Designing Risk Control Strategies Using HIRARC-Based Risk Management to Comply Occupational Health and Safety Management System Standards in Manufacturing Activities

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ABSTRACT

Occupational Health and Safety (OHS) is crucial for protecting workers from accidents and work-related illnesses. In the manufacturing area of PT. XYZ, several OHS issues have been identified, including operator non-compliance with OHS Management System regulations, the absence of hazard identification and risk assessment, and low operator awareness of workplace safety. This study aims to analyze potential hazards, assess associated risk levels, and design appropriate control strategies using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method, which is widely applied in OHS implementation. Hazard identification was carried out using the STOP 6 approach and five factors: man, machine, material, method, and environment. Risk assessment was conducted by determining likelihood and severity values, resulting in risk levels ranging from extreme to low. Risk control strategies were formulated based on the Hierarchy of Control. The results show that 43.48% of identified risks are in the high-risk category, followed by medium (30.43%), low (19.57%), and extreme (6.52%). Recommended control strategies include eliminating or substituting hazards, such as relocating hazardous materials and using CNC machines. Additional measures include the development of SOPs, work instructions, safety signs, and ensuring the proper use of personal protective equipment (PPE) according to applicable standards.

Keywords: Occupational Health and Safety (OHS), Occupational Health and Safety Management System, Hazard Identification, Risk Assessment, Risk Control.

1. Introduction

Occupational Health and Safety (OHS) is crucial in creating a safe and healthy work environment (Hartati et al., 2024). Occupational health is defined as a condition free from physical or psychological disturbances caused by workplace environmental factors (Soesanto et al., 2023). Meanwhile, occupational safety involves measures to prevent accidents, injuries, and undesirable incidents in the workplace (Sarbiah, 2023).

Optimal implementation of OHS can minimize the likelihood of workplace accidents, ensuring that work processes run smoothly without disruptions (Fitri, 2020). Every work and activity had potential hazards and risks, requiring preventive and control measures to avoid accidents (Elviana et al., 2021). Meanwhile, the goal of OHS is to achieve zero accidents (Cintya et al, 2021).

PT. XYZ is an integrated area that functions as a center for innovation and technology development. In the manufacturing area, the implementation of a good Occupational Health and Safety Management System is crucial to protect operators from various risks associated with activities, such as milling, turning, cutting, benchworking, welding, and CNC. Each activity presents different potential hazards (Putra, 2021).

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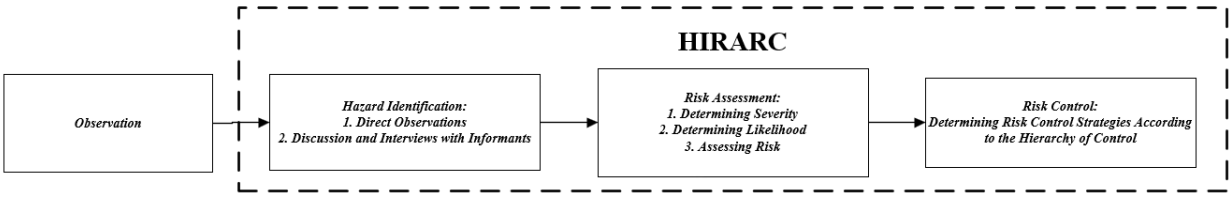

Figure 1. Research Framework

Based on interview results, workplace accidents involving operators frequently occur due to negligence and lack of focus during activities. Operators sustain injuries and cuts from workpieces. Understanding of OHS standards has not been properly implemented, as many operators still fail to wear personal protective equipment (PPE) according to procedures, and the placement of materials and waste is not well organized. A well-implemented OHSMS would not only benefit company but also provide a sense of comfort and safety for operators performing activities.

Based on the problem, various methods can be employed to identify and assess risks, such as Job Safety Analysis (JSA), Failure Mode and Effects Analysis (FMEA), What-If Analysis, Hazard Identification, Risk Assessment, and Risk Control (HIRARC). However, HIRARC is the most commonly used method for implementing an OHS management system as it simplifies the process into three core stages: hazard identification, risk assessment based on likelihood and potential impact, and determination of control measures according to the hierarchy of controls (Lubis, Sihombing, & Yanto, 2024).

