

Risk Factors of Coal Mine Accidents in the Production Area of PT. XXX Kutai Timur, Indonesia

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Abstract — The mining industry is known worldwide for its highly risky and hazardous working environment. Coal mining is the most dangerous occupation in Indonesia, with high frequency of injury compared to other industries. The mining sector in East Kalimantan is still a contributor to the number of accidents. Coal mine accidents are workplace accidents which occur in mining activities during the start and the end of the working hours. Based on PT. XXX's incidents resume during 2017 up to October there have been 63 accident thresholds which have caused property damage, lost time injury (LTI). The causes of accidents or injuries are important factors. Therefore, the authors decide to investigate the influencing factors of accidents in mining operation. This research used analytical survey research and case control research design. The total samples were 56 people in which 28 respondents were in the case group and 28 respondents were in the control group. The instrument in this study was a questionnaire which was adopted from previous researchers and observation sheets made by the researchers themselves. The chi-square was used to determine the association analysis with $\alpha = 0.05$. The results of this study indicate that the risk factors of accidents in mining sector are skills, motivation, and standard operating procedures. It can be concluded that the risk factors of mining accidents occurrence in production area of PT. XXX Kutai Timur are work skills, work motivation, and standard operating procedures. The authors recommend the companies to improve work skills through the provision of education and training, improve work motivation through rewards and punishments, and control the supervision of standard operating procedures.

Keywords: case control, mine accident, motivation, skill, SOP

I. INTRODUCTION

According to International Labour Office Statistics, 120 million occupational injuries and 210,000 fatal injuries occur annually at workplaces worldwide. The mining industry has a high incidence of injury among all industry divisions, particularly of fatal injuries [1]. Workplace fatalities and injuries bring great losses to both individuals and societies. For example, every year 10 million of the 150 million workers in the European Community are affected by accidents or diseases at work. In the United States, work

related injuries have been estimated at \$125 billion per year. 17 employees die every day as a result of industrial accidents- a total of 63,589 deaths from 1980-1989. In 1992 alone 3.3 million work-disabling injuries were reported, and some 370,000 employees suffered work-related injuries [2].

Safety in the mine industry has been considered an important issue, with coal mine being one of the most dangerous industries. Coal Mine accidents, which are occupational accidents that occur at work/mining activities from the start to the end of working hours. Mining accidents should fulfill five elements, namely accidents that actually occur, result in mining workers' injuries, due to mining activities, occur during working hours and occur in the area of mining business activities [3].

Based on the Performance Report related to coal accidents in 2016, there were 146 accidents with details of minor accidents 59, weight 71, and death 16. Then, in 2017 the number of mining accident dropped to 135 with details of a minor accident 47, weight 75 and death 13 which then the number of cumulative working hours was 494,503,176 with a note that one million hours (1,000,000) was the number of working hours of 500 workers who worked 40 hours a week and 50 weeks per year [4]. In East Kalimantan, it is stated that Work Accidents in the coal mining sector increase with the number of accidents of mining workers continues to increase from year to year. In 2014, it was noted that there were 8 cases of mining accidents. Whereas in 2015 from January to mid-December, there were 14 cases of work accidents and in the end of 2016, there were 22 fatal accidents in workplace.[5].

PT. XXX is a company engaged in the business of "mining & earthmoving contractor". The production area is the department that supports and is responsible for all mining operations and coal and OB (overburden) production targets. Activities in the production area such as overburden and disposal, overburden activity are the process to remove rock layers. Meanwhile, disposal is a place to store overburden material originating from the mining. Work accidents in the production area are caused

by fatigue, stress, lack of skills and inappropriate motivation. Three were as a result of fatigue, four were due to stress, seven were due to lack of skills, and 14 were due to improper motivation. This creates risks such as a unit that is overturned, crashed, hit, grazed, collapsed, collapses, exits the fire from the unit, and is exposed to material issues. [6]. Losses due to accidents can be in the form of losses related to the occurrence of accidents to workers (fatality, serious injuries, minor injuries, fractures or other injuries), material damage/loss, loss of work time, reduced quality of work, loss of interest in work, decreased production. The purpose of this study is to determine the risk factors of coal mine accidents occurrence in the production area of PT. XXX Kutai Timur coal mines.

