DIJEMSS: Dinasti International Journal of Education Management and Social Science
E-ISSN: 2686-6331
P-ISSN: 2686-6358
DINASTI PUBLISHER
https://dinastipub.org/DIJEMSS dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/dijemss.v7i2


# Socialization Strategy for the Implementation of HIRADC for Workers in the Operation of Dust Collectors in Mining Areas

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**Abstract:** This study aims to examine workplace hazards and assess occupational risks associated with dust collector operations in mining environments, while formulating an effective socialization strategy to enhance workers' understanding of HIRADC implementation. The research method involves identifying potential hazards, evaluating risk levels, and determining appropriate control measures based on real field activities. Findings indicate two primary hazards: the possibility of electrical short circuits during equipment operation and dust exposure during filter cleaning, both categorized as moderate to high risks. The proposed socialization approach includes interactive training sessions, visible hazard information postings at the worksite, and regular evaluations of control effectiveness. In conclusion, continuous HIRADC socialization can improve workers' safety awareness, reduce accident and health risks, and strengthen the overall safety culture within the mining industry. Validation of the research findings was carried out by a certified Occupational Safety and Health (OSH) expert, confirming that the proposed socialization and control strategies align with practical safety standards and effectively support risk reduction in mining operations.

**Keywords:** HIRADC, Dust Collector, Occupational Safety, Risk Assessment, Mining Industry.

## INTRODUCTION

Mining is one of the industrial sectors with a high level of occupational safety and health risks (Rahim Marsukik et al., n.d.). One of the important pieces of equipment that plays a role in maintaining air quality and controlling dust exposure is *a dust collector* (Noor Iriandi & Kurniawan Suksmono, 2023). Although this system functions to protect workers from the dangers of inhaling harmful particles, its operation still carries potential hazards, both from a mechanical and electrical perspective, as well as

unmanaged dust exposure (Irawan et al., 2025; Rahayu et al., n.d.). Therefore, the application of risk analysis through the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method is an important step to ensure safety in every operational activity (Noor Iriandi & Kurniawan Suksmono, 2023; Suryana et al., n.d.).

However, the effectiveness of HIRADC does not only depend on the documents or procedures created, but also on the level of understanding and compliance of workers in the field. This is where the role of HIRADC socialization becomes crucial (Agung et al., 2024; Junita et al., 2025). Through interactive socialization strategies, workers can understand potential hazards in the workplace, recognize risk control methods, and foster *a* sustainable *safety culture* (Marwah et al., 2024a). Therefore, this article will discuss HIRADC and HIRADC socialization to workers in the dust collector operation area (Rahardja, 2023).

## METHOD

This study uses a qualitative method with a focus on analyzing occupational safety risks for workers who operate dust collectors in the mining industry. The approach applied in occupational risk and safety assessment is the HIRADC (Hazard Identification, Risk Assessment, and Determining Control) method (Hazizi & Ghaleeh, 2023), which includes the stages of identifying potential hazards from work activities, analyzing the level of risk that may arise, and determining control measures to reduce the possibility of occupational accidents.

The hazard identification process was carried out through direct observation in the field and interviews with employees involved in the operation. The results of the HIRADC analysis were then disseminated to workers through interactive in-class training. It is hoped that this activity can increase workers' understanding of the potential hazards that may arise during the operation of dust collectors (Fadhilah et al., 2023).

The risk level assessment of the identified hazards refers to two main parameters, namely likelihood (frequency of occurrence) and severity (level of severity of the consequences) (Ilyasa et al., 2024). The risk value is obtained using the following formula:

$$\textit{Risk}\ (R) = \textit{Likelihood}\ (L) \times \textit{Severity}\ (S)$$

**Table 1. Risk Assessment Method Based on *Likelihood***

| Level | Category | Description |
|---|---|---|
| 1 | Rare | An event that is only likely to occur under extremely rare or extraordinary conditions, usually after a long period of time without occurrence. |
| 2 | Unlikely | An event that has a low probability of occurring in a specific situation. |
| 3 | Moderate | An event that has the potential to occur in several possible circumstances. |
| 4 | Likely | This happens quite often in most situations. |
| 5 | Almost certain | An event that is almost certain to occur in every situation or in all activities carried out by an organization/business. |

