ЦИВІЛЬНА БЕЗПЕКА
CIVIL SAFETY

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Vitaliy Tsopa[1], Doctor of Technical Sciences, Professor
ORCID ID: https://orcid.org/0000-0002-4811-3712 ***e-mail:*** dr.tsopav@gmail.com

Olena Yavorska[2], Doctor of Technical Science, Professor
ORCID ID: https://orcid.org/0000-0001-5516-5310 ***e-mail:*** elenayavorska80@gmail.com

Olena Borysovska[2], Candidate of Technical Sciences, Associate Professor
ORCID ID: https://orcid.org/0000-0001-7309-0236 ***e-mail:*** borysovska.o.o@nmu.one

Lydia Cheberyachko[2], postgraduate
ORCID ID: https://orcid.org/0009-0001-2685-7809 ***e-mail:*** cheberiachko.lm@nmu.one

Tetiana Nehrii[3], Candidate of Technical Sciences, Associate Professor
ORCID ID: https://orcid.org/0000-0002-4239-3178 ***e-mail:*** tetiana.nehrii@gmail.com

[1]International Management Institute, Kyiv, Ukraine
[2]Dnipro University of Technology, Dnipro, Ukraine
[3]Kyiv National University of Construction and Architecture, Kyiv, Ukraine

THE PROCESS OF DANGEROUS EVENT MANAGEMENT TAKING INTO ACCOUNT ECONOMIC, ENVIRONMENTAL AND OCCUPATIONAL LOSSES

Abstract. Aim of the research *is in risk management process development of a dangerous event taking into account economic, environmental and professional losses.*

Materials and methods. *To develop the process of risks management from various dangers through the integration of their losses (economic, environmental, life and health of employees), we take the most common model "bow tie", which allows to establish a cause and effect relationship between danger – a dangerous event and the severity of the consequences.*

Results. *As a result of the research, it was found that each hazard must be considered based on three different types of damage. This makes it possible to implement another mechanism for identifying the most significant dangerous factors that lead to significant general economic losses. In the case of risk acceptability from each individual dangerous factor, there is an additional opportunity to analyze them based on the relationship between financial activity, economic and professional losses. The second consists in determining the limits of the acceptability of risks, which are formed not only based on the total acceptable economic losses, but also taking into account the stability of the enterprise's work. This implies the need to actively invest in new technologies based on short-term and long-term perspectives. The main types of dangers are defined in the risk register, which is developed by the organization to determine the integration of dangers consisting of*

natural, technogenic, environmental, occupational and economic groups of dangers and dangerous factors. The authors develop the model and algorithm of risk management based on the combination of different consequences of dangers in economic, environmental character, life loss and health.

***Scientific relevance**. The article determines the relationship between the probability of a dangerous event and the severity of different types of consequences – economic, environmental and occupational dangers through the analysis of Euler-Venn diagrams.*

***Practical relevance.** The authors develop the basic principles of risk management of different types of losses: economic, environmental ones, loss of life and health of employees.*

***Key words:** Risk, occupational dangers, economic risk, environmental risk, occupational risk.*

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Introduction

Integrated Management System (IMS) is defined as a set of interrelated processes that use a single fund of human resources, information, materials, infrastructure and financial resources to achieve the goals to meet various stakeholders [1]. The basis of such a system is the risk management process, which allows to identify the dangers and evaluate their risks, which, in turn, lead to the consequences of losses: economic, environmental and occupational (human health) losses.

As a result, it is possible to substantiate and provide protective and preventative measures to ensure the stability of the organization in changing conditions [2]. That is, the purpose of risk management is to predict the development of negative events under the influence of various types of devastating dangers and dangerous factors and to find measures to reduce risks – economic, environmental and occupational ones. This fact shows the necessity in creation of risk management process in an organization as the measures to find constructive solutions to effective control under the economic, environmental and occupational risks in organization management systems [3].

Creating an effective organization management is needed, first of all, to reduce losses from various hazards and dangerous events, increase profits, identify and attract new consumers, strengthen positions in the market, train staff, reach safety of technological processes, reduce wastes, and search for ways for the future business processes development. In this case, the integration of management systems, as we can see, is a natural stage of growth, which creates new opportunities for organizations, also leads to the need for special management of risks from various dangers due to differences of consequences, respectively, and financial costs to reduce them. It generates a task to identify priority directions to reduce risks under conditions of limitation of financial resources.

