Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

Assessment of occupational risks: New approaches, improvement, and methodology

Oleksiy I. Polukarov *, Nataliia A. Prakhovnik, Yury O. Polukarov, Liudmyla O. Mitiuk, Hlib V. Demchuk

Department of Labor Protection, Industrial and Civil Safety, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine

ARTICLE INFO

Article history:
Received 10 June 2021
Received in revised form
28 August 2021
Accepted 31 August 2021

Keywords:
Occupational risks
Industrial activity
Potential threats
Industrial risk
Safety
Accident

ABSTRACT

This study raises the issues of occupational risks and the new approaches to their assessment, improving research methods in this direction. The relevance of the stated subject is due to a wide variety of situations that arise in modern industries and have a high degree of risk for employees of enterprises. The purpose of this study is to determine new approaches to occupational risk assessment, as well as to study various aspects of improving production activities in the context of using new methods for assessing the degree of risks. The leading scientific method is a combination of analytical and logical approaches to the set of issues brought into the topic of this study. The main results of this study: identification of new, effective methods for assessing the degree of risks of occupational injuries and estimation of the level of occupational injuries at Ukrainian enterprises in 2020 and several previous years. Prospects for further study in this direction introduce methods for assessing the real level of occupational risks in the production sphere, in order to reduce the total number of situations associated with risk for workers of modern industrial enterprises that arise in the process of conducting work activities. The applied value of this study lies in the possibility of the subsequent practical application of the obtained results, in order to form the basis for the safe implementation of professional activities by employees of enterprises and organizations operating in various spheres of the economy, industry, and production. Identification of various aspects of occupational risks assessment in various areas contributes to the elimination of such risks and prevents their occurrence in the future.

1. Introduction

Today, the issues of improvement and search for new approaches and methods for occupational risk assessment are an urgent problem, due to the prevalence of industrial injuries and the need to search and implement effective methods to combat this phenomenon. At the same time, it is precisely the improvement and modernization of the currently existing occupational safety and health management system (OSH MS) of modern industrial enterprises. The transition from factual registration of injuries to risk management and the development of preventive measures to reduce the impact of production conditions on employee health is the main task (Staseva and Filatova, 2018). It is the search for new approaches to occupational risk assessment that is the main task of an OSH MS today, requiring a timely solution with the implementation of the results obtained on a practical level (Martinez Montes et al., 2007; Liba et al., 2019; Lutkovska, 2020).

In this context, the OSH management system of a modern industrial enterprise should be viewed exclusively as an important, but only primary, element of the process of creating healthy and safe working conditions (Klimova et al., 2018; Polukarov et al., 2020). This system aims to determine the grounds for providing guarantees and compensations to workers in harmful and hazardous working conditions and does not take into account the risks of injury. Today, working conditions with a risk of injury in terms of such parameters as noise, infrasound, vibration, etc., can be assessed as acceptable, therefore, measures to reduce risks and injuries will not be developed (Martyn, 2018; Bakiko et al., 2020; Lin et al., 2021).

* Corresponding Author.
Email Address: yu-polukarov@uohk.com.cn (O. I. Polukarov)
https://doi.org/10.21833/ijaas.2021.11.011
Corresponding author's ORCID profile:
https://orcid.org/0000-0003-4260-0330

A qualitative assessment of the degree of occupational risk requires the collection of objective data in order to make an informed decision to determine how to overcome such risks (Teplyakova and Turyanskaya, 2018). The choice of methodology in each specific case is determined by the belonging of a particular enterprise to a certain economic sector and the nature of the production processes taking place at this enterprise. Working conditions at enterprises in various spheres of the economy may vary depending on a number of factors that ultimately determine the risks of conducting work activities in each specific case. Most often, statistical analysis of the accident rate at the enterprise is used for occupational risk assessment (Loktionov and Kondrateva, 2020; Wang et al., 2020). The advantages of this method include the ability to obtain clear trend data that is taken for analytical research. Statistical analysis of data on injuries makes it possible to study the conditions conducive to the occurrence of accidents both for individual categories of workers, and for specific industrial sectors (Teplyakova and Turyanskaya, 2018). At the same time, it is not possible to track the patterns of occurrence of injuries and, as a result, prevent work-related fatalities, injuries, and diseases without the collection of statistical information on various indicators. These include time and place of injury, gender, age, qualifications of the injured person, type of work performed, type, and reasons of the incident (Dautbayeva-Mukhtarova et al., 2013; Fentsyk, 2018). The introduction of such a method allows obtaining an overall picture of an accident, tracking the rise in work-related injuries, its dynamics, without revealing the conditions for activities that have caused injuries and accidents. Subsequently, an in-depth analysis of various causes of injuries at industrial enterprises contributes to the development of a whole range of measures to prevent industrial accidents (Velykanova, 2020; Zaburanna et al., 2020).

