

Mikhail Yu.
Kozminykh ¹
Yuri S. Klochkov

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SUPERVISION AND SAFETY QUALITY IMPROVEMENT OF HIGH-TECH ENTERPRISES BY A RISK-BASED APPROACH

Abstract: *The study describes the application of a methodology for assessing the safety of high-tech enterprises based on a risk-based approach within the control and supervisory activities.*

The authors justify the need to assess various risk groups (technogenic, environmental, economic) in the activities of high-tech enterprises and show their impact on the level of safety of enterprises.

The paper describes the possibilities of applying a criteria system for a comprehensive assessment of technogenic, environmental and economic risks in the activities of high-tech enterprises and presents an assessment mechanism of high-tech enterprises safety based on a comprehensive assessment of technogenic, environmental and economic risks.

The study describes approaches to risk assessment in the activities of high-tech enterprises; carries out an analysis of existing approaches and methods of risk assessment in the activities of high-tech enterprises; shows a methodology for assessing the safety of high-tech enterprises based on a risk-based approach.

The authors prove the possibility of applying the methodology for assessing the safety of high-tech enterprises by a risk-based approach within the control and supervisory activities as means of improving the quality and efficiency of supervisory activities, while reducing the cost of control and supervisory measures.

Improving the quality of supervisory activities is achieved through an integrated approach that allows taking into account different groups of risks in the activities of enterprises, automating the safety assessment process due to strict assessment criteria.

The practical significance of the presented study is justified by the possibility of introducing a methodology for assessing the safety of high-tech enterprises by a risk-based approach within the control and supervisory activities, which will reduce the time and material costs of this activity and reduce administrative pressure on business entities.

Keywords: *safety, supervisory activities, risk-oriented management, enterprise, indicators of violation risk of mandatory requirements, technogenic processes, technogenic safety, environmental safety, economic safety.*

¹ Corresponding author: Mikhail Yu. Kozminykh

Email: mk@alfa.su

1. Introduction

Increasing the efficiency of control over production and other activities of high-tech enterprises in modern conditions is one of the priority tasks. The solution of this task will allow both to increase productivity and therefore economic efficiency, and to ensure the fulfillment of the social function (increase in the number of highly skilled jobs), as well as to reduce the risks of violations of technological, production logistics, other processes and emergencies.

However, the solution of this problem is impossible without ensuring effective external control of high-tech enterprises activities. First of all, this is a control carried out by authorized special subjects - control and supervisory authorities.

The complexity and importance of ensuring high quality of supervisory activities is determined by the characteristics of high-tech enterprises. High-tech enterprises constantly introduce new technologies into production and auxiliary processes. The study (Nawrocki & Jonek-Kowalska, 2022) notes that the introduction of innovative technologies into production creates increased technogenic risks in the activities of industrial enterprises. A similar position is presented in the study devoted to the introduction of methods for assessing the safety of research and development activities (Guseva et al, 2016). Ensuring technogenic safety is an important factor in the introduction of innovative technologies into production (Peizheng, 2018).

The economic security of high-tech enterprise, which is a large mainstay, directly determines the economic security of regions (Akhmetshin et al., 2018) and economic sectors (Tarasova & Barsova, 2023), including strategically important sectors (Chernysheva et al., 2024; Elshin, 2020a, Elshin, 2020b).

Thus increasing the efficiency and quality of supervisory activities in high-tech enterprises (which can be achieved through simplifying

control procedures, reducing the costs, taking into account possible risks in the activities of enterprises) is an important factor not only in ensuring their functioning, but also a factor influencing the state of industries and macroeconomic systems.

Control and supervision of high-tech enterprises involves identifying violations and risks of violations in their activities of the current legislation requirements, which in turn reflect the established requirements in organizing technological processes, requirements in usage and protection of environmental components, requirements in compliance with economic and corporate legislation (Ivanov & Bukhvald, 2021).

At the present time one can note studies that show the characteristics of individual types of risks in the activities of high-tech enterprises. The study (Zhang et al., 2023) presents the results of risk assessment of placement and use of hazardous facilities at the enterprise (using tanks with toxic substances as an example), the paper (Liu et al., 2024b) describes the risks of introducing equipment for working with hazardous substances (Alshaikh et al., 2023), develops a mechanism for assessing information risks.

The paper (Liu et al., 2024a) describes a method of risk assessment in chemical spill emergencies at enterprises. However, it should be noted that the situations described in the study also have risks to the environment (Gao et al., 2024), as well as to the economic activity of the enterprise, but the corresponding risk groups are not taken into account in the assessment.

Often potential risks to the environment as well as to the health and life of the population are assessed separately from technogenic risks in the activities of enterprises (Baktybaeva et al., 2018; Boev et al., 2018).

A number of studies emphasizes the need to estimate corporate and management risks of high-tech enterprises, which also affect technological processes (Ruighaver et al., 2010; Movtyan & Danilaev, 2018; Malikova, 2018; Chernysheva et al., 2022; Kiselev,

2023) as well as legal and environmental risks associated with possible economic costs (Strembelev & Yamshchikova, 2021; Xu Chu, 2021). Environmental safety management of industrial enterprises based on a risk-oriented approach also involves identifying and recording possible risks of environmental damage in the activities of enterprises (Fomenko et al., 2018), a comprehensive assessment of these risks, taking into account their possible simultaneous processing as well as its automated control (Bhosale et al., 2024).

It is impossible not to mention the importance of assessing information risks, which is also emphasized in many studies (Ruefle et al., 2014; Movtayan & Danilaev, 2018; Mastroianni et al., 2023; Mishra, 2023), while information risks are often assessed separately from other risk groups - technogenic, industrial, economic, environmental and others (Ferra et al., 2020; Wairimu et al., 2024) despite their obvious correlation.

A number of papers are devoted to the assessment of a set of risks within projects (Bavafa et al., 2018, Kuzmina et al., 2021; Timoshenko, 2020). However, it can be concluded that there is a lack of comprehensive studies that describe the assessment of various types and groups of risks in the activities of high-tech enterprises.

The great importance in ensuring technological safety is the use of automated algorithms that can be implemented to assess the strength of structures and materials risks (Abdi et al., 2024); links in technological and logistic processes (Campanile et al., 2021; Jin et al., 2024; Chen & Bai, 2024), information, information processes, information support (Brunner et al., 2020), entrepreneurial risks (Akhmetvalieva et al., 2020).

Automated standardized algorithms of risk assessment are currently used in the activities of single large enterprises (Alshaikh et al., 2023), but are practically not used in control and supervisory activities despite the importance of introducing a risk-oriented

approach in state administration is also emphasized in many studies (Arkadyeva & Berezina, 2019; Kazakovtseva, 2021; Larina, 2021; Minakov, 2024). The paper (George & Renjith, 2021) identified a tendency towards automation of the identifying and assessing risks process and noted the disadvantages of methods and means of process automating.

Particular attention is paid to the issue of ensuring continuous risk assessment of high-tech enterprises in dynamics, for the purpose of their prompt identification and prevention (Feng et al., 2022; Golubev & Shcherbakov, 2018; Henriksen-Bulmer et al., 2020; Ivanov & Bukhvald, 2020; Iacono et al., 2024), the need to assess the correlation between different groups of risks, their joint impact (Tian et al., 2021; Siegfried et al., 2022; Huo et al., 2024), which also requires automation, computer algorithms for identifying and calculating the scope of risks.

Some studies emphasize the need to develop comprehensive risk assessment systems for high-tech enterprises and note the lack of relevant developments and approaches (Werlinger et al., 2009; Khakzad, 2015; Wu et al., 2022; Yuan et al., 2024; Schiele et al., 2024; Santos-Olmo et al., 2024), which determined the choice of the problem to be solved within this study.

