World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Level of safety performance achievement / safety maturity level in nickel mining: Study at PT. Putra Perkasa Abadi Jobsite MLP Southeast Sulawesi

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World Journal of Advanced Research and Reviews, 2023, 20(03), 201–210

Publication history: Received on 20 October 2023; revised on 27 November 2023; accepted on 30 November 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.20.3.2441

Abstract

Background: Occupational Safety and Health in Mining are all activities to guarantee and protect workers to be safe and healthy through efforts to manage work safety, work health, work environment, and work safety and health management systems. The work process in mining has high potential for danger and risk, for this reason, safety, occupational health and environmental aspects are requirements that must be met in every work activity. This study aims to measure the level of *Safety Maturity Level Assessment* on workers in each department and employee level at PT. Putra Perkasa Abadi (PPA) site Makmur Lestari Primatama (MLP).

Method: This type of research is quantitative descriptive. In this research, there are 4 indicators in the safety maturity level, namely: Mining Worker Participation; Responsibilities of Work Unit Leaders; Accident Statistics, Dangerous Events, Occupations Due to Workforce Diseases, Occupational Diseases; and Control Efforts. The data collection method for Mining Safety Level Assessment consists of several methods, namely document review, distribution of questionnaires, data analysis, interviews, observations, focus group discussions, and simulations. Respondents were 301 people consisting of Operational Responsible Persons, Vendors/Work Partners, Section Heads/Coordinators, Group Leaders, Operators, Mechanics, Labor Helpers, and Non-Staff and Laborers.

Results: The mine worker participation indicator is at a proactive level with an achievement value of 0.13. Indicators of Responsibility of Work Unit Leaders; Accident statistics are at a proactive level with an achievement value of 0.32. The statistical indicators for accidents, dangerous events, incidents resulting from occupational diseases and occupational diseases are at the planned level with an achievement value of 0.17. The Control Efforts indicator is at a proactive level with an achievement value of 0.26. Based on the recapitulation results of all the Company's Safety Maturity Level indicators, it is at the Proactive level with a value of 0.88.

Conclusion: Mining OSH management system at PT. PPA began to involve workers in the improvisation stage of OSH management. Awareness and involvement of workers in OSH management is starting to change the pure *top-bottom* management approach into two-way communication in the sense that all levels of positions actively participate in efforts to create a safe, comfortable, healthy and safe work environment.

Keywords: Safety Maturity Level; Occupational Safety and Health; Mining

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1. Introduction

The mining industry is a vital industry that has a big role in supplying energy in Indonesia. The work process in mining has high potential for danger and risk, for this reason, safety, occupational health and environmental aspects are requirements that must be met in every work activity. In accordance with Minister of Energy and Mineral Resources Regulation No. 26/2018 concerning the implementation of good mining principles and supervision of Mineral and Coal mining, where it is explained that the SMKP (Mining Safety Management System) is part of the system that exists in the company as a whole, helping companies to implement Mining Occupational Safety and Health (OSH) and Safety Implementation Mining Operations (KO). A technical explanation of how to properly implement mining principles is explained in Minister of Energy and Mineral Resources Decree No. 1827K/30/MEM/2018 concerning guidelines for implementing good mining engineering principles and Decree of the Director General of Mineral and Coal and Energy and Mineral Resources Number 185.K/37.04/DJB/2019 concerning technical instructions for implementing mining safety and implementation, assessment and reporting of Minerba SMKP (1,2).

According to the Decree of the Director General of Minerals and Coal, Energy and Mineral Resources No. 10.k/MB.01/DJB.T/2023 that the level of achievement of Mining Safety performance is part of the initial review process that must be carried out by mining companies and mining service companies in the planning stage of the Mining Safety Management System. These levels include: basic level, reactive level, planned level, proactive level, and resilient level(3).

The implementation of SMKP is mainly in element 2, namely planning, where before starting to develop SMKP the company must carry out an initial study, the results of which are used as a *baseline assessment* to determine the mining safety conditions. An initial assessment can be carried out by assessing safety performance through interviews, observations and existing secondary data so that the level of maturity of workers in implementing safety at work (*Safety Maturity Level*) can be analyzed. In SMKP, after the planning stage, there is the implementation stage, where the management of mining operations must consider a safety approach based on the behavior of mine workers.