International practices in the field of occupational safety at industrial enterprises are developing a set of preventive measures, which allow to properly assessment the degree of risks characteristic of specific employment conditions. New approaches to the development of risk management systems are integrated into the structure of the enterprise management system in general and into the structure of occupational safety at the enterprise in particular. Today, the Guidelines on occupational safety and health management systems, ILO-OSH 2001, developed by the International Labour Organisation, are in force (Staseva and Filatova, 2018; Chitaka et al., 2018; Kruzhilko et al., 2020).

Occupational risks assessment in the context of the new approaches, improvement of the methodological principles, presupposes a comprehensive study of the issue, in accordance with the modern requirements and the increasing need to form work environment that meets the current technological realities.

2. Literature review

A review of the available materials on occupational risks and the search for new ways to assess, prevent, and overcome them allows us to consider the variety of opinions expressed by researchers. So, Staseva and Filatova (2018) studied occupational risks, note that "Assessment of occupational risks is a system of measures that provide for a special assessment of working conditions, assessment of injury risks, assessment of the safety of employees, assessment of individual occupational risks of employees" (Staseva and Filatova, 2018; Storozh et al., 2018). The authors also point to the link between risk factors at enterprises and safety measures. "Risk assessment is a consistent analysis of working conditions and the accompanying factors that may harm employees. At the same time, the employer has the opportunity to assess and analyze the precautions taken. Workers and other persons employed at the enterprise have a legal right to protection from harm that may be caused in the course of work activities and also have a right to reasonable safety measures" (Staseva and Filatova, 2018).

In turn, Teplyakova and Turyanskaya (2018) studied the working conditions of a construction organization, came to the conclusion that "an analysis of the causes of occupational injuries leads to the conclusion that each accident is preceded by a number of errors and violations of labor protection requirements, as well as working conditions. For a more detailed study of the conditions for the occurrence of injuries, the available official statistics are insufficient. In this regard, the use of in-process control materials and the results of a special assessment of working conditions (SAWC) for risk assessment allows a deeper understanding of the conditions, sources, and causes of injuries" (Teplyakova and Turyanskaya, 2018). At the same time, "the main task of the new OSH MS is the transition from responding to occupational injuries and diseases to injury risk management of employees using employers' interest in improving working conditions and mechanisms of social partnership" (Teplyakova and Turyanskaya, 2018).

Assessing professional risks in the occupational safety management system at the enterprise, Bulanova et al. (2019) indicated the presence of various options for assessing the degree of occupational risks at industrial enterprises. According to the team of authors, "There are various methods, approved by the occupational safety standards, for assessing occupational risks as constant factors of the work environment. They are designed to determine the degree of risk exposure of workers and the risk category" (Bulanova et al., 2019; Macpherson et al., 2021). Here, the authors, in relation to the functioning of the occupational safety system, note "The OSH MS have several tools in possession, with the help of which the information flows necessary for assessing and making decisions on improving working conditions are formed. Each

data collection mechanism is unique in its own way, but not universal; each of them has its disadvantages. Therefore, in these conditions, an integrated approach that would improve the system for assessing the safety and comfort of work is required. One of the tools (with some limitations) can be the calculation of occupational risks" (Bulanova et al., 2019; Deng et al., 2020).