The purpose of the study is to analyze the possibilities of applying a risk-oriented approach to assessing the safety of high-tech enterprises as a factor in improving the quality of supervisory activities.

The goal was achieved by solving the following tasks: characterization risk assessment approaches in the activities of high-tech enterprises; analysis of existing approaches and methods for risk assessment in the activities of high-tech enterprises, methodology for assessing the safety of high-tech enterprises by a risk-oriented approach using high-tech enterprises as an example.

Research methods include analysis of theoretical studies on the implementation of risk-oriented management, comparative analysis, correlation and regression analysis.

The research materials are presented by the results of planned control (supervisory) activities of the North-West Interregional Department of the Federal Service for Supervision of Natural Resources and the Federal Service for Environmental, Technological and Nuclear Supervision in relation to large enterprises operating in the North-West Federal District for 2023. Data on the number of emergencies and irregularities provided by business entities immediately to the Federal Service for Environmental, Technological and Nuclear Supervision is also used. The sample size is 40 enterprises included in the plans of control (supervisory) activities of the above-mentioned bodies.

2. Materials and Methods

The safety assessment methodology of high-tech enterprises by a risk-oriented approach is presented in the study (Kozminykh, 2024). Earlier in the study of Kozminykh and Klochkov “A model of risk management of hazardous technogenic processes in the high-tech industries based on the results of control and supervisory activities” authors proposed a scale for assessing the possibility of hazardous man-made processes in the activities of high-tech industries based on risk indicators of violation of mandatory requirements in nature management (Kozminykh & Klochkov, 2024).

The author proved the dependence between economic, technogenic and ecological risks on correlation and regression analysis. In particular, a high correlation was confirmed between the volume of economic losses (the amount of damage caused by an enterprise to the environment) and the parameters that characterize the intensity of the enterprise's economic activity, the level of its impact on the environment (the mass of industrial emissions, the mass of pollutants discharged into a water body, the mass of incoming/generated waste per year and their hazard class, the number of administrative

violation).

This study uses a developed system of risk assessment criteria and the procedure for assessing them in the activities of high-tech enterprises: scales for assessing the corresponding risk groups – technogenic (Table 6, Appendix), environmental (Table 7, Appendix), economic (Table 8, Appendix).

Thus, the safety assessment taking into account the above system of risks in the activities of high-tech enterprises covers the assessment of the following risk groups:

- technogenic risks (indicators of technogenic enterprise safety);
- environmental risks (indicators of environmental enterprise safety);
- economic risks (indicators to assess the economic enterprise safety).

To assess the three risk groups within the methodology under consideration, a single scale is provided for assessing the level of each risk:

- 0,20 – very low risk;
- 0,40 – low risk;
- 0,60 – medium risk;
- 0,80 – high risk;
- 1 – very high risk.

The maximum value of the risk degree will be 10 (taking into account 10 risks), the minimum - 2 (all risks are assessed as “very low”, value 0,2). The limit separating the maximum and minimum risk values is the value of 0,6 - the median value of 0,2 and 1. The significance of the risks is determined by an expert survey of control (supervisory) bodies specialists in control of technogenic and environmental safety, as well as managers of high-tech enterprises (Kozminykh & Klochkov, 2024; Kozminykh, 2024).

According to the risk assessment results risk maps were compiled. The environmental risk map is presented in the study (Kozminykh & Klochkov, 2024); the technogenic and economic risk maps are presented in the research by Kozminykh (2024).

Based on the risk maps in the study (Kozminykh & Klochkov, 2024), Kozminykh (2024) were identified risks located beyond

the tolerance limit (unacceptable) and acceptable ones - Table 1.

Table 1. Results of risk significance assessment of various groups (Kozminykh & Klochkov, 2024; Kozminykh, 2024)

Unacceptable risks	Acceptable risks
Technogenic risks	
Risk of employee age	Risk of lack of industrial safety control systems
Information and production risk	Risk of natural processes in the external environment
Risk of depreciation of technological (production) equipment	Risk of objects that can cause multiple pollution of the environment
Risk of production factors	Risk of decommissioned hazardous facilities and stopped technogenic processes
Risk of existing hazardous facilities and technogenic processes	Risk of industrial injuries
Environmental risks	
Negative Environmental Impact (NEI) object risk	Control frequency risk
Risk of air pollution	Emergency risk
Risk of impact on natural components	Risk of production waste
Risk of administrative liability based on the results of control (supervisory) activities	Risk of surface water bodies pollution
Risk of compliance with the conditions of nature management	
Information risk	
Economic risks	
Investment risk	Reputational risk
The risk of technological sovereignty	Risk of fair play of the controlling body (founder and executive body)
Tax regime risk	Risk of civil liability
Risk of lack of funds for production development and modernization	
Low profit risk	
Risk of insufficient reserves for the elimination of emergencies	
Financial stability risk	

The weight factors of the studied risks of different groups - technogenic, environmental, economic - were determined on the results of expert surveys. The studied risks of each group have weight factors from 0,1 to 1 depending on the experts' determination of the significance (rank) of this risk, where the most significant risk (rank 1) has a weight factor of 1, and the least significant risk (rank 10) – 0,1. (Kozminykh, 2024).

Taking into account the methodology described in the research (Kozminykh, 2024), the assessment of technogenic, environmental, and economic risks in the

activities of high-tech enterprises includes the following stages:

1. Risk assessment in points for each risk group (according to the degree of risk from 0,2 to 1).
2. Multiplying risks by a weight factor (from 0,1 to 1, depending on the risk rank), total summation of risks for each group.
3. Determining the risk level in the activities of the enterprise being assessed in terms of numbers.

The calculation of the individual risk degree can be represented as follows

$$Y1=(A1*1)+(A2*0,9)+(A3*0,8)+(A4*0,7)+(A5*0,6)+(A6*0,5)+(A7*0,4)+(A8*0,3)+(A9*0,2)+(A10*0,1),$$

where:

Y1, Y2, Y3 – assessed group of risks (technogenic, environmental, economic);

A1, A2, ... A10 – the value of each of ten risks in each group in points (from 0,2 to 1).

Based on the results of the assessment of each risk group, the value can be summed up (which will allow to analyze overall the enterprise’s security level) or a separate risk group can be assessed (depending on the

purpose of the assessment, as well as the direction and subject of supervisory activity). Based on the methodology described above, we will analyze the degree of risks in the activities of high-tech enterprises.

3. Results and Discussion

An example of assessing the risk degree of an individual economic entity (enterprise) based on the presented methodology is given in Table 2.

Table 2. Example of risk degree assessment based on the presented methodology

Risk (type)	Weight factor	Risk value in points at the enterprise	Risk value with weight factor
Risk of production factors	1,0	0,20	0,2
Risk of existing hazardous facilities and technogenic processes	0,9	0,40	0,36
Risk of decommissioned hazardous facilities and stopped technogenic processes	0,8	0,20	0,16
Risk of industrial injuries	0,7	0,40	0,28
Risk of depreciation of technological (production) equipment	0,6	0,20	0,12
Risk of natural processes in the external environment	0,5	0,20	0,1
Risk of objects that can cause multiple pollution of the environment	0,4	0,60	0,24
Risk of lack of industrial safety control systems	0,3	0,80	0,24
Information and production risk	0,2	0,40	0,08
Risk of employee age	0,1	0,60	0,06
Risk of compliance with the conditions of nature management	1,0	0,20	0,2
Risk of impact on natural components	0,9	0,40	0,36
Emergency risk	0,8	0,20	0,16
Negative Environmental Impact (NEI) object risk	0,7	0,20	0,14
Risk of administrative liability based on the results of control (supervisory) activities	0,6	0,40	0,24
Risk of air pollution	0,5	0,20	0,1
Risk of production waste	0,4	0,20	0,08
Risk of surface water bodies pollution	0,3	0,40	0,12
Control frequency risk	0,2	0,20	0,04
Information risk	0,1	0,20	0,02
Financial stability risk	1,0	0,40	0,4
Investment risk	0,9	0,20	0,18
Risk of lack of funds for production development and modernization	0,8	0,20	0,16
Risk of insufficient reserves for the elimination of emergencies	0,7	0,40	0,28