II. METHOD

This research was a case-control study conducted among workers in the production area of PT. XXX Kutai Timur coal mines. The respondents were categorized into case groups and control groups. The inclusion criteria in the case group were among others: 1) working in the same place, 2) having experienced some work accident, 3) willing to participate in the study. Meanwhile in the control group, matching was done based on the sex and workplace groups. The sample in this study were chosen using the Lemeshow formula in which results were 27.95 workers or rounded up to 28 workers with a proportion of 1: 1. The case samples were 28 people while the controls were 28 people so that the total samples were 56 people. The following calculation was based on the Lemeshow formula :

$$n = \frac{Nz_{1-\frac{\alpha}{2}}^2 P(1-P)}{d^2(N-1) + z_{1-\alpha}^2 P(1-P)}$$

$$n = \frac{100 (1.96)^2 0.5(1-0.5)}{(0.05)^2(100-1) + (1.96)^2 0.5(1-0.5)}$$

$$n = \frac{100 (3.8416)(0.25)}{2.475 + 0.9604}$$

n= 27.95 (workers)
n= 28 (workers)

The survey was conducted from May to August 2018 (four months). The data were collected using a questionnaire answered directly by workers of PT. XXX Kutai Timur. The method of measuring work stress variables used questionnaires adopted from Permenaker No. 5 of 2018. The variables of work skills in the questionnaires were made by the researchers themselves based on the Golden Rules Safety Management System at PT XXX. The work motivation variables was measured using Lusiana's questionnaire (2015) [7] and Margaretha's questionnaire (2014) [8]. Further, the standard operating procedures were measured using the questionnaire (2014) [9]. The data were analyzed descriptively using frequency tables and the correlation was analyzed using Chi Square test with $\alpha = 0.05$. The study was accepted after a complete internal review of proposal adjudicated to involve some staffs. Ethical permission was carried out through written informed consents obtained from all participants before data collection. Authors added determination of skill and non-skill levels or stress, and how to classify them. Stress level classification was based on Permenaker No.5 of 2018, mild stress = <9; moderate stress = 10-24; severe stress => 24. Non-skilled classification = <median 9; skilled = ≥ median 9.

III. RESULTS

The distribution of respondents can be seen from the age category, level of education, and years of service. Table 1 shows the age distribution of the highest case group respondents found in the age category between 25-30 and 31-36, with 25%, and the highest control group is in the age of 25-30 with 67.9%. The majority level of education of the case group respondents are Senior High School with a percentage of 96.4% and a control group with a percentage of 92.9%. The working experience of the case group and control respondents is the highest between 6-10 years, namely 39.3% and 67.9%.

TABLE I. CHARACTERISTIC OF RESPONDENTS

Variable	Case		Control		Total	
	n	%	n	%	n	%
Age						
19-24	6	21.4	4	14.4	10	17.9
25-30	7	25.0	19	67.9	26	46.4
31-36	7	25.0	5	17.9	12	21.4
37-42	3	10.7	0	0	3	5.4
43-48	4	14.3	0	0	4	7.1
49-54	1	3.6	0	0	1	1.8
Level of Education						
Senior High School	27	96.4	26	92.9	53	94.6
Associates Degree	0	0	1	3.6	1	1.8
Bachelor Degree	1	3.6	1	3.6	2	3.6
Working Experience						
1-5	6	21.4	6	21.4	12	21.4
6-10	11	39.3	19	67.9	30	53.6
11-15	8	28.6	3	10.7	11	19.6
21-25	1	3.6	0	0	1	1.8
26-30	2	7.1	0	0	2	3.6
Total	28	100.0	28	100.0	56	100.0

Table 2 shows the characteristic of job condition. It is known that the distribution of respondents based on work stress variables, role ambiguity in the case group and controls experience moderate stress at 82.1% and 57.1%. Job stress items conflict the role of the case group and control experience moderate stress at 89.3% and 67.9%. Job stress items are quantitatively overload cases and control groups experience moderate stress at 96.4% and 78.6%. Job stress items qualitative overload cases and controls experience moderate stress at 96.4% and 75%. Job stress

items for career development in the case group and controls experience moderate stress at 82.1% and 57.1%. Job stress items responsibility for other cases and control groups experience moderate stress at 85.7% and 57.1%. The variable skills in cases of unskilled workers is 64.3% and the skilled workers control group is 78.6%. Poor motivation of workers in the case group is 67.9% and good motivation in the control group is 71.4%. The act of doing SOP is not good in case group workers by 50% and actions based on good SOP in the control group is 78.6%.

