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Analysis of the Risk Level of Work Accidents Using the Hirarc Method at PT Inka Multi Solusi

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ABSTRACT

Occupational safety and health (K3) is something that needs to be considered by companies because it can affect the increasing effectiveness and productivity and can prevent things that can be detrimental from work accidents. Workers as one of the main resources in the running of the manufacturing industry, often experience health risks and occupational hazards such as minor accidents, and so on. At PT IMS itself, employees are very likely to experience work accidents that cause workers to be injured and production work time is reduced to lost due to these accidents because they are directly related to machines for production.There are 7 activities that have been identified in the metal production process at PT INKA Multi Solusi that is Manual welding machine operation (SMAW), CNC bending machine operation, Automatic gas cutting operation, Hydraulic press machine operation, Roll leveler machine process, Regulator installation, Use of hammer. By using the HIRARC method, it can be seen that there are 2 activities that fall into the moderate category that is Regulator installation and Use of hammer, 2 activities that fall into the high category that is Hydraulic press machine operation and Roll leveler machine process, and 3 activities that fall into the extreme category that is Manual welding machine operation (SMAW), CNC bending machine operation, and Automatic gas cutting operation.

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1. INTRODUCTION

Human resources in a company play a very important role and need to be developed optimally to create a balance between the needs of workers, job demands, and organizational capabilities. This balance is a key factor for companies to develop in a healthy and sustainable manner (Mukti et al., 2023). In this regard, workers play a crucial role in supporting company productivity, so companies must pay special attention to them. In addition to productivity, occupational safety and health aspects must also be a priority and responsibility of the company. By ensuring the safety and health of workers, company activities can run smoothly without disruption. Conversely, if a work accident occurs, company productivity can be significantly disrupted (Nur et al., 2023). The industry is currently facing increasingly fierce competition, so management needs to evaluate company performance and develop strategic plans for the future. Occupational Safety and Health (OSH) is one of the key factors in winning competition, as OSH is not only a basic right of every worker but also a key factor in improving work outcomes and productivity (Afredo & Tarigan, 2021).

Occupational safety and health (OSH) is an important aspect that companies must pay attention to because it affects the improvement of effectiveness and productivity, while also preventing losses due to workplace accidents (Fajar et al., 2022). Workplace accidents are unplanned, uncontrolled, and unforeseen events that can hinder a person's work effectiveness. These accidents can occur due to a combination of various causal factors at the workplace or during the production process. In other words, workplace accidents do not occur spontaneously but are triggered by a number of interrelated factors in an incident (Daulay & Nuruddin, 2021). There are two main groups of causes of accidents. The first group includes mechanical and environmental factors, i.e., everything outside the human element. The second group is human factors themselves, which are the main cause of workplace accidents. According to research findings, approximately 85% of workplace accidents are caused by human factors. Regarding this factor, the issue is quite complex because it often relates to workers' emotional conditions or other specific factors related to human behavior as triggers for accidents (Afnella & Utami, 2021).

PT INKA Multi Solusi (IMS) is a subsidiary of PT INKA located in Madiun that operates in the manufacturing sector, producing various railway components and other land transportation products. In today's era, with rapid technological advancements, humans must truly understand the risks and hazards that may arise from the work they perform. An effective and efficient production process requires competent workers or employees who understand proper work procedures; however, this does not mean that achieving targets should compromise workplace safety (Rohmat & Hidayat, 2022).

In the manufacturing industry, the primary activity is the production process, which involves transforming raw materials into finished goods. Workers, who are one of the primary resources in the operations of this industry, often face health risks and workplace hazards, such as minor accidents and others. At PT IMS, employees are at risk of workplace accidents that can cause injuries, reduce production time, or even halt production entirely, as they work directly with the machinery used in the production process.