Long-term goals or objectives are goals or targets that are planned to be achieved in the future over a fairly long and long period of time (4) The right long-term goals can provide benefits to the organization because all activities carried out by the organization are headed in the same direction so that the possibility of problems or errors can be minimized (5).

In the mining and quarrying business sector, the average *risk maturity level* obtained is 5, which is slightly different from the results of the CRMS Indonesia research (6)which shows that *the risk maturity level* in the mining and quarrying business sector is 4.32, which may be influenced by differences in the number of samples used and research time. This indicates that every attribute in all parts is at the highest level. Even so, strategies are still needed to maintain *risk maturity levels* in the mining and quarrying business sector. This is because in mining work, work accidents and other possible dangers often occur, but by optimizing risk management, organizations can reduce the number of work accidents (7).

The maturity concept and model are an innovation in research in the field of work safety and has been applied in developing work safety culture in high-risk companies such as petrochemical, oil and gas companies, even aviation and mining companies. This is due to regulatory pressures, workforce empowerment, the need to avoid legal legitimization and develop a sustainable work environment. Therefore, the concept of occupational safety and health is developed within the organization's overall business culture and philosophy. Strategy authorities around the world also emphasize the fact that occupational health and safety culture is a high priority area of business operations today and will continue to be so in the future. Every large-scale company with high risks is ideally expected to reach the Generative level which reflects a mature work safety culture (8). This study aims to measure the level of safety performance /*Safety Maturity Level Assessment* for workers in each department and employee level at PT. Putra Perkasa Abadi job site Makmur Lestari Primatama.

2. Material and methods

This type of research is quantitative descriptive. This study was carried out from August to September 2023. Measurement of Safety Maturity Level Assessment carried out on workers in each department and employee level of PT. Putra Perkasa Abadi (PPA) job site Makmur Lestari Primatama (MLP). Cumulatively, the maturity level of OSH implementation is divided into 5 levels, namely: Stage 1 Basic (<0.5), Stage 2 Reactive ($0.5 \leq x < 0.70$), Stage 3 Planned ($0.70 \leq x < 0.80$) , Stage 4 Proactive ($0.80 \leq x < 0.90$) , Stage 5 Resilient ($0.90 \leq x \leq 1$).

In this research, there are 4 indicators in the safety maturity level, namely: Mining Worker Participation, Responsibilities of Work Unit Leaders, Accident Statistics, Dangerous Events, Occupations Due to Workforce Diseases, Occupational Diseases, and Control Efforts. Partially determining the achievement level category for each indicator, namely:

- Mining worker participation: for achievement scores < 0.07, it is included in the basic category; achievement 0.07 ≤ x 0.10 reactive level; 0.10 ≤ x 0.12 planned level; 0.12 ≤ x 0.14 proactive level; 0.14 ≤ x 0.15 resilient level.
- Responsibilities of work unit leaders: for achievement scores < 0.17 are included in the basic category; achievement 0.17 ≤ x 0.24 reactive level; 0.24 ≤ x 0.29 planned level; 0.29 ≤ x 0.33 proactive level; 0.33 ≤ x 0.35 resilient level.
- Analysis and statistics of accidents, dangerous incidents, incidents resulting from occupational diseases, and occupational diseases: for achievement scores < 0.10 are included in the basic category; achievement of 0.10 ≤ x 0.14 reactive level; 0.14 ≤ x 0.17 planned level; 0.17 ≤ x 0.19 proactive level; 0.19 ≤ x 0.20 resilient level.
- Control efforts carried out: for achievement values < 0.15 are included in the basic category; achievement of 0.15 ≤ x 0.20 reactive level; 0.21 ≤ x 0.25 planned level; 0.25 ≤ x 0.28 proactive level; 0.28 ≤ x 0.30 resilient level.