TABLE II. THE CHARACTERISTIC OF JOB CONDITION

Variable	Case		Control		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Job Stress items Ambiguity Role						
Mild Stress	5	17.9	12	42.9	17	30.4
Moderate Stress	23	82.1	16	57.1	39	69.6
Job Stress items Conflict Role						
Mild Stress	3	10.7	9	32.1	12	21.4
Moderate Stress	25	89.3	19	67.9	44	78.6
Job Stress items the Quantitative Overload						
Mild Stress	1	3.6	6	21.4	7	12.5
Moderate Stress	27	96.4	22	78.6	49	87.5
Job Stress items the Qualitative Overload						
Mild Stress	1	3.6	7	25	8	12.5
Moderate Stress	27	96.4	21	75	48	87.5
Job Stress items Career Development						
Mild Stress	5	17.9	12	42.9	17	30.4
Moderate Stress	23	82.1	18	57.1	39	69.6
Job Stress items Responsibility towards Others						
Mild Stress	4	14.3	12	42.9	16	28.6
Moderate Stress	24	85.7	16	57.1	40	71.4
Job Skills						
Not Skilled	18	64.3	6	21.4	24	42.9
Skilled	10	35.7	22	78.6	32	57.1
Job Motivation						
Low	19	67.9	8	28.6	27	48.2
High	9	32.1	20	71.4	29	51.8
Performing the Standard Operating Procedure						
Not Good	14	50	6	21.4	22	39.3
Good	14	50	22	78.6	34	60.7
Total	28	100	28	100	56	100

Table 3 shows that there is a relationship between work stress, role ambiguity ($p = 0.042$; $OR = 0.290$), role conflict ($p = 0.253$; $OR = 0.051$), quantitative overload ($p = 0.043$; $OR = 0.136$), qualitative overload ($p = 0.022$; $OR = 0.111$), career development ($p = 0.042$; $OR = 0.290$), responsibility to others ($p = 0.018$; $OR = 0.222$) with coal mine accidents in the production area of PT. XXX Kutai Timur. There is no relationship between work stress items role conflict ($p = 0.051$; $OR = 0.253$) with coal mine accidents in the production area of PT. XXX Kutim. It proves that

workstress, ambiguity of role, role conflict, quantitative overload, qualitative overload, career development, responsibility towards others are the protective factors for coal mine accidents.

There is a relationship between work skills ($p = 0.001$; $OR = 6.600$), work motivation ($p = 0.003$; $OR = 5728$), work SOPs ($p = 0.026$; $OR = 3.667$) and coal mine accidents in the production area of PT. XXX Kutai Timur. Job skills, Work motivation, Standard operating procedures are the risk factors of coal mine accidents.

TABLE III. BIVARIATE ANALYSIS

Variable	Coal Mine Accident				Total		p	OR 95% CL
	Case		Control		n	%		
	n	%	n	%				
Job Stress items Role Ambiguity								
Mild Stress	5	17.9	12	42.9	17	30.4	0.042 ^a	0.290 (0.085 - 0.985)
Moderate Stress	23	82.1	16	57.1	39	69.6		
Job Stress items Role Conflict								
Mild Stress	3	10.7	9	32.1	12	21.4	0.051	0.253 (0.060-1.065)
Moderate Stress	25	89.3	19	67.9	44	78.6		
Job Stress items Quantitative overload								
Mild Stress	1	3.6	6	21.4	7	12.5	0.043 ^a	0.136 (0.015-1.214)
Moderate Stress	27	96.4	22	78.6	49	87.5		
Job Stress items Qualitative overload								
Mild Stress	1	3.6	7	25	8	12.5	0.022 ^a	0.111 (0.013-0.975)
Moderate Stress	27	96.4	21	75	48	87.5		
Job Stress Career Development								
Mild Stress	5	17.9	12	42.9	17	30.4	0.042 ^a	0.290 (0.085-0.985)
Moderate Stress	23	82.1	18	57.1	39	69.6		
Job Stress Responsibility towards Others								
Mild Stress	4	14.3	12	42.9	16	28.6	0.018 ^a	0.222 (0.061-0.812)
Moderate Stress	24	85.7	16	57.1	40	71.4		
Job Skills								
Not Skilled	18	64.3	6	21.4	24	42.9	0.001 ^a	6.600 (2.011-21.661)
Skilled	10	35.7	22	78.6	32	57.1		
Job Motivation								
Low	19	67.9	8	28.6	27	48.2	0.003 ^a	5.728 (1.687-16.514)
High	9	32.1	20	71.4	29	51.8		
Standard Operating Procedure								
Not Good	14	50	6	21.4	22	39.3	0.026 ^a	3.667 (1.141-11.787)
Good	14	50	22	78.6	34	60.7		

^a Significant Variable

IV. DISCUSSION

This research is a case control study among coal miners in which the matching is done based on the sex and workplace groups to eliminate selection bias in the samples from among the workers in a coal company. All respondent workers are male. The questionnaires are administered through individual interviewers.

