Original scientific article
http://dx.doi.org/10.59456/afts.2024.1630.033V

ANALYSIS OF OCCUPATIONAL INJURIES IN AN IRON ORE MINE IN BOSNIA AND HERZEGOVINA IN THE PERIOD FROM 2002 TO 2021

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ABSTRACT

By designing protection measures, the occupational safety system should provide the best possible working conditions for all employees in every economic activity, including in mining production. The analysis of occupational injuries in a certain period of time should enable the collection of data on certain etiological specificities of injuries and in this way ensure the selection of adequate preventive measures of occupational safety. Monitoring the indicators of occupational injuries within the analysis, which is presented in this paper, provides information about the change in the state of working conditions and enables the determination of the general tendency of its decreasing or increasing change.

One-factor ANOVA analysis was applied to determine the variability of the results within the established groups of selected etiological factors and to determine the impact on the observed occurrence of the number of occupational injuries in the mining company. The application of Pareto analysis to determine the most dominant causes of occupational injuries is of crucial importance for determining the direction of action of preventive actions and corrective measures in the occupational safety system.

Keywords**:** *occupational safety, occupational injury, etiological factors, Pareto analysis, occupational safety measures*

INTRODUCTION

According to the report World Mining Data for 2022, it is stated that the world mining production in 2020 amounted to 17.2 billion metric tons of ores, and the largest part of the production was carried out in Asia (59.8%), North America (15.4%), Oceania (7.3%) and Europe (6.8%) [1]. Mining is a high-risk industrial activity and the main risks that arise are: risks to the safety and health of employees, environmental risks, social risks, land use risks, legal and financial risks and technical risks [2]. The imperative that has no alternative is the efficiency of production in mining production systems with a satisfactory level of safety and protection at work for employees. The occupational safety system in every production system should provide employees with working conditions in accordance with safety norms. The management of the protection system depends to a large extent on effective planning and timely and effective design of occupational safety measures, and for this purpose, the analysis of occupational injuries in the previous period should serve as a guide for

changing safety strategies, developing new models of risk assessment, information base for the guidance and correction of protection measures, as well as the improvement of legal regulations. In any case, the effective functioning of the occupational health and safety system for the company also implies certain positive economic effects in the form of a reduction in production costs: fewer lost working days (working hours) due to occupational injuries, costs of repairing the consequences of occupational injuries (sickness of workers, employment and training of new workers, disability benefits, etc.), stoppages and delays in the production process, etc.

An occupational injury is a change in the working environment on a person's integrity (physical, psychological and social), as a consequence of the sudden and immediate occurrence of inconsistencies between the behavior of a person in the performance of work activities and the elements of the working environment [3]. Damage to health, reduction or loss of working ability, material costs due to compensation for sick leave, treatment, rehabilitation, disability, reduction of life activities, disturbances in the family, disruption of the work process, decline in productivity and quality of work caused by occupational injuries make the problem of occupational trauma very topical [4]. The first prerequisite in the analysis of injuries and the use of such data for the improvement of working conditions and improvement of occupational safety measures is their recording. It is crucial to keep a record of injuries, to analyze the conditions that caused the injuries, and to use the information gathered and the experience gained in order to prevent future injuries and loss of life [5]. Injury analysis involves the application of various statistical techniques to determine the etiology of injuries and the factors that lead to their occurrence. Statistical tools have been developed in the light of epidemiological principals to see whether there is any role of some personal and impersonal factors in the occurrence of coal miner's injuries [6].

The goal of the research presented in this paper was to determine which etiological factors had an impact on the frequency of injuries in the mine in order to design appropriate occupational safety measures aimed at a given category of workers. Also, determine the dominant causes of occupational injuries, in order to direct the effect of corrective measures to the observed causes in order to avoid similar injuries in the future.

LITERATURE REVIEW

Analysis of the state of occupational health and safety in the mines of the Republic of Srpska in the period 2005-2009. show that 1 out of 30 employed workers are injured annually, that is, for every 1 million tons of ore material produced, 13.3 workers are injured [7]. In Bosnia and Herzegovina, research dealing with this issue was conducted at "Arcelor Mittal" Zenica in the period 2005-2012, on a sample of 574 injuries. There were no fatal injuries during that period. Only men were injured, in the first shift (46.6%). The injured workers were between the ages of 50 and 54 (26.6%) and qualified workers - KV (67%). Injuries affected the extremities in 60% of cases. Injuries most often occurred on Tuesdays (26.6%) and Saturdays (20%) [8]. Based on the available data on fatal injuries in mines in Serbia, it is concluded that changes in the legal regulations on occupational safety and health can significantly reduce fatal injuries. Fatal injuries were most common in excavations, and less educated workers were more likely to die [9]. Numerous researches in Europe have shown that younger workers are more often injured in similar jobs and under approximately equal working conditions, while older workers' injuries are of a more severe nature [10].