The most common approach to providing the effectiveness of the mentioned management systems of the organization is the well-known PDCA cycle [4], which is used in most organizations to ensure the planning, resource management, implementation and measurement process, constant improvement. To maintain a unified global risk management approach, the ISO 31000 standard was developed, but the issue of inconsistency, ambiguity only increased, especially when it applies to various types of dangers and dangerous events related to economic, environmental and professional (life and health of employees) losses that require the allocation of resources to ensure sustainable development of the organization.

Literature review

The construction of an integrated management system in organizations is a rather difficult task. Its solution can greatly simplify the management system by reducing the workflow, removing duplicated procedures, decreasing financial costs [5]. The main advantage of such systems is the increase in transparency in making decisions, determining goals, choosing technological processes, and even justifying risks assessment methods [6]. In their research [8], the authors offer to evaluate the risks into the integrated system using the advanced FMEA method (Failure Mode and Effects Analysis). For this purpose, it was developed a universal matrix for ranking different types of risk, taking into account the intensity of their manifestation, but it is still not clear how to assess the risks of various dangers.

The introduction of management systems in organizations is often based on the "blind" compliance with the requirements set by the standard, while sometimes they are not directly related to risks, which leads to a disagreement of the assessment scales, and most importantly to the real needs of organizations [9]. In this research, there are no recommendations for combining the various requirements of standards that contradict each other.

The integrated model of quality management and environmental safety is transmitted in study [10], which is based on hypothesis that the processes that have a greater risk should be adequately evaluated and described for the development of preventive measures. The authors, protesting the model in several companies, concluded the need to reduce the volume of documented information, which requires the development of a new algorithm for processing risks and measures to reduce them.

In the next study [11], the authors to successfully manage the risks, offer a system of ranking with discrepancies and threats to priority, which were determined by the strategic goals of the organization, which, in their opinion, would ensure effective management of the company. However, it is not always an assessment of the risk based on this approach, which corresponds to the reality formed due to the global change in values of partners or the state, which requires constant processing of a risk ranking system.

The analysis of scientific papers showes that most wide-spread approaches to integration of organization management systems are based on the combined two areas (quality and ecology, quality and safety) at the centre of which is the "bow tie" model [12]. There are also general approaches to combining management systems based on the requirements of well-known standards. The main purpose of building such systems is to reduce any loss in the organization. Hence there is a significant need to understand the process of risk management of various dangers.

The aim of the research is in development of a risk management process of a dangerous event taking into account economic, environmental and professional losses.

Materials and methods

To develop a risk management process of a dangerous event, taking into account losses of economic, environmental character and life and health of employees, we take the most common model "bow tie", which allows to establish a cause-effect relationship between danger – a dangerous event and a dangerous event severity of consequences. Taking into account that every dangerous event can lead to the

economic, environmental loss and life and health problems of employees at the same time the loss model can be represented in the following form (Fig. 1). In this case, the level of risk is determined by the importance of each type of loss, including the influence of different groups of dangerous factors [13].

Each danger – *j* leads to three risks: economic, ecological and occupational ones:

$$R_j^{ek} = \sum_{i=1}^{n}(B_{ji} \times TH_{ji}^{ek}), \quad (1)$$

$$R_j^{el} = \sum_{i=1}^{n}(B_{ji} \times TH_{ji}^{el}), \quad (2)$$

$$R_j^{pr} = \sum_{i=1}^{n}(B_{ji} \times TH_{ji}^{pr}), \quad (3)$$

where $R_j^{ek}; R_j^{el}; R_j^{pr}$ – the level of appropriate risk: economic, environmental and professional risk of danger *j* from dangerous factors *i*; B_{ji} – probability of dangerous events occurrence from danger *j* under the influence of dangerous factors; $TH_{ji}^{ek}; TH_{ji}^{el}; TH_{ji}^{pr}$ – the severity of the economic, environmental and loss of life and health of employees from the occurrence of a dangerous event that arose from danger *j* under the influence of a dangerous factor *i*.

