MIDDLE POMERANIAN SCIENTIFIC SOCIETY OF THE ENVIRONMENT PROTECTION

Rocznik Ochrona Środowiska

Volume 22. Year 2020 ISSN 1506-218X 130-143

The Level of Risk and Decision-making in Managing Industrial Activity with the Elimination of Negative Environmental Impacts

Oľga Végsöová, Martin Straka[*]*, Kamil Kyšeľa*

Technical University of Kosice, Slovakia

[*]*corresponding author's e-mail: e-mail: martin.straka@tuke.sk*

1. Introduction

Surface extraction has a long tradition in the Central European region. Since time immemorial, the surface method of extracting raw materials has been one of the irreplaceable activities of our ancestors, and this method, considering modern technologies, has an important economic dimension as well as social and societal dimension. Ancic et al. (2017) point out how the extraction of minerals leaves indelible marks on the cultural and economic development of the mining region.

In recent years, high environmental demands have been placed on all methods of obtaining raw materials. In the case of surface extraction of raw materials, these requirements are particularly strict. Rotz et al. (2018) note the need to increase the efficiency of already approved quarries in relation to the increasing requirements for the authorization of new areas for extraction. At present, the environmental requirements for the operation of a quarry have been noticeably increasing. Ogrodnik et al. (2019) consider the main problem in extractive industries to be addressing the negative impact of extraction on the environment. For this reason, quarry operators are forced to renew material and technical equipment used for the extraction and subsequent transport of raw materials. Patyk et al. (2019) state that a rational choice of components used in extraction must meet economic, environmental and safety requirements. Regular modernization of quarry facilities contributes to increasing ecological standards protecting the environment and also the people working in the quarry or living in its immediate vicinity. Rodovalho et al. (2020) take the view that, in connection with the extraction of minerals, the handing of waste generated during the extraction process and its subsequent disposal should not be neglected either. It is undeniable that

irresponsible management of mining waste can have adverse consequences for nature and for the health of the population.

Kong et al. (2017) argue that it is necessary to find a balance between economic development and environmental protection. It is essential to try to minimize the environmental impact on the area in all activities related to the extraction of mineral resources. Randelovic et al. (2014) are of the view that in minimizing the environmental burden on the area extracted from, it is necessary to individually examine the soil characteristics and appropriately choose the form of environmental reclamation used. Urosovic etal. (2018) considers mining to be an important source of pollution in adjacent areas. Babi et al. (2016) are of the opinion that the role of the extractive industries in sustainable development is to balance economic, environmental and social burdens with the benefits of extraction.

Since the end of the 19th century, increasing efforts by companies have been observed to protect employees at work. National legislation seeks to minimize adverse events in the work process. With economic development, new challenges arise in the field of safety at work. According to Kahraman, et al. (2019) globalization brings many threats to working life. These threats are generally linked to the level of economic development of countries. In the European Union, the working conditions of employees are extremely strict concerning safety. Zielinska et al. (2019) consider health and safety in the work environment to be basic prerequisites for the quality of work. Unfortunately, despite high standards of protection for employees at work, undesirable situations still commonly occur which endanger or harm the lives or health of employees. Santos et al. (2020) claim that, despite improving working conditions in the world, each ye hundreds of thousands of people die from occupational injuries and around 2 million people die from occupational illnesses, which offers considerable room for improvement. In the event of harm to health caused to an employee during the performance of work tasks, or in direct connection with them, regardless of their will by a short-acting, sudden and violent action of external influences, we call such an event an accident at work. Pereira et al. (2020) considers accidents at work to be a complex phenomenon and one of the main public health problems.

The existence of an injury at work has a negative economic and social impact on the employee as well as the employer. The employee is excluded from the normal work routine due to the harm to their health and a significant impact on their social ties is also possible. Jonczy et al. (2019) highlight the interesting fact that workers in the extraction sector are exposed to levels of danger that are difficult to reduce or easily eliminate, and so have a low occupational safety culture in comparison with professions where the level of danger is lower or easy to eliminate.