In addition to research that included the analysis of etiological factors of injuries in mining, numerous authors dealt with determining the causes of injuries. Determining and analyzing the causes of injuries in any activity, including mining, is the basis for establishing an effective occupational safety system. Research on the frequency of injuries in surface coal mines in India singled out the most significant influencing factors: unsafe behavior of workers, years of work experience and age of workers [11]. Research in China that analyzed 320 accidents in coal mines showed that 74.3% of accidents were the result of unsafe conditions and rules: unsafe operator behavior, unsafe equipment, and unsafe working environment conditions [12]. In an analysis of injuries in mines in Spain from 2003 to 2012, it was determined that collisions with moving objects, physical exertion and radiation were the main causes

of injuries [13]. According to data from the Australian mining sector, 79% of injuries occur as a result of falls, trips and slips, body contact with moving or stationary objects and handling materials [14]. The most common causes of deaths in mines are motor vehicle and powered haulage accidents, falls from a height and machinery according to data for 2010 in Canada (Ontario state) [15]. According to an analysis of injuries in mines in Ghana, 85% of all injuries and 90% of deaths in mining are related to mining equipment, while less skilled workers were more often involved in fatal accidents [16]. In surface mines in Turkey (71 surface mines), miners under the age of 40 were at greater risk of injury than older ones, with the most common types of fatal injuries occurring during blasting operations, motor-driven transport, and falls [17]. According to research [18], for the period 1995 to 2004, in mines in the USA, hand tools without drive were the equipment category most often associated with non-fatal injuries, while off-road ore transport was the most common source of deaths, younger employees had an increased risk of injury, while workers over the age of 55 had an increased risk of death.

MATERIAL AND METHOD

The analysis of occupational injuries was carried out in the iron ore mine "Arcelor Mittal" Prijedor, in the Republic of Srpska - Bosnia and Herzegovina for the period 2002-2021. year, and are based on the database on occupational injuries. The injury database was created based on the recording of occupational injuries. All injuries are recorded: incidental minor injuries and injuries with lost time. Injuries are recorded using a special document (injury report), which contains all the etiological data about the occupational injury. The analysis in this study includes injuries with lost time i.e. injury with sick leave (’injury with time burden’ - open injury list). In the period from 2002 to 2021, an average of 747 workers were employed in the iron ore mine. In the iron ore mine, the ore is mined in an open pit, and the ore preparation technology is magnetic-gravitational separation. For transport and exploitation, standard mining machines are used (conveyor belts, loading machines, rotary excavators, dumpers, bulldozers, etc.). An occupational safety service is organized in the mine, a risk assessment has been carried out at all workplaces and all workers have prescribed (standard) protective equipment. The occupational safety system in the mine organizes occupational safety tasks by performing the following activities: hazard identification and risk assessment, monitoring and measuring the effect of occupational safety, inspection and control, creation and management of occupational safety documentation, communication with workers (education and training) [19].

Etiological analysis of occupational injuries includes analysis of: severity of injury (light, severe, fatal, collective), place of injury (at the workplace, at another workplace, on the road, etc.), time of injury (day, month, season , work shift, etc.), characteristics of the worker who suffered an injury (gender, age, work qualification, injured body part, etc.), the source and cause of the injury [20]. For a more complete overview of the state of health and safety at work, in the production and business system, in addition to the absolute indicators of the number of injuries, relative indicators are also used for the analysis of changes in the number of injuries from the aspect of the trend over time, most often, the injury frequency index and the injury severity index. Relative indicators of injuries are calculated in relation to the number of employees or the number of effective working hours, such as the index (coefficient) of the frequency of occupational injuries and the index (coefficient) of the severity of occupational injuries as a ratio of lost working days and the number of injuries, i.e. number of effective working hours. Index relative indicators were also used for the analysis, which show the percentage change in the state of occurrence (in this case, the number of injuries at work) in successive time periods: base (in relation to the selected base period) and chain (in the current period in relation to the previous one). Anova analysis is used to analyze variance (variability of results) with the aim of determining the character and strength of the influence of one or more factors on the observed object or process (in this case, the number of occupational injuries). In this paper, one-factor Anova analysis was used to process etiological data on injuries done in the Excel software package. The graphical Pareto method or ABC diagram is used to analyze phenomena in a way to rank sizes/phenomena or errors and their causes in descending order. The theoretical basis of the Pareto principle is based on the claim that most of the problems in a certain area (up to 80%) arise from the 20% most significant causes. This method is used with the aim of identifying dominant causes in order to undertake

corrective activities to eliminate them. The Solidworks software package was used to create a 3D model of the graphical interpretation of the analysis of injuries in the mine according to the etiological factor of the injured part of the worker's body.

