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SAFETY COMMUNICATION IN MINING COMPANIES: DIFFERENCES ACROSS ORGANIZATIONAL STRUCTURE

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Original Scientific Paper

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For mining processes to operate safely, information about safety is crucial. Numerous authors pay attention to fostering a good safety climate without paying attention to safety communication across organizational structure, which motivates this survey. Accordingly, this paper aims to check the hypothesis whether there is a difference between the attitudes of managers, operators, and auxiliary workers in the mining industry regarding safety communication, since differences on their attitudes about safety communication issues have potential to cause safety performance. A survey of 123 respondents working in different positions in Serbian mining companies, which have evaluated the importance of communication as well as the current state regarding the quality of communication in their organizations, was conducted. After evaluating the data and conducting descriptive statistics, followed by the Mann-Whitney test, it was determined that there are no statistically significant differences in the attitudes of managers, operators, and support staff toward safety communication. This indicates that issues with an organization's safety performance are not brought on by the differences on safety attitudes at different hierarchical levels. Proposal for the future research is to examine other possible causes, such as cognitive biases in risk perception, safety training and education and similar, and to use larger sample that may confirm our hypothesis.

Keywords: Safety communication; Mining industry; Managers; Operators; Auxiliary workers.

INTRODUCTION

Employees in the mining sector face numerous safety risks due to the nature of the work they perform (Carvalho, 2017; Saleh et al., 2011). It is evident that mining companies should place higher importance on occupational safety, and numerous tools have been utilized to enhance it (Jarosławska-Sobór, 2015). Although some measures are constantly being tried in order to improve safety performance, occupational injuries in the mining industry continue to be a severe problem despite all the steps and actions taken (Stemn et al., 2019). Certain authors propose that issues should be looked at and evaluated through the lens of corporate complexity (Rudakov et al., 2021).

Safety climate evolves as a result of the emergence of behavioral safety standards and common understandings of safety systems (Parker et al., 2017). Fostering a good safety climate is key to improving safety performance in the mining industry (Stemn et al., 2019). Ismail and colleagues (2021) have shown that communication is very important for strengthening the safety climate. One of the most recurring themes in the literature

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assessment was the high management commitment to safety in companies with successful safety programs, but it is also noticed that it is important to maintain open lines of communication between management and employees (Zohar, 1980). Komljenovic and colleagues (2017) indicated that organizational performance appears to be a crucial factor in the creation of stressful circumstances that lead to failure through the erosion of safety margins in organizations, because one of the dominant aspects in this context concerns various motivational biases, primarily at the management level. On one side, managers appear to be able to improve occupational safety in the sector by using less passive/avoidant leadership and more transformational leadership (Grill et al., 2019). On the other hand, employees engagement and satisfaction promotes a more positive attitude toward work and superiors, as well as employees loyalty (Petrović et al., 2019). However, managers and staff frequently disagree on what causes accidents and risky work practices (Prussia et al., 2003). Organizations need communication to streamline their tasks in desired directions and gain expected performance levels (Widhiastuti, 2012). Organizational performance issues are both a cause and a consequence of poor communication (Kibe, 2014). Communication issues can be caused by poorly designed organizations, inefficient procedures, bureaucratic systems, misaligned incentives, a lack of clarity in the focus on customers or partners, hazy visions, values, and purposes, incompetent team leaders and members, cluttered goals and priorities, low levels of trust, and inadequate indicators and feedback cycles (Kibe, 2014).

Employees get five forms of information from managers through communication, including job instructions, job justification, organizational policies and practices, performance feedback, and indoctrination of corporate goals (Watson et al., 1984). In addition, employees share information with managers about themselves, their issues, organizational practices, and rules, as well as what needs to be done and how to do it (Watson et al., 1984). It is evident that communication structures strongly affect perceived responsibility, which is very important for safety (Ellman et al., 2010), while a formal organizational structure is in relation to organizational communication (McPhee, 1985).The aim of each organizational structure is to develop positive communication channels and trusting relations, but it is not easy to realize that aim (Ambrose et al., 2003). According to numerous research, a number of elements, including organizational structure, combine to affect organizational effectiveness (Spasojević Brkić et al., 2023). Those facts make the analysis of communication within the framework of the organizational structure even more difficult.

According to the facts given above, progress in the field is not great in other industrial sectors on the given topic, too. However, there are certain researches in other fields that put attention to differences in attitudes of operators and managers regarding risk management (Golubović et al., 2022). Also, Spasojević-Brkić and others (2022) reported no differences in the safety attitudes between operators of mining and construction machinery. Yet, attitudes regarding safety communication issues in mining industry till now have not been analyzed.