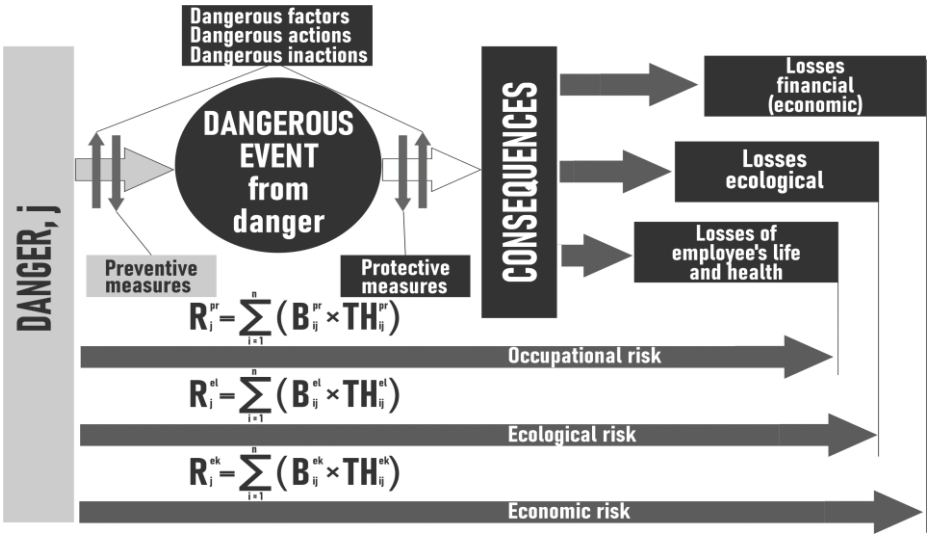

Fig. 1. Model of risk management: economic, environmental and occupational risks from danger – *j*

The form for identifying all the dangers, taking into account the influence of dangerous factors (DF) analysis and assessment of risk from dangers for each negative consequence to determine the level of risk as acceptable or unacceptable is presented in Table 1.

The risk management algorithm with various types, which is different from well-known variants and the need to identify the severity of economic, environmental losses and losses of life and health of employees from each dangerous danger, taking into account the influence of various dangerous factors, is presented in the following steps.

Firstly, we identify risk components: dangers – dangerous event and negative consequences on economic, environmental and occupational consequences. Taking into account that most often in companies the following combination of standards – ISO 9001, ISO 14001, ISO 45001 is introduced, the following danger groups can be distinguished: natural; biological and social; technogenic; ecological; professional; information; economic; terrorist; military; economic, qualitative ones. Every danger leads to a certain dangerous event, the consequences that we divide into economic, environmental and occupational.

Table 1. Form for danger identification – *j*, DF, analysis and risk assessment from danger – *j* provided that the risk level is acceptable A_{cc}/unacceptable In_{acc} for the consequences DF: loss of economic, environmental ones and life and health of employees

№ of danger	Identification				The primary analysis – determining the level for each DF and risk and assessment of risk on the loss of economic, environmental and life and health of workers			
	Danger	Dangerous event	Negative consequences from economic, environmental losses and life losses	Impact on the probability of a dangerous event and/or on the severity of the consequences of a dangerous event	The probability of an occurrence of a dangerous event from DF for every negative consequence	Severity from the occurrence of a dangerous event of each DF for each negative consequence		
						economic	ecological	occupational
j	Danger at the workplace	Dangerous event during the occupational activity	Violation of the normal economic and financial activities of the organization, violation of life in the ecosystem of injury, occupational diseases that are the result of dangerous event	DF 1		Sec_{j1}	$Secol_{j1}$	$Socc_{j1}$
				DF 2		Sec_{j2}	$Secol_{j2}$	$Socc_{j2}$
				DF 3		Sec_{j3}	$Secol_{j3}$	$Socc_{j3}$
				DF 4		Sec_{j4}	$Secol_{j4}$	$Socc_{j4}$
				DF 5		Sec_{j5}	$Secol_{j5}$	$Socc_{j5}$
				DF 6		Sec_{j6}	$Secol_{j6}$	$Socc_{j6}$
				DF 7		Sec_{j7}	$Secol_{j7}$	$Socc_{j7}$
				DF 8		Sec_{j8}	$Secol_{j8}$	$Socc_{j8}$
				DF 9		Sec_{j9}	$Secol_{j9}$	$Socc_{j9}$
				DF 10		Sec_{j10}	$Secol_{j10}$	$Socc_{j10}$
				DF 11		Sec_{j11}	$Secol_{j11}$	$Socc_{j11}$
				….		…	…	…
				DF *i*		Sec_{ji}	$Secol_{ji}$	$Socc_{ji}$
				…		…	…	…
				DF *n*		Sec_{jn}	$Secol_{jn}$	$Socc_{jn}$
				Total risk from dangers by type of loss				