The data collection method for Mining Safety Level Assessment consists of 7 methods, namely document review, distribution of questionnaires, data analysis, interviews, observations, focus group discussions, and simulations based on the Decree of the Director General of Minerals and Coal, Energy and Mineral Resources No. 10.K/MB.01/DJB.T/2023. Distribution of Questionnaires, FGDs and Interviews is carried out online. Meanwhile, Data Analysis, Observation, Document Review and Offline Simulation. The sampling method used is proportional sampling. The total population is 1215 people. The sample was 301 people consisting of Operational Responsible Persons, Vendors/Work Partners, Section Heads/Coordinators, Group Leaders, Operators, Mechanics, Labor Helpers, and Non-PPA and Labor Staff.

3. Results and discussion

3.1. Indicators of Mining Worker Participation

The assessment of mining worker participation indicators is the average value of workers' perceptions of Mining Worker Participation both as individuals, members of work unit groups and members of organizations/companies.

Table 1 Mining Worker Participation

Parameter	Number of Questions	Total number of measurement items	Total Value of Measurement Items	Maximum Value Measurement Guidelines	Achievement Value	Achievement Category
Individual Concern and Behavior towards Mining Safety Risks	5	25	20	0.05	0.04	Proactive
Worker Involvement in Mining Safety Management	24	120	107	0.10	0.09	
Total Indicator Value				0.15	0.13	

Source: (Primary Data, 2023)

Based on the results of data collection through questionnaires, data analysis, interviews, observations, focus group discussions and simulations, an achievement value of 0.13 was obtained. This shows that indicators of miner participation are at a proactive level.

3.2. Indicators of Responsibility of Work Unit Leaders

The assessment of indicators for the responsibility of work unit leaders is the average value of workers' perceptions of the responsibilities of work unit leaders, both as individuals, members of work unit groups and members of organizations/companies.

Table 2 Responsibilities of Work Unit Leaders

Parameter	Number of Questions	Total number of measurement items	Total Value of Measurement Items	Maximum Value Measurement Guidelines	Achievement Value	Achievement Category
Implementation of Mining Safety Policy	4	20	18	0.05	0.05	Proactive
Mining Safety Leadership and Commitment	31	155	137	0.05	0.04	
Compliance and Enforcement of Mining Safety Regulations	8	40	38	0.05	0.05	
Determination of Roles, Responsibilities and Authorities in Mining Safety	12	60	55	0.04	0.04	
Mining Safety Strategy and Operations Management	4	20	17	0.04	0.03	
Information, Communication, Assistance, Mining Safety Consultation	18	90	79	0.04	0.04	
Mining Safety Quality Control in Operational Activities	16	80	73	0.04	0.04	
Mining Safety Quality Assurance through SMKP Internal Audit	5	25	25	0.04	0.04	
Total Indicator Value				0.35	0.32	

Source: (Primary Data, 2023)

Based on the results of data collection through questionnaires, data analysis, interviews, observations, focus group discussions and simulations, an achievement value of 0.13 was obtained. This shows that the Work Unit Leadership Responsibility indicator is at a proactive level.

3.3. Indicators for Analysis and Statistics of Accidents, Occupational Diseases, Occupations Due to Workforce Diseases, and Dangerous Events

The assessment results are the average value of workers' perceptions of accident statistics, dangerous incidents, incidents resulting from worker illnesses, work-related illnesses both as individuals, members of work unit groups and members of organizations/companies.

Table 3 Analysis and Statistics of Accidents, Occupational Diseases, Occurrence Due to Occupational Diseases, and Dangerous Events

Parameter	Number of Questions	Total number of measurement items	Total Value of Measurement Items	Maximum Value Measurement Guidelines	Achievement Value	Achievement Category
Analysis of Mining Safety Case Data	3	15	13	0.05	0.04	Planned
Mining Safety Case Investigation	7	35	30	0.05	0.04	
Mining Safety Performance Statistics Based on Lagging Indicators	6	30	24	0.05	0.04	
Organizational Learning	2	10	9	0.05	0.04	
Total Indicator Value				0.20	0.17	

Source: (Primary Data, 2023)

Based on the results of data collection through questionnaires, data analysis, interviews, observations, focus group discussions and simulations, an achievement value of 0.13 was obtained. This shows that the indicators for Analysis and Statistics of Accidents, Occupational Diseases, Occurrence Due to Occupational Diseases, and Dangerous Events are at the planned level.