Low profit risk	0,6	0,20	0,12
The risk of technological sovereignty	0,5	0,20	0,1
Tax regime risk	0,4	0,40	0,16
Risk of fair play of the controlling body (founder and executive body)	0,3	0,20	0,06
Risk of civil liability	0,2	0,60	0,12
Reputational risk	0,1	0,40	0,04
Total enterprise amount			4,92

While applying the above described methodology for assessing the safety of high-tech enterprises by a risk-oriented approach the following indicators were used:

1. Number of identified violations of technological safety, in units (based on the results of inspections by the Federal Service for Environmental, Technological and Nuclear Supervision for 2023).
2. Number of identified environmental violations, in units (based on the results of inspections by the North-West Interregional Department of the Federal Service for Supervision of Natural Resource for 2023).
3. The total amount of fines in thousands of Rubles imposed by the results of inspections by the above-mentioned bodies.
4. Number of emergency and (or) abnormal situations, 2023, in units (based on the results of Federal Service for Environmental, Technological and Nuclear Supervision of Russia activities, based on data from the obligation established for economic entities to report emergency situations at operating facilities to Federal Service for Environmental, Technological and Nuclear Supervision of Russia).
5. Technogenic risks (the sum of risks and their weight factors) were assessed for each enterprise in points by analogy with the assessment example given in Table 2.
6. Environmental risks (the sum of risks and their weight factors) were assessed for each enterprise in points.
7. Economic risks (the sum of risks and their weight factors) were assessed for each enterprise in points.
8. All risks (the sum of risks and their weight

factors).

The correlation analysis of the studied indicators is presented in Table 3.

According to Table 3, the results of the correlation analysis show a high correlation between the number of technogenic and environmental violations (0,98), which further confirms the complex nature of the economic activity of enterprises as a security object, as well as the need for a comprehensive approach to its assessment. A significant correlation (0,85) was noted between the number of emergency and abnormal situations at the enterprise and the sum of all risks (the sum of risks and their weight factors) – technogenic, environmental, economic. Thus, the high value of the applied methodology for safety assessment of high-tech enterprises based on the risk-oriented approach was confirmed.

The high correlation (0,94) between the number of identified violations of mandatory requirements and the amount of fines is due to the fact that fines are assigned based on the results of monitoring, taking into account the identified violations. The high correlation (0,91, 0,93, respectively) between the number of emergency and abnormal situations at the enterprise and the number of identified violations of technological safety and identified violations of environmental protection requirements can be explained in a similar way.

Then the authors present the linear regression coefficients in assessing the dependence of the number of identified violations of technogenic safety and the studied risk groups (technogenic, environmental, economic), identified on regression analysis – Table 4.

Table 3. Correlation analysis of safety indicators of high-tech enterprises based on a risk-oriented approach

Indicators	Number of identified violations of technological safety, units	Number of identified environmental violations, units	Total amount of fines, thousand Rubles	Number of emergency and (or) abnormal situations, 2023, units	Technogenic risks (the sum of risks and their weight factors)	Environmental risks (the sum of risks and their weight factors)	Economic risks (the sum of risks and their weight factors)	All risks (the sum of risks and their weight factors)
Number of identified violations of technological safety, units	1							
Number of identified environmental violations, units.	0,984808492	1						
Total amount of fines, thousand Rubles	0,943166133	0,941924529	1					
Number of emergency and (or) abnormal situations, 2023, units	0,912094922	0,934957558	0,868213	1				
Technogenic risks (the sum of risks and their weight factors)	0,696958704	0,671125726	0,637518	0,612639	1			
Environmental risks (the sum of risks and their weight factors)	0,599278356	0,628096699	0,565538	0,621868	0,619409	1		
Economic risks (the sum of risks and their weight factors)	0,554159008	0,56947595	0,46347	0,510965	0,140311	0,097901	1	
All risks (the sum of risks and their weight factors)	0,878037961	0,892297364	0,794555	0,848687	0,759324	0,747245	0,623982	1

The results of the regression analysis showed that the R-square is 0,98; the normalized R-square is 0,97, which indicates a high

accuracy of the approximation of the linear regression model when assessing the dependence of the number of identified

violations of technogenic safety and the studied risk groups (technogenic, environmental, economic).

The significance of F is also significantly less than 0,05, which indicates high reliability of the calculation results.

Then the authors present the calculation of the linear regression coefficients when assessing the dependence of the number of emergencies per year and the studied risk groups – Table 5.

Table 4. Linear regression coefficients in assessing the dependence of the number of identified violations of technogenic safety and the studied risk groups (technogenic, environmental, economic)

Indicators	Coefficient	The value of the linear regression equation coefficient	Standard error
Y-intersection (Number of identified technogenic violence, units)	a0	-0,7067449	0,706312
Number of identified environmental violations, units.	a1	0,649006348	0,106793
Total amount of fines, thousand rubles	a2	0,001222263	0,000837
Number of emergency and (or) abnormal situations, 2023, units.	a3	-0,06021525	0,242182
Technogenic risks (the sum of risks and their weight factors)	a4	0,947819471	0,636985
Environmental risks (the sum of risks and their weight factors)	a5	-0,1337297	0,627077
Economic risks (the sum of risks and their weight factors)	a6	0,315731243	0,558713
All risks (the sum of risks and their weight factors)	a6	-0,25391719	0,601664

Table 5. Linear regression coefficients in assessing the dependence of the number of emergencies per year and the studied risk groups (technogenic, environmental, economic)

Indicators	Coefficient	The value of the linear regression equation coefficient	Standard error
Y-intersection (Number of emergencies, abnormal situations)	a0	-1,5081	0,533194
Technogenic risks (the sum of risks and their weight factors)	a1	-1,15517	0,633462
Environmental risks (the sum of risks and their weight factors)	a2	-1,03851	0,63619
Economic risks (the sum of risks and their weight factors)	a3	-1,02502	0,555862
All risks (the sum of risks and their weight factors)	a4	1,956246	0,536014

The results of the regression analysis showed that R-square is 0,74; normalized R-square is 0,71, which indicates high accuracy of the linear regression model approximation when assessing the dependence of the number of identified violations of technogenic safety

and the studied risk groups (technogenic, environmental, economic). The significance of F is also significantly less than 0,05, which indicates high reliability of the calculation results.

4. Conclusion

The results of the correlation analysis show a high correlation between the number of technogenic and environmental violations (0,98), which further confirms the complex nature of the economic activity of enterprises as an object of security, as well as the need for a comprehensive approach to its assessment. A significant correlation (0,85) was found between the number of emergencies and abnormal situations at the enterprise and the total amount of all risks (technogenic, environmental, economic), which confirms the high value of the applied methodology for assessing the safety of high-tech enterprises based on a risk-oriented approach.

The methodology for assessing the safety of high-tech enterprises by a risk-oriented approach allows estimating the safety of enterprises based on various risk groups. While the assessment results show a high correlation with the results of assessing technogenic and environmental safety. These results are received during control (supervisory) activities, the subject of which is assessing compliance with mandatory requirements in technogenic and environmental safety.

The use of the methodology for assessing the safety of high-tech enterprises based on the presented system of criteria will improve the efficiency and quality of control (supervisory) activities (as indicated by the possibility of reducing costs while increasing the effectiveness of supervisory activities), reduce the level of control burden on high-tech enterprises, and ensure a more comprehensive assessment of the activities of enterprises based on various indicators that affect the level of safety, which is nowadays not provided within the supervisory activities.