One step that can be taken is to identify accidents and assess risks, so that control measures can be implemented to reduce workplace accidents and improve effective work productivity. To identify all incidents or conditions that could potentially cause work-related illnesses and accidents at the workplace, hazard identification can be conducted. Workplace accidents can be prevented by understanding and recognizing potential hazards and risks in the work environment, enabling control measures to be implemented (Aprilyanto et al., 2022). Therefore, a workplace accident risk analysis was conducted using the HIRARC method to determine the risk level of workplace accidents, thereby providing recommendations for improvements. Several studies using the HIRARC method have been conducted, including one by Muhammad Nur on the analysis of occupational health and safety (OHS) risk levels at PT XYZ, a palm oil plantation company. Another study was conducted by Ghika Smarandana et al. on risk assessment in the manufacturing process at PT Tri Jaya Teknik Karawang. Based on the discussion above, the author is interested in conducting research using the Hazard Identification and Risk Assessment Control (HIRARC) method. The HIRARC method is an effective approach for identifying and controlling risks as a preventive measure against work-related injuries and illnesses (Samarandana et al., 2021).

Occupational Safety and Health

Occupational health refers to a person's overall physical, mental, and emotional well-being. A person is considered healthy if they are free from illness, injury, or mental and emotional disorders that could hinder their activities (Afnella & Utami, 2021). Occupational safety and health is a field of knowledge aimed at preventing workplace accidents and related illnesses. Accidents can occur not only to individuals but also in activities or jobs involving many people, such as in companies or industries. Occupational safety and health aims to achieve zero accidents (Giananta et al., 2020). Occupational safety and health is an effort to avoid or reduce workplace accidents by eliminating risks or hazards to achieve work or production goals. Additionally, safety can also be interpreted as being free from risks, losses, and damage (Nur et al., 2023).

Hazard Identification Risk Assesment and Risk Control (HIRARC)
The HIRARC (Hazard Identification and Risk Assessment Control) method is an effective approach for identifying and controlling risks as a preventive measure against work-related injuries and illnesses. The HIRARC process involves several stages, namely classifying the type of work, identifying potential hazards, assessing risks, and determining risk ratings. The application of HIRARC can categorize various types of risks into several categories, namely low risk, moderate risk, high risk, and extreme risk (Samarandana et al., 2021). The purpose of this method is to prevent and reduce the likelihood of workplace accidents in an effective manner through risk avoidance and control measures. The application of HIRARC also aims to ensure that maintenance and repair activities can be carried out safely. The processes of hazard identification, risk assessment, and risk control efforts are important components of the risk management system, which serves as the foundation for the implementation of the Occupational Safety and Health Management System (OSHMS) (Rahmadani et al., 2023).

Risk Assessment and Control
Risk parameters consist of two main components, namely probability and severity. Probability refers to the chance of a risk occurring due to the existence of a potential hazard. The assessment of probability is carried out using a probability matrix, which classifies the frequency of occurrence from very rare to almost certain. Meanwhile, severity refers to the most likely consequences of a potential accident, such as injury, illness, damage, or even death. The magnitude of the impact of this potential hazard is determined based on a severity matrix, which covers a scale from minor impact to major disaster (Apriliani et al., 2023). The results of the risk assessment are used as a reference in determining risk control measures. The purpose of this control is to reduce the likelihood of workplace accidents and minimize the potential impact (Fikri et al., 2022).

2. RESEARCH METHOD

Data collection was carried out at PT INKA Multi Solusi which focuses on the Metal production division and the data obtained is secondary data obtained from the K3LH division. The method used in this research is Hazard Identification, Risk Assessment, and Risk Control (HIRARC). HIRARC is a process that aims to identify the types of hazards that can occur or analyze various problems that arise during operations, due to differences in objectives in the design of processes in the factory. HIRARC consists of three stages, namely; hazard identification, risk assessment, and risk control (Pratama & Apsari, 2024).