The study conducted by Saragih and Fitriani (2024) highlights the importance of HIRARC in addressing issues within the manufacturing production area. Meanwhile, research by Anwar et al. (2024) shows that the use of the HIRARC method can prevent workplace accidents in machining workshop areas, thus strengthening the implementation of OHS. Therefore, the HIRARC method can be chosen to comply with the OHS management system.

By applying the HIRARC method, PT. XYZ can identify risk sources, assess their impacts, evaluate risks, and design appropriate OHS risk control strategies to reduce the occurrence of workplace accidents. Structured OHS risk control strategies through the HIRARC method can significantly impact ensuring operators' protection and comfort during their work activities.

2. Methodology

This study used two types of data: primary and secondary. The primary data used in this study were obtained through interviews, observations, and discussions with informants such as OHS stakeholders and operators. Meanwhile, the secondary data used is a literature review on regulations such as OHSAS, ISO, government regulations, and laws related to OHS.

The method used in this study is the HIRARC method as shown in Figure 1. HIRARC (Hazard Identification, Risk Assessment, and Risk Control) is a series of processes to identify potential hazards arising from routine and non-routine activities within a company, assess the resulting risk levels, and develop control measures to reduce those risks. The ultimate goal is to prevent workplace accidents. This research was conducted in the manufacturing area, analyzing all activities such as benchworking, cutting, welding, milling, turning, and CNC operations.

The first step is hazard identification. Hazard identification is essential for companies to implement because it helps understand the sources of hazards in each work activity. The hazard identification process aims to determine the potential risks associated with each activity using 5 factors (man, machine, material, method, environment) and the STOP 6 safety category. STOP (Safety Toyota Zero Accident Project) 6, as shown in Table 1, is an effort to prevent

workplace accidents. It helps simplify hazard identification by segmenting potential hazards into specific categories (Nursitasari, 2019). These two steps are essential for deepening hazard analysis and classifying incidents based on various factors and their impacts across multiple categories.

Next, the risks of the identified hazards are assessed. According to Burhanudin et al. (2024), risk assessment is a procedure used to identify potential hazards that may occur. Risk assessment is carried out based on ISO 31010:2019, an international standard that provides technical guidance on various risk assessment techniques. In the context of ISO 45001:2018 on OHS management systems, ISO 31010:2019 supports clause 6, which requires organizations to identify hazards and assess risks and opportunities.

The assessment refers to ISO 31010:2019, which includes criteria for likelihood, severity, and risk levels presented in the form of a matrix as shown in Table 2 and Table 3.

Table 1. STOP 6

Category	Description
A (Apparatus)	Potential for being pinched, struck, cut, scratched, etc.
B (Big Heavy)	Potential for heavy objects falling
C (Car)	Potential for being hit by vehicles (forklift, hand pallet, truck, etc.)
D (Drop)	Potential for falling from heights
E (Electric)	Potential electrical hazards
F (Fire)	Potential for fire hazards
O (Other)	Potential for chemical, biological, environmental hazards, etc. (other A-F)

Source: Nursitasari (2019)

Table 2. Likelihood Criteria

Level	Overview	Explanation	Note
5	Almost Certain	Can occur at any time or very frequently	Occurs once a week
4	Likely	Occurs frequently	Occurs twice a month
3	Possible	May occur several times	Occurs once every 6 months
2	Unlikely	Rarely occurs	Occurs once a year
1	Rare	Rarely or never occurs	Occurs 0 times in a year

Source: Risk Assessment Techniques ISO 31010 (2019)

Table 3. Severity Criteria

Level	Overview	Note
5	Catastrophic	- Incidents resulting in fatalities - Material losses exceeding Rp20,000,000.
4	Major	- Incidents resulting in permanent disabilities. - Medical treatment costs greater than Rp10,000,000. - Work time lost for more than three days. - Material losses ranging from Rp5,000,000 to Rp20,000,000.
3	Moderate	- External medical treatment under Rp1,000,000 without permanent disability. - Work time lost between one and three days. - Material losses ranging from Rp100,000 to Rp5,000,000.
2	Minor	- Minor treatment onsite, delayed return to work. - Work time lost less than 24 hours. - Material losses below Rp100,000.
1	Insignification	- Minor treatment onsite, immediate return to work. - No work time lost and material damage.

