SYSTEM SAFETY: HUMAN - TECHNICAL FACILITY – ENVIRONMENT
6(1), 2024, pp. 26-34

OCCUPATIONAL RISK MANAGEMENT IN OHS BASED ON RISK ASSESSMENT AND CONTROL

DOI: 10.2478/czoto-2024-0004
Received: 18/04/2024
Accepted: 22/05/2024

Aleksandra Kuzior [1,2,3] – *orcid id: 0000-0001-9764-5320, e*-mail: aleksandra.kuzior@polsl.pl
Grzegorz Kopij – *orcid id: 0000-0001-9748-3413, e*-mail: kopijgrzegorz@gmail.com
[1]Silesian University of Technology – **Poland**
[2]Oleg Balatskyi Department of Management, Sumy State University – **Ukraine**
[3]Academy of Economic Sciences of Ukraine – **Ukraine**

Abstract: Nowadays, occupational risk management presents a significant challenge for enterprises and occupational health and safety (OHS) services. Economic changes drive efforts to verify working conditions and optimize production processes involving human participation. Employers are obligated to provide safe and hygienic working conditions using all available technical and organizational solutions. However, many enterprises still marginalize the correlation between reliable occupational risk assessments and employee absenteeism. Employers often fear high economic costs with potentially low returns. Such actions often stem from the lack of precise analyses clearly determining the costs of inadequate employee safety and ignorance of the possible consequences of workplace accidents. A well-prepared occupational risk assessment can beneficially impact employee safety, company profits, and the reduction or elimination of material and financial losses. This article discusses appropriate remedial measures for accurately determining occupational risk levels and the elements of its control. The reliability of the assessment will determine the effectiveness of the adopted OHS policy and management overall.
Keywords: health and safety, risk management, job hazard, risk assessment, occupational risk.

1. INTRODUCTION

Every day we expose ourselves to some risk, often without realizing it. We have performed a risky activity so many times that it has become a habit and it has become normal for the action to be undertaken in this way. The issue of risk management is addressed in science from many different perspectives (Kuzior et al., 2023a,b; 2022a; Pilarczyk and Ulewicz, 2023; Yarovenko et al., 2021; Kuzmenko et. al., 2020; Vasylyeva et al., 2014; including occupational risk management (Klimecka-Tatar et al., 2023). Occupational risk management is intended to provide a solid basis for the entire occupational health and safety system. It can be defined as a business approach that includes a systemic approach to security, taking into account: organizational structures, company policy,

© 2024 Author(s). This is an open access article licensed under the Creative Commons Attribution (CC BY NC ND 4.0) License (https://creativecommons.org/licenses/by-nc-nd/4.0/).

internal procedures, liability. Occupational risk management in the enterprise management process is, unfortunately, in many cases perceived as an additional task and problem and not as one of the components of the overall system. Occupational health and safety is associated with removing "defects" that appear in the work process and not eliminating their direct cause. There is a common misconception that accidents at work only occur through unsafe behavior or human error. Improving safety in an enterprise is often limited to attempts to change employee behavior through motivational programs and other activities of low substantive value. Such behavior based on "putting out fires" without focusing on their essence increases the potential costs of enterprise management. However, in this process, broad-based actions should be taken to introduce good practices, support management staff and engage employees to participate in risk assessments at their workplaces. Appropriate conditions in the area of occupational health and safety constitute added value for both employees and the company (Kuzior, 2014). By ensuring a high level of safety at the workplace, employee productivity increases, as does satisfaction and commitment to the company's development (Pocztowski, 1998; Kuzior et al., 2022b). In turn, a company that eliminates losses caused by accidents at work achieves significantly higher financial results. Occupational risk management in occupational health and safety should be based on the classification of control measures aimed at reducing the level of risk resulting from the work performed, the environment and the human factor. Reducing the level of risk can be divided into several elements, such as: eliminating the threat, avoiding the threat, minimizing the threat, activities aimed at improving the broadly understood work culture (Klimecka-Tatar, et al., 2023), employee self-control, support for management staff, employee participation in risk assessment processes. The above-mentioned hierarchy is not accidental, the basic goal of risk management in occupational health and safety is to eliminate the emerging threat and it should always remain within the spectrum of action and then, if it is not possible to eliminate the risk, further steps should be taken to reduce it or make it acceptable.