After an accident at work, the employer loses the employee's labour for a certain period of time, which is associated with economic losses for the company and at the same time the employer's attractiveness in the eyes of potential new employees decreases. Singh et al. (2020) and Tilabi et al. (2019) argue that workplace safety management is an urgent requirement for organizations and companies, especially in a highly competitive world, where the success of companies depends on the overall productivity of organizations. Despite the clear motivation of both sides of the working relationship, surface extraction of minerals is unfortunately an activity that is associated with the relatively frequent occurrence of accidents at work. The role of the employer is to create a working environment that will minimize the possibility of accidents at work. Lopez-Garcia et al. (2019) consider the organization of working conditions to be an important task.

Wiganowska et al. (2018) and Trebuna et al. (2019) are of the opinion that the creation of a suitable working environment affects the health and safety of workers at work. Amponsah-Tawiah, et al. (2017) state that the employer's management should invest its resources in protecting the life and health of its employees. Zinoviev et al. (2014) argue that the insufficient allocation of the employer’s financial resources for protection and health at work results in the threat to the life and health of employees multiplying.

There is no doubt that the right choice of extraction method has an exceptional impact on the incidence of accidents at work. Ozturk et al. (2019) argues that mining accidents are one of the critical safety issues worldwide.

Kazanin et al. (2016) and Ižaríková (2019) highlight the need to obtain and evaluate information on the stress-strain state of the rock mass with reference to the importance of this information in terms of safety.

Work in a quarry is based on the deposit exploitation plan. In this plan, it is necessary to assess the dangers and threats which cannot be removed and to propose and suggest measures to eliminate these dangers and threats. The assessment of workplace safety is currently an integral part of the preparatory work before the start of extraction. Szeszenia-Dabrowska et al. (2013) are of the opinion that careful monitoring of working conditions and implementation of preventive health programs should be carried out in areas and divisions of the national economy where a high risk of occupational diseases has been identified.

Measurable and non-measurable factors must be taken into account when assessing the degree of risk. With regard to eliminating or minimizing the degree of risk, it is more difficult to remove non-measurable factors, which largely lie in the human factor in the actual performance of work. Chen et al. (2019) are of the opinion that physiological fatigue, mental fatigue or mental illness are frequent determinants of dangerous situations in the workplace. According to Dieterich et al. (2020) it is necessary to know the exact circumstances of each accident in order to identify the risks that must be minimized for prevention. This view is

also held by Lombardi et al. (2019), according to whom the analysis of accidents, as well as their main causes and determinants, can definitely contribute to the development of more effective preventive interventions.

The aim of the presented paper is to offer a comprehensive and systematic procedure for risk assessment, as well as to apply it in selected activities at the Kecerovský Lipovec quarry. This procedure can assist in the decision-making activities of quarry management, especially with regard to the environmental and safety requirements of the operation.

2. Methodology for the approach for determining risk values for a quarry operation

Measures to ensure safety and health at work are an important part of every quarry operation, and are generally based on the basic safety regulations in force in the Slovak Republic.

In order to carry out an analysis of the examined state of extraction operations, it is necessary to understand basic concepts such as danger, threat and risk. We can imagine danger as an essential property of a material, machine, work activity, etc., which can cause harm to health or damage to machinery. Technology and working activities are characterized by the ability to create an unexpected negative consequence of harm to a person or property. A threat can be defined as an active property of an object, machinery, technology and work activities that can cause a negative phenomenon, or the possibility of activating a threat in a specific space and time. We understand risk as expressing the probability of the occurrence of a negative phenomenon and the consequence of this phenomenon. The risk (R) is thus a function of the probability (P) and consequence (D) of the negative event.

Mathematical expression of a non-linear function of risk:

$$R = f\,(P \times D) \tag{1}$$

Due to the efforts to take into account the risk of other factors when quantifying risk, a broader description of risk is applied:

$$R = P \times D \times E_x \times O \tag{2}$$

where:
E_x – exposure, exposure to threats,
O – application of protective measures.