Source: Risk Assessment Techniques ISO 31010 (2019)

Then, the risk matrix level is determined based on severity and likelihood as shown in Table 4. Risk matrix level refers to the risk management standard ISO 31010:2019. The

determined risk values are then used to establish a priority scale for action, ensuring that hazard management can be addressed through effective measures.

Table 4. Risk Matrix Level

Like-lihood	Severity				
	1	2	3	4	5
5	H	H	E	E	E
4	M	H	H	E	E
3	L	M	H	E	E
2	L	L	M	H	E
1	L	L	M	H	H

Source: Risk Assessment Techniques ISO 31010 (2019)

The assessed risk values are subsequently utilized to establish a priority scale for actions, ensuring that hazard management is conducted through effective and targeted measures. Table 5 shows the action risk matrix.

Table 5. Action Risk Matrix

Category	Action
Extreme	Extreme risk requires immediate action or intervention.
High	High risk demands the attention of top management.
Medium	Moderate risk requires designated management responsibility to set target timelines for further actions.
Low	Low risk can be managed through routine procedures to ensure conditions remain safe.

Source: Risk Assessment Techniques ISO 31010 (2019)

After that, evaluation serves as a basis for determining the appropriate risk control strategies to reduce workplace accidents. The risk control strategies follow the Hierarchy of Control as shown in Figure 2 to ensure proper management of each activity requiring control.

The Hierarchy of Control (HoC) has received increasing attention recently and has been recommended by national occupational health and safety agencies in Australia, Canada, Denmark, and the United States. This hierarchy typically leads to the implementation of much safer structures, where the risk of injury or illness is greatly minimized (Gonawan & Othman, 2022). The process prioritizes hazard elimination and, as a last resort, relies on the use of personal protective equipment (PPE).

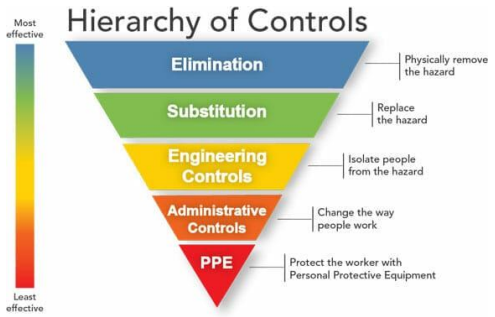

Figure 2. Hierarchy of Control

3. Results and Discussion

HIRARC is one of the mandatory requirements for the implementation of the Occupational Health and Safety Management System (OHSMS) based on the OHSAS 18001:2007 standard. The purpose of HIRARC is to identify potential hazards and assess operational capabilities in each process that may be disrupted due to deviations from the design objectives within the plant (Giananta et al., 2020).

The HIRARC method is divided into three stages: hazard identification, risk assessment, and risk control (Setiawan et al., 2024). The following presents the results of observations conducted in the manufacturing area.

3.1. Hazard Identification

Based on the observations conducted, the identified hazards in the manufacturing are shown in Table 6.

Table 6. Hazard Identification

Activity	Factor	Potential Hazard	STOP 6	Hazard Risk
Benchworking	Man	Operator negligence and lack of concentration	A	Injured, scratched, and pinched.

