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ANALYSIS OF THE CAUSES OF OCCUPATIONAL ACCIDENTS IN NICKEL MINING ACTIVITIES IN MOROWALI

Mohammad Sakti, Nirmalawati and Sukardan Tawil
Master's Program in Civil Engineering, Postgraduate Program, Tadulako Universitas University, Indonesia
E-Mail: m.saktif11219007@gmail.com

ABSTRACT

The development of the nickel mining industry in Morowali Regency has brought progress to the economy of the region, but the phenomenon is that there are frequent accidents and occupational diseases. So the purpose of this study is to determine the main factors causing work accidents and how to control and minimize work accidents in nickel mining in Morowali. The type of research is descriptive research, the population in this study are all 50 employees actively working in nickel companies. The research used *purposive sampling technique.*Collecting data using the technique of distributing questionnaires and documentation. Data analysis with factor analysis method. Based on the results of the study, it was found that ten factors were the basic causes of work accidents in the nickel mining activities of PT. XX in Morowali, the ten factors are: low knowledge and physical weakness of workers, dangerous equipment, lack of worker competence, not implementing occupational health and safety management system procedures, lack of experience, carelessness of workers, unsafe work methods, working too fast, lack of maintenance occupational health and safety equipment and unforeseen circumstances, and dispose of hazardous objects carelessly. The most influential factor is the low level of knowledge and the physical weakness of workers. How to control and minimize the risk of work accidents in nickel mining activities in Morowali, namely (a) Eliminate the risk of work accidents by not using equipment that is not suitable for use. (b) The company strives to improve the ability of workers, especially in mastering various equipment with more modern specifications. (c) Take efforts to prevent work accidents through controlling hazards in the workplace such as monitoring and controlling unsafe conditions, as well as unsafe actions in the workplace. (d) Encouraging consistency of workers to use safety equipment, especially personal protective equipment. (e) The company participates in helping to improve the competence of employees or mining workers with various activities. (f) The company provides vacation time to employees, which is accompanied by bonuses. (g) Preventing work accidents through management systems such as administrative control, namely by conducting periodic safety inspections of equipment, conducting safety induction, ensuring that forklift operators have the required licenses, providing work instructions, placing workers according to their expertise. Make rules for occupational health and safety in the workplace (SOP and JSA); provide facilities and infrastructure for occupational health and safety and their supports in the workplace. (h) Using personal protective equipment, this equipment serves to protect or protect all or part of the worker's body from potential hazards in the workplace, personal protective equipment in the form of safety clothes, safety shoes, protective glasses, earplugs (ear protection), and safety gloves.

Keywords: factor, work accident, nickel mining.

1. INTRODUCTION

The mining sector is one of the pillars of a country's economic development, because its role as a provider of mineral resources owned by the country is indispensable for the economic growth of a country. This has the potential to grow new companies in the mining sector. Companies engaged in the mining sector from year to year experience additional companies. This indicates that companies in the mining sector have good prospects for continuing to develop in improving the country's economy.

The mining environment itself is also a challenge because they are changing rapidly as mining is sustainable. Dust and noise are inherently associated with rock breaking and excavation processes. The use of explosives and the mining process itself often releases harmful gases into the surrounding environment. Apart from environmental factors, hazards associated with working conditions and methods are also important factors in mining. For example, ergonomic problems are a common problem for mining workers who are assigned to handle heavy equipment and also do heavy work (Nasution, 2015).

But on the other hand the mining sector is one of the main contributors to accidents and occupational diseases, which has caused the mining sector's reputation as the most dangerous industrial sector. Accidents that occur in the mining industry are referred to as mining accidents, this is regulated in laws and regulations related to minerals and coal. Cases of work accidents / mining accidents in several areas, including the Morowali Regency, Central Sulawesi Province, are very high, as in the data that the author obtained that there have been several work accidents in the mining site area in Morowali Regency, such as a worker being hit by equipment causing serious injuries. on the head, there has also been an accident where the *Wheel Loader* used to push soil material was buried by landslides, work accidents / mining accidents resulted in death where the victim fell into a ravine with the unit being driven (Tabrani, 2017).