This means that the value of risk as a function of probability and consequence is multiplied by a coefficient expressing human exposure in the danger area and a coefficient expressing the impact of protective measures. However, the

risk is affected by many more factors than those given in the last definition (E_x, O). These factors can be divided into measurable and non-measurable (see Table 1). The factors listed in Table 1 affecting probability must be taken into account when determining probability and consequence. These factors are therefore the parameters of probability and consequence. It follows from these considerations that it is important for normal work practice, especially in small and medium-sized enterprises, to be able to identify all the relevant factors that affect risk and to be able to assess their impact on the final effect. Therefore, it is appropriate to use methods that give instructions on how to assess the effect of multiple risk factors.

Table 1. Factors influencing the probability of an accident

Factors influencing the probability of an accident	
Measurable	Non-measurable
duration of danger, time of exposure	human factor, attention, classification, stress, etc.
system parameters (machine speed, etc.)	level of maintenance activities
suddenness of event	quality of inspection and testing activities
	reliability and compliance with security measures
	diversity of threat existence

There is an increasing emphasis on safety in quarry operations, so risk assessment is an integral part of any such operation.

In practice, there are cases where a dangerous situation is not addressed by a risk prevention measure. In this case, it is up to the experts and the quarry owners to estimate the degree of risk.

An obvious legal obligation of the employer is to provide a workplace, machinery, working conditions and work aids that do not endanger safety and health at work, which must be an integral and equal part of the performance of work and production tasks.

The analysis is followed by a risk assessment. It is based on an assessment - an estimate of the probability of an accident and an assessment - an estimate of the consequences of this accident or adverse event. Factors influencing the probability of an accident are described in Table 1.

It is also worth noting that when estimating the probability of an accident, we start from different levels of input data, which are defined in more detail in Fig. 1.

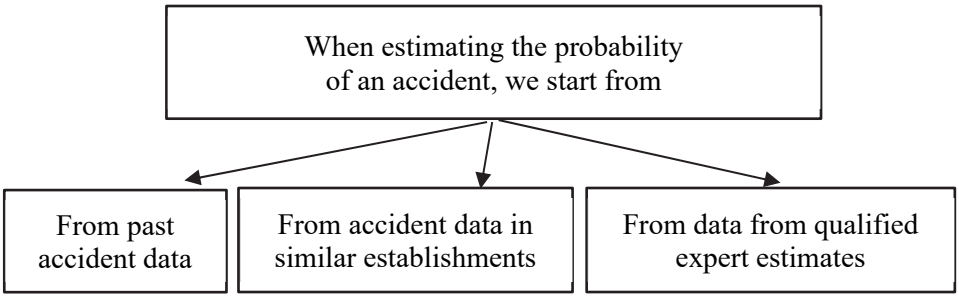

Fig. 1. Relationship of data with the probability of an accident. Source: own elaboration

Determining the influence of the severity of individual factors on the frequency of a particular negative phenomenon is shown in Table 2, where the main aspects are seen as probability, the frequency of occurrence and the duration of the effect of the threat.

Table 2. Determining the influence of the severity of individual factors on the frequency of a particular negative phenomenon

Probability	Class	Frequency of phenomenon	Temporal effect of the threat
Very high	A	Very often	Nonstop
High	B	Several times	Temporary threat
Moderate	C	Sometimes	Rare
Low	D	Rarely	Very rare
Very low	E	Almost none	Almost impossible

The consequences of the negative manifestation of the phenomenon are shown in Table 3. It should be borne in mind that different risk factors may take different levels. It follows from Table 3, that with the decreasing severity of individual factors, the consequences of negative phenomena in the quarry also decrease.

Table 3. Determining the influence of the severity of individual factors on the consequence of a negative phenomenon

Consequence type	Category	Description of the consequence
Catastrophic	I.	death due to an accident at work or complete destruction of the system, irreparable damage
Critical	II.	serious accident at work, occupational disease or extensive damage to the system, loss of production, large financial losses.
Little significant	III.	registered occupational injury, suspected occupational disease or minor damage to the system, minor financial loss
Negligible	IV.	registered occupational injury, negligible system failure, no financial loss

After determining the effect of probability and the consequence of an adverse event, we use Table 4. The highest risk is value 1 and the lowest is value 20.