Activity	Factor	Potential Hazard	STOP 6	Hazard Risk
	Machine	Vise on benchwork	A	Pinched
	Material	Falling material	B	Foot injury
		Material dust	A	Eye irritation
		Sharp workpiece surface	A	Injured
	Methods	Sparks contacting the body	F	Injured or burned
		Uncomfortable working posture	O	Muscle fatigue and musculoskeletal disorders
	Environ-ment	Noise from grinding machines	O	Hearing impairment
		Poor air circulation and high temperatures	O	Dehydration and heat related illness
Cutting	Man	Operator negligence and lack of concentration	A	Injured, scratched, or cut
	Machine	Sharp saw blade	A	Injured, scratched, or cut
		Vise on the machine	A	Pinched
	Material	Heavy and long material	B	Foot injury
	Methods	Uncomfortable working posture	O	Muscle fatigue and musculoskeletal disorders
	Environ-ment	Noise from the machine	O	Hearing impairment
Welding	Man	Operator negligence and lack of concentration	A	Injured, blindness
	Machine	Overheating of the welding machine	F	Fire or explosion
		Damaged welding machine cables or connectors	E, F	Electric shock or short circuit
	Material	Incorrect use of electrodes or welding wire	E, F	Electric shock, burns
	Methods	Improper welding parameters	F	Sparks causing fire
		Uncomfortable working posture	O	Muscle fatigue and musculoskeletal disorders
	Environ-ment	High temperatures	O	Dehydration and heat related illness
		Welding fumes	F	Respiratory issues
Milling	Man	Operator negligence and lack of concentration	A	Injured, scratched, or cut
	Machine	Sharp end mill	A	Injured or slashed
	Material	Falling material	B	Foot injury
		Material dust	A	Respiratory issues
		Spilled oil and coolant	O	Slipping and skin irritation
	Methods	Uncomfortable working posture	O	Muscle fatigue and musculoskeletal disorders
	Environ-ment	Noise from the machine	O	Hearing impairment
Turning	Man	Operator negligence and lack of concentration	A	Injured, scratched, or cut
	Machine	Exposed cables	E, F	Electric shock, or fire
		Entanglement machine	A	Injured
	Material	Falling material	B	Foot injury
		Material dust	A	Respiratory issues
		Spilled oil and coolant	O	Slipping and skin irritation
	Methods	Uncomfortable working posture	O	Muscle fatigue and musculoskeletal disorders

Activity	Factor	Potential Hazard	STOP 6	Hazard Risk
	Environ-ment	Noise from the machine	O	Hearing impairment
CNC	Man	Operator negligence and lack of concentration	A	Injured, scratched, or cut
	Machine	Pinched by chuck	A	Injured
		Sharp cutting tools	A	Cut
	Material	Falling material	B	Foot injury
		Spilled oil and coolant with placed near the machine	O	Slipping and skin irritation
	Methods	Long waiting times	O	Muscle fatigue and musculoskeletal disorders
	Environ-ment	Noise from the machine	O	Hearing impairment
		Poor air circulation	O	Dehydration and heat related illness

3.2. Risk Assessment

After hazard identification, a risk assessment was conducted to determine the appropriate control strategies to reduce the risk of workplace accidents. The results of the risk assessment are shown in Table 7.

Table 7. Risk Assessment

Activity	Potential Hazard	Hazard Risk	L	S	Score	Category
Benchworking	Operator negligence and lack of concentration	Injured, scratched, and pinched.	3	3	9	High
	Vise on benchwork	Pinched	3	2	6	Medium
	Falling material	Foot injury	3	2	6	Medium
	Material dust	Eye irritation	2	2	4	Low
	Sharp workpiece surface	Injured	2	2	4	Low
	Sparks contacting the body	Injured or burned	3	2	6	Medium
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	4	2	8	High
	Noise from grinding machines	Hearing impairment	3	3	9	High
	Poor air circulation and high temperatures	Dehydration and heat related illness	3	2	6	Medium
Cutting	Operator negligence and lack of concentration	Injured, scratched, or cut	3	3	9	High
	Sharp saw blade	Injured, scratched, or cut	1	3	3	Low
	Vise on the machine	Pinched	2	3	6	Medium
	Heavy and long material	Foot injury	3	2	6	Medium
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	4	2	8	High
	Noise from the machine	Hearing impairment	3	3	9	High
Welding	Operator negligence and lack of concentration	Injured, blindness	3	3	9	High
	Overheating of the welding machine	Fire or explosion	2	4	8	High
	Damaged welding machine cables or connectors	Electric shock or short circuit	2	4	8	High
	Incorrect use of electrodes or welding wire	Electric shock, burns	2	3	6	Medium
	Improper welding parameters	Sparks causing fire	2	3	6	Medium
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	4	2	8	High
	High temperatures	Dehydration and heat related illness	2	3	6	Medium