3.4. Indicators of Control Efforts

The results are the average value of workers' perceptions of control efforts carried out both as individuals, members of work unit groups and members of organizations/companies.

Table 4 Control Efforts Taken

Parameter	Number of Questions	Total number of measurement items	Total Value of Measurement Items	Maximum Value Measurement Guidelines	Achievement Value	Achievement Category
Governance-Based Mining Safety Risk Control	4	20	18	0.04	0.04	Proactive
Mining Occupational Health Management	3	15	12	0.03	0.02	

Mining Work Environment Management	3	15	12	0.03	0.02	
Engineering Management & Process Design	5	25	22	0.04	0.03	
Mining Safety Asset Management	10	50	44	0.04	0.03	
Worker Reliability Management in Mining Safety Management	11	55	46	0.03	0.03	
Change management	5	25	22	0.04	0.04	
Emergency Management	2	10	10	0.03	0.03	
Mining Services Company Management	3	15	15	0.01	0.01	
Mining Safety Document & Records Management	3	15	12	0.01	0.01	
Total Indicator Value				0.30	0.26	

Source: (Primary Data, 2023)

Based on the results of data collection through questionnaires, data analysis, interviews, observations, focus group discussions and simulations, an achievement value of 0.26 was obtained. This shows that the indicators of control efforts undertaken are at the proactive level.

3.5. Total Value of Mining Safety Performance Achievement / Safety Maturity Level

Table 5 Achievement of Safety Maturity Level Performance

Indicator	**Total Indicator Value**	**Achievement Category**
Mine worker participation	0.13	Proactive
Responsibilities of Work Unit Leaders	0.32	
Analysis and Statistics of Accidents, Occupational Diseases, Occupations Due to Workforce Diseases, and Dangerous Events	0.17	
Control Efforts Taken	0.26	
Total Performance Achievement Value	0.88	

Source: (Primary Data, 2023)

Based on the results of the recapitulation of indicators for mining worker participation, responsibility of work unit leaders, Analysis and statistics of accidents, work-related diseases, incidents resulting from work-related illnesses and

dangerous incidents, as well as control measures undertaken, obtained an achievement value of 0.88. This shows that the Safety Maturity Level is at the Proactive level.

3.6. Mining Worker Participation

Every organization may have "blind spots," or instances in which they unknowingly take actions that could compromise another organization's ability to maintain security. This can only be resolved by gathering various partners to talk about their safety concerns and see whether there are any better (safer-all-around) ways to collaborate (9). Cheyne in Andi (2005) believes that worker involvement in work safety programs is very important as a form of worker awareness of work safety programs (10). Engagement and Involvement is a form of employee participation and active feedback from all levels of the organization. Employee involvement and participation can take the form of decision-making processes, OSH planning, and contributing ideas for improvement (11). The application of leadership requires employee involvement in work planning. Worker involvement in work safety programs is very important as a form of worker awareness of work safety programs (10). Research has shown that managers can involve or involve 117 (engage or involve) employees in safety activities through empowerment. A good safety culture in an organization, employee empowerment is carried out to ensure that employees understand their important role in promoting safety. With this empowerment, employees tend to have more responsibility for ensuring operational security (12).

The attitude of workers who are responsible and concerned about the safety of co-workers must communicate information (communication and information) about things such as dangers, safety procedures and available assistance. Meanwhile, top management must ensure that the role of responsibility and authority of employees is in accordance with job description 118 as required in the OSH management system and is communicated at all levels in the organization and maintained as documented information (13). Responsibility is a thing or situation that an individual must do, carry out and complete when they receive a task or activity properly and correctly. Describes the level of responsibility of employees which is characterized by a sense of care and attention in maintaining the safety and health of themselves and other people in the workplace (14).

Responsibility variable is positively related to information & communication. This involves the organization managing information, how information analyzes accidents and accidents in the workplace, as well as the organization informing and communicating to employees about a problem. incident. Every worker and other people in the workplace must participate in maintaining and controlling the implementation of OSH. Commitment can also mean an individual's strong acceptance of the organization's goals and values, and the individual makes efforts and works and has a strong desire to remain in the organization.