Reducing threats is usually one of the effects of implementing the elements of "lean management" (Ulewicz and Ulewicz, 2020; Ulewicz et al., 2021), as there is a significant reduction in the number of potential threats even in maritime transport (Deja et al., 2021). This effect also occurs when implementing sustainable technologies, because the reduction of environmental loads simultaneously reduces environmental risks for the employee and is observed in the chemical (Kozlowski et al., 2002; Ulewicz et al., 2003; Radzymińska-Lenarcik and Ulewicz, 2019), biotechnology (Skrzypczak-Pietraszek and Pietraszek, 2014), energy (Ulewicz et al., 2020), but also in the machinery (Knop et al., 2019) industries, where modified welding techniques (Patek et al., 2014; Radek et al., 2018) and special coatings (Radek and Konstanty, 2012; Radek et al., 2019) are introduced reducing wear and extending service life. The factors supporting these activities are statistical (Radek et al., 2014; Pietraszek et al., 2016) and non-parametric (Pietraszek and Skrzypczak-Pietraszek, 2015; Pietraszek et al., 2017) methodologies that enable modeling processes and thus determining such operating points that threats are either eliminated or reduced to an acceptable level.

2. RISK MANAGEMENT BY SELECTING APPROPRIATE COUNTERMEASURES

Measures to minimize risks at workplaces can be divided into three groups:

1. Technical measures

2. Organizational measures
3. Personal protective equipment (so-called PPE)
Technical measures are aimed at improving the safety of machines and devices used in the work process by, for example, limiting the possibility of human interference, improving the structure, using additional covers or security systems. In order to eliminate the risk, you can use passive protection in the form of collective protection, and active protection in the form of individual protection, which aims to isolate the employee from factors that threaten his life or health. In order for this protection to properly prevent interaction between the user and the threatening factor, make sure that the necessary covers and systems have been selected correctly - appropriate to the threat, and then deployed and installed.
Organizational measures are aimed at making employees and managers aware (Ziarko, 2016) of the essence of threats arising from individual work processes in the enterprise through:
a) correct marking of the work area,
b) training of all employees focusing on specific threats that may occur at their position,
c) periodic training in the field of occupational health and safety,
d) developing instructions on how to proceed in the event of a failure or other sudden event not resulting from the work process
e) development of job instructions aimed at defining the scope of operation and repair of operated machines and devices,
f) development of procedures in the field of materials management, transport and waste management
g) conducting periodic medical examinations,
h) carrying out tests and measurements of factors harmful to health that may occur in the work environment,
i) limiting exposure to harmful or dangerous factors,
j) limiting the number of people exposed,
k) periodic inspection of work conditions and processes, as well as technical measures introduced into individual processes.
Personal protective equipment, or the so-called PPE, is the last group of preventive measures and is an essential element of an employee's equipment. In accordance with the provisions of Directive 89/656/EEC, this term means any equipment used or worn by an employee, which is intended to protect him against hazards and harmful and dangerous factors resulting from the work process. Personal protective equipment can be divided into: upper and lower limb protection measures – gloves and footwear; head protection equipment – helmets; eye protection equipment - safety glasses and goggles; face protection equipment - face shields, welding masks; hearing protection equipment - earmuffs, plugs; respiratory protection equipment - masks, filters; protective clothing - clothing that prevents the employee's personal clothes from getting dirty or damaged, specialized clothing, overalls, aprons; protective equipment for work at heights - harnesses, ropes, shock absorbers, belts; specialized protection measures - adapted to the nature of the work performed.
The use of personal protective equipment is necessary where it is not possible to eliminate the threat through technical or organizational measures. PPE is one of the basic ways to prevent accidents and occupational diseases. The most important element of the use of personal protective equipment is their correct selection in terms of the risks arising at given

workplaces, as well as training appropriately tailored to the recipients, because an incomprehensible message may lead to their incorrect use. The parameters of individual personal protective equipment should also be periodically monitored to eliminate them when they lose their protective parameters.