Those, previously mentioned researches led us to put forward a hypothesis if there are differences regarding safety communication across organizational structure in mining companies and it is the main focus of this paper. The structure of this paper is as follows. After problem definition based on previous research, the methodology is described in the next section. The third part of the paper presents results of statistical analysis applied, while the last part gives conclusions, which are avenues for future research.

METHODOLOGY

A survey was conducted in six mining companies in Serbia. A total of 123 employees willingly participated in the survey. The survey included respondents in various positions within three different hierarchical level of the organization, i.e., managers, operators, and auxiliary workers. The four questions below, related to safety communication, were examined, on the basis of previous research such as Milijic and colleagues (2013) and Lin and his colleagues (2008):

Q1: I am involved in enforcing safety rules at work.
Q2: Supervisors often give notices about how to work safely.
Q3: I often discuss safety rules with my supervisor.
Q4: I can get information about safety at work in my company.

Both the significance assessment of safety communication and the actual state/situation of safety communication in the organizations where

they work were evaluated by mining sector employees. The research was carried out as follows:

1. Selection of respondents: The research was conducted on a sample of data collected through a survey. From the employees of 6 mining companies included in the survey, valid results were obtained from 123 employees. The selection included managers, operators, and auxiliary workers in the mining industry.
2. Likert scale: Respondents ranked the significance of their assessment of safety communication importance and the current situation in their organization on a Likert five-point scale. This scale allowed for the collection of quantifiable information on employees' attitudes toward safety communication.
3. Data analysis: Descriptive statistics were performed to describe the data obtained using the Likert scale. Also, the nonparametric Mann-Whitney U test was performed to search for differences in views among various employees' categories.
4. Identifying the impact: This study aims to identify if the employee's attitudes towards safety communications differs between various hierarchical level and what impact does it have on safety performance issues. This can be accomplished by comparing of collected answers on importance and actual state/situation of safety communication dimensions between different types of employees.
5. Results interpretation: The analysis of the research's findings is the final step. Here, the statistical data collected in the previous steps is used to determine the differences between employees' attitudes toward safety communication as possible cause of company's unsatisfactory safety performance.

RESULTS

Descriptive Statistics

Results of descriptive statistics of the responses expressed by the managers, both for the significance assessment and for the actual situation, are given in Table 1, which includes sample size (N), mean values, median (Med.), minimum (Min), maximum (Max), range (R), standard deviation (SD), coefficient of variation expressed in percent (CV), 5 and 95 percentiles (Pe.5 and Pe.95). When the coefficient of variation is greater than 30% non-parametric statistics are applied, indicating that the variable is not homogeneous. The initial extraction of non-parametric variables was carried out based on the initial descriptive statistics and the coefficient of variation. The Kolmogorov test for normality was used to perform the second extraction of non-parametric variables since values of coefficient of variation are smaller than 30%. In any case, the Kolmogorov test for normality was carried out, and its d test values and p values were provided. Where (p) value presents the level of statistical significance, which when lower than 0.05 implies that the distribution is not normal and that a non-parametric test should be used

Results of descriptive statistics for responses collected from the operators, both for significance assessment and for the actual state/situation of safety communication, are given in Table 2.

Results of descriptive statistics of the responses obtained by auxiliary workers, both for significance assessment and for the actual situation, are given in Table 3.

Table 1: Descriptive statistics of safety communication dimensions for managers

Descriptive statistics for significance assessment													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	**33**	**4.545**	**5**	**2**	**5**	**3**	**3**	**5**	**0.794**	**17.47**	**0.32268**	**< 0.01**	non-parametric
Q2	**33**	**4.424**	**5**	**3**	**5**	**2**	**3**	**5**	**0.830**	**18.77**	**0.31093**	**< 0.01**	non-parametric
Q3	**33**	**4.515**	**5**	**1**	**5**	**4**	**3**	**5**	**0.834**	**18.46**	**0.28043**	**< 0.01**	non-parametric
Q4	**33**	**4.485**	**5**	**2**	**5**	**3**	**3**	**5**	**0.834**	**18.59**	**0.31396**	**< 0.01**	non-parametric
Descriptive statistics for the actual situation													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	33	3.939	4	2	5	3	2	5	0.864	21.93			parametric
Q2	33	3.727	4	2	5	3	2	5	0.876	23.50			parametric
Q3	**33**	**3.939**	**4**	**2**	**5**	**3**	**2**	**5**	**0.933**	**23.69**	**0.25316**	**< 0.05**	non-parametric
Q4	33	4.030	4	1	5	4	2	5	1.015	25.19			parametric