Table 4. Determining the influence of the severity of individual factors on the consequence of a negative phenomenon

Result Probability	Catastrophic I.	Critical II.	Low significance III.	Negligible IV.
A – very high	1	3	7	13
B – High	2	5	9	16
C – Medium	4	6	11	18
D – Low	8	10	14	19
E – very low	12	15	17	20

Numerical values for risk resulting from Table 5 must then be divided into four groups as shown in Table 5.

Table 5. We classify numerical risk values into groups

Point range	Risk scale	Safety criteria
1-5	unacceptable	the system is unacceptable – immediate application of protective measures, immediate shutdown of the system
6-9	adverse	the system is dangerous – application of protective measures
10-17	moderate	the system is safe, conditional on training of operators, inspections, instructions, etc.
18-20	acceptable	the system is safe

For the first two levels, the system cannot be considered safe. Appropriate measures must be taken to remedy the problem. The third level, moderate, enables the assessment of the system to be completed however with certain conditions, e.g. employees must be trained. The fourth level is acceptable and therefore the situation in the workplace can be considered to be safe.

3. Application of methodology – Case Study in the Andesite Quarry in Eastern Slovakia

The andesite quarry we analysed is located in the eastern part of Slovakia, near the town of Košice at the western foot of the hills known as the Slanské vrchy. This quarry is one of the most important deposits in Slovakia. It is used for quarry stone and crushed stone. The extracted raw material is mostly used for the construction of roads. Dark-grey andesites with feldspar outgrowths appear in the wall of the quarry. The properties of the mined raw material are given in Table 6.

Table 6. Properties of the raw material mined in the quarry

Property	Dimension	Value
absorbability	%	1.2
porosity	%	1.8
abrasion	%	21.4
weight loss after ventilation	%	0.1
weight loss after freezing	%	0.2

During the exploration of the deposit, the extraction is guided by surface extraction by a wall quarry through an external notch in 3 levels of the quarry, in a combined manner of face fronts. The method of rock separation is subordinated to the main production in the quarry, namely gross stone production. The management of extraction works is determined by the current state of digging in the quarry. Methods of mechanical rock separation are used in extraction.

Based on the method mentioned in the previous chapter, a risk assessment was performed for the core work activities in the extraction operation at the Kecerovský Lipovec quarry, which are level preparation and extraction. In both cases, the points-based method was used to assess the risk.

During the process of preparatory work or when opening a new level, it is necessary to take into account the threats that most often occur during the process in question. These threats include, in particular, injuries to the upper and lower limbs, fall of the extraction machinery, damage to the extraction machinery, etc. Table 7 shows the assessment of the probability, consequence and the result of the threat.

Table 7. Risk assessment for preparatory work, overburden work to open a new level

Threat identification	Probability	Result	Result
Injuries to the leg and other parts of the body when descending and exiting the extraction machinery	D	III.	14
Fall from the machinery during maintenance work and cleaning work	C	III.	11
Injury caused by extraction machinery (crash, push, pass)	D	II.	10
Fall of the extraction machinery to depth, overturning of the extraction machinery	D	II.	10
Damage to the extraction machinery by other extraction machinery – an accident	D	III.	14
Fall while working with hand tools	D	III.	14
Injury to employees caused by a fall or landslide	D	III.	14

Table 7 therefore leads to a risk assessment during the preparatory work, or overburden work. According to the established procedure, the level of risk was calculated, where the sum of points for the overburden is 83, the number of the parameters for the overburden is 7, the arithmetic mean is therefore 12. From the

given data it is clear under Table 6, that the assessed extraction work activity is moderate on the risk scale – moderate. In this case, however, the importance of the measures must not be forgotten, especially in the form of quality expert training, inspections, instructions, etc.