The study reports that a higher risk coal mine accidents is observed among older workers. Ageing results in a decrease in physical and mental abilities which may alter the quality

of work performance and the ability to notice work environmental hazards, particularly when the demanding level of the tasks is high. However, some discrepancies are found in some studies. Gauchard et al. find no difference for injuries due to falls [10]. Bazroy et al. reveal that younger subjects have higher risk [11]. Young age is associated to lack of knowledge, lack of experience, and risk taking behaviour [12]. Based on the result of the research, age is not considered as a risk factor. It might have been better to collect the samples by matching the age of the case group and the control group in the future research.

McShane and Von Glinow (2008) state that stress is an adaptive response to a situation that is perceived as challenging or threatening to the person's well-being. These events produce distress-the degree of psychological, psychological, and behavioral deviation from healthy functioning [13]. A combination of role conflict, role overload, and role ambiguity indicates work stress [14]. Role conflict refers to the degree of incongruity or incompatibility of expectations associated to a person's role. Role overload is the degree to which inadequate time,

An important finding of this study is that occupational stress is a protective factor for the occurrence of mining accidents. It means that if the workers do not experience work stress, the mine accident will not occur. Work stress management should be implemented so that work conflicts (role ambiguity, role conflicts) do not occur so that workers do not experience work stress. This finding is consistent with research finding of Bhattacharjee in which job stress is significant factors with accidents of Dumper Operators in Coal Mines in India [16]. Role ambiguity is related to coal mine accidents occurrence. It indicates that almost all respondents understand what is expected from their work. The respondents are also aware of their job responsibilities. They also know to whom they should report. This is not in line with ___[17] which shows that role ambiguity is not significantly related to work stress experienced by PT. XXX yet both are positively related. Karima argues that the absence of a significant relationship between the inaction of roles and work stress in that study can be influenced by job characteristics [16]. Role ambiguity is also related to obscurity in giving assignments to workers. Therefore, this can lead to frustration and difficulty for workers to achieve satisfaction in work [18]. Role conflicts are not related to work accidents. It indicates that the respondents also do the tasks accordingly. Based on a study conducted by Karima (2014), although role conflict has a high propensity scores, it is not significantly associated with work stress experienced by PT. XXX. This can happen since it is influenced by the differences in sample characteristics which can be affected with work culture implemented in a country. Role conflict usually occurs among individuals when the company's expectations are high for them. However, the high expectations make it difficult to achieve the tasks assigned. Role conflict is a general form of stressors that occurs in the workplace. This conflict usually arises when workers are required to behave in ways that are contrary to themselves. Pomaki et al. (2007) mention that role conflict is directly associated with emotional exhaustion, depressive symptoms, and somatic complaints [19]. Workers who suffer from more role conflict have lower job satisfaction and higher job tension [18].

Being physically or mentally overloaded by having to do too many things is a possible source of job stress. The element that gives rise to this quantitative overload is the pressure of time. Time in industrial society is a very important element. Each task is expected to be completed as quickly and accurately as possible. Time is a measure of efficiency [18]. Based on this study, quantitative overload is related to workplace accidents. However, it is a protective factor because most respondents do their work on time so they do not need to take them home. Some respondents also handle work projects in accordance with their respective responsibilities. The threat is the quantitative excess load

training and resources affect performance. Job-related stress has a negative effect on professional work and personal welfare. This includes low organizational commitment, low job satisfaction and a higher incidence of workplace accidents. Stressful jobs or increased intensity of occupational stressors may increase the risk of occupational injury [15]. Role Ambiguity refers to the lack of clarity and predictability of the outcomes of a person's behavior. Role ambiguity produces unclear role perception which directly affects job performance [13].