In Indonesia, until now there are still many work accidents experienced by workers. According to the KPMB Sub-Directorate of the Ministry of Energy and

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Mineral Resources (2020) within a period of 5 years, Indonesia has succeeded in significantly reducing the *frequency rate* (FR) of mining accidents. In 2016, the FR of Indonesian mining accidents was 1.00, then decreased gradually to 0.70 in 2017, 0.68 in 2018, 0.69 in 2019 and 0.40 in 2020. Then from the data Mining accidents stated that in 2015 to 2019 the number of mining accidents in the fatal category occurred very little, even in 2015 to 2017 there was a decrease in work accident cases, until then there was an increase in cases in 2018 and 2019 (Directorate of Engineering and the Environment Mineral and Coal, Ministry of Energy and Mineral Resources, 2020).

On the other hand, the amount of coal and mineral production increased significantly. Indonesia's total coal production in 2006 was 196,538,000 tons, increasing to 216,930,000 tons in 2017, 240,000,000 tons in 2018, 259, 999, 112.53 tons in 2019, and 275, 000, 000 tons in 2020. So In addition, Indonesia's mineral production, such as copper, gold, silver, nickel ore, Ni+CO in matte, ferronickel, bauxite and iron ore increased significantly.

The rapid development of the nickel mining industry in Morowali Regency has brought progress to the region's economy, but on the other hand, phenomena related to accidents and occupational diseases in the mining industry also often occur, based on information obtained by researchers, in recent years there have been many work accidents. at several nickel mining companies in Morowali, meanwhile citing BPJS claim data during January-September 2019, SPIM said that there had been 154 cases of work accidents in nickel-based industrial areas in Morowali Regency, Central Sulawesi Province (source: https://www.beritasatu .com/). An example of a case that occurred on November 24, 2019 resulted in death, the victim died being run over by a water tanker truck wheel on the mine road access due to the brakes not functioning properly, after an investigation into a mining accident (work), it is suspected that the worker died due to the weak application of the related SOP K3 applied by the company. The victim lacks knowledge in analyzing potential accidents so that there is an unsafe condition that makes the victim jump from the unit that is still running at high speed. (Accident inspection report by Central Sulawesi Mining Inspector, 2019), In addition, in 2021 there will also be work accidents / mining accidents resulting in death. So based on the above, the researchers will conduct research with the aim of analyzing the factors that cause work accidents in Nickel mining activities in Morowali. (Accident inspection report by Central Sulawesi Mining Inspector, 2021)

2. PREVIOUS RESEARCHER

The following is a previous study in the form of several journals related to the research conducted by the author.

Latuconsina (2019), with the title "Factors Affecting Work Accidents in Employees at PT. Maruki International Indonesia Makassar Year 2018". The purpose of this study was to analyze the determinants of the occurrence of work accidents at PT. Maruki International Indonesia Makassar Year 2018 in terms of respondent characteristics, work attitudes and knowledge. The type of research used is analytic observational with a cross sectional study approach. The sampling technique was *purposive sampling* as many as 84 using the Slovin formula. Data was collected by observing the work environment and questionnaire instruments. The results showed that there was a relationship between variables, attitudes and knowledge with work accidents on employees of PT. Maruki International Indonesia. Attitude and knowledge variables must receive special attention to prevent work accidents at PT. Maruki International Indonesia. It is hoped that the company will provide OSH socialization in the form of posters that are easy and clear to read and attract attention. The company must also update the job safety analysis if there is a change in the work process.

Kristiawan (2017), with the title "Factors Causing Work Accidents in the Limestone Mining Area of PT. Heavy Equipment Unit. Semen Padang". The purpose of this study is to determine the factors that cause accidents and potential hazards that can cause accidents at PT. Padang Cement. Based on data obtained from the company, almost all work accidents that occur at the limestone mining site of PT. Semen Padang is caused by the low knowledge of employees and inadequate communication facilities. Estimated work accidents at PT. Semen Padang is the existence of rules regarding Occupational Safety and Health (K3) that have not been implemented properly.