The methodology for assessing the safety of high-tech enterprises based on a risk-oriented approach allows assessing the safety of enterprises by various risk groups, while the assessment results show a high correlation with the results of assessing technogenic and

environmental safety. These results are received during control (supervisory) activities, the subject of which is assessing compliance with mandatory requirements in technogenic and environmental safety.

The results of the safety assessment of high-tech enterprises based on the presented system of criteria and methodology allow making some decisions without control (supervisory) activities.

A scale may be adopted for the corresponding decisions.

The maximum value of the integral indicator of technogenic, environmental or economic safety is 5,5 points (if each risk is assessed at 1 point and multiplied by the corresponding weigh factor from 1 to 0,1). The minimum value of the integral indicator of technogenic, environmental or economic safety is 1,1 points (if each risk is assessed at 0,2 points and multiplied by the corresponding weight factor from 1 to 0,1).

The range of values between the maximum and minimum values is found as a difference and is 4,4 points accordingly. Taking into account the maximum and minimum values for each risk group (for each integral indicator) the following scale can be provided as an example:

For values of risks of one group of 1,1 – 1,6 points: sending a notification to the economic entity about the need of a self-analysis and sending a report to the regulatory authority.

For values of risks of one group of 1,7 – 2,2 points: sending a notification to the relevant regulatory authority about the need to of preventive measures.

For values of risks of one group of 2,3 – 2,8 points: sending a notification to the relevant regulatory authority about the need to include the economic entity in the scheduled control (supervisory) measures plan while simultaneously conducting a preventive measure event.

For values of risks of one group of 2,9 – 3,4 points: sending a notification to the relevant regulatory authority about the need to carry

out a control (supervisory) measure event at the location of the regulatory authority.

For values of risks of one group of 3,5 – 4,0 points: sending a notification to the relevant regulatory authority about the need to initiate an unscheduled control (supervisory) measure event at the location of the economic entity.

For values of risks of one group of 4,1 – 4,6 points: sending a notification to the prosecutor's office about the need to send a request for an immediate unscheduled control (supervisory) measure.

For values of risks of one group of 4,7 – 5,5 points: sending a notification to the prosecutor's office about the need to send a request for an immediate unscheduled control (supervisory) measure, informing all regulatory authorities about the risk of an emergency at the enterprise.

The methodology for assessing the safety of high-tech enterprises based on a risk-oriented approach allows significantly reduce the budget funds on control (supervisory) activities.

In particular, nowadays the planned and unscheduled control (supervisory) activities are one of the few ways to assess the compliance of an economic entity with mandatory requirements, including those upon receipt of reports (requests) about requirements violations from citizens.

To carry out one control (supervisory) event in the practice of control bodies at least two officials (inspectors) are involved, the average salary of each is 1000 rubles per day (based on the salary of the lowest position). According to current legislation the duration of one control (supervisory) event is 10 working days, interaction with the controlled person within one event, the implementation of control (supervisory) actions is 3 working days. Without taking into account transport, provision of equipment for laboratory research, testing and measurements by an expert organization, the cost of one control (supervisory) event is 6000 rubles. When

using the methodology for assessing the safety of high-tech enterprises based on the presented system of criteria, there is an opportunity to reduce the costs of conducting control (supervisory) activities.

The application of the high-tech enterprises safety assessment methodology based on the presented system of criteria allows providing a comprehensive approach to assessing the safety of high-tech enterprises, taking into account technogenic, environmental and economic risks. Currently, these lines of supervisory activities are carried out by various bodies independently of each other and are not taken into account when assessing the activities of an enterprise or the risks that exist in its activities.

In addition, when applying the high-tech enterprises safety assessment methodology based on the presented system of criteria, there is the possibility of reducing the administrative burden on high-tech enterprises. This can be explained by the fact that nowadays the control (supervisory) measures events are planned taking into account such a feature as the safety category of the object or the category of the object with a negative impact on the environment. Such a feature as the honest or dishonest behavior of the controlled object is not taken into account. This does not allow covering the supervisory activities of some enterprises, which violate mandatory requirements in technogenic and environmental safety.

The use of high-tech enterprises safety assessment methodology based on the presented system of criteria will allow some of the control (supervisory) measures for enterprises whose behavior is characterized by integrity to be replaced by preventive measures (for example, based on the scale presented above).

Therefore improving the quality and efficiency of control (supervisory) activities through the application of the high-tech enterprises safety assessment methodology based on three risk groups (technogenic, environmental, economic) is ensured through

cost reduction (while increasing the effectiveness of supervisory activities), a reduction in the control burden on high-tech enterprises, and a comprehensive assessment of the enterprises activities based on various indicators that affect the level of safety.

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References:

- Abdi, K., Sahraoui, Y., Kebaili, N., Nahal, M., & Djouhri, M. (2025). Self-Compacting Concrete Durability Assessment via Fuzzy-Logic and Bayesian Networks. *Iranian Journal of Science and Technology, Transactions of Civil Engineering*, 49(3), 2345-2365. doi.org/10.1007/s40996-024-01576-6
- Akhmetshin, E. M., Pavlyuk, A. V., Kokorev, A. S., Lazareva, T. G., & Artemova, E. I. (2018). Assessment of the economic security of the region (on the example of Chelyabinsk region). *Journal of Applied Economic Sciences*, 13(8), 2309-2322.
- Akhmetvalieva, M. G. & Zinnatullina, O. F. (2020) Algorithm for selecting methods for managing entrepreneurial risks. *PolitBook*, 3, 135-151.
- Alshaikh, M., Chang, S., Ahmad, A., Maynard, S. B., & Alammary, A. (2023). Embedding information security management in organisations: improving participation and engagement through intra-organisational Liaison. *Security Journal*, 36(3), 530-557. doi.org/10.1057/s41284-022-00352-3
- Arkadyeva O. G., & Berezina, N. V. (2019) Controversial issues of risk management theory and practice in the public administration sector. *National interests: priorities and security*, 15(4), 745–760.
- Baktybaeva, Z. B., Sulejmanov, R. A., Valeev, T. K., & Rahmatullin, N. R. (2018). Assessment of the impact of the oil refining and petrochemical industry on the ecological and hygienic condition of the environment and public health (literature review). *Meditsina truda i ekologiya cheloveka [Occupational Health and Human Ecology]*, 4, 12-26.
- Bavafa, A., Mahdiyar, A., & Marsono, A. K. (2018). Identifying and assessing the critical factors for effective implementation of safety programs in construction projects. *Safety science*, 106, 47-56. doi.org/10.1016/j.ssci.2018.02.025
- Bhosale, P., Kastner, W., & Sauter, T. (2024) Automation ML Meets Bayesian Networks: A Comprehensive Safety-Security Risk Assessment in Industrial Control Systems. *IEEE Open Journal of the Industrial Electronics Society*, 99, 1-13 doi:10.1109/OJIES.2024.3439388
- Boev, V. M., Karpenko, I. L., Boev, M. V., Barchatova, L. A., Zelenina, L. V., & Kryazhev, D. A. (2018). Hygienic Assessment of Aerogenic Health Risk for the Population Living Near the Hazardous Class I, II Enterprises with Determination of Sanitary Protection Zones Sizes. *Occupational medicine and human ecology*, 14(2), 5-10.
- Brunner, M., Sauerwein, C., Felderer, M., & Breu, R. (2020). Risk management practices in information security: Exploring the status quo in the DACH region. *Computers & Security*, 92, 101776. doi.org/10.1016/j.cose.2020.101776