Continuation of table 1

№ of danger	Identification	The primary analysis – determining the level for each DF and risk and assessment of risk on the loss of economic, environmental and life and health of workers					
	Impact on the probability of a dangerous event and/or on the severity of the consequences of a dangerous event	The level of risk from the onset of dangerous event of each DF for each negative consequence			Primary risk assessment of danger – *j* on each DF – and for each negative consequence		
		economic	ecological	occupational	economic	ecological	occupational
j	DF 1	Rec_{j1}	$Recol_{j1}$	$Rocc_{j1}$	Pr/NegCons	Pr/NegCons	Pr/NegCons
	DF 2	Rec_{j2}	$Recol_{j2}$	$Rocc_{j2}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 3	Rec_{j3}	$Recol_{j3}$	$Rocc_{j3}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 4	Rec_{j4}	$Recol_{j4}$	$Rocc_{j4}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 5	Rec_{j5}	$Recol_{j5}$	$Rocc_{j5}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 6	Rec_{j6}	$Recol_{j6}$	$Rocc_{j6}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 7	Rec_{j7}	$Recol_{j7}$	$Rocc_{j7}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 8	Rec_{j8}	$Recol_{j8}$	$Rocc_{j8}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 9	Rec_{j9}	$Recol_{j9}$	$Rocc_{j9}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 10	Rec_{j10}	$Recol_{j10}$	$Rocc_{j10}$	Pr/NCons	Pr/NCons	Pr/NCons
	DF 11	Rec_{j11}	$Recol_{j11}$	$Rocc_{j11}$	Pr/NCons	Pr/NCons	Pr/NCons
	….	…	…	…	Pr/NCons	Pr/NCons	Pr/NCons
	DF *i*	Rec_{ji}	$Recol_{ji}$	$Rocc_{ji}$	Pr/NCons	Pr/NCons	Pr/NCons
	…	…	…	…	Pr/NCons	Pr/NCons	Pr/NCons
	DF *n*	Rec_{jn}	$Recol_{jn}$	$Rocc_{jn}$	Pr/NCons	Pr/NCons	Pr/NCons
	Total risk from dangers by type of loss	$\sum Rec_{ji}$	$\sum Recol_{ji}$	$\sum Rocc_{ji}$	Pr/NCons	Pr/NCons	Pr/NCons

For the first risk management step, it is important to establish a relationship between danger, dangerous event and consequences that affect the organization [14]. The analysis of national regulatory documents has allowed to develop an appropriate register of dangers (see Table 2), which are characterized by different losses.

Economic losses are characterized by violation of normal economic and financial activities due to the loss of the value of fixed assets of the enterprise; losses of value of circulation funds of the enterprise; lack of potential income due to the appearance of dangerous events; loss of contracts of suppliers and consumers; losses of the image of the enterprise; compensation to legal entities and individuals affected by the manifestation of dangerous events.

Table 2. Analysis of the dangers consequences of different character

№	Group (kind) of dangers	Dangerous events	Consequences		
			Economic (financial) losses	Ecological losses	Occupational losses
1	*2*	*3*	*4*	*5*	*6*
1.	Natural	Geological (earthquake, lava stream, rock collapse Hydrogeological (flood, flooding, villa) Metrological (whirlwind, hurricane, storm, rain, frost, icing)	Destruction and destroying of tangible assets	Disruption of the human life system	Death, injury to employees in an organization, physical and mental exhaustion
2.	Biological and social	Epidemic (influenza, kovid, tuberculosis) Epizootia (bird flu, African plague, rabies) Epiphytone (rust of grain cereals, blight)	Financial losses	Deterioration of the state of biota, disease, death of people	The death of employees in the organization, physical and mental exhaustion
3.	Techno-genic	Industrial accidents (radioactive, chemical, biological contamination) Fire Explosions (shock wave) Transport (road, rail, air, water, etc.)	Destruction and destroying of tangible assets	Pollution of the natural environment by harmful substances that exceed the permissible concentrations in the air, water and soils	Death, injury of employees, experience of stress, physical exhaustion
4.	Ecological	Pollution (abiotic, biotic, anthropogenic)	Destruction and destroying of tangible assets, financial loses	Pollution of the natural environment by harmful substances that exceed the permissible concentrations in the air, water and soils	Death, injury of employees
5.	Occupati-onal	Incidents, accidents, occupational diseases	Financial loses	Pollution of the natural environment by harmful substances that exceed the permissible concentrations in the air, water and soils	Death, injury of employees, experience of stress, physiological strain