Thus, the researchers emphasize the fundamental importance of the tools of the OSH system at the enterprise for assessing the quality of working conditions and improving approaches to the assessment of industrial risks. In general, the review of the available literature clearly demonstrates the variety of approaches to assessing occupational risks. It has a positive effect on the depth of the study and contributes to the qualitative disclosure and development of a system of views on the issues of occupational safety at industrial enterprises.

3. Materials and methods

The task of this study is to consider the assessment of occupational risks in the context of finding new approaches to the resolution of the issues of occupational safety at an enterprise. This includes the formation of a methodology for solving a set of practical tasks to improve the safety of industrial enterprises.

The basis of the methodology of this study is a combination of analytical and logical approaches to a set of issues under consideration. An in-depth analytical review of information sources available within the declared subject matter was carried out. The fundamental aspects of occupational risk assessment at industrial enterprises and the possibilities of their prevention have been highlighted. Application of analytical approach within the framework of this study allows to reveal the essence of the questions stated in its subject matter and contributes to the formation of the initial results and conclusions. A significant amount of information was taken from the scientific developments of foreign authors who conducted similar studies on the dangers of occupational risks and the search for approaches to their prevention and elimination. In order to form the most objective picture of the study and to facilitate the perception of information, all papers of foreign authors taken for research were translated into English.

The issues of occupational safety and associated risks were considered on specific examples that took place in the activities of industrial enterprises in various sectors. Therefore, the analytical approach to the identification of the main aspects important for this study is the most acceptable from the standpoint of analytical identification of new approaches to addressing issues of occupational safety. The logical approach contributes to the forms of the final conclusions of this study, their structuring and division into main and secondary aspects. Logical structuring is necessary to form a clear idea of the sequence of presentation of the results and create a complete picture of this research. The chosen approaches meet the assigned tasks and make it possible to get an optimal idea of the sequence of stages in consideration of the issues mentioned above. In addition, this choice of research methods can serve as a basis for further study in this direction. The practical application of this scientific methodology makes it possible to find and objectively assess the degree of risks at industrial enterprises. It will contribute to the search for optimal solutions in the direction of increasing the safety of enterprises, reducing the risk of occupational injuries, and creating optimal working conditions in various industries.

The materials and methods of this paper will be useful for conducting studies in the field of occupational safety and reducing the risk of occupational injuries at industrial enterprises. They can also be used to develop effective measures to prevent occupational injuries and create conditions necessary for the safety of workers and service personnel of enterprises. In general, this will positively affect the development of the economy and improve working conditions at enterprises of various industrial sectors.

4. Results and discussion

The study of the issues of occupational risk assessment in the context of improving the methodology for its management and search for new approaches to highlighting this issue gave the following results.

As a rule, risk assessment at industrial enterprises is based on the need to comply with the following stages:

- Production control carried out in accordance with industry standards and regulations adopted at a particular enterprise;
- State sanitary and epidemiological control over the activities of enterprises in a specific sector;
- Sanitary and epidemiological assessment of the equipment of the industrial enterprise;
- Assessment of the quality of products and their conformance with the permissible volume of rejects in the specific type of product;
- Special assessment of working conditions at the enterprise carried out in accordance with industry standards;
- Periodic medical examination of employees of enterprises in order to identify injuries received at work.

The methodology for calculating risk indicators at industrial enterprises should be formed taking into account the following factors:

- The sector of the industrial enterprise;
- Assessment of working conditions at an enterprise of specific industrial sector;
- The number of employees at an enterprise;

- Criteria of safe working conditions at a specific industrial enterprise.

The criteria of the safe working conditions at the enterprise include:

- Conditions for protecting the life of employees;
- Conditions for the preservation and restoration, if necessary, of the functional capabilities of employee's organism;
- Preliminary estimation of the subsequent life expectancy of employees of a particular enterprise, after their dismissal or retirement.

To assess the class of occupational risks, an integral value should be used, which is calculated by the Eq. 1:

$$I_v = (\Sigma CDI/\Sigma SF)100\% \quad (1)$$

where: I_v is integral value, ΣCDI is compensation for damage incurred by insured workers of an industrial enterprise as a result of accidents and occupational diseases, which was accrued in a specific industry during one calendar year, ΣSF is the size of the salary fund in the industry from which admission to the social insurance fund was placed within one calendar year.