- Campanile L., Cantiello, P., Iacono, M., Marulli, F., Mastroianni, M. (2021) Risk analysis of a GDPR-compliant deletion technique for consortium blockchains based on pseudonymization. In: Gervasi, O., et al. (eds.), *ICCSA, LNCS*, T. 12956, 3–14. Springer, Cham. doi.org/10.1007/978-3-030-87010-2_1
- Chen, D., & Bai, X. (2024). Quantitative risk analysis of road transportation of hazardous materials in coastal areas. *Journal of Infrastructure Intelligence and Resilience*, 3(4), 100124.
- Chernysheva G. N., Ivashina T. B., Savich Yu. A. (2024). The current state of the defense-industrial complex of Russia. *Region: Systems, Economics, Management*, 64(1), 134-142. doi.org/10.22394/1997-4469-2024-64-1-134-142
- Chernysheva G. N., Savich Yu. A., & Netyaga N. N. (2022) Risks of contractual relations of regime enterprises in state defense orders system. *Production Organizer*, 30(2), 90–98.
- Elshin, V. A. (2020a) Approaches to the development of the management system of enterprises and industries of the defense-industrial complex (DIC). *Journal of Applied Research*, 2, 16-21.
- Elshin V. A. (2020b) Features of strategic management systems for the development of the defense-industrial complex. *Journal of Applied Research*, 1, 20-25.
- Feng, J. R., Zhao, M., Yu, G., Guo, Y., & Lu, S. (2022) Dynamic risk assessment framework for fire of power critical infrastructure: The case study of UHV converter transformer. *Reliability Engineering & System Safety*, 228, 108760. doi.org/10.1016/j.res.2022.108760
- Ferra, F., Wagner, I., Boiten, E., Hadlington, L., Psychoula, I., & Snape, R. (2020) Challenges in assessing privacy impact: Tales from the front lines. *Security and Privacy*, 3(2), e101. doi.org/10.1002/spy2.101
- Fomenko, G. A., Komarov, S. I., Fomenko, M. A., Borodkin, A. E., & Luzanova, A. K. (2018) Risk-oriented approach to environmental safety management of an oil refinery. *Strategic decisions and risk management*, 2(107), 102-109.
- Gao, H., Yang, Y., Hou, Sh., Han, K., & Shi, H. A. (2024) Miscellaneous model for comprehensive attractiveness assessment of chemical plants: Integrating chemical hazards, domino effects and plant traits. *Process Safety and Environmental Protection*, 187, 518–532. doi.org/10.1016/j.psep.2024.04.136
- George, P. Gr., & Renjith, V. R. (2021) Evolution of Safety and Security Risk Assessment methodologies towards the use of Bayesian Networks in Process Industries. *Process Safety and Environmental Protection*, 149, 758–775. doi.org/10.1016/j.psep.2021.03.031
- Golubev, S. S., & Shcherbakov, A. G. (2018) The Impact of Information Technologies on the Activities of Defense Industrial Enterprises in Russia. *Bulletin of the State University of Education. Series: Economics*, 3, 55–68.
- Guseva, I. B., Dalekin, P. I., & Kovyrzina, K. V. (2016). Research and Development at defense industry enterprises: modern problems. *Bulletin of the Institute of Economics of the Russian Academy of Sciences*, 2, 100–114.
- Henriksen-Bulmer, J., Faily, S., & Jeary, S. (2020) Dpia in context: applying dpia to assess privacy risks of cyber physical systems. *Future Internet*, 12(5), 93. doi.org/10.3390/fi12050093
- Huo, X., Yin, Y., Jiao, L., & Zhang, Y. (2024) A data-driven and knowledge graph-based analysis of the risk hazard coupling mechanism in subway construction accidents. *Reliability Engineering & System Safety*, 250, 110254. doi.org/10.1016/j.res.2024.110254

- Iacono, M., Mastroianni, M., Palmieri, F., & Saporito, A. (2024). A tool to support automation of risk assessment. In O. Gervasi et al. (Eds.), *Computational science and its applications – ICCSA 2024 workshops (Vol. 14822)*. Springer, Cham. doi.org/10.1007/978-3-031-65318-6_9
- Ivanov O. B., & Bukhvald E. M. (2020) National security and the “high-risk economy”, *ETAP: Economic Theory, Analysis, Practice*, 3, 56–59.
- Ivanov O. B., & Bukhvald E. M. (2021) Risk-oriented management in the public authority system in Russia. *ETAP: Economic Theory, Analysis, Practice*, 4, 67–69.
- Jin, H., Wang, M., Xiang, H., Wang, C., & Fu, D. (2024) A PSO-RBF prediction method on flow corrosion of heat exchanger using the industrial operations data. *Process Safety and Environmental Protection*, 183, 11–23. doi.org/10.1016/j.psep.2024.01.001
- Kazakovtseva, M. V. (2021) Implementation of risk-oriented financial management in public administration. *Bulletin of the Mari State University. Series “Agricultural Sciences. Economic Sciences”*, 7(3), 295–300.
- Khakzad, N. (2015) Application of dynamic Bayesian network to risk analysis of domino effects in chemical infrastructures. *Reliability Engineering & System Safety*, 138, 263–272. doi.org/10.1016/j.res.2015.02.007
- Kiselev, A. A. (2023) Risk-oriented approach as a factor in ensuring the competitiveness of domestic organizations. *Progressive Economy*, 11, 50–63.
- Kozminykh, M. Y. (2024) Standardization of supervisory activities based on a risk-oriented approach in relation to high-tech enterprises. *News of the Samara Scientific Center of the Russian Academy of Sciences*, 26(4).
- Kozminykh, M. Y., & Klochkov, Y. S. (2024) A model of risk management of hazardous technogenic processes in the high-tech industries based on the results of control and supervisory activities. *Bulletin of the Samara Scientific Center of the Russian Academy of Sciences*, 26(1), 33–45. doi.org/10.37313/1990-5378-2024-26-1-33-45
- Kuzmina S. N., Leonova T. I., & Timshina D. K. (2021) Risk-oriented model of project management in an organization. *Petersburg Economic Journal*, 4, 137–148. doi.org/10.24412/2307-5368-2021-4-137-148
- Larina, I. A. (2021) Methods of risk identification and construction of a risk model of state programs and projects. *Economic security*, 4(1), 73–88. doi.org/10.18334/ecsec.4.1.110867
- Peizheng, L. (2024) Technological Security as One of China's Main Strategic Priorities. *Proceedings of BSTU. Series 5: Economics and Management*, 1(280), 148-161.
- Liu, J., Tan, L., & Ma, Y. (2024a) An integrated risk assessment method for urban areas due to chemical leakage accidents. *Reliability Engineering & System Safety*, 247, 110091. doi.org/10.1016/j.res.2024.110091
- Liu, Y., Yang, Y., Hu, Y., Ma, Z., & Dong, Y. (2024b) Risk Assessment of Hydrogen Production Station Equipment Based on Event Tree Cascading Fault Deduction and Evidential Reasoning. *International Journal of Hydrogen Energy*, 54, 1367–1385. doi.org/10.1016/j.ijhydene.2023.11.324
- Malikova D. M. (2018) Features of the organization of production in the defense-industrial complex of the Russian Federation at the present stage. *Production Organizer*, 26(1), 7–22.
- Mastroianni, M., Palmieri, F., Ficco, M., Kozik, R., & Choraś, M. (2023) Privacy risk analysis and metrics in capturing and storing network traffic. *24th International Conference on Control Systems and Computer Science (CSCS)*, 580–585. IEEE. doi.org/10.1109/CSCS59211.2023.00097