Continuation of table 2

1	*2*	*3*	*4*	*5*	*6*
6.	Terroristic	Attacks on infrastructure, transport systems, etc.	Destruction and destroying of tangible assets	Pollution of the natural environment by harmful substances that exceed the permissible concentrations in the air, water and soils	Death, injury of employees, experience of stress, physio-logical strain
7.	Military	War actions	Destruction and destroying of tangible assets	Pollution of the natural environment by harmful substances that exceed the permissible concentrations in the air, water and soils	Death, injury to a large number of people, an increase in psychological stress of stress experience, physical exhaustion
8.	Informa-tional	Leakage of commercial information from the organization	Loss of financial profit	Reduction of financing and environmental safety protective measures	Stress experience of employees
9.	Economic	Organizational errors Reduced demand Changes of currency Licenses loss Credit debt Bankruptcy	Loss of financial profit	Reduction of financing and environmental safety protective measures	Reduction of funding for safety and protective measures, experience of stress by employees
10.	Qualota-tive	Lack of production	Loss of financial profit	Increasement of wastes	Experience of stress by employees

Environmental losses from dangers violate life in a certain territory, which is manifested in the increase in the disease and/or death of people; deterioration of biota (environment), pollution of the environment.

Occupational losses are characterized by the creation of a threat to the life and health of the staff of the organization, the experience of stress and physiological overload due to violations of production cycles, the refusal of technical means of production, which lead to dangerous situations (accidents, fires, explosions).

In the second step, there is an identification of dangerous factors (DF), dangerous actions or inaction that increase the probability of a dangerous event and the severity of the consequences. For this step, for example, we can use methods such as SWOT analysis, PEST analysis or PIMs analysis, questionnaire, observation, employee surveys, discussions and etc. As a result, we get a register of dangerous factors that are convenient to divide into several groups: human, organizational, ergonomic, technical and others. An example of such registers is given in the researches [15].

During the third step, we analyze and determine the risk of danger from the influence of all the identifyed dangerous factors, which are determined by formulas (1-3). That is, the level of risk from each dangerous factor is culculated by summing the risks from all dangerous external and internal factors at the workplace, taking into account dangerous actions and inaction of employees. At the same time, as it is mentioned above above, three types of risk of economic, environmental and

occupational losses are calculated. An important condition for conducting this procedure is to establish the scale of the probability of a dangerous event and the severity of the consequences. If the first one can use the recommendations of the ISO 31073: 2022, which determines that probability is a measure of the possibility of occurrence, which is given by the number between 0 and 1, where 0 is inability, and 1 is absolute confidence, then with the scale of severity of consequences. Determination of the severity of the consequences of economic environmental and occupational losses should be made specific and understandable to employees of companies (Table 3).

During the fourth step, we evaluate the level of risks from economic, environmental and occupational losses, based on certain conditions of acceptability or inacceptability of their level [20, 21]. Initially, we evaluate the risks of each type of consequences separately, summing the points from the influence of all the identified dangerous factors. Then, we compare the calculated risk with a critical one (for example, for matrix 5 by 10 it is 50 points), which is established in terms of the matrix of risk assessment, taking into account the financial capabilities of the organization.

Table 3. The criteria of the scale of severity of consequences from economic, environmental and occupational losses from the occurrence of a dangerous event [16–19]

№	The severity of losses		The severity of the consequences of a dangerous event from losses		
	Name	Points	Economic	Ecological	Occupational
1	Low	1	0-100$	Ecosystem objects in the natural state are usually oligotrophic, suitable for all kinds of residence	Injury of the employee
2	Insignifi-cant	2	100-1000$	Ecosystem objects are close to the natural state or poorly eutrophied, suitable for all types of residence	Light injury of the employee or group injury
3	Moderate	3	1000-10000$	Ecosystem objects are under the influence of sources of collapse or other types of technogenic influence, suitable for residence only for strong species	Moderate injury of the employee or light group injury
4	Signifi-cant	4	10000-500000$	Ecosystem objects are significantly contaminated in the result of harmful pollutants, objects are only suitable for those species in which less stringent requirements for the quality of components	Significant injury of the employee or significant group injury
5	Catastro-phic	5	more than 500000$	Ecosystem destruction	Death of an employee or group serious injury

In case of lack of risk from each loss, we move to the fifth step, where we determine that significant dangerous factors that have the highest rates or the probability of a dangerous event or severity of consequences. We analyze the ways of reducing their impact, using a hierarchy of preventive and protective measures.

If the levels of risk from each loss are acceptable we move to the sixth step, where we compare them with the limit of acceptability, which is set from three losses at a time. It is not possible to do the usual summation of the set critical levels of risk from each loss. Because the risks are interconnected and have some impact on each other. For example, through human activity [19]. So, most environmental problems (depletion of biodiversity, lack of fresh water, etc.), as well as dangerous situations (injury to employees, accidents, failures) are caused by people. On the other hand, the reduction of human activity can be the most effective technique, both to reduce environmental problems and to increase the size of the resource base. However, human activity is important for the economic development of organizations. Hence their relationship can be expressed due to a general economic loss from a dangerous event (Fig. 2).