RESULTS AND DISCUSSION

Monitoring of the number of injuries in the iron ore mine in the period from 2002 to 2021 is shown by the values of absolute and relative index indicators in Table 1. In the observed period, the structure of injuries according to severity that occurred in the mine is: 81% minor, 16% serious and 3% fatal injuries. The highest number of injuries was in 2006 (19 injuries), and there were no injuries in three years: 2008, 2013 and 2014. The largest number of minor injuries occurred in 2006 (17 injuries), and the largest number of serious ones in 2009 (5 injuries). In that period, three fatal injuries occurred in 2002, 2004 and 2006. The annual average of the total number of injuries at work is 5.30, minor injuries 4.3, serious injuries 0.85 and fatal injuries 0.15. Table 1 shows an overview of the number of employees in the mine. Based on the review of base indices (Table 1), for the selected base period of 2009, we see that the largest percentage change (increase) in the number of injuries occurred in 2006 (increase in the number of injuries compared to the selected base from 5 injuries to 19 injuries in year). Also from the review of the chain indices (Table 1), we see that the biggest percentage change (increase) in the number of injuries occurred between 2017 and 2018 (increase in the number of injuries from 1 to 7 injuries per year).

Table 1. Relative index indicators in an iron ore mine
in the Republic of Srpska (B&H) for the period 2002-2021.

Year	Number of occupational injuries, average number of employees and effective working hours*						Index	
	Number of injuries				Number of employees	Effective working hours	Base	Chains
	M	S	F	Total**				
2002	10	0	1	11	845	-	220.00	-
2003	4	0	0	4	424	-	80.00	36.36
2004	11	0	1	12	570	-	240.00	300.00
2005	13	2	0	15	639	-	300.00	125.00
2006	17	1	1	19	717	1313675	380.00	126.67
2007	9	1	0	10	723	1301101	200.00	52.63
2008	0	0	0	0	731	1320590	-	0.00
2009	0	5	0	5	696	1171361	100.00	-
2010	2	1	0	3	705	1302555	60.00	60.00
2011	1	4	0	5	824	1541360	100,00	-
2012	0	1	0	1	843	1565904	20.00	20.00
2013	0	0	0	0	854	1569103	-	0.00
2014	0	0	0	0	854	1568943	-	0.00
2015	1	0	0	1	848	1555526	20.00	-
2016	1	0	0	1	813	1368091	20.00	100.00
2017	1	0	0	1	803	1364028	20.00	100.00
2018	6	1	0	7	788	1364480	140.00	700.00
2019	4	1	0	5	767	1345911	100.00	71.43
2020	2	0	0	2	743	1228206	40.00	40.00
2021	4	0	0	4	746	1317719	80.00	200.00
Ukupno	86	17	3	106	14933	22198553		
Annual average	4.3	0.85	0.15	5.30	746.65	1109927.65		

∗Internal records of the mining company

∗∗Total number of injuries with lost time (Minor, Serious, Fatal) in the iron ore mine: injuries at the workplace + injuries from/to the place of work.

Figure 1 shows the trend of minor and serious injuries at work in the mine for the period 2002-2021. A decreasing trend of light and serious injuries is noticeable. The trend of minor injuries is decreasing at an annual rate of 10.35%, and the trend of serious injuries is decreasing at an annual rate of 4.33%. Figure 1 shows that despite the declining trend, the end of the observed period is characterized by an increase in the number of injuries. The applied occupational safety measures that have given results in a certain period should be reviewed in order to increase the efficiency of their effect.