3.7. Responsibilities of Work Unit Leaders

Leadership is a personality attitude that can organize, give, give an example to others to have a positive impact on those around or the ability to influence a group towards achieving its vision and mission (11). Leadership is recognized as a basic component of an organization's safety culture which is This is a condition that must be fulfilled to achieve a good work safety culture. The reflection of achieving a good work safety culture is in sustainable organizational learning through several applications such as feedback systems, monitoring and analysis, concern for sources of danger in the form of sharing safety information. Organizational safety performance is positively impacted by ethical leadership (15). Beside that good safety communication mediates the association between safety culture and safety performance (16).

Based on survey data in measuring Safety Maternity Level found that the variable of responsibility of work unit leaders with the parameters of implementing mining safety policies found that Management had provided concrete examples of the actualization of the internalization of the Golden Rules of Mining Safety (Golden Rules) and company values to workers. On the parameters of leadership and commitment to mining safety, Top Management provides adequate resources and has succeeded in creating a climate of innovation in all departments/sections of workers, with a focus on improving poor performance as well as maintaining good performance, management provides support related to innovation and improvement. mining safety so that the focus and implementation of improving mining safety performance, Top Management in Responding to Mining Safety Issues. The role of management, KTT/PJO, department heads, and even operational supervisors play an active role and collaborate in Mining Safety Risk Management.

According to Andi (2005) the commitment factor is one of the main safety culture factors, where without management support it is very difficult to achieve success in implementing a work safety program. To start a work safety program, top management must formulate a policy that shows a form of commitment to safety issues in the organization. Research conducted by Fernandez-Muniz (2007) said that the commitment variable has a positive relationship with responsibility. Developing a safety policy shows an organization's commitment to safety in the form of clear responsibilities.

OSH management's commitment to implementing OSH can be seen from the existence of an OSH Policy written and signed by the highest management, as proof of their commitment to being responsible for OSH. The next form of OSH management commitment in making efforts to prevent and control work accidents is supervision. Supervision can help to assess whether management functions are effective in their implementation. After monitoring is carried out, the organization can take the necessary corrective actions to ensure that the organization's goals can be achieved.

Several attributes in the information and communication business sector that have the lowest risk maturity level values include the leadership and commitment section, stakeholder management attributes, the design resource attribute section, the implementation section, communication and consultation attributes, risk assessment, risk treatment, monitoring and review, and recording and reporting, evaluation section attributes measuring risk management performance and achieving organizational goals, improvement section attributes adaptation to change, continuous improvement, as well as resilience and sustainable business. A survey conducted by CRMS Indonesia (2017) stated that 86% of the information and communication business sector had obstacles in commitment and 29% had obstacles in the operational implementation of risk management. So these things need to be immediately corrected and improved because in the information and communication business sector there are also many crucial risks that have a high impact value (17).

Competence possessed by workers as a whole is the knowledge, understanding and responsibility of workers for their work, as well as knowledge of the risks and dangers that can threaten workers in carrying out their work. In accordance with ISO 45001: 2018, the competency variable has a positive relationship with risk. It is stated that workers' competencies must include the knowledge and skills needed to correctly identify hazards and deal with OSH risks related to their work and workplace (18).

3.8. Analysis and Statistics of Accidents, Dangerous Events, Incidents resulting from worker Diseases, Occupational Diseases

To make the process industry more environmentally friendly and economically responsible, it is essential to avoid and mitigate accidents, incidents, and risky behaviors. Measurement, investigation, and assessment of the safety culture utilizing behavior observation, questionnaires, interviews, and document analysis, as well as its effect on an organization's safety performances, are intricate, difficult, and demand dedication from every employee(19). Good information channels from management to workers and vice versa from workers informing management of unsafe conditions. In relation to the risk of OSH hazards, employees' ability to mitigate these risks can arise due to open and intensive communication about OSH, where communication about OSH functions to inform workers about OSH hazards, risks and how to work safely (11).