Fig. 2. Relationship of general economic loss from a dangerous event and its components: economic losses from benefit decrease, environmental losses and losses of life and health of people

If we present the limits of acceptability of economic, environmental and occupational risks from the occurrence of a dangerous event, a certain set (eg monetary equivalent), according to the Euler-Venn diagram (Fig. 4), it is possible to establish a zone (1-2-3) that will provide minimal losses which on the other side allows to determine the limits of stability of the organization [22].

Hence, there are several variants (Table 4) of the risk distribution, which are determined by the intersection of sets that are illustrated in Fig. 6. So, variants A - D with Fig. 6 show that it is not possible to ensure the limit of acceptability due to the discrepancy of one of the components of costs.

Again, in the event of inacceptability of total losses from certain levels of risk, we return to the fifth step and suggest additional safety and protective measures, based on what level of losses for the organization is the most critical. Afterwards, we return to the stage of analysis and reassessment of the risk to find out the effectiveness of the offered measures or actions.

Table 4. Analysis of options for distribution of dangers risk by three types of losses (the Euler-Venn diagram)

Variant	Zone	Risk of economic (financial) losses – decreased economic benefit	Risk regarding the loss of life and health of employees	Risk regarding environmental losses
№1	1	Acceptable	Unacceptable	Unacceptable
№2	2	Unacceptable	Acceptable	Unacceptable
№3	3	Unacceptable	Unacceptable	Acceptable
№4	1-2	Acceptable	Acceptable	Unacceptable
№5	2-3	Unacceptable	Acceptable	Прийнятний
№6	3-1	Acceptable	Unacceptable	Acceptable
№7	1-2-3	Acceptable	Acceptable	Acceptable

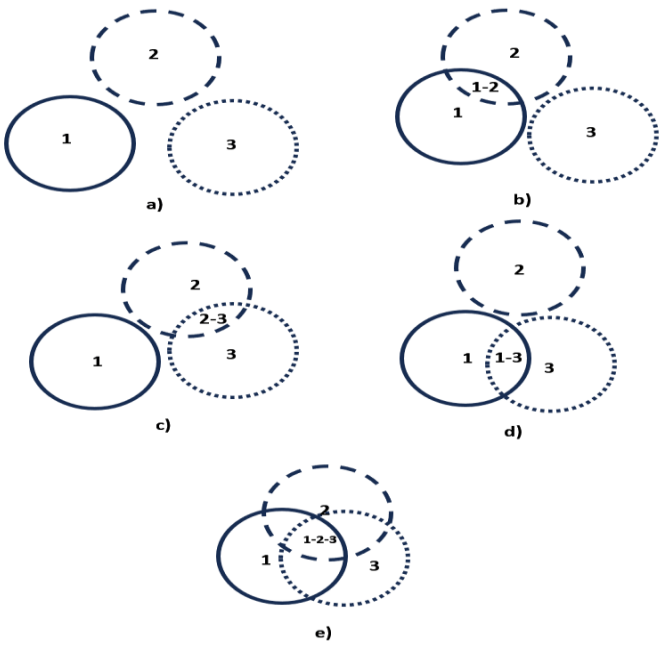

Fig. 3. Euler-Venn diagram of risk of economic (1), environmental (2), occupational (3) losses

The seventh step is documentation of risk levels where the relevant registers are created, both hazards and dangerous factors, as well as the description of the possible consequences of their manifestation. The appropriate risk maps are filled, which record the initial risk assessment data, and then, taking into account preventive and protective measures – a permanent one. An appropriate plan for periodic risks is predicted.

During the last step, we develop a risk monitoring procedure, including lines of informing, staff training and increased maturity of risk management activities (level of risk management development, which is characterized by the efficiency and effectiveness of the approaches over the results of the organization's activities).

Discussion of research results

An important condition for the effective functioning of an organization is the ability to find interaction between the requirements of society, which is ensured by economic growth and the capabilities of the environment.

With consideration of ISO 9001: 2015, the International Standardization Organization has tried to focus on improving the processes and identification and control of risks, which will allow us to better conduct a risk management process: economic, environmental and occupational focus on these purposes, any organization determines the way to manage risks for satisfaction of stakeholders. We pay attention to the peculiarity of integration of environmental risks specified in the ISO 14001: 2015. It turns out that it requires organizations to follow the rules to ensure environmentally friendly technologies by reducing pollution and maintaining investment in sustainable projects. Hence, there is a need to support stakeholders through the developed tools to ensure the improvement of the overall corporate style on the organization development, in combination with economic and occupational dangers, which are often interconnected and even interdependent. Such dangers include inadequate waste management, uncontrolled consumption of energy and emissions of pollutants into water, air and soil, risks to improve production processes and reduce environmental risks, which is also characteristic of economic discrepancies, as dangerous factors that increase the probability of economic losses [7].