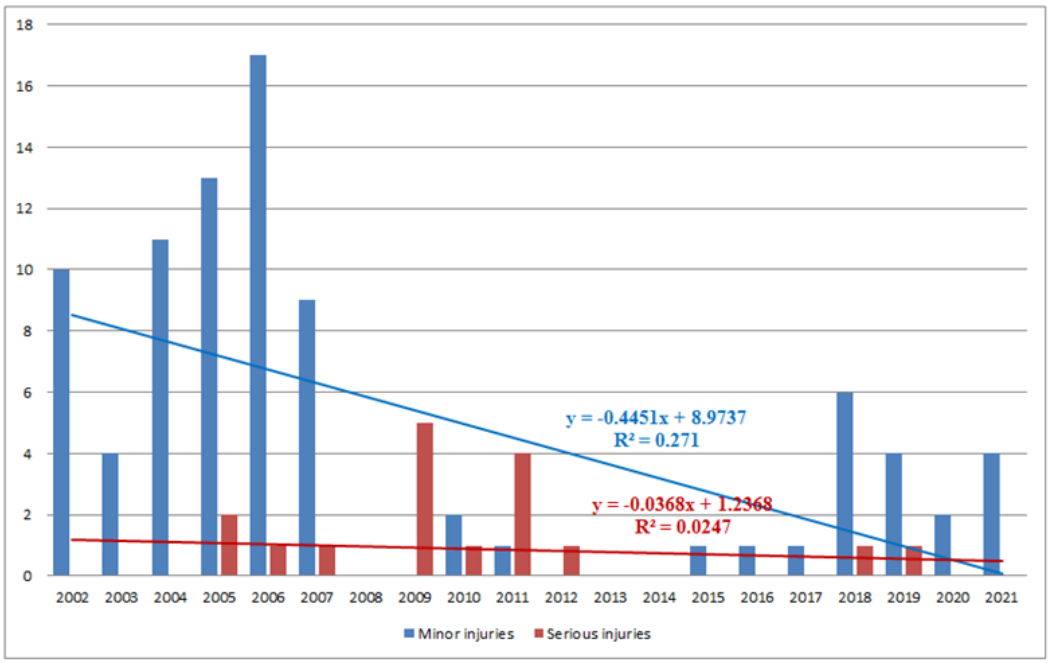


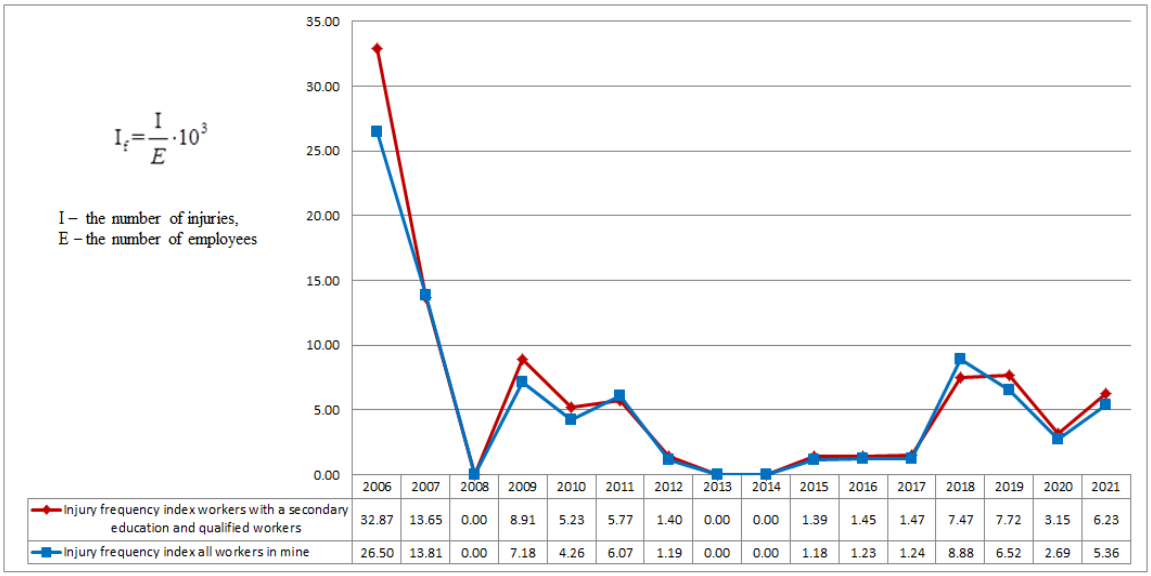
Figure 1. Trend of minor and serious occupational injuries in an iron ore mine i n the Republic of Srpska (B&H) for the period 2002-2021.

From the analysis of injuries in the iron ore mine in the RS for the period 2002-2021. we conclude: that the male workforce is most injured (90%), that workers aged 41 to 50 are most injured (47%), that injuries occur at the workplace (42%), according to the level of professional education, most are injured workers with a secondary education and qualified workers (89%), workers with 21 to 30 years of experience (41%), in the 1st shift (59%), in the 3rd-4th hour after starting work (32 %), in April and May (11%) and on Mondays and Tuesdays (19%).

The result of the analysis by gender is expected, because the mining industry employs a predominantly male workforce (the percentage of employed women in mining companies does not exceed 10%, at the world level). Also, this industry has the highest percentage of employed labor force with secondary vocational education and qualified workers, so the highest percentage of injured workers is among the workers with these qualifications. Figure 2 shows the injury frequency index of workers with secondary education and qualified workers employed in the mine. Figure 2 shows that in certain years (2006, 2009, 2010, 2012, 2015, 2016, 2017, 2019, 2020 and 2021) that index is higher than the injury frequency index of all employed workers in the mine.

In relation to the work shift, there are the most injuries in the 1st shift, because the organization of work determines the number of workers engaged in other shifts because the exploitation of ore is carried out during the daylight. During the shift, injuries are most common after 3 to 4 hours of work, when workers are already tired before the daily break. According to the day of the week, there are more injuries at the beginning of the working week, due to 'getting in' into the working rhythm. The analysis of injuries according to the place of occurrence includes 25% of occupational injuries that occurred on the way from/to the place of work, because they are also treated as occupational injuries

according to national legislation, which is in line with European standards. The percentage of 18% of injuries that occurred at another workplace indicates the practice of assigning workers to other workplaces before getting to know the dangers specific to that workplace. The highest number of occupational injuries, 90%, occurs in the production and technical sector, which is expected because in that sector work operations of mining, preparation and transport of iron ore are carried out, while the other sectors support the primary production sector.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Injury frequency index workers with a secondary education and qualified workers	32.87	13.65	0.00	8.91	5.23	5.77	1.40	0.00	0.00	1.39	1.45	1.47	7.47	7.72	3.15	6.23
Injury frequency index all workers in mine	26.50	13.81	0.00	7.18	4.26	6.07	1.19	0.00	0.00	1.18	1.23	1.24	8.88	6.52	2.69	5.36

Figure 2. Index of the frequency of occupational injuries of workers with a secondary vocational education and qualified workers in an iron ore mine in the Republic of Srpska (B&H) for the period 2006-2021.