Table 8 represents the results according to the set methodology, based on which number of points for overburden is 131, the number of parameters for overburden is 10, the arithmetic mean is 13. From this data it is clear that overburden belongs in the moderate risk group. The Kecerovský Lipovec quarry can be considered a safe workplace, but we must always keep the relevant safety criteria for individual work activities in mind.

Table 8. Risk assessment for preparatory work and overburden work to open a new level

Identification of threat	Probability	Result	Result
Injuries to the leg and other parts of the body when descending and exiting the extraction machinery	D	III.	14
Fall from the machinery during cleaning and maintenance	D	III.	14
Collision injury, pressed by machinery	D	II.	10
Overturning of the machinery	D	III.	14
Damage to the machinery by other extraction machinery – accident	D	III.	14
Employees falling during the performance of work	D	III.	14
Injury to employees caused by a fall or landslide	D	III.	14
Injury carrying load	D	III.	14
Injury to the leg or other parts of the body while descending from and exiting the machinery	D	III.	14
Fall from the machinery during maintenance and cleaning work	C	III.	11
Injury caused by the extraction machinery-impact, pressing, running over	D	II.	10
The fall of the extraction machinery in depth, the overturning of the extraction machinery	D	II.	10
Damage to the machinery by other extraction machinery – an accident	D	III.	14
Employee falling in the performance of work	D	III.	14
Injury to employees caused by a fall or landslide	D	III.	14

Given the cases of both risks, which are at an acceptable level according to the methodology used, it is necessary to inform employees about the measures taken and the residual risks. It is important to know whether the safety measures at the workplace are sufficient and it is necessary to monitor whether there are ongoing threats, especially when introducing new machines, using new substances, etc. In the event that a new risk arises, every effort must be made for its mitigation. Each official information provided for employees must be properly documented so that there is no doubt that employees are not aware of the possible risks. This makes it possible to minimize any legal claims in the event of accidents or incidents.

4. Conclusion

We analysed an andesite quarry in Eastern Slovakia, which is one of Slovakia's most important andesite deposits and it is able to ensure the supply of the entire immediate vicinity with sufficient excavated rock. In terms of economic supply, mineral extraction is a promising opportunity for the development of the whole region. As early as the quarry's design phase, high requirements were placed on a low ecological footprint of the structure, but the main goal of the design activity was to define extraction processes so that the work activities of employees in the quarry would fulfil high safety criteria. However, despite the perfect and detailed design, it cannot be expected that nothing undesirable will occur during extraction as a result of subjective and objective influences. With this in mind, the task of this paper was to evaluate the degree of risk of individual activities associated with the operation of the quarry and on the basis of that data to adapt the extraction of andesite in the Kecerovský Lipovec quarry to high environmental and safety requirements.

It is undeniable that the degree of risk in quarry operation depends on the specific phase of quarry use. For this reason, it is desirable to consistently distinguish between risk in preparatory work – overburden work and risk in work performed as part of extraction. The basic monitored criteria for assessing the degree of risk was the result of the threat, which resulted from the identification of the threat, probability and consequence. The identification of the threat included a variety of adverse events that may adversely affect the physical safety of workers and the operability of the extraction facilities. As for the probability of the occurrence of an adverse circumstance, it is based on the frequency of the threat and the length of its duration. The consequences of the adverse event can range from negligible to catastrophic. From the analysis and evaluation, it is clear that the level of risk in both monitored phases of extraction activity in the quarry is in the moderate risk group.

The main benefit of the paper is a comprehensive and systematic view of the risk assessment of individual activities in the Kecerovský Lipovec quarry. The paper offers a description of threats, with the main emphasis on the resulting level of risk based on the determination of the probability and the consequence of the event. It is clear from the research that the extraction activity in the Kecerovský Lipovec quarry is at a minimum level with regard to the burden on the environment and workers and does not represent such a threat to its surroundings that could be assessed as undesirable. The facts presented in the research part can serve as an important basis for decision-making activities associated with the operation of the quarry so that solutions are selected are those that minimize the potential negative effects on the environment. However, it is necessary to ask the question whether the extraction activity in the Kecerovský Lipovec quarry, in addition to the environmental and safety point of view, also meets the economic requirements for the rational use of the environment and resources. It is also necessary to take into account the lack of staff for individual extraction jobs in the region resulting from the significant outflow of this type of labour out of the region.