As a result of the proposed risk management process, a better consistency of actions within the organization is ensured, enhancing the synergistic effect, which is that the overall result of mutual actions is higher than the sum of individual results. It allows:

1) to increase the competitiveness of the enterprise by increasing the level of its business reputation and the quality of management of the organization;

2) to minimize the functional separation of staff in an organization that arises during the development of autonomous management systems;

3) to ensure the functioning of integrated control systems with the help of less efforts than creating several parallel systems;

4) to ensure the balance of interests of the external sides of the organization than several systems that operate in parallel;

5) to achieve greater "transparency" and control by the organization, because the number of internal and external connections in the integrated system is less than the total number of these connections in several systems;

6) to reduce the total volume of documents in several parallel systems;

7) to reduce the conflict and probability of possible contradictions between issues related to economics, ecology and security, more complete approach to the growth of profitability, more efficient use of resources, increasing the coherence of the information exchange process, preventing duplication.

Sustainable development of the organization is an important issue that will not only provide competitive advantages in the future, but also contribute to the minimization of losses through appropriate risk management processes, taking into account the economic losses from their consequences. This encourages organizations, seek the limits of stability that will balance the challenges (dangers) and the losses that the organization will incur to eliminate them. Considering that the largest economic burden of organizations is imposed by environmental standards,

there is a task in the redistribution of financing and determining the boundaries of safe activity of the organization. This is quite convenient to use here the Euler-Venn diagrams that will demonstrate how much the boundary of opportunities will be changed under different input conditions (Fig. 4).

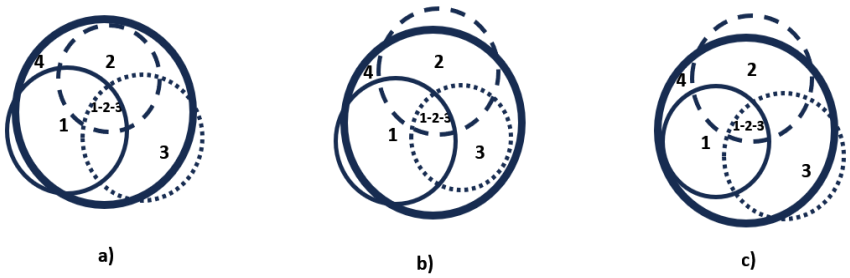

Fig. 4. Euler-Venn diagram on risk acceptance of general risk (4) from economic (1), ecological (2), occupational (3) loses: a) acceptable occupational risk of less than other acceptable risks; b) acceptable occupational risk of less than other acceptable risks; c) acceptable occupational risk of less than other acceptable risks

All kinds of sustainable development activities can be determined by the overall economic loss that allows us to set an unacceptable level of general economic risk – R_j should be not more than or equal to the amount of unacceptable levels of risks:

$$R_j = R_j^{ek} + R_j^{el} + R_j^{pr}. \quad (4)$$

This research shows two contributions. The first one consists in the fact that every danger must be based on three different losses. This allows us to implement another mechanism to identify the most significant dangerous factors that lead to significant general economic losses. Even in the case of risk of each individual dangerous factor, there is an additional possibility of analyzing them from the condition of sustainable development, that is, on the basis of the relationship between financial activity, economic and occupational losses on the stability of the organization. The second contribution consists in determination of the limits of the risks acceptability, which are formed not only on the basis of the overall acceptable economic loss, which should not exceed the profit, but also taking into account the stability of the enterprise. This implies the need to actively invest in new technologies, based on short-term and long-term prospects.

It is important to understand that sustainable management helps organizations to perform innovative processes, reduce wastes and get an idea of possible areas of growth. Thus, sustainable development is not only an environmentally oriented strategy, but a multifunctional solution that encompasses the concern and the environment, society and effective management in public and private sectors.

Conclusions

1. The article identifies the main dangers consisting of natural, technogenic, environmental, occupational and economic groups of dangers and dangerous factors.

2. The authors develop the model and algorithm of risk management based on a combination of different consequences of economic, environmental characters, life loss and health problems.

3. Through Euler-Venn diagram the authors determine the relationship between the probability of a dangerous event and the severity of the consequences between groups of economic, environmental and occupational risks.