ANOVA ANALYSIS OF ETIOLOGICAL FACTORS INJURIES

One-factor ANOVA analysis showed which analyzed etiological factors influence the number of occupational injuries in the analyzed company, namely: age of the worker, injured body part and work shift.

Workers are divided into three groups by age (group 1: 40 or less; group 2: from 41 to 50; group 3: over 50). A statistically significant difference was found at the $p < 0.05$ level in the results of the three age groups: $F(2, 34) = 3.59$, $p = 0.04$. The size of the difference between the groups is large, and expressed using eta square, it is 0.17. The results of Tukey's HSD show that the mean of group 1 ($M = 1.86$, $SD = 0.95$) is significantly different from the mean of group 2 ($M = 3.85$, $SD = 2.76$) and not different from the mean of group 3 ($M = 3$, $SD = 1.63$). The mean value of group 2 does not differ significantly from the mean value of group 3.

Injuries according to the injured part of the body are divided into three groups (group 1: head and torso; group 2: extremities; group 3: multiple injuries). A statistically significant difference at the $p < 0.05$ level was found in the results of the three groups: $F(2, 34) = 6.03$, $p = 0.006$. The size of the difference between the groups is large, and expressed using eta square, it is 0.26. The results of Tukey's HSD show that the mean of group 1 ($M = 2$, $SD = 1.09$) is significantly different from the mean of group 2 ($M = 4.57$, $SD = 3.8$) and not different from the mean of group 3 ($M = 1.42$, $SD = 0.9$). The mean value of group 2 differs significantly from the mean value of group 3.

According to the shift in which the injury occurred, the division was made into three groups (group 1: I shift; group 2: II and III shifts; group 3: before/after work). There was a statistically significant difference at the $p < 0.05$ level in the results of the three groups: $F(2, 30) = 4.83$, $p = 0.015$. The size of the difference between the groups is large, and expressed using eta square, it is 0.24. Tukey's HSD results show that the mean of group 1 ($M = 5.25$, $SD = 4.35$) is significantly different from the mean

of group 2 (M = 2.1, SD = 1.37) and mean of group 3 (M = 2, SD = 1.34). The mean value of group 2 does not differ significantly from the mean value of group 3.

Considering the established influence of certain groups of etiological factors on the number of occupational injuries in this mining company, the direction of the effect of safety measures at work that is proposed:

- programs for training workers for safe and healthy work, as well as programs for improving the safety culture, should be aimed at categories where workers are most often injured, as well as at the younger categories of workers,
- through organizational measures: schedule of shifts, change in the number of workers in shifts, more short breaks during work, etc., as well as educational measures: the importance of quality use of free time, the importance of preparing for a work shift, etc. react to the impact of shift work on the number of occupational injuries,
- additional educational programs on personal protective equipment.

THE ANALYSIS OF OCCUPATIONAL INJURIES, ACCORDING TO THE INJURED PART OF THE BODY

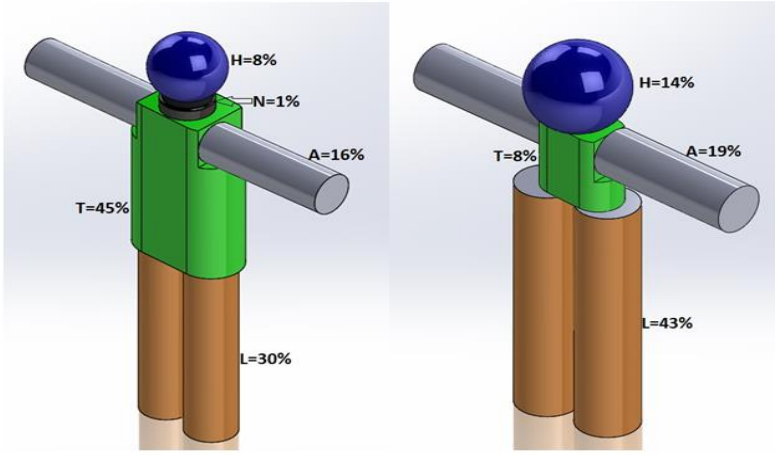
The analysis of occupational injuries, according to the injured part of the body, is primarily important for determining the health status of the worker, the course of treatment and the possibility of restoring work ability [21]. For the occupational safety system in an organization, this analysis should primarily enable the proper selection of the most adequate means of personal protection in the design of occupational safety measures. The classification of injuries according to this criterion also enables the detection of defects in work procedures or in the construction of machines and devices with which work processes are carried out.