Table 2: Descriptive statistics of safety communication dimensions for operators

Descriptive statistics for significance assessment													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	**34**	**4.971**	**5**	**4**	**5**	**1**	**5**	**5**	**0.171**	**3.45**	**0.43192**	**< 0.01**	non-parametric
Q2	**34**	**4.971**	**5**	**4**	**5**	**1**	**5**	**5**	**0.171**	**3.45**	**0.43192**	**< 0.01**	non-parametric
Q3	**34**	**4.912**	**5**	**3**	**5**	**2**	**4**	**5**	**0.379**	**7.71**	**0.40791**	**< 0.01**	non-parametric
Q4	**34**	**4.941**	**5**	**4**	**5**	**1**	**4**	**5**	**0.239**	**4.83**	**0.40273**	**< 0.01**	non-parametric
Descriptive statistics for the actual situation													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	**34**	**3.941**	**4**	**3**	**5**	**3**	**5**	**2**	**0.814**	**20.66**	**0.22906**	**< 0.05**	non-parametric
Q2	34	4.147	4	3	5	3	5	2	0.744	17.94			parametric
Q3	**34**	**4.176**	**4**	**3**	**5**	**3**	**5**	**2**	**0.626**	**14.99**	**0.31683**	**< 0.01**	non-parametric
Q4	**34**	**4.265**	**4**	**3**	**5**	**3**	**5**	**2**	**0.710**	**16.64**	**0.23367**	**< 0.05**	non-parametric

Table 3: Descriptive statistics of safety communication dimensions for auxiliary workers

Descriptive statistics for significance assessment													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	**34**	**4.971**	**5**	**4**	**5**	**1**	**5**	**5**	**0.171**	**3.45**	**0.43192**	**< 0.01**	non-parametric
Q2	**34**	**4.971**	**5**	**4**	**5**	**1**	**5**	**5**	**0.171**	**3.45**	**0.43192**	**< 0.01**	non-parametric
Q3	**34**	**4.912**	**5**	**3**	**5**	**2**	**4**	**5**	**0.379**	**7.71**	**0.40791**	**< 0.01**	non-parametric
Q4	**34**	**4.941**	**5**	**4**	**5**	**1**	**4**	**5**	**0.239**	**4.83**	**0.40273**	**< 0.01**	non-parametric
Descriptive statistics for the actual situation													
	N	Mean	Med.	Min	Max	R	Pe.5	Pe.95	SD	Cv(%)	d	p	variable type
Q1	**68**	**4.779**	**5**	**3**	**5**	**2**	**4**	**5**	**0.514**	**10.75**	**0.33951**	**< 0.01**	non-parametric
Q2	**68**	**4.838**	**5**	**3**	**5**	**2**	**4**	**5**	**0.444**	**9.18**	**0.35787**	**< 0.01**	non-parametric
Q3	**68**	**4.838**	**5**	**3**	**5**	**2**	**4**	**5**	**0.444**	**9.18**	**0.35787**	**< 0.01**	non-parametric
Q4	**68**	**4.779**	**5**	**3**	**5**	**2**	**3**	**5**	**0.569**	**11.91**	**0.36737**	**< 0.01**	non-parametric

Comparison of the safety communication significance assessments between managers and operators, managers and auxiliary workers, and auxiliary workers and operators

Following the completion of the descriptive statistics, the z* statistic was performed based on the Mann-Whitney test, and the p value of significance — the level of significance at which the result indicates statistical significance among compared samples — were calculated. Table 4. shows the comparisons of significance assessments between managers and operators, managers and auxiliary workers, and operators and auxiliary workers. Test showed that there are no differences between the trends of responses collected by the employees at these three work positions.

Comparison of the actual state/situation evaluations on safety communication between managers and operators, managers and auxiliary workers, and auxiliary workers and operators

Finally, a comparison of the opinions about the actual situation among managers and operators, managers and auxiliary workers, and operators and auxiliary workers has been done and is displayed in Table 5., where test showed that there are no significant differences between evaluated groups of employees perspectives on observed topic.

Table 4: Comparison of the safety communication significance assessments between managers and operators, managers and auxiliary workers, and auxiliary workers and operators

				z*	p	significance
Q1	Managers	vs.	Operators	0.000	1.000	not significant.
	Managers	vs.	Auxiliary workers	0.000	1.000	not significant.
	Operators	vs.	Auxiliary workers	0.000	1.000	not significant.
Q2	Managers	vs.	Operators	0.000	1.000	not significant.
	Managers	vs.	Auxiliary workers	0.000	1.000	not significant.
	Operators	vs.	Auxiliary workers	0.000	1.000	not significant.
Q3	Managers	vs.	Operators	0.000	1.000	not significant.
	Managers	vs.	Auxiliary workers	0.000	1.000	not significant.
	Operators	vs.	Auxiliary workers	0.000	1.000	not significant.
Q4	Managers	vs.	Operators	0.6036	0.5461	not significant.
	Managers	vs.	Auxiliary workers	0.000	1.000	not significant.
	Operators	vs.	Auxiliary workers	0.000	1.000	not significant.