Ariani (2019), with the title "A Case Study of Work Accidents at Coal Mining Operators PT. X in South Kalimantan". This study aims to obtain an overview of work accidents at mining operators at PT X. This research was conducted using a qualitative method using a case study approach. The research subjects were 9 people consisting of 3 subjects of hauling operators, 3 group leaders, and 3 supervisors of PT. X. Based on the results that have been carried out, it is known that work accidents occur due to environmental factors, one of which is due to the lack of lighting in the traffic lane and human factors, where the mining area is adjacent to residential areas and employee working time which affects psychological conditions. It can be concluded that the human factor and the environment is one of the indicators of accidents in mines stone coal PT XX. By because it needs to be done repair environmental systems and human behavior.

Iqbal (2021), with the title "Analysis of Factors Causing Work Accidents in Mining Workers". This research is a systematic review (*Systematic Review*) using the PRISMA (*Preferred Reporting Items for Systematic Review and Meta-analysis*) method. The percentage of causes of work accidents is 100% due to education level, 67.67% working age, 47% working time, 77.78% K3 knowledge and 55.56% behavior that does not use personal protective equipment (PPE). The biggest factor causing accidents in the mining industry is the level of education, which is 100% and the smallest is due to age of

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work, which is 47%. Mining companies should conduct OSH training for workers who have just entered work and employees who have worked in their company. The company must evaluate the causes of accidents that occur and document every accident that occurs.

Jeferson (2018), with the title "Analysis of Potential Hazards Using the *Job Safety Analysis* Method in the Shipping Section of the Pakal Site of PT. Aneka Tambang Tbk. UBPN North Maluku". The purpose of this study was to analyze the potential hazards at the ore treaming process stage in etobuli, the material transfer stage on the hauling road to the barge and the material arrangement stage on the barge. Research method: The research method used in this study is a qualitative research type by interviewing 5 informants consisting of managers, supervisors, formants, excavator operators and dumptruck operators. The data is presented in the form of writing or sentences based on the JSA, in-depth interviews, observations, recordings, notes and documentation. Result: The dangers in the ore treaming process in etobuli are being crushed, pinched, electrocuted and noisy. The types of hazards involved in collision, unit tripping over a rock, unit slipping, unit falling rock, unit hitting an embankment, and Rump door breaking. The types of hazards encountered in the material arrangement stage on the barge workers are electrocuted, noise, and the unit slips from the ore pile. Suggestion: The advice given is that supervision of the work process must be improved so that workers do not do things that deviate from the provisions that have been given, such as obeying vehicle speed signs.

Rinawati (2018), with the title "The Level of Worker Safe Behavior with the Approach of Implementing the PT BBB East Java Hot Work Permit". The purpose of this study was to determine the level of worker's safe behavior with the approach of implementing a hot work permit at PT. BBB East Java. The research method is by describing (observational descriptive) data from research results through data, interviews and direct observations as they are by analyzing data on safe behavior and work permit systems in hot work. The results of the data collection obtained will be analyzed with laws and related references. Results: This study informs about the level of safe behavior of workers in hot work in the good category (70%) on the application of the hot work permit system has met applicable regulations and based on the results of the assessment 70-98% is in good category, but there are still obstacles in the documentation system, PPE and sanctions/rewards.

Garcıa (2019), with the title "Psychosocial *and Ergonomic Conditions at Work: Influence on the Probability of a Workplace Accident"*. The purpose of this study was to analyze the relationship between working conditions and the probability of having an accident at work, selecting individual variables from the ergonomic conditions of postal work and the psychosocial aspects of workers. It was concluded that the ergonomic risks associated with physical strain in the workplace, together with a lack of job satisfaction on behalf of the employer, both gave rise to a highly significant increase in the likelihood of being involved in a work accident, over the other study variables.