The submitted paper is a part of the projects "Projects of applied research as a means for development of new models of education in the study program of industrial logistics" KEGA 016TUKE-4/2020 and the project "Research and development of new smart solutions based on the principles of Industry 4.0, logistics, 3D modelling and simulation for streamlining production in the mining and building industry" VEGA 1/0317/19.

References

Ancic, M.P., Gasparovic, S. (2017). Quarries on the island Veliki Brijun the beginnings of their rehabilitation and adaptive reuse in Croatia. *Prostor, 25*(1), 75-85.

Amponsah-Tawiah, K., Mensah, J. (2016). Occupational health and safety and organizational commitment: Evidence from the Ghanaian Mining industry. *Saffety and Health at Work, 7*(3), 225-230.

Babi, K., Asselin, H., Benzaazoua, M. (2016). Stakeholders' perceptions of sustainable mining in Marocco: A case study of the abandoned Kettara mine. The *Extractive Industrries and Society, 3*(1), 185-192.

Dieterich, C., Herrmann, C., Parzeller, M. (2020). Death at work-An analysis of fatal work accidents based on autopsies performed at the institute of legal medicine in Frankfurt am Main from 2005 to 2016. *Rechtsmedizin, 30*(3), 144-152.

Chen, Z.B., Oiao, G.Z., Zeng, J.C. (2019). Study on the relationship between worker states and unsafe behaviours in coal mine assidents basted on a Bayesian networks model. *Sustainability, 11*(18), Article Number: 5021.

Ižaríková, G. (2019). Supplier planning with analytical hierarchy process. *Acta Tecnología*, *5*(4), 103-107.

Kaharaman, E., Akay, O., Kilic, A.M. (2019). Investigation into the relationship betwen fatal work accidents, national income, and employment rate in developed and developing countries. *Journal of Occupational Health*, *61*(3), 213-218.

Kazanin, O.I., Rudakov, M.L. (2016). Banchmarking initiatives in the Fied of occupational safety and health in the context of development of the coal industry of Rusia. *Research Journal of Pharmaceutical Biological and Chemical Sciences*, *7*(2), 2092-2099.

Kong, R., Xue, F.F., Wang, J., Zhai, H.Y. (2019). Research on mineral resources and environment of salt lakes in Qinghai province based on system dynamics theory. *Resources Policy, 52,* 19-28.

Lombardi, M., Fargnoli, M., Parise, G. (2019). Risk profiling from the European statistics on accidents at work (ESAW) accidents' databases: A case study in construction sites. *International Journal of Environmental Research and Public Health, 16*(23), Article Number 4748.

Lopez-Garcia, J.R., Garcia-Herrero, S., Gutierrez, J.M., Mariscal, M.A. (2019). Psychosocial and ergonoimc conditions at work: Influence on the probability of a workplace accident. *Biomed Research International, 8*, 473-481.

Morcinek-Slota, A. (2019). Impact of occupational safety culture on the occurrence of accidents in a selected coal mine. *Mining of Sustainable Development, 216*, Article Number: 012035.

Ogrodnik, R. (2019). Investment outlays on environmental protection in Polish coal mining. *Energy and Fuels, 10*8, Article Number: UNSP: 01008.

Ozturk, I., Mevsim, R., Kinik, A. (2019). *Ermenek mine accident in Turkey: The root Causes of a disaster*. Proceedings of the 20th congress of the international ergonomics association (IEA 2018). In book: Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018).

Patyk, M., Bodziony, P., Kasztelewicz, Z. (2019). Analysis of quarrying equipment operating cost structure. *Inzynieria Mineralna-Journal of the Polish Mineral Engineering Society*, *2*, 311-318.

Pereira, K.T., Silva, A.C.R.D., Silva, L.F. (2020). Prevalence study on self-declared work accidents in areas covered by family health strategies: a coross- soctional study. *Sao Paulo Medical Journal*, *138*(1), 79-85.