- Minakov, A. V. (2024) State regulation of high-tech production in Russia in modern conditions. *Economy and Business: Theory and Practice*, 8, 159–166. doi.org/10.24412/2411-0450-2024-8-159-166
- Mishra, Sh. (2023) Exploring the Impact of AI-Based Cyber Security Financial Sector Management. *Applied Sciences*, 13(10), 5875. doi.org/10.3390/app13105875
- Movtyan B. A., & Danilaev D. P. (2018) The role of the corporate center in increasing the efficiency of state defense order fulfillment by defense industry enterprises. *Production Organizer*, 26(3), 44–56.
- Nawrocki, T. L., & Jonek-Kowalska, Iz. (2022) Is Innovation a Risky Business? A Comparative Analysis in High-Tech and Traditional Industries in Poland. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(3), 156. doi.org/10.3390/joitmc8030155
- Ruefle, R., Dorofee, A., Mundie, D., Householder, A. D., Murray, M., & Perl, S. J. (2014) Computer Security Incident Response Team Development and Evolution. *IEEE Security & Privacy*, 12(5), 16–26. doi.org/10.1109/MSP.2014.89
- Ruighaver, A. B., Maynard, S. B., & Warren M. (2010) Ethical decision making: Improving the quality of acceptable use policies. *Computers and Security*, 29(7), 731–736. doi.org/10.1016/j.cose.2010.05.004
- Santos-Olmo, A., Sánchez, L. E., Rosado, D. G., Fernández-Medina, E., & Piattini, M. (2024). Towards an integrated risk analysis security framework according to a systematic analysis of existing proposals. *Frontiers of Computer Science*, 18(6), 186341. doi.org/10.1007/s11704-023-1582-6
- Schiele, N., Egberts, J., & Gadyatskaya, O. (2024). Nobody Knows the Risks I Have Seen: Evaluating the Gap Between Risk Analysis and Security Operations. *2024 IEEE European Symposium on Security and Privacy Workshops (EuroS&PW)* (pp. 473–483). IEEE. doi.org/10.1109/EuroSPW61312.2024.00059
- Siegfried, H., Sauter, Th., & Kastner, W. (2022). Risk assessments considering safety, security, and their interdependencies in OT environments. *The 17th International Conference on Availability, Reliability and Security (ARES 2022)*. Article 48. doi.org/10.1145/3538969.3543814
- Strembelev S. V., & Yamshchikova, D. S. (2021) Problems of development of land plots in zones with special conditions for the use of territories near water bodies. *Law and Economics*, 9(400), 24–35.
- Tarasova, T., & Barsova, T. (2023). Assessment of the system of economic security of mining enterprises. In K. S. Zokirjon ugli, A. Muratov, & S. Ignateva (Eds.), **Fundamental and applied scientific research in the development of agriculture in the Far East (AFE-2022)** (Vol. 706, pp. 821–830). Springer. Cham. doi.org/10.1007/978-3-031-36960-5_82
- Tian, J., Li, Z., & Xi, J. (2021) Safety risk Assessment for Construction of Highway on Plateau Mountainous, *IOP Conference Series Earth and Environmental Science*, 643(1), 012188. doi.org/10.1088/1755-1315/643/1/012188
- Timoshenko, K. A. (2020) Risk-oriented approach to managing state programs of the Russian Federation: substantive aspect. *Audit reports*, 4, 43-50.
- Wairimu, S., Iwaya, L.H., Fritsch, L., & Lindskog, S. (2024) On the evaluation of privacy impact assessment and privacy risk assessment methodologies: a systematic literature review. *IEEE Access*, 12, 19625–19650. doi.org/10.1109/ACCESS.2024.3360864

- Werlinger, R., Hawkey, K., Botta, D., & Beznosov, K. (2009). Security practitioners in context: Their activities and interactions with other stakeholders within organizations. *International Journal of Human-Computer Studies*, 67(7), 584–606. doi.org/10.1016/j.ijhcs.2009.03.002
- Wu, X., Huang, H., Yu, W., Cai, Q., & Xu, J. (2022) Accident analysis and risk prediction of tank farm based on Bayesian network method. *Process Safety and Environmental Protection*, 158, 146-158. doi.org/10.1016/j.psep.2021.10.040
- Xu Chu (2021) Request for an effective strategy for managing intellectual property rights of high-tech enterprises. *Economy and Society*, 9(88), 732-737.
- Yuan, S., Yang, M., & Reniers, G. (2024). Integrated process safety and process security risk assessment of industrial cyber-physical systems in chemical plants. *Computers in Industry*, 155, 104056. doi.org/10.1016/j.compind.2023.104056
- Zhang, C., Wang, Z., Chen, X., & Xiang, Y. (2024). Risk assessment of liquid ammonia tanks based on Bayesian network and Probit model. *Process Safety Progress*, 43(2), 287-298. doi:10.1002/prs.12560

Mikhail Yu. Kozminykh

North-West Interregional Department of the
Federal Service for Supervision of Natural
resources,
St. Petersburg,
Russian Federation
mk@alfa.su
ORCID 0009-0005-3236-4946

Yuri S. Klochkov

Tyumen Industrial University,
Tyumen,
Russian Federation
y.kloch@mail.ru
ORCID 0000-0002-7913-8285

Appendix

Table 6. A criteria system for identifying technogenic risks - assessing the level of technogenic safety of enterprises (Kozminykh M.Y., 2024)

Risk type	Criteria for classifying production (enterprise) to a certain level (degree) of risk (numerical value in points)				
	Very high risk – 1	High risk – 0,80	Medium risk – 0,60	Low risk – 0,40	Very low risk – 0,20
Information and production risk	Lack of information on types of activities and production (technological) processes from regulatory authorities, in official sources (state registers, etc.)	Invalid information about the types of activities at the enterprise in official sources, production processes (generally or partly)	Invalid information about some of the production processes at the enterprise in official sources.	The types of activities of the enterprise are displayed correctly. Invalid information about some of the production processes at the enterprise in official sources	Information about the types of activities and production (technological) processes from regulatory authorities in official sources fully corresponds to the activities of the enterprise.
Risk of decommissioned hazardous facilities and stopped technogenic processes¹	The enterprise carried out activities previously with substances of a high hazard class and has mothballed (liquidated) production facilities of the I (first) hazard class on its territory.	The enterprise carried out activities previously with substances of a high hazard class and has mothballed (liquidated) production facilities of the II (second) hazard class on its territory.	The enterprise carried out activities previously with substances of a high hazard class and (or) has mothballed (liquidated) production facilities of the III (third) hazard class on its territory.	The enterprise carried out activities previously with substances of a high hazard class or has mothballed (liquidated) production facilities of the IV (fourth) hazard class on its territory	The enterprise did not have any activities with substances of a high hazard class, and does not have mothballed (liquidated) production facilities of I-IV hazard classes on its territory.
Risk of existing hazardous facilities and technogenic processes²	The enterprise currently operates with high-hazard class substances and has operating production facilities of hazard class I (first) on its territory	The enterprise currently operates with high-hazard class substances and has operating production facilities of hazard class II (second) on its territory.	The enterprise currently operates with substances of a high hazard class and (or) has operating production facilities of the III (third) hazard class on its territory	The enterprise currently operates with substances of high hazard class or has operating production facilities of IV (fourth) hazard class on its territory	The enterprise does not carry out activities with substances of high hazard class, does not have on its territory operating production facilities of I-IV hazard class

¹ In Russian legislation it is established by: Federal Law of July 21, 1997 №116-FZ (as amended on November 14, 2023) “On Industrial Safety of Hazardous Production Facilities” // SPS Consultant Plus. URL: https://www.consultant.ru/document/cons_doc_LAW_15234/928be6671acc6ba6e6da54aec949a23259a65002/#dst100158 (reference data: 20.08.2024).

² The same reference as above.