Nai'em (2021) with the title "*Trend analysis and projection of work accidents cases based on work shifts, workers age, and accident types*". The purpose of this study was to examine cases of work accidents during the period (2009–2022) based on work shifts, age of workers, and types of accidents. Methods: The research design is a *time series* design with work accident data in the 2009-2015 company period as the population. Results: The work shift variable in 2009–2015 was dominated by work accidents in the morning shift and night shift by 0.47%. After the projection, it is known that work accidents that occur during shifts will decrease from 0.22% to 0.11%. For 2009-2015, accidents were dominated by the age group >50 years with a percentage of 0.52%. In 2022 for this category it fell 0%. For work accidents that occurred in 2009-2015, the most cases fell from a height with a percentage of 0.76-0.17%. After seven years, the projection results obtained that the highest results turned into work accidents with hazardous substances with a percentage of 0.17% in 2016 and increased to 0.30% in 2022. Conclusion: Trends and predictions from 2016 to 2022 are a decrease in accidents work based on work, a decrease in accidents based on the age of workers, as well as a decrease in the type of accident variable.

Tortorella (2020), with the title "*Design of a methodology to incorporate Lean Manufacturing tools in risk management, to reduce work accidents at service companies*". The aim of this research is to integrate Lean Manufacturing tools in risk management to help control work related accidents. Based on work accident data in service companies, the causes of accidents were analyzed with the main *Lean Manufacturing* tools reviewed and integrated, to develop a new methodology for implementing these tools to help prevent accidents and occupational diseases and to develop a culture of self-care. The results show that risk mitigation and control to reduce the accident rate where most of the tools used today can contribute to this goal.

Kim (2021), with the title "Analysis of industrial accidents causing through jamming or crushing accidental deaths in the manufacturing industry in South Korea: Focus on non-routine work on machinery". This study analyzes accidental deaths caused by *jamming* or *crushing* during non-routine work, in the manufacturing industry from 2014 to 2018. The analysis was conducted on 203 cases of non-routine work among 359 deaths. In South Korea, where heavy industry and chemical industry have flourished, many accidental deaths due to non-routine work have been reported under this condition. Non-routine work accounted for 56.5% of jamming accidents, which were caused by seven main equipment such as *conveyors*, mixers, food manufacturing equipment, crushing machines, injection molding machines, *press* machines, and industrial robots. In addition, employees do not fully comply with basic safety rules, such as not turning off the power or using *lockout-tagout* (LOTO), during maintenance work. Finally, various

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measures are proposed to prevent accidental deaths resulting in non-routine work.

3. RESEARCH METHOD

This study aims to determine the main factors that cause work accidents and how to control and minimize work accidents in nickel mining in Morowali. Data collection methods in this study consisted of questionnaires and documentation (documents and photos). The data analysis method in this study is quantitative statistical analysis techniques using *Statistical Product and Service Solution* (SPSS) software. This analysis is a number-based data analysis (which includes categorical and numeric data) using various statistical techniques. The test data instruments used in this study were validation tests, reliability tests and factor analysis. The population in this study are employees who work at the company PT.XX. The sample in this study were 50 respondents who were employees who worked on field activities using *purposive sampling technique.* Determination of the number of samples in this study refers to the opinion (Sugiyono 2014).