3. OCCUPATIONAL RISK CONTROL

The National Institute for Occupational Safety and Health (NIOSH) has identified key aspects of risk control in an enterprise, basing them on five hierarchical levels from the most effective to the least effective (Smal and Gaik, 2017). Compliance with this hierarchy may reduce the risk of loss of health or life of employees and reduce the level of exposure to dangerous or harmful factors. The hierarchy presented by NIOSH allows you to determine which of the listed control elements has the best effect in controlling occupational risk

Elimination – eliminates threats at their sources. It involves separating the employee and his/her work subject in place and/or time so that they do not interact with each other. It can lead to far-reaching changes in work processes, among others through: stopping the use of harmful substances, eliminating tools or using only safe ones, replacement or modernization of existing machinery, automating processes to minimize employee participation (Kuzior, 2022).

This is the most optimal action because the risk of exposing the employee to loss of health or life disappears.

Replacement - it involves the use of a substitute for previously used materials, machines, processes, etc. that may cause a threat. When considering a replacement, the risk should be compared to that of the original solution. Such a comparison should include a detailed analysis of how a given substitute will interact with other elements of the process. Effective selection of a substitute should reduce occupational risk at the workplace. Replacement in itself does not necessarily reduce the probability of a threat occurring, but it cannot generate new threats.

Elimination and replacement are easiest to introduce at the stage of designing and implementing the work process at positions because they are the most difficult activities to introduce into an already operating process.

Engineering Controls – engineering controls can reduce the risk of employee contact with a hazard resulting from the work process or prevent the employee from contact with this risk. Inspections aimed at verifying the actual state of affairs may cover all work areas where there is even minimal exposure of the employee to health damage or exposure to harmful and dangerous factors.

The most effective engineering controls are those where:

a) we operate based on the instructions of the manufacturers of individual machines and devices located directly at the workplaces but also outside them,

b) we eliminate the source of the threat before it causes consequences that are difficult to predict and interacts with the user,

c) interact seamlessly with other security systems,

d) do not impede the operation and functioning of machines and devices,

e) do not interfere with the work process,

f) require little user intervention (automation),

g) prevent unauthorized employees from interfering with the operation of machines and devices,

h) automatically notify about damage or possible malfunction,
Frequent technical inspections may generate correspondingly higher costs than organizational measures or personal protective equipment, but in the long run the inspection costs are usually lower than the total cost of sickness absence. Moreover, technical inspections can also bring significant savings due to the lack of material losses, interruptions in the operation of machines and devices, negative impact on other processes in the enterprise, and disruption of the functioning of company facilities.
Administrative controls – aims to systematize work with specific provisions, documents and internal regulations.
Administrative regulations that have a significant impact on reducing or eliminating threats in the work process include: appropriately selected scope of training in the field of occupational health and safety; employee turnover; ensuring appropriate length of breaks for meals and rest; adjusting the work speed to the employees' predispositions; determining the methods of marking the working areas of machines and devices, as well as communication routes.
The primary goal of administrative controls is to ensure an appropriate level of organizational culture and security, which can only exist when(Ejdys, 2010):
a) the management staff is fully aware of the work processes,
b) the orders issued are clear and realistically specify the actions necessary to execute them,
c) the safety culture goes beyond the framework rigidly defined by regulations,
d) gender and cultural differences and individual predispositions were taken into account in the planning,
e) the risk is managed and fully controlled.
When assessing risk and analyzing threats arising from work processes, attention should also be paid to the employee's performance and psychomotor abilities; it is not limited to mechanical and routine filling of forms. To manage risk, you should pay attention not only to the elements that make up work processes, but above all to the human factor, which is one of the most unreliable elements of processes.
Personal protective equipment – used to minimize exposure to hazards resulting from the work process that cannot be eliminated by technical and administrative means. The need to use individual personal protective equipment should be selected for individual workstations and indicated by an appropriate pictogram placed at a given position.