This integral value is an indirect estimate of the current accident rate at an enterprise in the current calendar year. Its definition makes it possible to attribute a specific industrial enterprise to a specific group of occupational risks.

To assess the occupational risk of employees involved in the production activities, a number of generalized indicators should be taken into account, such as:

C_r: Coefficient of the accident rate at an enterprise;
C_{fo}: Coefficient of the accident rate at an enterprise, with the fatal outcome;
S_i: Severity of injuries sustained as a result of industrial accidents;
I_{om}: Index of occupational morbidity at an enterprise.

Calculation of the value of the last parameter gives grounds to estimate the degree of occupational risks of health deterioration as a result of work activities:

$$I_{om} = 1/C_s \times C_f \quad (2)$$

where, C_s is the coefficient of the severity of the identified occupational disease; C_f is the coefficient of the frequency of detection of such occupational diseases.

If the parameters directly proportional to the presented characteristics will act as the values of C_s and C_f, Eq. 2 takes the following form:

$$I_{om} = C_s \times C_f \quad (3)$$

The formation of a methodology for assessing the degree of risk involves the creation of a model of the mechanism of the occurrence of the probable occupational risk, which can be schematically represented in the following form (Fig. 1):

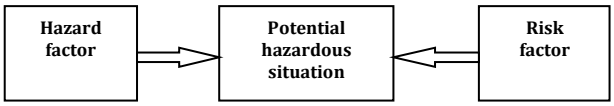

Fig. 1: Potential hazard diagram

In this context, a hazard is an exposure that can cause injury under certain conditions. The risk factor creates the conditions for the implementation of the hazard factor in the form of an occupational injury with a high probability of occurrence.

From this perspective, it seems appropriate to provide data on workplace injuries by the type of economic activity in Ukraine for the first half of 2020.

The data presented in Table 1 indicate relatively low rates of workplace injuries in Ukraine in 2020. This is facilitated by the implementation of new methods for assessing the quality of the occupational safety system in industrial production and other sectors of economic activity. New approaches to the assessment of the degree of risks help to reduce the overall level of occupational injuries at enterprises in Ukraine and create conditions for the improvement of industrial production safety (Kucher and Zamrii, 2020).

Table 1: Data on workplace injuries by the type of economic activity in Ukraine for the first half of 2020

Economic sectors	Loss of labor capacity for one working day in relation to 1000 employees	Of the specified number, fatalities per 1000 employees
Industry	2.5	0.006
Construction	3.8	0.235
Agricultural production	3.0	0.165

Fig. 2 shows the accident rate in industrial production in Ukraine according to statistics for 2017:2020. The indicators are presented for workers who have lost the labor capacity for one working day in relation to 1000 employees.

The data presented in Fig. 2 testifies to the emerging trend in recent years towards a decrease in occupational injuries in Ukraine. This is facilitated by the improvement of the safety control systems of industrial enterprises and the gradual introduction of new methods for timely risk assessment. In general, the issues of controlling the risks of occupational injuries at enterprises of various spheres of economic activity in Ukraine are under the jurisdiction of special services that constantly monitor production activities to timely identify and

prevent the occurrence of risks. In addition, the tasks of the management include constant control over the state of the labor safety and the quality of its performance. It helps to reduce the overall rate of injuries at industrial enterprises (Lialiuk, 2020).

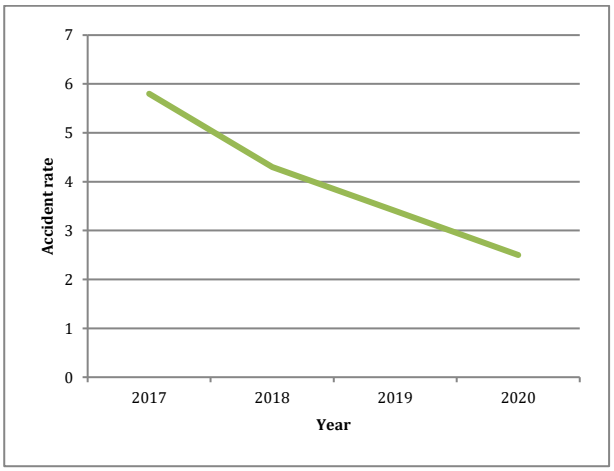

Fig. 2: Dynamics of accidents at industrial enterprises in Ukraine according to statistics for 2017-2020