4. RESULTS AND DISCUSSIONS

Identification of the basic causes of work accidents in nickel mining activities in Morowali conducted by researchers on existing data at the company PT. XX, and its contractor company, namely PT. XX1, PT. XX2, and PT. XX3 of the variables that became the basis for the occurrence of work accidents in nickel mining activities in Morowali which were sourced from the results of these observations. The data shows that there are 3 (three) variables and 6 (six) sub-variables, and developed into 30 (thirty) indicators or factors that are suspected to be the basic cause of work accidents in nickel mining activities of PT. XX in Morowali. So to simplify these factors, and obtain results regarding the most dominant factor or the highest influence on the basis of the occurrence of work accidents in nickel mining activities, it can be done through a factor analysis process which first tested the validity and reliability of the instruments used in the study. this. (a) Validity testing in this study was conducted by correlating the score of each item statement addressed to the respondent with the total score for all items. This study examines the results of the respondents' answers as many as 50 respondents were involved, with a *confidence interval* of 95% or a *level of significance* (α) = 0.05, so that the r table value of 0.279 was obtained. (b) Reliability test Reliability testing is carried out on statement items that are included in the valid category. Reliability testing is done by testing the instrument only once. Then analyzed using the *Cronbach alpha* method with values varying above 0.7 for each variable. The questionnaire is said to be reliable if the reliability coefficient is positive and greater than 0.6. Calculations are carried out with the help of the SPSS computer program, (c) Factor analysis from factor analysis data, there are large numbers of variables grouped in a number of factors that have almost the same nature and characteristics, making it easier to process. Grouping is done by measuring the correlation of a set of variables and then placing the variables with a high correlation in one factor, and other variables having a lower relative correlation in other factors. Factor analysis in this study using the *Kaiser Meyer Olkin test. Measure of Sampling* (KMO) was used to measure the adequacy of sampling (*sampling adequacy*). This index compares the magnitude of the observed correlation coefficient with the partial correlation coefficient. A small KMO value indicates that the correlation between pairs of variables cannot be explained by other variables and factor analysis may not be appropriate. Furthermore, the *Measure of Sampling Adequacy* (MSA) test is used to measure the homogeneity between variables and perform filtering between variables so that only variables that meet the requirements can be processed further. Factor analysis will be appropriate if the KMO value obtained is >0.50. To test the accuracy of the factor model, there is a formal statistic, namely *Bartlett's test of sphericity,* that the variables are uncorrelated in the population. While the MSA test if MSA = 1.0 the variable can be predicted without error by other variables, MSA > 0.5 the variable can still be predicted and can be analyzed further and if MSA < 0.5 the variable cannot be predicted and cannot be analyzed further or must be excluded. In this study, the KMO test and MSA test were carried out twice, the first test was the KMO and *Barlett's test* scores were 0.756 with a significance value of 0.000, because these figures were already above 0.5 and the significance was far below 0.05 (0.000 < 0 ,05). For the first test value of the MSA Test of 30 factors, there are 2 factors that have an MSA value below 0.5, which means that the factor does not meet the MSA requirement limit, for that the 2 factors will be removed from the matrix and the test will be repeated again. In the second test, the KMO value was obtained at 0.781 with a significant value of 0.000, the number was already above 0.5. Then the second MSA test was carried out so there were 28 factors that met the criteria from the previous 30 factors, these results showed all MSA was above 0.5 and could be analyzed further. The *communality* estimation test explains how much the value of diversity or variation of the original item/variable can be explained by the formed factor with a value > than 0.5 which is obtained by adding up the eigenvalues of the existing factors. From the results of the study, it can be seen that as many as 28 variables have communal values above 0.5, so that all of these variables can be tested using further factor analysis. Determination of the number of factors used to determine the number of factors obtained in this study is based on the eigenvalues of variance presentation and scree plot. The factor will be formed from components that have an *eigenvalue* with an *eigenvalue* >1 criteria. The number of factors formed from the extraction results showed that there were 7 factors formed from the 28 factors that were entered. Each factor *eigenvalue* > 1. In the *Total Variance Explained* data above, it shows that there are 7 factors formed from the 28 sub-factors entered. Each factor *eigenvalue* > 1.

a) Factor1 eigenvalue of 11.522 with Variance (41.152%)

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b) Factor 2 *eigenvalue* of 2.684 with *Variance* (9.587%)
c) Factor 3 *eigenvalue* of 2.153 with *Variance* (7.691%)
d) Factor 4 *eigenvalue* of 1.532 with *Variance* (5.471%)
e) Factor 5 *eigenvalue* of 1.285 with *Variance* (4,589%)
f) Factor 6 *eigenvalue* of 1.178 with *Variance* (4,209%)
g) The *eigenvalue* factor is 1.115 with Variance (3.982%)