Based on survey data in measuring Safety Maternity Level which was carried out using 3 methods, namely survey, FGD, interviews with PT. Putra Perkasa Abadi workers found that the variables Analysis and Statistics of Accidents, Occupational Diseases, Occurrences Due to Workforce Diseases, and Dangerous Incidents where management has carried out a Mining Safety Case Investigation Paradigm, in this case investigations if there are incidents (near misses or work accidents) so that they can improve the ability of all pre-conditions that support operational activity work systems. Management can take retrospective learning from mining safety management (things that are learned from experience, both from failure and success) and follow up on the results of mining safety management learning.

Information and Communication is a process of conveying messages from one party to another party with the aim of expressing opinions, providing information, and obtaining clear and correct information. Describes awareness, attention and willingness to communicate information and problems related to OSH (14). One of the problems that occurs can be failure of production results and the possibility of near misses. According to the IAEA (2002), organizations with a good safety culture consider failures and near misses as learning that can be used to avoid more serious events. Ultimately, there is a strong push to ensure that all potentially hazardous incidents are reported and investigated to find the root cause, and provide appropriate feedback for improvement efforts, either to the work groups involved or to individuals.

3.9. Control Efforts

It is vitally important for workers, business, and society at large to prevent illnesses and injuries related to the workplace. It is now well acknowledged that corporate safety culture, which refers to shared principles inside an organization that impact its members' attitudes, values, and beliefs on safety, has a significant impact on preventing workplace accidents and injuries (20).

The implementation of work safety in the company has been maximized, both in the facilities and infrastructure provided by the company to support the work safety of its employees and work productivity. OSH supporting facilities and infrastructure include fire extinguishers which must be available on every floor of the building, safety helmets, safety shoes, ear plugs, gloves and masks which must always be worn when carrying out their work, especially employees who work in the field. Installation of OSH signs such as high voltage, flammable and smoking prohibition signs, etc.

In the Engineering and Process Design parameters, the company has implemented appropriate mining engineering applications in the context of the design reliability of mining operational activities and has proven successful in contributing to improving the performance of all aspects of Good Mining Engineering Principles. Apart from that, Asset management is continuously updated according to actual conditions. The company controls the availability of equipment and materials and the amount of supply of KP aspect assets required by user work units. An analysis of the Reliability, Availability and Feasibility of Maintenance of assets has been carried out as a basis for efforts to improve asset performance.

In terms of employee reliability parameters in Mining Safety Management, the company approaches and improves education and training on mining safety aspects, characterized by management conducting personal education and training in a creative-innovative manner with various prepared scenarios. Workers are supported to create original knowledge with the guidance of trainers and are prepared to make the right decisions in dealing with variations in operational conditions that will be faced, including non-routine conditions, so that post-education and training workers are able to contribute to improving organizational scale performance.

In terms of change management parameters, the company carries out change management on an ongoing basis and involves all elements in the company so as to produce process changes that can be used as the company's intellectual property and the company's competitive advantage. Change management is carried out appropriately so as to provide benefits for improving performance in all aspects of Good Mining Engineering Principles and economic aspects. The Company has the ability to detect and overcome early warnings and carry out regular reviews and continuous improvements to the suitability of the Company's management system and resources.

In the management parameters of Mining Safety Documents and Records, the company has a knowledge or information management program or activity related to mining safety aspects. The company has KP information that has been confirmed to be accurate and is always available to help workers do their jobs safely. Knowledge is analyzed and applied so as to provide guidance for mine workers to be wise in managing KP. Business Intelligence capabilities in collecting, storing and analyzing KP data from operations (Enterprise intelligence) in KP aspects have been developed very adequately.

4. Conclusion

Overall, the Mining OSH management system at PT. Putra Perkasa Abadi job site MLP is in the proactive category where in its implementation it begins to involve workers in the improvisational stage of OSH management. Awareness and involvement of workers in OSH management is starting to change the pure *top-bottom* management approach into two-way communication in the sense that all levels of positions actively participate in efforts to create a safe, comfortable, healthy and safe work environment. On the other hand, increased efforts are needed to optimize supervision and innovative programs to minimize unsafe acts and unsafe conditions in the workplace.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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