Thus, the issues of risk assessment in the industrial sector are the responsibility of occupational health monitoring systems at enterprises. Their responsibilities include monitoring the current situation with the risks of occupational injuries and the development of research methodology in this area. The development of new approaches to the study and competent coverage of the risks of occupational injuries contributes to an increase in production safety at enterprises of various sectors of the Ukrainian economy. In the future, improvement of the methodology for assessing occupational risks, in the context of the search for new approaches to a given subject, can expand the base for further scientific inquiries in this direction (Puhachevska et al., 2020).

A qualified discussion of the issues of occupational risk assessment from the standpoint of a search for new approaches to highlighting a given topic and improving the existing methodology contributes to the most complete disclosure of the conditions for its further development. In particular, some researchers propose to introduce a model for assessing occupational risks in enterprises. So, Trushkova (2012) noted that "many experts propose to introduce a specific value of human life in monetary terms. This approach raises objections among a certain circle of people who argue that human life is sacred and financial transactions in this regard are unacceptable" (Trushkova, 2012; Ricco et al., 2020). A similar position can be traced in the study of Chernyshenko and Zanina (2017), dedicated to the issues of a special assessment of working conditions and occupational risks in the OSH MS at enterprises of various economic sectors. According to the researchers, "An innovative approach ensuring the work safety is based on the assessment of the health of employees and the working conditions of each workplace" (Chernyshenko and Zanina, 2017). Thus, the authors agree on the importance of the life and health of employees as the primary elements in the activities of the occupational safety system at enterprises.

Foreign authors also note the importance of the OSH at enterprises in the context of reducing occupational injuries. In particular, the team of authors represented by He et al. (2020) noted "accumulated practical experience in the study of industrial safety indicates that the practical implementation of workplace monitoring is the key to occupational risk mitigation" (He et al., 2020). In turn, Martinelli et al. (2020) studied the efficiency and economic value of various systems of poultry farming indicate that "without a qualitative and timely assessment of industrial risks to the health of employees, the operation of any enterprise is not possible" (Martinelli et al., 2020; Ahmad et al., 2021).

Shkrabak (2008) investigated the issues of occupational risks in the agro-industrial complex, points out the fact that "The versatility of occupational safety is closely related to the socio-economic situation of enterprises and industries. The latter largely determine the effectiveness of preventive safety measures. It is the state of the economy, fixed assets, the environment, the quality of training, staffing, and scientific support that makes possible to determine the strategic and tactical aspects of prevention and, in some cases, the elimination of industrial injuries" (Shkrabak, 2008; Wang and Boukamp, 2009). In addition, the author identifies the most effective ways to address injuries in the workplace. According to the researcher, "... at this stage, the most promising way is the provision of engineering and technical security measures without detraction of others" (Shkrabak, 2008). Teplyakova and Turyanskaya (2018), examined the issues of occupational safety in the workplace in relation to enterprises in the construction sector, note "The main purpose of occupational risk assessment is to provide, on the basis of objective evidence, the information necessary to make an informed decision on ways to reduce risk". Such an assessment is decisive in the development of new methods for studying industrial risks. Without collecting a sufficient amount of information on risk levels, it is impossible to create and then implement a coherent system for their prevention and elimination.

A similar opinion is expressed by Staseva and Filatova (2018); deal with the issues of determining the degree of occupational risks, based on a special assessment of working conditions. According to the authors, "Any production may need to use new equipment, new chemicals, and procedures, which can lead to new risks. Therefore, in any production, the employer needs to regularly review current activities, so that it will be possible to make timely adjustments. The employer should periodically analyze the current situation in the workplace in order to ensure the relevance of the occupational safety policy at the enterprise. Based on the severity of risks in the workplace, priorities can be set to

eliminate them entirely or partially" (Staseva and Filatova, 2018).