4. OCCUPATIONAL RISK ASSESSMENT

Occupational risk is the possibility of loss of health or life while performing duties at the workplace. According to the Ministry of Labor, occupational risk is: "the probability of occurrence of undesirable events (hazards) related to work performed, causing losses and their effects on the health or life of employees in the form of occupational diseases and accidents at work" (Ministry of Labor and Social Policy, 1997). It occurs as a result of unforeseen and, above all, undesirable events that may arise during the work process. Occupational risk is defined in legal regulations and as such should be assessed and documented, and employees should be notified of its results.
Occupational risk assessment should then be understood as a detailed verification and assessment of what may negatively affect the employee's health or life at the workplace and determining the permissible risk. Thanks to such an assessment, the entrepreneur

has the opportunity to verify whether the applied security measures are sufficient and eliminate the risk or reduce it to an acceptable degree.
The ability to identify threats resulting from work processes at employee positions allows for their effective neutralization. A well-conducted occupational risk assessment is the basis for preventive health protection of employees. The risk assessment can be performed by the employer, an expert from outside the enterprise or, if applicable, a representative of the occupational health and safety service in the enterprise, but the responsibility for the correctness of the occupational risk assessment always rests with the employer (Elsharkawy, 2024).
Employees performing their duties at given job positions should also be involved in the process of developing an occupational risk assessment - because who knows the processes and threats best than they do?
The course of occupational risk assessment can be described as follows:
a) collecting the necessary information,
b) identifying threats,
c) risk assessment in accordance with the identified hazards (in case of unacceptable risk, work should be stopped until it is changed to acceptable or eliminated)
d) determining appropriate remedial measures to eliminate or reduce the risk,
e) risk assessment after implementing countermeasures,
When collecting information necessary to perform an occupational risk assessment, information should be obtained, among others: about:
a) location of the workplace,
b) tasks and technological operations performed at the position,
c) individual predispositions of employees,
d) materials and agents used in the process,
e) the type and method of activities performed by the employee,
f) threats identified so far,
g) possible effects of identified threats,
h) personal protective equipment used so far,
i) results of tests and measurements at the workplace, such as dust, harmful factors, noise, etc.
j) Requirements of legal regulations and standards regarding work at a given position as well as machines, devices and materials and means used,
k) Accidents and occupational diseases occurring in a given position in the past,
The employer is obliged to notify employees about the occupational risk occurring in their position. For evidentiary purposes, the employee's reading of the risk assessment should be recorded in writing.

5. CONCLUSION

Occupational risk management in occupational health and safety is an important set of principles and interrelated components of overall enterprise management. It ensures the achievement of organizational goals in terms of improving occupational health and safety conditions at and outside workplaces. Risk management should set standards of action aimed at facilitating the maintenance of the appropriate level of occupational health and safety in the enterprise. These standards should set directions for practical action in terms of meeting legal regulations and creating proper working conditions. Risk management must be carried out in a transparent, credible and, above all, systematic manner. Due to

constantly changing technologies, materials and individual employee predispositions, a systematic risk assessment can protect employees against new, not fully identified threats. The emergence of new risks at workplaces forces employers to look for more advanced technological solutions that guarantee improvement of working conditions. Individual stages of occupational risk management should be carried out in accordance with the hierarchy of occupational risk control. This type of management gives us the ability to respond to threats in real time and personalize the assessment of occupational risk by taking into account the individual predispositions of a given employee. The presented risk management concept considers multi-level possibilities of actions taking into account an extensive hierarchy of measures designed to reduce or eliminate risk.

REFERENCES

Chojnicki J., Jarosiewicz G., *ABC BHP – Informator dla pracodawców,* Państwowa Inspekcja Pracy, Główny Inspektorat Pracy, Warszawa, 40-71.

Deja, A., Ulewicz, R., Kyrychenko, Y., 2021*. Analysis and assessment of environmental threats in maritime transport*. Transportation Research Procedia, 55, 1073-1080. DOI: 10.1016/j.trpro.2021.07.078

Ejdys J., 2010. *Kształtowanie kultury bezpieczeństwa i higieny pracy w organizacji*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok, 119-157.