Table 5: Comparison of the actual situation evaluations between managers and operators, managers and auxiliary workers, and auxiliary workers and operators

				z*	p	significance
Q1	Managers	vs.	Operators	-0.490748	0.623605	not significant.
	Managers	vs.	Auxiliary workers	1.806499	0.070841	not significant.
	Operators	vs.	Auxiliary workers	-0.254762	0.798907	not significant.
Q2	Managers	vs.	Operators	-0.025950	0.979297	not significant.
	Managers	vs.	Auxiliary workers	-1.16487	0.244072	not significant.
	Operators	vs.	Auxiliary workers	-0.685160	0.493243	not significant.
Q3	Managers	vs.	Operators	1.084435	0.278173	not significant.
	Managers	vs.	Auxiliary workers	-0.084921	0.932324	not significant.
	Operators	vs.	Auxiliary workers	0.219578	0.826200	not significant.
Q4	Managers	vs.	Operators	-0.611010	0.541193	not significant.
	Managers	vs.	Auxiliary workers	-0.488627	0.625106	not significant.
	Operators	vs.	Auxiliary workers	0.000	1.000	not significant.

CONCLUSION

The primary purpose of this research was to determine if there are differences in perceptions regarding safety communication among managers, operators, and auxiliary workers in mining companies. Employees' opinions on safety communication were evaluated, and they were asked to express their opinion on the significance of the safety communication as well as the observation of the current situation.

Descriptive statistics of the responses of managers, operators, and support workers to questions related to safety communication were conducted. Depending on the statistical level of significance, it is determined whether a parametric ($p>0.05$) or non-parametric test ($p<0.05$) is required (Montgomery et al., 2020). In most of the cases, it showed out that the data were not distributed according to the Gaussian distribution, requiring the use of non-parametric tests.

Then it was determined if there are a difference in their responses. The tests revealed no statistically significant differences between the responses in these three groups of respondents, indicating that they had similar attitudes about safety communication. Based on the analysis of the collected data on attitudes about safety communication among mining industry managers, operators, and auxiliary workers, it is concluded that there are no statistically significant differences between these groups of workers. This further suggests that this does not significantly cause safety performance issues, as supposed.

However, the contribution of this work is not small. The fact that there has been no similar research in this field so far makes gives a contribution for the future research that should take into account that the attitudes both regarding importance and the current state of safety communication are not different among the employees at different hierarchical levels. This implies that other possible causes, such as cognitive biases in risk perception, safety training and education or similar, should be investigated. Maybe larger sample would confirm our hypothesis, so this is a proposal for further research, too.

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BEZBEDNOSNA KOMUNIKACIJA U RUDARSKIM KOMPANIJAMA: RAZLIKE U ORGANIZACIONOJ STRUKTURI

Da bi poslovi u rudarskoj industriji bili urađeni na bezbedan način, informacije o bezbednosti su ključne. Brojni autori obraćaju pažnju na negovanje dobre bezbednosne klime, ne obraćajući pažnju na bezbednosnu komunikaciju i njene tokove u celoj organizacionoj strukturi, što motiviše ovo istraživanje. Shodno tome, ovaj rad ima za cilj da proveri hipotezu da li postoji razlika između stavova menadžera, rukovaoca i pomoćnih radnika u rudarskoj industriji po pitanju bezbednosne komunikacije, jer razlike u njihovim stavovima o pitanjima bezbednosne komunikacije utiču na bezbednosne performanse. Sprovedeno je istraživanje među 123 ispitanika koji rade na različitim pozicijama u domaćim rudarskim kompanijama, a koji su ocenili značaj komunikacije kao i trenutno stanje u pogledu kvaliteta komunikacije u svojim organizacijama. Nakon evaluacije podataka i sprovođenja deskriptivne statistike, praćene Mann-Whitneytestom, utvrđeno je da nema statistički značajnih razlika u stavovima menadžera, rukovaoca i pomoćnog osoblja po pitanju bezbednosne komunikacije. Ovo ukazuje da problemi neadekvatnih bezbednosnih performansi organizacija nisu izazvani razlikama u stavovima o bezbednosti na različitim hijerarhijskim nivoima. Predlog za buduća istraživanja je da se ispitaju drugi mogući uzroci, kao što su kognitivne pristrasnosti u percepciji rizika, obuka i edukacija i slično, i da se koristi veći uzorak koji može potvrditi postavljenu hipotezu.

Ključne reči: Bezbednosna komunikacija; Rudarska industrija; Menadžeri; Rukovaoci; Pomoćni radnici.