Thus, researchers agree on the need for the collection and systematization of information on injuries at industrial enterprises, to develop and implement a system for the prevention of risks and their subsequent elimination. Also, further study in this direction will contribute to more complete disclosure of a given topic and an in-depth analysis of occupational risks, in the context of finding ways to prevent and eliminate them.

5. Conclusion

The study of occupational risks, in the context of their assessment and the search for ways to improve research methodology in this direction, has led to the following conclusions. Assessment of occupational risks in industries in various sectors of the economy is assigned to the system of occupational safety at enterprises. The safety of the enterprise itself, as well as the health of its employees, largely depends on the operation of this system. The introduction of new approaches to the improvement of such systems involves an emphasis on a number of aspects, the key ones among which are the following. Firstly, to form a qualitative methodology for assessing the level of occupational risk, it is necessary to collect reliable statistical information on the number of accidents at each enterprise during a given period of time and the reasons for their occurrence. Secondly, it is necessary to develop and implement a set of measures for conducting introductory briefings, both for employees of enterprises and for employees of the occupational safety system. Thirdly, a general increase in the production culture and improvement of material and technical equipment should reduce occupational risks.

The qualifications of the personnel of industrial enterprises are also essential in occupational risk assessment, as well as for preventing accidents and reducing the level of workplace injuries. A qualitative assessment of statistical information on the number of industrial accidents, injuries, and the causes of their occurrence contributes to an accurate determination of the level of production culture of each enterprise, which, in turn, is a reliable basis for the development of a system for assessing risks and ways to reduce them. In general, at the enterprises of various spheres of the Ukrainian economy in recent years, there has been a clear trend towards a decrease in the level of occupational injuries, which is evidence of the professionalism of work safety services at industrial enterprises. The need to introduce new equipment at enterprises contributes to an increase in the level of production risks, creating the preconditions for an increase in occupational injuries. In this context, a general increase in the level of production culture, qualification, and professionalism of employees is of great importance. An assessment of the level of occupational risks should be carried out taking into account these factors, as having a significant impact on the entire structure of the activities of any industrial enterprise as a whole. The methodology for assessing the level of occupational risks involves a periodic analysis by the management of the enterprise of its current state, in order to determine the current relevance of the policy of the work safety service at the enterprise.

To improve the quality of its functioning, it is necessary to periodically make adjustments to its activities, taking into account changes in the operating conditions of the enterprise itself. Analysis of literature on the risks of the enterprise's activities creates the initial base for the assessment of such risks. Conducting a primary analysis is necessary to clarify the most significant risks of professional activity, as well as the reasons for their occurrence and ways to overcome them. Often at enterprises, there are specific risks due to the specifics of the activities of each specific enterprise, which can cause the development of occupational diseases in its employees. Assessment of the factors of occurrence of such risks consists in determining the factors that influence the frequency and nature of the occurrence of occupational risks, their impact on the activities of the enterprise as a whole. In this case, only the factors that have the greatest impact on the safety of life or the danger of working conditions should be taken into account.

Amendments to the Labour Code should improve the efficiency of the safety system at enterprises in various sectors of the economy. This will create a legal basis for the development of new methods to improve the occupational safety systems at enterprises. This, ultimately, should lead to an increase in the level of industrial safety and reduce occupational risks, up to their complete or partial elimination. Such a measure should pursue the task of preserving the health of employees since it is the human factor that is key in assessing the level of occupational risks and improving methods of their prevention and elimination.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Ahmad M, Akram W, Ikram M, Shah MAA, Rehman A, Jabeen G, and Chandio AA (2021). Estimating dynamic interactive linkages among urban agglomeration, economic performance, carbon emissions, and health expenditures across developmental disparities. Sustainable Production and Consumption, 26: 239–255. https://doi.org/10.1016/j.spc.2020.10.006

Bakiko E, Serdyuk V, Yanchij S, Ignatovich I, and Bardina E (2020). The labour protection specialist competence influence on the professional risk management state. In the E3S Web of Conferences, EDP Sciences, 178: 01087. https://doi.org/10.1051/e3sconf/202017801087

Bulanova AV, Pushhenko SL, and Staseva EV (2019). The value of the assessment of occupational risks in the system of occupational safety management. Safety of Technogenic and Natural Systems, 1: 2–7. https://doi.org/10.23947/2541-9129-2019-1-2-7

Chernyshenko OV and Zanina IA (2017). Special assessment of working conditions and assessment of professional risk in the occupational safety management system. Concept, 7: 11–14.