Risk of objects that can cause multiple pollution of the environment	The enterprise operates facilities that may cause radioactive contamination of the environment	The enterprise operates facilities that may cause extensive chemical or biological pollution of air and water in case of a leak of volatile and/or easily spread toxic substances (organisms)	The enterprise operates facilities that may cause extensive chemical or biological air pollution in case of a leak of volatile and/or easily spread toxic substances (organisms)	The enterprise operates facilities that may cause extensive chemical or biological contamination of water in case of a leak of easily spread toxic substances (organisms)	The enterprise does not operate facilities that may cause extensive environmental pollution.
Risk of depreciation of technological (production) equipment	The depreciation rate of fixed assets is over 50% ³	The depreciation rate of fixed assets is over 50%; The depreciation rate of other equipment is over 50%	The depreciation rate of fixed assets is below 50%. The depreciation rate of equipment that serves to prevent negative impacts on the environment (sewage treatment plants, aerators, etc.) is over 50%.	The depreciation rate of fixed assets and other equipment is below 50%.	The depreciation rate of fixed assets and other equipment is below 25%.
Risk of production factors	During production the process is carried out in contact with radioactive radiation and (or) three or more of the following factors: - toxic chemicals; - biological agents; - conditions of extremely high and (or) extremely low temperatures (above +50°C; below -50°C); - sound level above 110 dB; - electromagnetic radiation level above 300 GHz	During production the process is carried out in contact with two or more of the following factors: - toxic chemicals; - biological agents; - conditions of extremely high and (or) extremely low temperatures (above +50°C; below -50°C); - sound level above 110 dB; - electromagnetic radiation level above 300 GHz	During production the process is carried out in contact with one of the following factors: - toxic chemicals; - biological agents; - conditions of extremely high and (or) extremely low temperatures (above +50°C; below -50°C); - sound level above 110 dB; - electromagnetic radiation level above 300 GHz	During production the process is carried out under conditions of harmful production factors, but their indicators do not exceed maximum permissible levels.	There are no harmful or hazardous production factors at the enterprise.

³ The value of 50% is the threshold value of the fixed asset depreciation coefficient (FADC), which the enterprise manager uses as a guide when calculating depreciation and the tax base. FADC is the ratio of the depreciation amount to the initial price of the asset: $FADC = A / IP \times 100\%$, where: A is the amount of depreciation charges accumulated as of the calculation date (balance on account 02); IP is the initial purchase price of fixed assets (balance on account 01).

Risk of natural processes in the external environment	The enterprise is located in high seismic and/or volcanic activity zone (the seismic wave intensity can reach rate 8-9 and 9-10).	The enterprise is located in permafrost conditions	The enterprise is located in a flood zone, underflooding and (or) near large water bodies, watercourses with significant fluctuations in water level (rivers, the observed water spill of which is 10 km or more)	The enterprise is located in a lowland area with periodic bogging and a high groundwater level (up to 1 m below the soil surface).	The enterprise is located in temperate or subtropical area, without other specified risk indicators
Risk of employee age	Over 75% of employees are over 60 years old and/or under 30 years old	Over 50% of employees are over 60 years old and/or under 30 years old	Over 25% of employees are over 60 years old and/or under 30 years old	Over 25% of employees are under 30 years old	75% of employees are between 30 and 60 years old
Risk of industrial injuries	The enterprise has recorded industrial injuries cases last year, resulting in moderate and serious harm to health, and/or death.	The enterprise has recorded industrial injuries cases last year, which resulted in minor harm to health.	The enterprise has not recorded any industrial injuries cases in the last calendar year.	The enterprise has not recorded any industrial injuries cases in the last 3 years	The enterprise has not recorded any industrial injuries cases in the last 5 years
Risk of lack of industrial safety control systems	The enterprise does not have industrial safety control systems	The enterprise ensures continuous monitoring of incidents and accidents (information transfer to controlling and other control entities in automatic mode is not provided) Monitoring of the reliability of equipment, construction and buildings is not ensured	The enterprise ensures continuous monitoring of incidents and accidents (information transfer to controlling and other control entities in automatic mode is not provided) Non-automated monitoring of the reliability of equipment, construction and buildings is organized	The enterprise ensures continuous monitoring of incidents and accidents in online mode (monitoring, processing and transmission of data to regulatory authorities); Automated monitoring of the reliability of equipment, construction and buildings has been organized	The enterprise has implemented an automated system of industrial safety production control over

Table 7. A criteria system for identifying environmental risks - assessing the level of environmental safety of enterprises (Kozminykh M.Y., 2024)

Risk type	Criteria for classifying production (enterprise) to a certain level (degree) of risk (numerical value in points)				
	Very high risk – 1	High risk – 0,80	Medium risk – 0,60	Low risk – 0,40	Very low risk – 0,20
Information risk	Lack of information about the object (enterprise) in the Negative Environmental Impact (NEI) register	Incorrect information about an object (enterprise) in the Negative Environmental Impact (NEI) register	Incorrect information on certain types of environmental impacts	The boundaries, location of the NEI object, the operator are incorrectly displayed, or the factor of the object's location in a zone with special conditions of territories, protected area is not taken into account. If two factors coincide, the risk is assessed as medium.	The information in the NEI register fully corresponds to the economic activity of the enterprise.
Risk of production waste	The enterprise generates I hazard class waste	The enterprise generates II hazard class waste	The enterprise generates III hazard class waste	The enterprise generates IV hazard class waste	The enterprise generates V hazard class waste
Risk of air pollution	During the enterprise's operation, pollutants of 1 hazard class are emitted into the atmosphere.	During the enterprise's operation, pollutants of 2 hazard class are emitted into the atmosphere	During the enterprise's operation, pollutants of 3 hazard class are emitted into the atmosphere	During the enterprise's operation, pollutants of 4 hazard class are emitted into the atmosphere	There are no emissions into the atmosphere
Risk of surface water bodies pollution	During the enterprise's operation, pollutants of 1 hazard class are discharged into surface water bodies.	During the enterprise's operation, pollutants of 2 hazard class are discharged into surface water bodies.	During the enterprise's operation, pollutants of 3 hazard class are discharged into surface water bodies.	During the enterprise's operation, pollutants of 4 hazard class are discharged into surface water bodies.	There are no discharges of pollutants into surface water bodies.
Control frequency risk	The last scheduled inspection was a year ago or more, violations were identified that indicate a threat to the life and health of the population.	The last scheduled inspection was a year ago or more and minor or no violations were detected.	The last scheduled inspection was three months ago, the enterprise did not fully comply with the issued order to eliminate violations of mandatory requirements.	The last scheduled inspection was three months ago, the enterprise fully complied with the issued order.	The last scheduled inspection was three months ago, no violations were found, no orders were issued.

Risk of impact on natural components	The enterprise was issued a permit for discharges (emissions) of pollutants into water/air in a larger volume than provided by regulatory documents and a license for handling waste of 1-4 hazard classes.	The enterprise was issued a permit for discharges (emissions) of pollutants into water/air in a larger volume than provided by regulatory documents or a license for handling waste of 1-4 hazard classes	The enterprise has the right for discharges (emissions) of pollutants within the limits of concentrations established by “general” regulatory documents. A waste management license is not required	The enterprise either discharges into water bodies or emits into the atmosphere. A waste management license is not required	The enterprise does not discharge (emit) pollutants. A waste management license is not required.
Risk of compliance with the conditions of nature management	The enterprise has not developed a plan to reduce its impact on the environment, even if it has such an obligation (for example, a plan to reduce discharges)	The company has developed but is not implementing a plan to reduce its impact on the environment	The company has developed a plan but is implementing it fully.	The company has developed a plan to reduce its impact on the environment and is implementing it fully.	There is no need to develop a plan due to the low level of environmental impact
Negative Environmental Impact (NEI) object risk	Extremely high risk (1 hazard class)	High risk (2 hazard class)	Significant risk (3 hazard class 3)	Medium risk (4 hazard class 4)	Moderate or low risk (5 and 6 hazard class)
Emergency risk	More than one emergency situation has been identified at the enterprise in the current half of the year	One emergency situation has been identified at the enterprise in the current half of the year	This year one emergency situation was identified at the enterprise.	The last emergency situation at the enterprise occurred within the previous three years.	There have been no emergency situations at the enterprise for the previous three years.
Risk of administrative liability based on the results of control (supervisory) activities	In the previous year, the enterprise was repeatedly subjected to administrative responsibility under Article of the Administrative Offense Code of the Russian Federation, the sanction of which provides for suspension of operation.	In the previous year, the enterprise was subjected to administrative responsibility under Article of the Administrative Offenses Code of the Russian Federation, the sanction of which is a suspension of operation.	In the previous year, the enterprise was repeatedly subjected to administrative responsibility under Article of the Administrative Offenses Code of the Russian Federation, the sanction of which is a fine.	In the previous year, the enterprise was subjected to administrative responsibility under Article of the Administrative Offenses Code of the Russian Federation, the sanction of which is a fine.	The enterprise was not subjected to administrative responsibility in the previous year.

