of public-private partnership mechanisms in order to attract investments in strategically important and vulnerable sectors of regional production (logistics, mechanical engineering, construction, high-tech production), as well as for the implementation of infrastructure and technological projects aimed at increasing the resilience and adaptability of the production environment to external risks and crisis influences.

Thus, effective provision of industrial safety in the Black Sea region is possible only under the conditions of an integrated approach that combines strategic planning, innovative management, state support and active participation of business structures, which will allow the formation of a sustainable model of regional development capable of confronting modern challenges and contributing to strengthening the national economic security of Ukraine.

References:

- [1] Bohma, O. S. (2016) Analysis of the Production Component of Ukraine's Economic Security. *Black Sea Economic Studies*, 5: 45–49.
- [2] State Statistics Service of Ukraine. E-source: <https://www.ukrstat.gov.ua>
- [3] Harykova, V. F. (2019) Economic Security of the Region: Essence of the Concept. *Eastern Europe: Economy, Business and Management*, 4 (21). E-source: https://www.easterneurope-ebm.in.ua/journal/21_2019/59.pdf
- [4] Hbur, Z. V. (2018) Economic Security of Ukraine in Modern Conditions. *Investytsii: praktyka ta dosvid*, 2: 97–101.
- [5] Hnatenko, V. (2021) Main Components of Economic Security of the State. *Scientific Herald: Public Administration*. Vol. 1, No. 7: 66–82. DOI: [https://doi.org/10.32689/2618-0065-2021-1\(7\)-66-82](https://doi.org/10.32689/2618-0065-2021-1(7)-66-82)
- [6] Principal Departments of Statistics in Mykolaiv. E-source: <https://www.mk.ukrstat.gov.ua/>
- [7] Principal Departments of Statistics in Odesa. E-source: <https://www.od.ukrstat.gov.ua/>
- [8] Principal Departments of Statistics in Kherson. E-source: <https://www.ks.ukrstat.gov.ua>
- [9] Ivanova, N. S., & Malovychko, S. V. (2019) Assessment of the Level of Economic Security of Regions of Ukraine. *Visnyk of Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky. Series "Economic science"*, 2: 9–19. DOI: <https://doi.org/10.33274/2079-4819-2019-70-1-9-19>
- [10] Kulish, A. V., & Liadska, V. V. (2019) Assessment of the Dynamics of Production Security Indicators of Ukraine. *International scientific e-journal LOGOS. ONLINE*. No. 4. E-source: <https://www.ukrlogos.in.ua/10.11232-2663-4139.04.01.html>
- [11] Mkhallitska, N. Ya., & Tsvaih, Kh. I. (2017) Modern State of Calculations of the Integral Index of Economic Security. *Scientific Journal of Lviv State University of Internal Affairs. Economics*, 2: 84–91.
- [12] Ovcharenko, O. V. (2021) Analysis of Existing Approaches to Assessing the Economic Security of the Region. *Science, Technologies, Innovations*, 3: 20–29.
- [13] Pikhotskyi, V. F., & Pikhotska, M. R. (2022). Economic Security of the State in Modern Conditions of Functioning. *Biznes, innovatsii, menedzhment: problemy ta perspektyvy: materials of III International Scientific-Practical Conference 2022*: 192–193.
- [14] Approval of Methodological Recommendations for Calculating the Level of Economic Security of Ukraine: Order No. 1277 of 29.10.2013. Official site of the Verkhovna Rada of Ukraine. E-source: <https://zakon.rada.gov.ua/rada/show/v1277731-13#Text>
- [15] Tkach, V. O. (2015) Economic Security of the Region as a Component of the State's Economic Security. *Visnyk Dnipropetrovsk University*, 4(1): 113–120.
- [16] Vashai, Yu. V., & Doroshenko, O. O. (2019) Methodological Aspects of Studying the State of Industrial Security of the State under Military-Political Instability. *Biznes Inform*, 5: 150–156.

Received on: 27th of July, 2025

Accepted on: 25th of August, 2025

Published on: 30th of September, 2025