Can be seen in the following table

Table-1. Factor extraction results total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loading			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11,522	41,152	41,152	11,522	41,152	41,152	4,584	16,372	16,372
2	2,684	9.587	50,738	2,684	9.587	50,738	4,399	15,711	32,084
3	2,153	7,691	58,429	2,153	7,691	58,429	3,791	13,540	45,624
4	1.532	5.471	63,900	1.532	5.471	63,900	2,974	10,622	56,245
5	1.285	4,589	68,490	1.285	4,589	68,490	2.365	8,446	64,692
6	1.178	4.209	72.698	1.178	4.209	72.698	1,870	6.677	71.368
7	1.115	3.982	76,680	1.115	3.982	76,680	1.487	5.312	76,680
8	0.985	3,517	80,197						
9	0.921	3.290	83,487						
10	0.719	2,566	86.053						
11	0.589	2.104	88.157						
12	0.568	2,029	90.186						
13	0.466	1,663	91,850						
…….	…….	…….	…….						
…….	…….	…….	…….						
…….	…….	…….	…….						
…….	…….	…….	…….						
24	0.056	0.200	99,636						
25	0.032	0.113	99,750						
26	0.029	0.104	99,853						
27	0.024	0.086	99,939						
28	0.017	0.061	100,000						
Extraction Method: Principal Component Analysis.									

The *eigenvalues* describe the relative importance of each factor in calculating the variance of the variables being analyzed. The total variance if all the variables are extracted into 10 factors are:

41,152 + 9,587 + 7,691 + 5,471 + 4,589 + 4,209 + 3,982 = 76.680%

The amount of *variance* that can be explained by the newly formed factor is 76.680% while the remaining 23.320% is explained by other factors not studied. The vector extraction can be seen in the following image

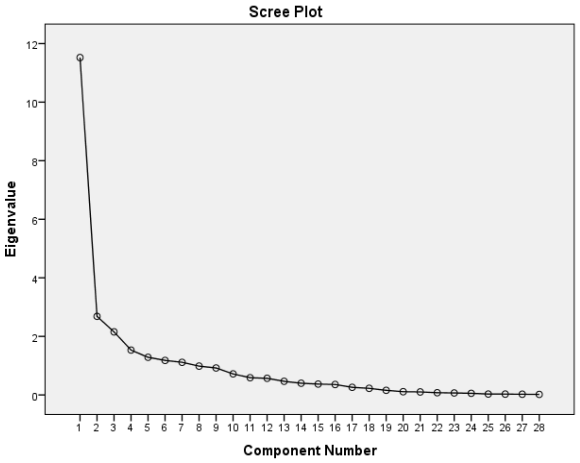

Figure-1. Scree Plot.

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Then carried out the *varimax* method which focuses the analysis on the simplification of the factor matrix column. After knowing that the formed factor is 7, the previous data *Component Matrix* after rotation shows the distribution of 28 variables to the 7 formed factors.

Table-2. Component matrix after rotation.