Table 8. A criteria system for identifying economic risks - assessing the level of economic safety of enterprises (Kozminykh M.Y., 2024)

Risk type	Criteria for classifying production (enterprise) to a certain level (degree) of risk (numerical value in points)				
	Very high risk – 1	High risk – 0,80	Medium risk – 0,60	Low risk – 0,40	Very low risk – 0,20
Investment risk	1. No short-term and long-term (over 12 months) investment in the enterprise. 2. The financial risk (leverage) ratio is more than 1.	1. No long-term investment in the enterprise. Availability of short-term investments. 2. The financial risk (leverage) ratio is more than 1.	1. Availability of long-term investments in the enterprise, not exceeding the volume of short-term ones. 2. The financial risk ratio (leverage) is from 0,75 to 1.	1. Availability of long-term investments in the enterprise, exceeding, but comparable to the volume of short-term ones. 2. The financial risk ratio (leverage) is from 0,5 to 0,75.	1. Long-term investments in the enterprise are more than 10 times greater than the volume of short-term investments. 2. The financial risk ratio (leverage) is from 0,25 to 0,5.
Financial stability risk	1. The enterprise has an absolute liquidity ratio of less than 0,1	1. The enterprise has an absolute liquidity ratio from 0,1 to 0,2	1. The enterprise has an absolute liquidity ratio from 0,2 to 0,5.	1. The enterprise has an absolute liquidity ratio from 0,5 to 1.	1. The enterprise has an absolute liquidity ratio more than 1.
Reputation risk	There are enforcement proceedings against the legal entity and there are current liabilities in taxes and fees	There are enforcement proceedings against the legal entity and there are current liabilities in taxes and fees	There are no enforcement proceedings initiated against the enterprise, the enterprise has no current liabilities for taxes and fees, but has labor disputes during the last year.	There are no enforcement proceedings initiated against the enterprise, the enterprise has no current liabilities for taxes and fees, but has labor disputes during the last three years.	There are no enforcement proceedings initiated against the enterprise, the enterprise has no current liabilities for taxes and fees, and has no labor disputes during the last three years.
Low profit risk	1. The company has a shortage of working assets, the assets have been decreasing in the last three years. 2. The company has high accounts payable and receivable; they have been increasing in the last three years. 3. The company has a leverage ratio of over 75%, and it has been increasing in the last three years.	1. The company has a shortage of working assets, there has been no reduction or growth in the last three years. 2. The company has high accounts payable and receivable; there has been no reduction or growth in the last three years. 3. The company has a leverage ratio of over 75%, there has been no reduction or growth in the last three years.	1. The company has an overflow of working assets, there has been no reduction or growth in the last three years. 2. The company has low accounts payable and receivable, there has been no reduction or growth in the last three years. 3. The company has a leverage ratio from 25% to 75%, there has been no reduction or growth in the last three years.	1. The company has an overflow of working assets, there has been no reduction in the last three years. 2. The company has low accounts payable and receivable, there has been no reduction in the last three years. 3. The company has a leverage ratio up to 25%, there has been no growth in the last three years.	1. The company has an overflow of working assets, there has been a growth in the last three years. 2. The company has low accounts payable and receivable, there has been a reduction in the last three years. 3. The company has a leverage ratio up to 25%, there has been its reduction in the last three years.

Risk of insufficient reserves for the elimination of emergencies	The enterprise does not have its own funds sufficient to eliminate predicted emergencies and does not have other reserves (a bank guarantee, insurance policy, third-party agreements on assistance in emergency management, etc.)	The enterprise does not have its own funds sufficient to eliminate predicted emergencies but has other reserves (a bank guarantee, insurance policy, third-party agreements on assistance in emergency management, etc.)	The enterprise has its own funds in the amount of up to 50% of those required to eliminate predicted emergencies, and does not have other reserves (a bank guarantee, insurance policy, third-party agreements on assistance in emergency management, etc.)	The enterprise has its own funds in the amount of up to 50% of those required to eliminate predicted emergencies and also has other reserves (bank guarantees, third-party agreements on assistance in emergency management)	The enterprise has its own resources sufficient to eliminate predictable emergencies.
Risk of lack of funds for production development and modernization	The company has a return on assets (ROA) ratio of less than 5%	The company has a return on assets (ROA) ratio from 5% to 10%	The company has a return on assets (ROA) ratio from 10% to 15%	The company has a return on assets (ROA) ratio from 15% to 20%	The company has a return on assets (ROA) ratio more than 20%
The risk of technological sovereignty	Over 75% of the production facilities used at the enterprise and their components are not produced on the territory of the Russian Federation, and (or) individual production equipment is individual, manufactured exclusively upon request (order)	Over 75% of the production facilities used at the enterprise and their components are not produced on the territory of the Russian Federation. There is no need to order them.	Over 50% of the production facilities used at the enterprise and their components are not produced in the territory of the Russian Federation.	Over 25% of the production facilities used at the enterprise and their components are not produced in the territory of the Russian Federation.	The production facilities used by the enterprise and their components are totally produced on the territory of the Russian Federation.
Risk of civil liability	In relation to legal entities, the number of civil and arbitration claims has been growing in the last three years, the cost of which exceeds 50% of the annual net profit of the enterprise	In relation to legal entities, the number of civil and arbitration claims has been growing in the last three years, the cost of which exceeds 25% of the annual net profit of the enterprise	In relation to legal entities, the number of civil and arbitration claims has been growing in the last three years, the cost of which is lower than 25% of the annual net profit of the enterprise	The number of civil and arbitration claims against legal entities has not increased in the last three years	In relation to legal entities, the number of civil and arbitration claims has been decreasing over the past three years, or such claims do not exist.

Risk of fair play of the controlling body (founder and executive body)	A bankruptcy procedure has been initiated against a legal entity; a criminal case has been opened against the controlling person(s) for economic crime.	A bankruptcy procedure and a procedure for bringing the executive body or other controlling person to subsidiary liability have been initiated against a legal entity	In the last three years the legal entity has concluded transactions that meet the criteria of suspicious transactions, transactions with preference [determined by 2]	In the last three years a legal entity has concluded transactions that worsen its financial position, but do not meet the criteria for suspicious transactions or transactions with preference	The legal entity has not concluded any transactions in the last three years that would worsen its financial position.
Tax regime risk	The enterprise is located in the general tax regime zone and pays additional taxes (Mineral extraction tax, etc.)	The enterprise is located in the general tax regime zone and does not pay additional taxes	The enterprise is located in the general tax regime zone and has certain benefits, such as an exception from the general tax regime (VAT exemption, etc.)	The company operates in a special economic zone (SEZ)	The enterprise operates in the territory of advanced economic development (TAED)