According to the analysis of injuries in 71 surface mines in Turkey, injuries affected three parts of the body (mainbody, head and hand) in 79% of all injuries [17]. The structure of injuries according to the injured part of the body, in the statistical reports of the analysis of accidents and injuries in iron mines in Australia, is that arm injuries are 42%, legs 23% and torso 15% of the total number of injuries for the period 2019-2020, i.e. hands 39%, legs 25% and trunk 22% of the total number of injuries for the period 2020-2021 [22]. Previous investigations of safety and health at work in the mines of the Republic of Srpska for the period 2005-2009. gave the following results: the most frequently injured parts of the body were the extremities: arms and legs 64%, head 16%, eyes 5%, back 3%, and 9% had multiple injuries [7].

The analysis of injuries in the iron ore mine in the RS according to the injured part of the worker's body showed that the extremities of the legs 43% and hands 19% were injured the most, and there was also a significant percentage of multiple injuries 16% (the analysis did not include the three fatal injuries that occurred in the period 2002-2021.). Figure 3 presents an innovative graphic representation (3D model) of injury analysis according to the injured part of the body in an iron ore mine in the RS in relation to the graphic model of the body structure of an average person.

The percentage share of body parts of an average person with body units (H = head, N = neck, A = arms, T = torso and L = legs) [23] is represented by the model (figure 4a), while in figure 4b. graphical model of the percentage share of injuries to certain parts of the workers' bodies according to the analysis in the iron ore mine for the period (from 2002 to 2021). This graphic illustration does not include multiple injuries.

Based on the analysis of injuries according to the injured part of the worker's body, we conclude that when choosing personal protective equipment, special attention should be paid to personal protective equipment for the protection of legs and hands. Also, a significant percentage of multiple injuries points to the need for increased control of the application of work safety procedures and activities to build a work safety culture with an emphasis on measures to develop concentration and attention at work.



a) Percentage share of body parts in the body structure of an average person

b) The percentage of injuries to individual parts of the body according to the analysis carried out in the mine

Figure 3. Analysis of occupational injuries according to the injured part of the body in an iron ore mine in the Republic of Srpska for the period 2002-2021.

THE ANALYSIS OF SOURCE AND CAUSE OF OCCUPATIONAL INJURIES

Determining the source and cause of occupational injuries, from the group of etiological factors, is the most important for the design of expedient occupational safety measures. The sources of injury are related to material (means of work, materials, tools, etc.), energy and workplace factors that cause injury by their direct effect on the worker's body, the causes of injuries are related to the reasons, i.e. 'roots' of injuries and it is much more difficult to determine them, as well as to divide them into certain groups, due to the often present complex action of several causes [24]. The most common causes of occupational occupational injuries are:

- subjective causes dominated by the so-called human factor,
- objective causes related to the degree and duration of objective danger/harm in the working environment and/or at the workplace or to factors arising in the social environment [25].

According to the study [26], numerous factors that determine the occurrence of occupational injuries in mines are systematized into two categories:

- Personal variables: demographics, negative personality, safe work behaviour, job dissatisfaction, job stress,
- Sociotechnical variables: social support, safety environment, work hazards.

The results of the analysis of sources of injury for the researched mining company are shown in Figure 4. In the analysis, the most common sources of injuries were determined, namely: means, equipment and tools for work in 26% of cases and characteristics of the workplace in 24% of cases. However, in 36% of cases, the actual source of the injury was not determined (the source of the injury was not specified in the report on the occupational injury).

Occupational health and safety measures should be focused both on the improvement of work equipment (modernization of work equipment and tools, planned preventive maintenance of work equipment, etc.), and on the improvement of the ergonomic characteristics of workplaces.

Pareto analysis of the causes of occupational injuries and identification of the main one with the aim of directing the preventive effect of occupational safety measures is shown in Figure 5. Theoretical sources and research data of other authors state that the most common cause of occupational injuries is man, i.e. a certain procedure, action or behavior that a person performs in the working environment,

e.g. carelessness, non-observance of safety rules, underestimation of danger, non-use or improper use of personal protective equipment, etc. 'Human factor' was a crucial factor in around 90% of occupational injuries [27].