Rotated Component Matrix [a]							
	Component						
	1	2	3	4	5	6	7
F1	0.321	0.458	0.688	0.238	0.038	0.239	0.054
F2	0.160	0.092	0.042	0.778	0.191	0.178	-0.204
F3	0.084	-0.123	0.451	0.042	0.440	0.272	0.469
F4	0.522	0.290	0.333	-0.030	0.237	0.158	0.194
F5	0.002	0.124	0.149	0.911	0.164	0.071	0.062
F6	0.171	0.335	0.255	0.324	0.118	0.720	-0.106
F7	0.253	0.186	0.061	0.176	0.859	0.043	0.081
F8	0.248	0.464	0.688	0.205	0.122	0.207	0.067
F9	0.508	0.466	0.581	0.253	0.086	0.027	0.158
F10	0.577	0.249	0.279	-0.089	-0.119	-0.054	0.191
F12	0.474	0.317	0.562	0.176	-0.008	0.048	0.213
F13	0.015	0.184	0.133	0.928	0.090	0.048	0.094
F14	0.692	-0.129	-0.192	-0.087	0.131	0.319	0.048
F15	-0.051	0.656	0.297	0.186	-0.027	0.080	-0.039
F16	-0.039	0.587	0.474	0.083	-0.084	0.279	0.153
F17	0.149	0.128	0.148	0.315	0.857	0.037	0.005
F18	0.524	-0.081	-0.146	0.007	-0.443	0.211	0.324
F19	0.084	0.164	0.001	-0.026	0.030	-0.082	0.867
F20	0.109	0.299	0.199	0.097	-0.021	0.826	0.005
F21	0.317	0.795	0.159	0.072	0.197	0.152	0.028
F22	0.762	0.169	0.201	0.159	0.109	0.133	-0.227
F23	0.735	0.214	0.153	0.154	0.307	-0.101	0.015
F24	0.449	0.741	0.132	0.123	0.214	0.087	0.082
F25	0.755	0.387	0.338	0.099	0.158	0.025	0.021
F26	-0.015	-0.015	-0.581	0.017	-0.183	-0.006	0.182
F27	0.198	0.374	0.662	0.195	0.032	0.263	0.113
F28	0.536	0.421	0.501	0.213	0.123	0.095	0.209
F30	0.294	0.798	0.094	0.130	0.178	0.217	0.104
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.							
a. Rotation converged in 12 iterations.							

The *loading* value identifies the correlation between variables and the formed factors. The higher the loading value means the closer the variable is to the factor. From the table above, the rotational factor group shows that all variables make up a factor based on the largest *loading* value. For example, factors 4, 10, 14, 18, 22, 23, 25, and 28 have the largest *loading* value in column 1 when compared to their values in other columns, as the researcher puts a bold line on these numbers which indicates that the five factors have the closest relationship

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with factor 1, so that the five factors are included in the first factor group. The results of rotation on the *Component Matrix* show that all variables have factor groups, some variables that were previously not clear on what factor, after rotation, these variables are in the factor group that has the largest *loading* value. After the factors are actually formed, each of which consists of several sub-factors under study, then the naming of the new factors formed is carried out based on the characteristics in accordance with the sub-factors. The naming of factors is done by looking at the things that underlie and adequately represent the properties of the sub-factors that are collected in one factor. The steps that can be taken are to apply generalizations to each of these sub-factors. XX in Morowali, are 7 (seven) factors that have just been formed from the results of factor analysis, the seven factors include lack of competence, unsafe attitudes and conditions, lack of awareness of Occupational Health and Safety, equipment condition factors and worker conditions, factors lack of worker experience, work method factors, and lack of vigilance. The most influential factor based on the *variance* value is the lack of competence factor with a *variance* value of 41.152%. In addition, this group of factors also has the highest total loading value, so it is considered to have the greatest or most significant influence on the cause of work accidents in the nickel mining activities of PT. XX in Morowali.