Elsharkawy, M.F., 2024. Workplace hazards and safety practices in the small-scale industries, Production Engineering Archives, 30(2), 241–250, DOI: 10.30657/pea.2024.30.23

Klimecka-Tatar, D., Ulewicz, R., Ingaldi, M., 2023. *Minimizing occupational risk by automation of the special processes - based on occupational risk assessment*, Procedia Computer Science, 217, 1145–1152, DOI: 10.1016/j.procs.2022.12.313

Knop, K., Olejarz, E., Ulewicz, R., 2019. *Evaluating and Improving the Effectiveness of Visual Inspection of Products from the Automotive Industry*. Lecture Notes in Mechanical Engineering, 1, 231-243. DOI: 10.1007/978-3-030-17269-5_17

Kozlowski, C.A., Ulewicz, M., Walkowiak, W., Girek, T., Jablonska, J., 2002. *The effect of tautomeric rearrangement on the separation of Zn(II) and Cd(II) in ion flotation process with 4-thiazolidinone derivatives*. Minerals Engineering, 15, 677-682. DOI: 10.1016/S0892-6875(02)00166-8

Kuzior, A., Babenko, V., Rekunenko, I., Pohodenko, B., 2023a. *Management Systems in Production Engineering*, 31(3), 322–331. DOI: 10.2478/mspe-2023-0036

Kuzior, A., Yarovenko, H., Brożek, P., Sidelnyk, N., Boyko, A., Vasilyeva, T., 2023b. *Company Cybersecurity System: Assessment*, Risks and Expectations. Production Engineering Archives, 29(4), 379–392. DOI: 10.30657/pea.2023.29.43

Kuzior, A., Brożek, P., Kuzmenko, O., Yarovenko, H., Vasilyeva, T., 2022a*. Countering Cybercrime Risks in Financial Institutions: Forecasting Information Trends*. Journal of Risk and Financial Management, 2022, 15(12), 613. DOI: 10.3390/jrfm15120613

Kuzior, A., Kettler, K., Rąb, Ł., 2022b. *Great Resignation—Ethical, Cultural, Relational, and Personal Dimensions of Generation Y and Z Employees' Engagement*. Sustainability 14 (11), 6764 The Current State of Scientific Research of the Process of Risk Management of Ukrainian Energy Sector Enterprises

Kuzior, A., 2014. *Aksjologia zrównoważonego rozwoju*, Belianum, Banska Bystrica.

Kuzior, A., 2022. *Technological Unemployment in the Perspective of Industry 4.0 Development*. Virtual Economics, 5(1), 7–23. DOI: 10.34021/VE.2022.05.01(1)

Kuzmenko, O., Šuleř, P., Lyeonov, S., Judrupa, I., Boiko, A., 2020. *Data mining and bifurcation analysis of the risk of money laundering with the involvement of financial institutions*. Journal of International Studies, 13(3), 332–339. DOI: 10.14254/2071-8330.2020/13-3/22

Kowalczyk C., 2010. *Jak ocenić ryzyko zawodowe?*, Państwowa Inspekcja Pracy, Główny Inspektorat Pracy, Warszawa, 3-11

Norma PN-N-18002:2011. *Systemy zarządzania bezpieczeństwem I higieną pracy*. Ogólne wytyczne do oceny ryzyka zawodowego.

Patek, M., Konar, R., Sladek, A., Radek, N., 2014. *Non-destructive testing of split sleeve welds by the ultrasonic TOFD method*. Manufacturing Technology, 14, 403-407. DOI: 10.21062/ujep/x.2014/a/1213-2489/MT/14/3/403

Pietraszek, J., Dwornicka, R., Szczotok, A., 2016. *The Bootstrap Approach to the Statistical Significance of Parameters in the Fixed Effects Model*. ECCOMAS Congress 2016, 3, 6061-6068. DOI: 10.7712/100016.2240.9206

Pietraszek, J., Skrzypczak-Pietraszek, E., 2015. *The uncertainty and robustness of the principal component analysis as a tool for the dimensionality reduction*. Solid State Phenomena, 235, 1-8. DOI: 10.4028/www.scientific.net/SSP.235.1

Pietraszek, J., Szczotok, A., Kołomycki, M., Radek, N., Kozień, E., 2017. *Non-parametric assessment of the uncertainty in the analysis of the airfoil blade traces*. METAL 2017 - 26th Int. Conf. on Metall. and Mater., 1412-1418.

Pilarczyk, M., Ulewicz, R., 2023. *Evaluating Occupational Hazards and Prevention Strategies in Agriculture: Case Study*. System Safety: Human - Technical Facility - Environment, 5(1), 212–223. DOI: 10.2478/czoto-2023-0023

Pocztowski A., 1998. *Zarządzanie zasobami ludzkimi. Zarys problematyki i metod*. Wydaw. Antykwa, Kraków, 261.