Source: (Yunandro Markus & Djunaidi, 2024)

**Table 2. Risk Assessment Methods Based on *Severity***

| Level | Category | Description |
|---|---|---|
| 1 | *Insignificant* | Does not cause injury and/or only causes very minor material damage. |
| 2 | *Minor* | Requires first aid or minor treatment and/or causes moderate material damage. |
| 3 | *Moderate* | Requires medical treatment (including possible temporary rest) that results in lost work time and/or causes significant material damage. |
| 4 | *Major* | Results in loss of bodily function (disability) and/or partial cessation of work processes, causing substantial material loss. |
| 5 | *Catastrophic* | Can cause death and/or result in enormous material losses. |

Source: (Pardede et al., 2025)

The risk level obtained after analysis based on *likelihood* and *severity* can be further categorized in the risk value matrix as follows:

**Table 3. Risk Value Matrix**

| **Risk Analysis Matrix** | | ***Likelihood* Level** | | | | |
|---|---|---|---|---|---|---|
| | | **1 Rare** | **2 Unlikely** | **3 Moderate** | **4 Likely** | **5 Almost** |
| Severity *(Severity)* | 1 Insignificant | 1 | 2 | 3 | 4 | 5 |
| | 2 Minor | 2 | 4 | 6 | 8 | 10 |
| | 3 Moderate | 3 | 6 | 9 | 12 | 15 |
| | 4 Major | 4 | 8 | 12 | 16 | 20 |
| | 5 Catastrophe | 5 | 10 | 15 | 20 | 25 |

Source: (Sukwika & Pranata, 2022)

The risk level resulting from the risk value calculation can be interpreted as follows:

**Table 4. Risk Score, Category, and Action**

| **Risk Score** | **Category** | **Color Indicator** | **Action** |
|---|---|---|---|
| >16 | *Very High / Extreme* | Dark Red | Immediate control measures are required to address potential hazards. This situation constitutes an emergency that must be prioritized for handling. |
| 10–16 | *High* | Red | Control measures must be implemented immediately to address |
| | | | the source of the hazard, with high priority to prevent more serious consequences. |

| | | | |
|---|---|---|---|
| 5–9 | *Medium* | Yellow | Planning steps are needed in hazard control to reduce the risk. |
| 0–4 | *Low* | Green | The risk is acceptable because the potential hazard is low, so it does not require specific control measures. |

Source: (Pardede et al., 2025)

Control measures need to be implemented after hazards and their risk levels have been identified, with the aim of reducing the likelihood of incidents occurring so that workplace accidents can be prevented (Marwah et al., 2024b; Nur Syawal, 2023). The risk control process is based on the hierarchy of control, which consists of five sequential levels, namely Elimination, Substitution, Engineering Control, Administrative Control, and Use of Personal Protective Equipment (PPE)(Hamidah & Prastawa, n.d.) as shown in Figure 1.

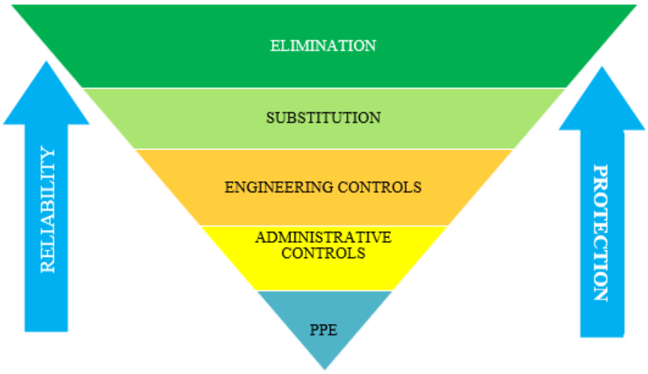


**Figure 1. Hazard Risk Control**
Image source: Yufahmi et al., 2021

The five levels in the hierarchy serve as the main guidelines in determining the stages and steps of systematic control to prevent and minimize potential risks in the workplace (Sjarifudin et al., 2023).