Table 1. Likelihood

Levels	Criteria
1	Rarely
2	Sometimes
3	Can happen
4	Frequently
5	Almost certainly

Table 2.Consequence

Levels	Criteria	Information
1	Insignificant	No injury,
2	Small	Minor injury/first aid
3	Medium	Moderate injury/medical care
4	Severe	Permanent disability
5	Disaster	Causes death

Table 3. Risk Matrix

Opportunity		Konsekuensi				
		Very Low	Low	Currently	Tall	Very High
		1	2	3	4	5
Very High	5	H	H	E	E	E
Tall	4	M	H	H	E	E
Currently	3	L	M	H	E	E
Low	2	L	L	M	H	E
Very Low	1	L	L	M	H	H

3. RESULTS AND DISCUSSIONS

Hazard Identification

Hazard identification is carried out by reviewing each area and work process to identify all potential hazards that may arise from a work activity. Based on the data obtained, there are several activities in metal production that can cause hazards. The results of hazard and risk identification are as follows:

Table 4. Hazard and Risk Identification

No.	Type of Work	Danger	Risk
1	Manual welding machine operation (SMAW)	Electric shock, hit by a spark	Burns
2	CNC bending machine operation	Hands pinched, scratched, electrocuted	Minor injuries, abrasions, and fatalities
3	Automatic gas cutting operation	Use of LPG and liquid oxygen	Burns, fatalities
4	Hydraulic press machine operation	Placement of materials	Pinched, scratched, bruised
5	Roll leveler machine process	Operation of machines	Hand pinched, scratched
6	Regulator installation	Incorrect installation of bottle regulators	Contusion, scratched
7	Use of hammer	Hit by a hammer, hit by material	Contusion, scratched, broken bones

Once identified, there are several jobs that have potential hazards. The potential hazards associated with manual welding machine (SMAW) operation are electric shocks that can cause burns. The potential hazards associated with CNC bending machine operation are hand entrapment, scratches, and electric shocks that can cause minor injuries. These can range from abrasions and broken bones to fatalities. The potential hazards associated with operating automatic gas cutting machines include the use of LPG and liquid oxygen, which can cause burns and even fatalities. Potential hazards associated with operating a hydraulic press include placing materials that can cause hands to be pinched, scratched, bruised, or crushed by materials. Potential hazards associated with operating a roll leveler machine include hands being pinched and scratched during machine operation. The potential hazards associated with regulator installation work are when the regulator is not installed properly, which can cause minor injuries, bruises, scratches, and burns. The potential hazards associated with hammer use are being struck by the hammer and coming into contact with materials, which can cause bruises and scratches.

Risk Assessment

After identifying potential hazards at the hazard identification stage, the next step is to conduct a risk assessment to determine the level of risk. To determine the risk level of each hazard, a reference to the company's Risk Matrix table based on AS/NZS 4360:2004 is used, which includes an assessment of the Likelihood scale and the Consequences scale. After the Likelihood and Consequences values are known, the risk score calculation is carried out. Risk score is calculated using a formula in accordance with the Australian Standard and New Zealand Standard (AS/NZS 4360), so that risk levels can be determined, such as extreme risk, high risk, medium risk, and low risk. (Rofiq & Azhar, 2022).

Risk Score (RS) = Likelihood x Consequency .....(1)

Table 5. Risk Assessment

No.	Type of Work	Danger	Risk	L	C	Risk Rating
1	Manual welding machine operation (SMAW)	Electric shock, exposure to gas sparks	Burns, fatalities	3	5	E
2	CNC bending machine operation	Hands trapped, scratched, electrocuted	Minor injuries, abrasions, fractures, fatalities	4	5	E
3	Automatic gas cutting operation	Use of LPG and liquid oxygen	Burns, fatalities	4	4	E
4	Hydraulic press machine operation	Placement of materials	Pinched, scratched, bruised	3	3	H
5	Roll leveler machine process	Operation of machines	Hand pinched, scratched	3	3	H
6	Regulator installation	Incorrect installation of bottle regulators	Contusion, scratched	2	3	M
7	Use of hammer	Hit by a hammer, exposed to materials	Contusion, scratched	2	3	M

From the risk assessment table, which has been matched with the existing risk matrix table, it can be seen that of the 7 activities in the metal processing department, 2 activities have a moderate risk level, namely regulator installation and hammer use, 2 activities have a high risk level, namely hydraulic press operation and roll leveler machine operation, and 3 activities with a potential for hazards at an extreme risk level, namely manual welding machine operation (SMAW), CNC bending machine operation, and automatic gas cutting machine operation. These activities require risk control measures to reduce the likelihood of workplace accidents.