that has negative effect on the workers. During the analysis on the motion times for workers, they show a sense of calm and suspicion. The workers are not happy with the management's perception of telling them to do work mode in a shorter period of time. In some cases, such analysis results in a slowdown in work and sabotage. However, the pressure of time is a stress generator of organizations which in most cases should be accepted. This seems to be one aspect of organizational life [18]. Qualitative overload with advances in technology make life more diverse. The work done by humans increasingly shifts its emphasis to the work of the brain. Work is increasingly diverse. This diversity of work results in qualitative overload. The higher the diversity of work, the higher the stress. The diversity of work that should be done by a workforce can easily develop into a qualitative overload if the diversity requires higher technical and intellectual abilities than the ones possessed. Based on the results of the study, qualitative overload is related to workplace accidents. However, work stress items qualitative overloads are protective factors because some respondents are trained and have experience to carry out tasks adequately. The results of this study are in accordance with Setyowati's research, in 2015 which found that perceptions of workload are not related to work stress [20]. Everly & Girdano (1980) in Munandar (2008) reveal that job diversity usually increases due to some factors, such as increase of the amount of information, sophistication of information, expansion of alternatives to work methods, and introduction of contingency plans. At some point, the plurality of jobs is no longer productive but destructive. At that point, workers have passed their ability to solve problems and reason in constructive ways. There is mental fatigue and emotional and physical reactions. This is all a form of stress [18].

Career development refers to work activities carried out over time which can involve several jobs and various jobs over time. Everly & Girdano in Munandar (2008), consider that to generate job satisfaction and prevent frustration in the workforce (which is a form of reaction to stress), it is necessary to pay attention to important elements in career development. Based on the results of the study, it is found that work stress items in career development are related to workplace accidents. However, work stress items in career development are protective factors because respondents feel that they are not harmed by settling on the organization currently underway. The respondents also consider that they still have adequate opportunities to advance in the organization currently underway [18]. This is in line with Nugraha's research (2013) in which there is a relationship between career development and work stress. Respondents consider that they are less likely to get a promotion. They work as temporary employees who are paid according to the results of the stitches made. This can lead to feelings of job insecurity or uncertainty which eventually become career

development stressors [21]. Career development is a potential stress generator that includes job uncertainty, over promotion and lack of promotion. Fear of losing a job, the threat that his job is deemed unnecessary is an ordinary thing that happens in working life. Environmental changes create new problems that can have an impact on the

others. Wardwell et al. (1964) in Munandar (2008) reveal that holding responsibility for other people can significantly trigger coronary heart disease compared to holding responsibility for objects [18]. In this study, it is found that work stress responsibility items toward other people are related to workplace accidents. However, it is a protective factor since some respondents assume that guiding and helping subordinates in completing their tasks is not a responsibility that should be undertaken. Respondents also consider that other people's careers are not their responsibility. This is in line with the research conducted by Karima (2014) in which the variable responsibility for others are negatively related to work stress experienced by workers at PT. XXX. This shows that the amount of responsibility carried out by workers does not affect the increase in work stress experienced by workers [17]. Karasek and Theorell (1990) in Munandar (2008) state that responsibility usually always goes hand in hand with the ability of workers to control their work. High responsibility is accompanied by the ability to control. It is able to reduce work stress experienced by workers [22].

Soehatman (2010) states that competency is an important requirement to ensure that the work has been done well, followed applicable work standards and met safety requirements. Competency can be obtained through education, training and adequate experience in carrying out tasks or activities. To achieve this, companies ought to have competency standards for each job [22]. In this study, it is found that working skill is related to workplace accidents. The authors recommend in the future that companies can improve work skills through the provision of education and training. Working skill is a risk factor because some respondents still carry out unsafe actions, such as parking too close and in the blind spot area, placing items in the cabin, operating the unit while doing other activities and operating units in a state of fatigue. The result of this research is in line with Aswadi's among drilling workers, it reveals that partially human factors significantly affect employee work accidents; the higher the human factor, the higher the level of workplace accidents. More than 60% of respondents agree and strongly agree that workplace accidents are caused by the lack of some skills. They also agree that the expertise of employees in carrying out work, and the lack of companies in providing education and training to employees affect the workplace accidents [24]. Even though the skills of workers are high, the possibility of an accident still exists. With skills, the work is carried out reflexively through habit. Therefore, the safety aspect is neglected. This is especially true for a repetitive work, especially if the time factor is crucial. As far as possible, the elements of safety can be included in these repetitive work habits. Soehatman (2010) also argues that many accidents occur because workers do not have sufficient competency at work. This competency includes mastery of knowledge and skills and attitudes and behavior in working according to the level of expertise based on the possessed skills. OHSAS

company. Reorganization is felt necessary to be able to deal with environmental changes in better way. As a result, there are old lost jobs and new jobs [18].