All stages of the research, from hazard identification to the determination of control measures, have been validated by a competent General Occupational Safety and Health Expert. This validation aims to ensure that the HIRADC method used complies with occupational safety standards and applicable regulations. With this validation, the research analysis results are more accurate, accountable, and support the effective implementation of OSH in the mining environment (Noor Iriandi & Kurniawan Suksmono, 2023).

## RESULTS AND DISCUSSION

HIRADC's research on *dust collector* operations in mining areas shows two main potential hazards: the risk of electrical short circuits when turning on equipment and the risk of dust exposure during filter cleaning. Both activities have a moderate to high risk level (score of 12), which could potentially cause fires, electric shocks, and respiratory problems for workers. This condition indicates that risk control needs to focus on technical and administrative aspects, including periodic electrical inspections, implementation of the LOTO system, and the use of personal protective equipment such as respirators and insulated gloves.

To reduce these potential hazards, an effective and sustainable HIRADC development socialization strategy is needed. Socialization can be carried out through interactive training based on field case studies, posting hazard information in the *dust collector* area *(Sondej et al., 2025)*, and routine evaluation of the effectiveness of risk control. By increasing workers' understanding and participation in the implementation of HIRADC, awareness of occupational safety will grow, thereby minimizing the risk of accidents and health problems and strengthening the OSH culture in the mining environment.

**Table 5. Results of HIRADC Risk Assessment for Workers in Dust Collector Operations**

| No | Worker Implementation | Hazard | Risk | Severity (1-5) | Probability (1-5) | Risk Level (Severity x Likelihood) |
|---|---|---|---|---|---|---|
| 1 | Turning on the dust collector | Electrical short circuit | Fire and electric shock | 4 | 3 | 12 |
| 2 | Cleaning the filter dust collector | Exposure to dust | Coughing, respiratory tract irritation | 3 | 4 | 12 |
| 3 | Maintaining fans/blowers moving parts | Pinch the Moving | Serious serious injury to the hand | 4 | 3 | 12 |
| 4 | Replacing the dust bag | Exposure to dust | Shortness of breath, asthma | 3 | 4 | 12 |
| 5 | Clean the area around the dust collector | Hit by a vehicle or heavy equipment | Minor injury to severe | 3 | 2 | 6 |
| 6 | Checking the electrical system | Electric shock | Serious injury or death | 5 | 2 | 10 |
| 7 | Turn on the automatic system | Sensor malfunction | Device not functioning, danger not detected | 4 | 2 | 8 |
| 8 | Opening ducting enclosed space | Oxygen deficiency, hazardous gases dangerous or | Shortness of breath, fainting | 5 | 2 | 10 |
| 9 | Cleaning dust channels | Sucked in by strong suction | Physical injury | 4 | 2 | 8 |
| 10 | Routine machine maintenance | Tripped over a cable or tools | Minor injury | 2 | 3 | 6 |
| 11 | Replacing electrical components | Short circuit or overh eating excessive | Small fires to large | 4 | 2 | 8 |
| 12 | Handling dust from the process | Dust explosion | Serious injury and damage devices | 5 | | |

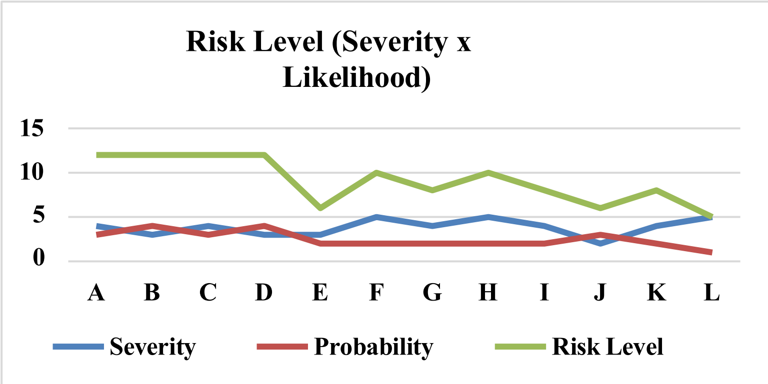


**Figure 2.** Graph of HIRADC Risk Assessment Results for workers in Dust Collector Operation

**Table 6.** Explanation of **Figure 2**. Graph of HIRADC Risk Assessment Results for Workers in Dust Collector Operation