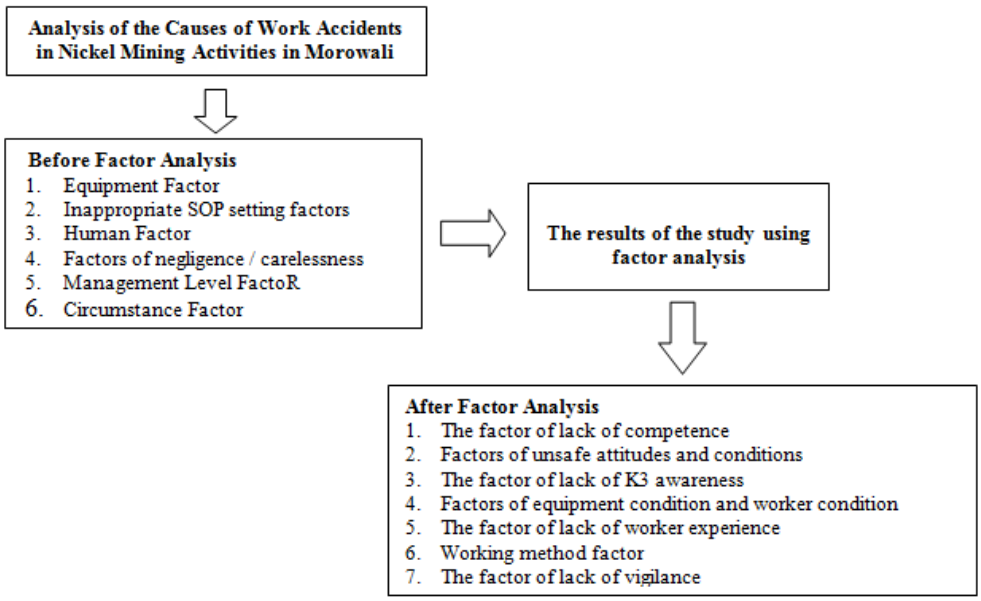

Figure-2. Diagram of research results before and after factor analysis.

After carrying out various processes or stages of factor analysis using SPSS version 24.00 application rock, the extraction results from several sub-factors that previously reached 30 have now become 28 sub-factors, and then grouped into seven factors that cause work accidents in nickel mining activities in Indonesia. Morowali, the four factors are:

a) The factor of lack of competence has a *Variance* value of 41.152%
b) Factors of unsafe attitudes and conditions with a *Variance* value of 9.587%
c) The factor of lack of K3 awareness with a *Variance* value of 7.691%
d) Equipment condition factor and worker condition with *Variance* value 5,571%
e) The factor of lack of work experience with a *Variance* value of 4.589%
f) Working method factor with a value of 4.209% *Variance*
g) Lack of awareness factor with a *variance* value of 3.982%

5. CONCLUSIONS AND SUGGESTIONS

Based on the results of research and discussion, there are 7 (seven) basic factors causing work accidents in nickel mining activities of PT. XX in Morowali, The most influential factor is the lack of competence with a value with a *variance* value of 41.152%. How to control and minimize the risk of work accidents in nickel mining activities in Morowali, namely (a) Eliminate the risk of work accidents by not using equipment that is not suitable for use. (b) The company strives to improve the ability of workers, especially in mastering various equipment with more modern specifications. (c) Take efforts to prevent work accidents through controlling hazards in the workplace such as monitoring and controlling unsafe conditions, as well as unsafe actions in the workplace. (d) Encouraging consistency of workers to use safety equipment, especially personal protective equipment. (e) The company participates in helping to improve the

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competence of employees or mining workers with various activities. (f) The company provides vacation time to employees, which is accompanied by bonuses. (g) Preventing work accidents through management systems such as administrative control, namely by conducting periodic safety inspections of equipment, conducting safety induction, ensuring that forklift operators have the required licenses, providing work instructions, placing workers according to their expertise. Make rules for occupational health and safety in the workplace (SOP and JSA), provide facilities and infrastructure for occupational health and safety and their supports in the workplace. (h) Using personal protective equipment, this equipment serves to protect or protect all or part of the worker's body from potential hazards in the workplace, personal protective equipment in the form of safety clothes, safety shoes, protective glasses, earplugs (ear protection), and safety gloves. .

Based on the conclusions that have been obtained from this research, it can be put forward some suggestions from the research as follows:

a) It is expected to increase the quantity of training on occupational safety and health for new and existing employees and provide continuous socialization regarding occupational health safety. As well as maintaining or maintaining vehicles and machine tools so that they remain in good condition and do not endanger employees at work.

b) The company pays more attention to the procedures for implementing occupational safety and health and provides continuous understanding to employees so that they comply with the use of personal protective equipment for work safety.

c) Improve the performance of the Head of Mining Engineering or leaders at the site (project area) so that they can carry out their duties properly in the application of occupational health and safety.

d) That in this study, the researcher did not conduct a review of material factors; therefore the researcher recommends that future researchers add material factors in further research.

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