Radek, N., Konstanty, J., 2012. *Cermet ESD coatings modified by laser treatment*. Archives of Metallurgy and Materials, 57, 665-670. DOI: 10.2478/v10172-012-0071-y

Radek, N., Pietraszek, J., Antoszewski, B., 2014. *The average friction coefficient of laser textured surfaces of silicon carbide identified by RSM methodology*. Advanced Materials Research, 874, 29-34. DOI: 10.4028/www.scientific.net/AMR.874.29

Radek, N., Pietraszek, J., Goroshko, A., 2018. *The impact of laser welding parameters on the mechanical properties of the weld*. AIP Conf. Proc., 2017, art. 020025. DOI: 10.1063/1.5056288

Radek, N., Pietraszek, J., Szczotok, A., Fabian, P., Kalinowski, A., 2019. *Microstructure and tribological properties of DLC coatings*. Materials Research Proceedings, 17, 171-176. DOI: 10.21741/9781644901038-26

Radzymińska-Lenarcik, E., Ulewicz, M., 2019. *The application of polymer inclusion membranes based on CTA with 1-alkylimidazole for the separation of zinc(II) and manganese(II) ions from aqueous solutions*. Polymers, 11, art. 242. DOI: 10.3390/polym11020242

Rozporządzeniem Ministra Pracy i Polityki Socjalnej z dnia 26 września 1997 r. w sprawie ogólnych przepisów bezpieczeństwa i higieny pracy (Dz.U. z 2011 r. nr 173, poz. 1034; tekst jednolity: Dz.U. z 2003 r. nr 169, poz. 1650).

Saml T., Gaik K., 2017. *Zarządzanie bezpieczeństwem na stanowiskach pracy na przykładzie uczelni wyższej*, Zeszyty Naukowe Uniwersytetu Przyrodniczo – Humanistycznego w Siedlcach, No. 115, 297-304.

Skrzypczak-Pietraszek, E., Pietraszek, J., 2014. *Seasonal changes of flavonoid content in Melittis melissophyllum* L. (Lamiaceae). Chemistry and Biodiversity, 11, 562-570. DOI: 10.1002/cbdv.201300148

Ulewicz, R., Kleszcz, D., Ulewicz, M., 2021. I*mplementation of Lean Instruments in Ceramics Industries*. Management Systems in Production Engineering, 29, 203-207. DOI: 10.2478/mspe-2021-0025

Ulewicz, R., Ulewicz, M., 2020. *Problems in the Implementation of the Lean Concept in the Construction Industries*. Lecture Notes in Civil Engineering, 47, 495-500. DOI: 10.1007/978-3-030-27011-7_63

Ulewicz, M., Walkowiak, W., Brandt, K., Porwolik-Czomperlik, I., 2003. *Ion flotation of zinc(II) and cadmium(II) in the presence of side-armed diphosphaza-16-crown-6 ethers*. Separation Science and Technology, 38, 633-645. DOI: 10.1081/SS-120016655

Ulewicz, M., Zhelykh, V., Furdas, Y., Kozak, K., 2020. *Assessment of the Economic Feasibility of Using Alternative Energy Sources in Ukraine*. Lecture Notes in Civil Engineering, 100, 482-489. DOI: 10.1007/978-3-030-57340-9_59

Vasylyeva, T.A., Leonov, S.V., Bohma, S.D., 2014. *The impact of implicit bank consolidation on systemic risk in the banking system of Ukraine*. Actual Problems of Economics, 159(9), 384–389.

Yarovenko, H., Bilan, Y., Lyeonov, S., Mentel, G., 2021. *Methodology for assessing the risk associated with information and knowledge loss management*. Journal of Business Economics and Management, 22(2), 369–387. https://doi.org/10.3846/jbem.2021.13925

Ziarko J., 2016. *Organizacyjna wiedza o psychospołecznych zagrożeniach bezpieczeństwa pracy w zarządzaniu ryzykiem zawodowym*, Teoria i Praktyka 4/2016, 22-26.