Risk Control

After hazard identification and risk assessment, risk control is then carried out to prevent and handle the risk of work accidents that may occur optimally. Risk control is based on a risk map that shows the priority of risk control for the hazards that have been identified. The following are risk control recommendations to reduce the risk of work accidents that may occur.

1. Manual welding machine operation (SMAW)

   The hazards that can occur when using a manual welding machine (SMAW) are electrocution and gram sparks. These hazards can pose a risk of burns to fatalities. Risk control that can be recommended is to use complete personal protective equipment (PPE) when using the machine, check cables and machines before and after use, work in accordance with the SOP, and conduct training for operators before operating the machine.
2. Operation of CNC bending machine

   Hazards that can occur when operating a CNC bending machine are pinched hands, scratches, and electric shock. These hazards can pose a risk of minor injuries. Abrasions, broken bones, and fatalities. Risk control that can be recommended is to work according to the

applicable SOP, check cables and machines before and after use, operators must comply with K3 signs around the work area, and conduct training for operators before operating the machine.

3. Automatic gas cutting operation

   The hazards that can occur when operating an automatic gas cutting machine are the use of LPG and liquid oxygen. These hazards can pose a risk of burns and fatalities. The recommended risk control is to place LPG and liquid oxygen cylinders away from the welding area to avoid sparks that can cause LPG and liquid oxygen to explode and catch fire, and to check LPG and liquid oxygen before and after use.

4. Operation of hydraulic press machine

   The hazards that can occur when operating a hydraulic press machine are when placing materials the risks that can occur are pinched hands, scratches, bruises, and crushed materials. Risk control that can be recommended is to apply the 5Rs in the work area, not to put materials on the green line, and put unused materials into a special pallet plate.

5. Roll leveler machine process

   The danger that can occur in the roll leveler machine process is during machine operation. The risks that can occur are pinched and scratched hands. Risk control that can be recommended is to conduct training to operators, perform regular machine maintenance, work according to SOP, and use PPE such as gloves when operating the machine.

6. Regulator installation

   The danger that can occur in the installation of regulators is when the installation of bottle regulators is not appropriate. The risks that can occur are minor injuries, bruises, scratches, and burns. Risk controls that can be recommended are using PPE when working, working according to existing SOPs, providing fire extinguishers around the regulator area, and keeping the regulator area away from the welding area.

7. Use of a hammer

   Hazards that can occur when using a hammer are being hit by the hammer and being hit by materials. The risks that can occur are bruises and scratches. Risk control that can be recommended is to work according to the SOP and use PPE when working.

4. CONCLUSION

Based on the discussion and analysis of the data above, using the HIRARC (Hazard identification, risk assessment, and risk control) method, it can be determined that of the 7 activities identified in the metal production process at PT INKA Multi Solusi, 2 activities fall into the moderate category, 2 activities fall into the high category, and 3 activities fall into the extreme category. Risk control recommendations that can be implemented include training machine operators, conducting regular machine maintenance to prevent machine errors, using proper personal protective equipment (PPE) while working, adhering to standard operating procedures (SOPs), and applying the 5S principles in all work areas. Risk control and activities that have the potential to cause hazards need to be monitored and directed by safety officers so that all work can be carried out safely and avoid the risk of workplace accidents. A suggestion for further research is to add the Fault Tree Analysis (FTA) method in analyzing workplace accident risks so that the detailed causes of potential workplace accidents can be identified.

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