Responsibility is a source of stress that comes from the role in the organization. Responsibility in the work is divided into two, responsibilities for objects and towards

18001 requires organizations to ensure that every individual who carries out work or activities that have an impact on K3 has the competence to carry it out [22].

Motivation theory is a core theory of the behavioral science which is used for dealing with relationship of need, motive, objective and behavior. The behavioral science thinks that the person's motive comes from need and need confirms people's behavioral objective. As a kind of inner activity, motivation plays the function of inspiring, driving and strengthening human behaviors. Therefore, motivation can be defined as a kind of process that influences person's innate need or motive for the sake of given purpose. Thus, it strengthens, leads or changes people's behavior to be advantageous to the organizational objective development [12]. Safety motivation in Liu, 2012, is indicated comprehensively using modern scientific principles and methods of management science, economics and so on. The purpose is to prevent accidents and disasters, guarantee systems operation at the acceptable safety level, and reasonably motivate the person in the system. Thus, it leads and controls its behavior to match safety norms. It not only promises an individual safety but also promises the safety of organization (business enterprise) environment or even social safety [24]. In this study, it is revealed that work motivation is related to workplace accidents. The authors recommend that the companies can improve work motivation through rewards and sanctions for workers in the future. Work motivation is a risk factor because some respondents consider doing good work only when there is overtime. Some respondents also consider working, not only when their conditions are good, but also when they are tired and lethargic. This result is in line with a research done by Margaretha (2014) which finds that work motivation possessed by each individual also greatly affects the quality of work. Although there are adequate facilities, good organization and management, and good work procedures, without high motivation, it is difficult to produce good work results. Motivation to do work in accordance with procedures is needed to fit the company's goals and guarantee safety for the workers themselves [8]. One of the most important things to consider for individuals to behave is motivation. The motivation of a person will affect whether he will do each task properly or vice versa, and whether he will behave safely or not. Efforts need to be made so that workers behave safely and improve the quality of K3 services to all employees. Therefore, wider and more tangible benefits can be obtained directly by the workforce. This effort can increase the motivation of employees to better understand and implement OSH principles and norms. Then, the final results would be the increase of the efficiency and productivity of the workforce.

In terms of work, following a procedure is something that is highly expected so that no incidents can be detrimental. However, some workers still do not care about it. Obedience to do work in accordance with the standards is certainly very

expected. If in reality all workers obey it, the risk of incidents will certainly decrease. Jobs carried out by an operator in carrying out their duties are sometimes not separated from the activity of operating the unit to facilitate a job. The condition of the unit being operated certainly has an influence on the course of a job. The condition of a unit that is not good or damaged can create a dangerous condition and when used, it is considered as unsafe actions. This study shows that standard operating procedures are related to workplace accidents. In the future, the authors recommend that companies can improve control and supervision of standard operating procedures. It is a risk factor. Some respondents at the time of carrying out the work bore a risk yet they continue to do the work individually or even in groups. Sometimes respondents also work using excessive physical abilities. This is in line with the research conducted by Raja (2018) which finds that there is a meaningful relationship between compliance with procedures and workplace accidents. Raja argues that many workers do not follow work procedures. They often converse while working so they are not focused on working. Meanwhile, the machines, such as wood cutting machines and press machines, are dangerous. Thus, there have been accidents, such as being hit by cutting machines or pinched by wood press machines [26].

Information obtained at work is very important if the work carried out carries a high risk of work. Information about hazard risks in the workplace can reduce the impact of workplace accidents if workers really care about workplace accidents. Many workers still set aside reading and recognizing Job Safety Analysis (JSA), i.e. the work procedures in carrying out their work. It makes them less informed about any hazard risks that exist in the workplace and not doing work according to applicable procedures. It can cause an accident. A similar study is also conducted by Siregar (2014) which reveals that there is a relationship between compliance with procedures and minor work accidents in which p value is 0.000. This indicates that the more disobedient the respondent, the higher the accident and vice versa [27]. It is in line with the research conducted by Rangga conducted among 78 workers in the Mining Support Division in which the results of the study show that there is a correlation between SOP compliance and the incidence of finger injury ($p = 0.033$). Rangga mentions that respondents have been good at adhering to SOPs but experiencing finger injuries. It can happen due to certain situations that allow a worker to do so. Many also do things that do not fit the SOP so that the risk of incidents is higher [9].

V. CONCLUSION

It can be concluded that the risk factors for the occurrence of mining accidents in the production area of PT. XXX Kutai Timur are work skills, work motivation, and standard operating procedures (SOP).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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