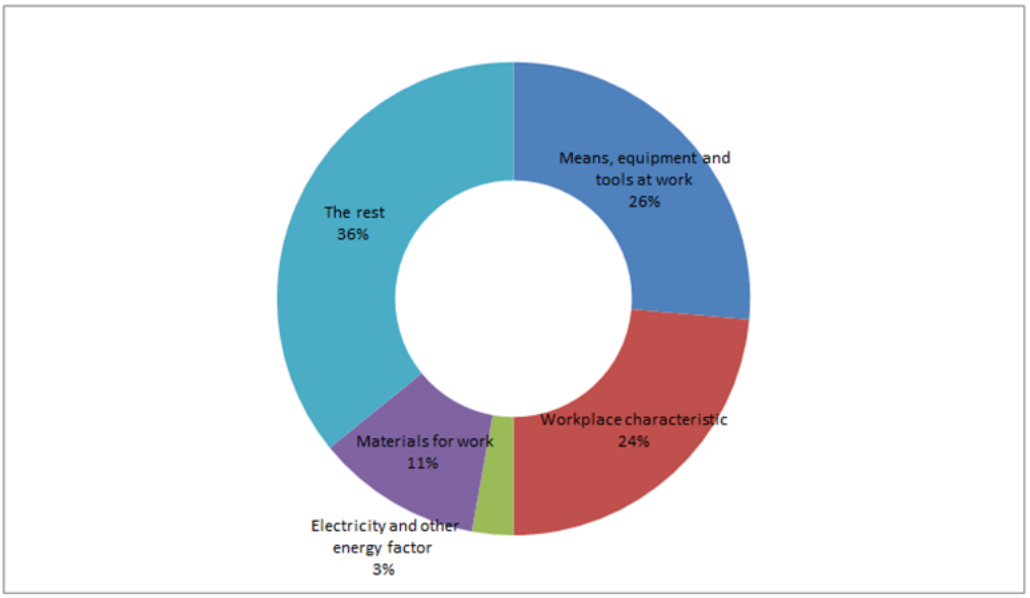


Figure 4. Sources of occupational injuries in an iron ore mine in the Republic of Srpska for the period 2002-2021.

An analysis of 295 mining accidents in Iran showed the importance of human and organizational factors in mining accidents: skill-based errors, routine violations, environmental factors and planned inappropriate execution of work operations were identified as the most common causes [28]. Research results [29] showed that although human error was the cause of most mining accidents, other causal factors such as the existing conditions (physical and technical environment), uncertain leadership climate and organizational factors also had an impact. The cause of worker injuries in mine, which is the subject of research, is the worker's inadequate actions in 44% of cases, so the activities of the occupational safety system should be focused on defining new forms of training and additional education of workers for safe and healthy work with an emphasis on the importance and importance of observing occupational safety measures.

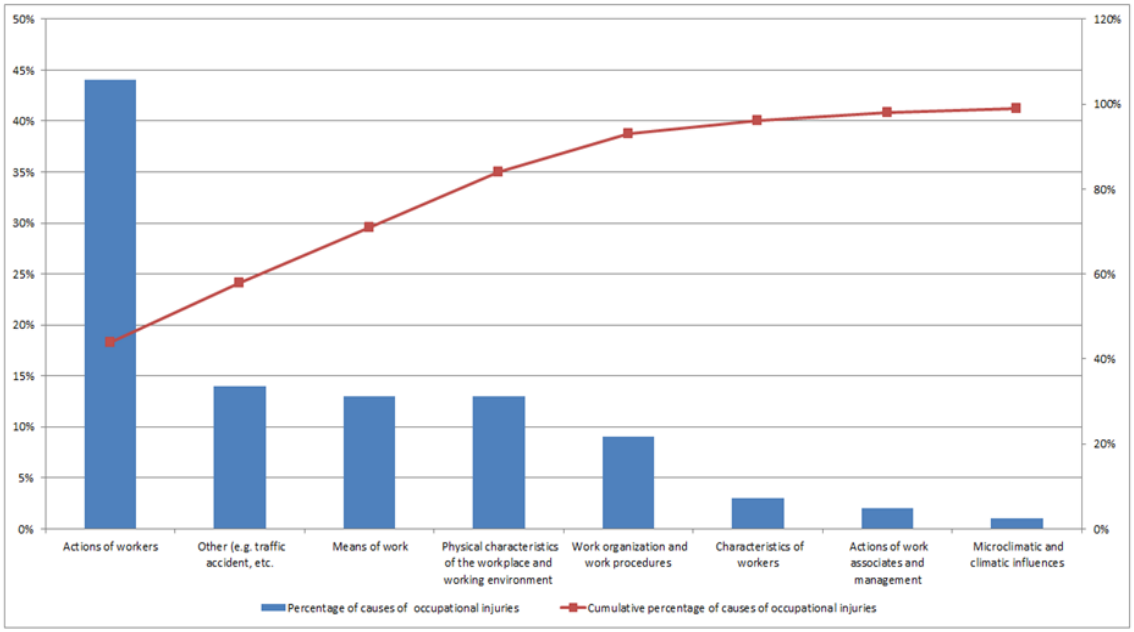


Figure 5. Pareto analysis of the causes of occupational injuries in an iron ore mine in the Republic of Srpska for the period 2002-2021.