Chitaka TY, Blottnitz H, and Cohen B (2018). The role of decision support frameworks in industrial policy development: A South African iron and steel scrap case study. Sustainable Production and Consumption, 13: 113-125. https://doi.org/10.1016/j.spc.2017.11.004

Dautbayeva-Mukhtarova E, Askarova AO, and Suleymenova SZ (2013). Civil law regulation of the right to life and right to health in the field of chemical safety of the Republic of Kazakhstan. Middle East Journal of Scientific Research, 14(4): 502–507.

Deng F, Li Y, Lin H, Miao J, and Liang X (2020). A BWM-TOPSIS hazardous waste inventory safety risk evaluation. International Journal of Environmental Research and Public Health, 17(16): 5765. https://doi.org/10.3390/ijerph17165765 **PMid:32784982 PMCid:PMC7460396**

Fentsyk OM (2018). Formation of professional competence of the future head of establishment of general secondary education: Communicative aspect. Bulletin of Mukachevo State University: Series "Pedagogy and Psychology", 2(8): 200–203. https://doi.org/10.31339/2413-3329-2018-2(8)-200-203

He Y, Payne SC, Yao X, and Smallman R (2020). Improving workplace safety by thinking about what might have been: A first look at the role of counterfactual thinking. Journal of Safety Research, 72: 153–164. https://doi.org/10.1016/j.jsr.2019.12.010 **PMid:32199558**

Klimova EV, Semeykin AY, and Nosatova EA (2018). Improvement of processes of professional risk assessment and management in occupational health and safety system. In the IOP Conference Series: Materials Science and Engineering, IOP Publishing, 451: 012198. https://doi.org/10.1088/1742-6596/451/1/012198

Kruzhilko O, Maystrenko V, Polukarov O, Kalinchyk VP, Shulha A, Vasyliev A, and Kondratov D (2020). Improvement of the approach to hazard identification and industrial risk management, taking into account the requirements of current legal and regulatory acts. Archives of Materials Science and Engineering, 105(2): 65-79. https://doi.org/10.5604/01.3001.0014.5763

Kucher LR and Zamrii OM (2020). The role of the competitive personality of the manager in management. Scientific Bulletin of Mukachevo State University: Series "Economy", 1(13): 32–37. https://doi.org/10.31339/2313-8114-2020-1(13)-32-37

Lialiuk GM (2020). The psychological-pedagogical support of development of professional identity of the future social pedagogues in the process of preparation for tutealage-educational activity. Scientific Bulletin of Mukachevo State University: Series "Pedagogy and Psychology", 1(11): 31–35. https://doi.org/10.31339/2413-3329-2020-1(11)-31-34

Liba OM, Liba NS, and Konchovych KT (2019). Formation of professional competence of future economists [Науковий вісник Мукачівського державного університету]. Сер. Економіка, 1(11): 17-20. https://doi.org/10.31339/2313-8114-2019-1(11)-17-20

Lin HC, Guo JM, Ge P, and Ou P (2021). Association between prenatal exposure to ambient particulate matter and risk of hypospadias in offspring: A systematic review and meta-analysis. Environmental Research, 192: 110190. https://doi.org/10.1016/j.envres.2020.110190 **PMid:32919959**

Loktionov OA and Kondrateva OE (2020). Improving approaches to the analysis of injury rate at the industrial enterprises. Bezopasnost' Truda v Promyshlennosti, (11): 76–81. https://doi.org/10.24000/0409-2961-2020-11-76-81

Lutkovska S (2020). Identifications of environmental risks in the system environmental economic safety. Scientific Horizons, 3(88): 136–143. https://doi.org/10.33249/2663-2144-2020-88-3-136-143