Randelovic, D., Cvetkovic, V., Mihailovic, N., Jovanovic, S. (2014). Relation between edaphic factors and vegetation development on Copper mine wastes: A case study from Bor (Serbia, SE Europe). *Environmental Management*, *53*(4), 800-812.

Rodovalho, E., Quaglio, O., Felsch, W.S., Pascual, R., de Tomi, G., Tenorio, J.A.S. (2020). Reducing GHG emissions through efficient tire consumption in open pit mines. *Journal of Cleaner Production*, *255*, Article Number:120185.

Rotz, M., Trynoski, R. (2018). 3D Geologic Modelling and mine planning to improve quarry and plant efficiency at cement operations. *2018 IEEE-IAS/PCA Cement Industry Conference (ISA/PCA)*.

Santos, A.J.R., Santos, S.P., Amado, C.A.F., Rebelo, E.L., Mendes, J.C. (2020). Labor inspectorates' efficiency and effectiveness assessment as a learning path to improve work-related accident prevention. *Annals of Operations Research, 288*(2), 609-651.

Singh, A., Misra, S.C., (2020). A dominance based rough set analysis for investigation employee perception of safety at workplace and safety compliance. *Safety Science, 127*, Article Number: UNSP 104702.

Szeszenia-Dobrowska, N., Wilczynska, U. (2013). Occupational diseases among workers employed in various branches of the national economy. *Medycyna Pracy, 64*(2), 161-174.

Tilabi, S., Tasmin, R., Takala, J., Palaniappan, R., Abd Hamid, N. A., Ngadiman, Y. (2019). Technology development process and managing uncertainties with sustainable competitive advantage approach. *Acta logistica*, *6*(4), 131-140.

Trebuna, P., Pekarcikova, M., Edl, M. (2019). Digital value stream mapping using the tecnomatix plant simulation software. *International Journal of Simulation Modelling*, *18*(1), 19-32.

Urosevic, S., Vukovic, M., Pejcic, B., Strbac, N. (2018). Mining-metallurgical sources of pollution in eastern Serbia and environmental consciousness. *Revista Internacional de Contaminacion Ambiental, 34*(1), 103-115.

Wyganowska, M., Tobor-Osadnik, K. (2018). Working environment and observance of occupational health and safety regulations – case study. *4th Polish mining congress-session: Human and Environment Facing the Challenges of Mining, 174*, Article Number: 012016.

Zielinska, A., Bajdur, W. (2019). Accident rates in Poland's foodstuff industry from the perspective of occupational safety management in the European Union. *Global Journal of Environmental Science and Management-GJES,* 5, 72-77.

Zinoviev, V.P., Kuznetsov, M.S. (2014). Labour conditions, traumatism, professional diseases of Siberian miners in the late 19th early 20th centuries. *Tomsk State University Journal, 379*, 127-135.

Abstract

This paper focuses on the assessment of the degree of risk in all phases of extraction activities in a selected quarry in the Slovak Republic. The research part of the paper assesses the degree of risk resulting from the assessment of the threat, the probability of the threat and the consequence of an adverse event in extraction activities. The paper offers an important basis for decision-making in quarry management in order to eliminate the negative consequences of andesite mining on the environment, equipment and people. The extraction activity in analysed quarry is assessed by this paper as low risk for two phases of extraction, specifically the preparation phase, and the extraction itself. The paper also highlights the importance of taking measures. Regarding the safety criteria in the analysed quarry, it is possible, based on the results of the analysis and evaluation, to consider the quarry to be safe. However, a condition for this is the necessary expert training of workers in all activities performed while working in the quarry. Here, the need for personnel to strictly adhere to the set standards for extraction activities is of prime importance. This finding confirms the above that the aim of diagnosing and naming the potential for adverse events in the extraction process must be to minimize risks, as their absolute exclusion is not possible due to the human factor and unforeseeable circumstances.

Keywords:
risk, danger, threat, risk analysis, risk assessment