The analysis of the causes of fatal injuries that occurred in this company showed that two fatal injuries were the result of a traffic accident (one on the way from home to the place of work, and one on a business trip). The cause of one fatal injury was faulty work equipment (pumping plant for tailings desilting). From the Pareto diagram of causes, it can be seen that other factors, among them traffic accidents, are the second most significant causal factor of all work injuries that occurred in the mine.

RELATIVE INDICATORS OF INJURIES FOR THE PERIOD 2006-2021.

Figure 6 shows the trend of the frequency index and severity index of occupational injuries for the period 2006-2021. in an iron ore mine. The monitoring of these indices in the occupational safety system in the mine has been applied since 2006, and the picture shows that there is a downward trend in these indices. The trend of the injury frequency index (I_f) is decreasing at an annual rate of 11.12%, and the trend of the injury severity index (I_s) is decreasing at an annual rate of 5.7%. The indices were calculated in relation to the effective working hours (table 1.), according to the forms [20,30,31]:

$$I_f = \frac{I}{H} \cdot 10^6 \quad (1)$$

$$I_s = \frac{LW_d}{H} \cdot 10^3 \quad (2)$$

where is:

I the number of injuries

H the number of effective working hours (product of the number of employees and the number realized working hours)

LW_d the number of lost working days due to injuries.

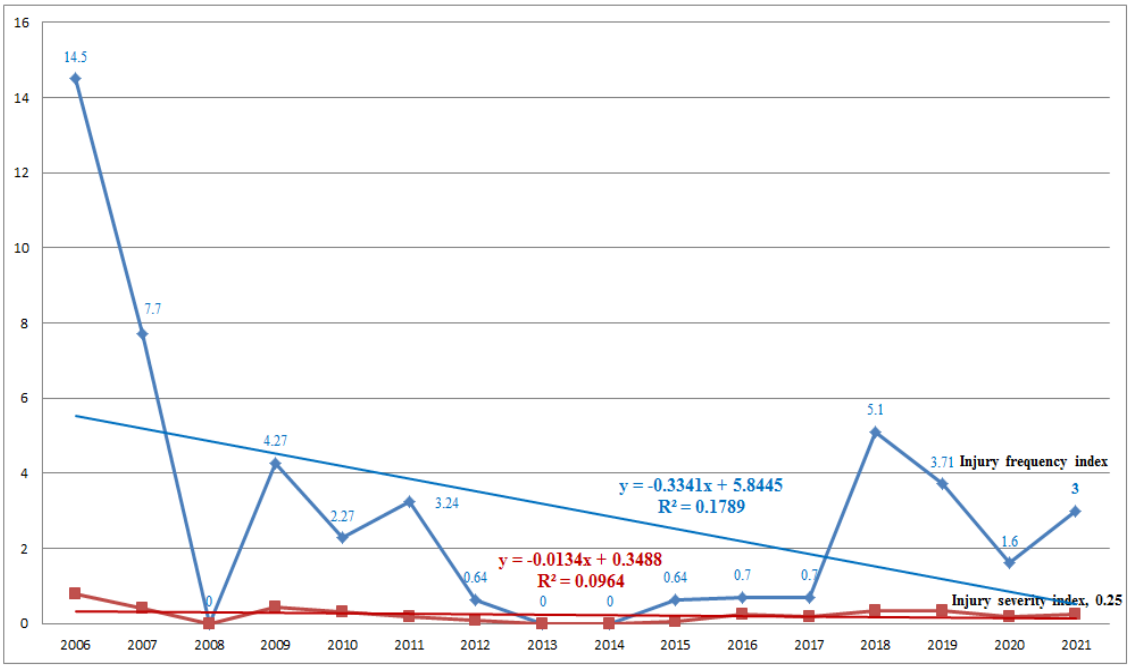


Figure 6. Trend of frequency index and severity index of occupational injuries in an iron ore mine in BiH (Republic of Srpska) for the period 2006-2021.

CONCLUSION

The modern approach to the management of the occupational safety system, within a certain activity, including mining, by analyzing injuries in the previous period and monitoring indicators is a simple and effective model for viewing and analyzing the current state of protection in the production system,

with the possibility of tentatively predicting the situation in the future by designing prevention measures and monitoring the trend of indicators. The categories of etiological factors that have an impact on the number of occupational injuries in a certain period (ANOVA analysis), as well as the determination of the dominant causes (Pareto analysis) of injuries, allow for directing the effect of occupational safety measures (organizational, educational, etc.) on those factors, ie. causes and correction of the state of occupational health and safety in the following period. In today's conditions of efforts to ensure socially responsible business, taking care of the safety and health of employees is high on the list of priorities. Employees who feel safe at their place of work and have motivating working conditions realize a greater work ethic, and thus provide their company with a better business result. The implementation of preventive safety measures at work and the implementation of employee training in the company reduce the possibility of injuries, and thus the quality of working conditions is raised to a higher level.

Received February 2024, accepted March 2024)

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