| **Note** | |
|---|---|
| **Code** | **Worker Implementation** |
| A | Turning on the dust collector |
| B | Cleaning the dust collector filter |
| C | Maintaining the fan/blower |
| D | Replacing the dust bag |
| E | Cleaning the area around the dust collector |
| F | Checking the electrical system |
| G | Turn on the automatic system |
| H | Opening ducting or enclosed spaces |
| I | Cleaning the dust channel |
| J | Routine machine maintenance |
| K | Replacing electrical components |
| L | Handling dust from the process |

**Figure 2** illustrates the results of the HIRADC analysis**,** which shows that *dust collector* operation activities have varying levels of risk, ranging from moderate to high, depending on the type of work and its potential hazards. High-risk activities include replacing dust bags (D), opening ducting or enclosed spaces (H), and replacing electrical components (K), as these activities have the potential to cause dust exposure, choking on fine particles, or electric shock. Activities such as turning on equipment (A), cleaning filters (B), maintaining blowers (C), and checking electrical systems (F) are classified as medium risk due to the potential for dust inhalation, noise, and mechanical hazards. Meanwhile, activities such as cleaning the area (E), routine maintenance (J), and handling process dust (L) are also classified as medium risk, but can increase if safe work procedures and the use of PPE are ignored (Rahim Marsukik et al., n.d.; Vindiani et al., 2025). Overall, the results of this assessment indicate the need for technical controls such as closed ventilation systems, the implementation of *lockout-tagout* procedures*,* the use of complete PPE (respirators, gloves, eye protection), and safety training to prevent exposure to dust and electrical hazards during the operation of *dust collectors (*Keselamatan et al., n.d.).

The results of the study show that the operation of *dust collectors* in mining areas has two main potential hazards, namely the risk of electrical short circuits and dust exposure, with a moderate to high level of risk. To reduce these potential hazards, a HIRADC development socialization strategy was implemented, which included interactive training based on real cases, installation of hazard information media in work areas, preparation of pocket guides and safety SOPs, periodic evaluation of worker understanding, and safety awards for disciplined units. This strategy has been proven to increase worker awareness and participation in the implementation of HIRADC, as reflected in the increased use of personal protective equipment and a reduction in work procedure violations. Thus, HIRADC socialization is not only a means of conveying information, but also a workplace-based vocational learning medium that strengthens the culture of occupational safety and health in the mining environment (Drying Using the Hiradc Method et al., 2022).

All HIRADC analysis results obtained in this study have been reviewed and validated by a certified General Occupational Safety and Health Expert. This validation ensures that the results of hazard identification, risk assessment, and control recommendations are in accordance with the principles and standards of occupational safety applicable in the mining industry. With this validation from experts, the results of this study are considered credible and can be used as a reference in improving the implementation of HIRADC in the field.

## CONCLUSION

The application of HIRADC in the operation of dust collectors in mining areas is important to prevent workplace accidents and protect workers' health. The results of the study found two main risks, namely electrical short circuits and dust exposure with a moderate to high level of risk. To reduce these hazards, a socialization strategy was implemented through interactive training, the installation of hazard information in the work area, the creation of safety guidelines, as well as routine evaluations and the awarding of safety awards. This strategy has been proven to help workers better understand potential hazards and how to control them. With the continued dissemination of HIRADC, safety awareness has increased and a culture of safe work has been established in the mining environment. All research results and risk control recommendations have been validated by a competent General K3 Expert. This validation ensures that the HIRADC analysis methods and results comply with occupational safety standards and applicable regulations in the mining industry. With this validation, the conclusions of this research have a strong scientific basis and can be used as a reference for implementing a more effective OSH management system in the field.

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