Macpherson RA, Yousefi M, and McLeod CB (2021). Determining hazard management changes in workplaces following workplace safety inspections by WorkSafeBC in British Columbia, Canada. Safety Science, 140: 105298. https://doi.org/10.1016/j.ssci.2021.105298

Martinelli G, Vogel E, Decian M, Farinha MJUS, Bernardo LVM, Borges JAR, Gimenes RMT, Garcia RG, and Ruviaro CF (2020). Assessing the eco-efficiency of different poultry production systems: An approach using life cycle assessment and economic value added. Sustainable Production and Consumption, 24: 181–193. https://doi.org/10.1016/j.spc.2020.07.007

Martyn OV (2018). Professional pedagogical education in European countries as an object of pedagogical research. Bulletin of Mukachevo State University: Series "Pedagogy and Psychology", 2(8): 222–225. https://doi.org/10.31339/2413-3329-2018-2(8)-222-225

Montes GM, Gámez MDCR, Romero JCR, Mondelo PR, and Terres F (2007). Work risk-prevention procedures in highway management and maintenance contracts. Human Factors and Ergonomics in Manufacturing and Service Industries, 17(3): 229-244. https://doi.org/10.1002/hfm.20061

Polukarov O I, Prakhovnik N A, Polukarov YO, Kruzhilko OY, and Demchuk HV (2020). Stratification of expenses of insurance funds to cover risk situations of production process. Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, 3: 137–144. https://doi.org/10.33271/nvngu/2020-3/137

Puhachevska KY, Homba AV, and Smochko VY (2020). Conceptual bases of corporate integrated structures formation. Scientific Bulletin of Mukachevo State University: Series "Economy", 1(13): 108–112. https://doi.org/10.31339/2313-8114-2020-1(13)-108-113

Ricco M, Vezzosi L, and Mezzoiuso AG (2020). Occupational Eye Injuries in the agricultural settings: A retrospective study from North-Eastern Italy. Acta Bio-Medica: Atenei Parmensis, 90(4): 457–467.

Shkrabak RV (2008). Characteristics, analysis and forecast of industrial injuries and effective ways to reduce it. Bulletin of the Krasnoyarsk State Agrarian University, 4: 255–262.

Staseva EV and Filatova SV (2018). Definition of occupational risk based on a special assessment of working conditions. Young Don Researcher, 2(11): 81-85.

Storozh Y, Kruzhilko O, Maystrenko V, and Polukarov O (2018). Information and analytical support improvement for production risk assessment in mining and processing industry. In: Toderas M, Nizametdinov F, and Makharadze L (Eds.), Resources and resource-saving technologies in mineral mining and processing: 16-37. Universitas Publishing, Montreal, Canada.

Teplyakova NA and Turyanskaya EI (2018). Assessment of professional risks of builders based on indicators of the state of labor protection. Young Researcher of Don, 6(15): 62–66.

Trushkova EA (2012). Study of the stages of the methodology for determining professional risk. Engineering Bulletin of the Don, 4: 68–72.

Velykanova MM (2020). Distribution of risk of harm in delictual responsibility from the standpoint of economic analysis of law. Journal of the National Academy of Legal Sciences of Ukraine, 27(2): 119–130. https://doi.org/10.37635/jnalsu.27(2).2020.119-130

Wang HH and Boukamp F (2009). Ontology-based job hazard analysis support. International Workshop on Computing in

Civil Engineering, Austin, USA: 676-685. https://doi.org/10.1061/41052(346)67

Wang S, Kalkhajeh YK, Qin Z, and Jiao W (2020). Spatial distribution and assessment of the human health risks of heavy metals in a retired petrochemical industrial area, south China. Environmental Research, 188: 109661. https://doi.org/10.1016/j.envres.2020.109661 **PMid:32604003**

Zaburanna L, Shubenko I, and Godniuk I (2020). Real and gitopetical risks of the future accumulative level of pension insurance in Ukraine. Scientific Horizons, 8(93): 13–20. https://doi.org/10.33249/2663-2144-2020-93-8-13-20