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В.А. Цопа, О.О. Яворська, О.А. Борисовська, Л.М. Чеберячко, Т.О. Негрій
ПРОЦЕС КЕРУВАННЯ РИЗИКОМ НЕБЕЗПЕЧНОЇ ПОДІЇ З УРАХУВАННЯМ ЕКОНОМІЧНИХ, ЕКОЛОГІЧНИХ І ПРОФЕСІЙНИХ ВТРАТ

Анотація. Мета роботи полягає у розробці процесу керування ризиком небезпечної події з урахуванням економічних, екологічних і професійних втрат.

Матеріали і методи. Для розробки процесу керування ризиками від різних небезпек через інтеграцію їх втрат (економічних, екологічних і життя та здоров'я працівників) за основу візьмемо найбільш поширену модель «краватка-метелик», яка дозволяє встановити причинно-наслідковий взаємозв'язок між небезпекою – небезпечною подією і тяжкістю наслідків.

Результати. В результаті проведених досліджень з'ясовано, що кожну небезпеку необхідно розглядати, виходячи з трьох різних видів збитків. Це дозволяє реалізувати ще один механізм з виявлення найбільш суттєвих небезпечних чинників, які призводять до значних загальних економічних втрат. У випадку прийнятності ризику від кожного окремого небезпечного чинника з'являється додаткова можливість їх аналізу на основі взаємозв'язку між фінансовою діяльністю, економічними та

професійними втратами. Другий полягає у визначенні меж прийнятності ризиків, які формуються не тільки виходячи із загальних прийнятних економічних втрат, а й з урахуванням стабільності роботи всього підприємства. Це передбачає необхідність активно інвестувати в нові технології, виходячи від короткострокових і довгострокових перспектив.

Визначені основні види небезпек, які наведені в реєстрі ризиків, який розробляє організація для визначення інтеграції небезпек, що складається з природних, техногенних, екологічних, професійних та економічних груп небезпек і небезпечних чинників. Розроблено модель і алгоритм керування ризиками на основі поєднання різних наслідків небезпек по економічним, екологічним факторам, втрати життя та здоров'я.

Наукова новизна. Визначено взаємозв'язок між ймовірністю настання небезпечної події та тяжкістю різних видів наслідків – економічних, екологічних та професійних небезпек через аналіз діаграм Ейлера-Венна.

Практична цінність. Розроблено основні принципи керування ризиками різних з урахуванням різних видів втрат: економічних, екологічних та життя і здоров'я працівників.

Ключові слова: Ризик, професійні небезпеки, економічний ризик, екологічний ризик, професійний ризик.

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Цопа Віталій Андрійович
доктор технічних наук, професор кафедри менеджменту, Міжнародний інститут менеджменту
Адреса робоча: вул. Шулявська, 10/12, м. Київ, Україна, 04116
ORCID ID: https://orcid.org/0000-0002-4811-3712 ***e-mail:*** dr.tsopav@gmail.com

Яворська Олена Олександрівна
доктор технічних наук, професор кафедри охорони праці та цивільної безпеки, Національний технічний університет "Дніпровська політехніка"
Адреса робоча: пр. Яворницького, 19, м. Дніпро, Україна, 49005
ORCID ID: https://orcid.org/0000-0001-5516-5310 ***e-mail:*** elenayavorska80@gmail.com

Борисовська Олена Олександрівна
кандидат технічних наук, доцент, зав. кафедри екології та технологій захисту навколишнього середовища, Національний технічний університет "Дніпровська політехніка"
Адреса робоча: пр. Яворницького, 19, м. Дніпро, Україна, 49005
ORCID ID: https://orcid.org/0000-0001-7309-0236 ***e-mail:*** borysovska.o.o@nmu.one

Чеберячко Лідія Миколаївна
аспірант кафедри екології та технологій захисту навколишнього середовища, Національний технічний університет "Дніпровська політехніка"
Адреса робоча: пр. Яворницького, 19, м. Дніпро, Україна, 49005
ORCID ID: https://orcid.org/0009-0001-2685-7809 ***e-mail:*** cheberiachko.lm@nmu.one

Негрій Тетяна Олександрівна
кандидат технічних наук, доцент кафедри технологій захисту навколишнього середовища та охорони праці, Київський національний університет будівництва і архітектури
Адреса робоча: пр. Повітрофлотський, 31, м. Київ, Україна, 03037
ORCID ID: https://orcid.org/0000-0002-4239-3178 ***e-mail:*** tetiana.nehrii@gmail.com