Activity	Potential Hazard	Hazard Risk	L	S	Score	Category
	Welding fumes	Respiratory issues	2	3	6	Medium
Milling	Operator negligence and lack of concentration	Injured, scratched, or cut	3	3	9	High
	Sharp end mill	Injured or slashed	2	3	6	Medium
	Falling material	Foot injury	3	2	6	Medium
	Material dust	Respiratory issues	2	2	4	Low
	Spilled oil and coolant	Slipping and skin irritation	4	3	12	Extreme
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	4	2	8	High
	Noise from the machine	Hearing impairment	3	3	9	High
Turning	Operator negligence and lack of concentration	Injured, scratched, or cut	3	3	9	High
	Exposed cables	Electric shock, or fire	2	4	8	High
	Entanglement machine	Injured	1	3	3	Low
	Falling material	Foot injury	3	2	6	Medium
	Material dust	Respiratory issues	2	2	4	Low
	Spilled oil and coolant	Slipping and skin irritation	4	3	12	Extreme
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	4	2	8	High
	Noise from the machine	Hearing impairment	3	3	9	High
CNC	Operator negligence and lack of concentration	Injured, scratched, or cut	3	3	9	High
	Pinched by chuck	Injured	1	2	2	Low
	Sharp cutting tools	Cut	1	3	3	Low
	Falling material	Foot injury	2	2	4	Low
	Spilled oil and coolant with placed near the machine	Slipping and skin irritation	4	3	12	Extreme
	Long waiting times	Muscle fatigue and musculoskeletal disorders	4	2	6	High
	Noise from the machine	Hearing impairment	3	3	9	High
	Poor air circulation	Dehydration and heat related illness	3	2	6	Medium

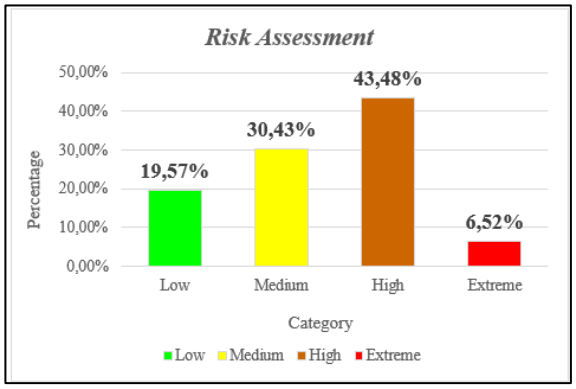

Figure 3. Risk Assessment Chart

Based on the risk assessment chart as shown in Figure 3, the distribution of risks tends to concentrate in the high-risk category. Approximately 43.48% of the total risks fall into this category, indicating that nearly half of the identified hazards pose significant risks and require immediate control measures. This high proportion is largely due to unsafe operator behavior, damaged equipment, and poor environmental conditions. Medium-risk hazards (30.43%) are mostly linked to equipment design and material handling and need structured management. Low-risk hazards (19.57%) are relatively safer but still need regular monitoring, especially where PPE use is lacking.

Although extreme risks account for only 6.52%, they involve serious dangers such as chemical exposure and slippery surfaces near machines. These must be addressed quickly to avoid severe accidents. In general, the results

highlight the need to prioritize risk control through appropriate strategies to comply with OHS management system standards in manufacturing area.

3.3. Risk Control

Table 8 presents the risk control strategies for each identified potential hazard.

Table 8. Risk Control

Activity	Potential Hazard	Hazard Risk	Category	HoC
Benchworking	Operator negligence and lack of concentration	Injured, scratched, and pinched.	High	*Administration Control* & PPE
	Vise on benchwork	Pinched	Medium	*Administration Control* & PPE
	Falling material	Foot injury	Medium	*Administration Control* & PPE
	Material dust	Eye irritation	Low	*Administration Control* & PPE
	Sharp workpiece surface	Injured	Low	*Administration Control* & PPE
	Sparks contacting the body	Injured or burned	Medium	*Administration Control* & PPE
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control. Administration Control* & PPE
	Noise from grinding machines	Hearing impairment	High	*Engineering Control* & PPE
	Poor air circulation and high temperatures	Dehydration and heat related illness	Medium	*Engineering Control* & PPE
Cutting	Operator negligence and lack of concentration	Injured, scratched, or cut	High	*Administration Control* & PPE
	Sharp saw blade	Injured, scratched, or cut	Low	*Administration Control* & PPE
	Vise on the machine	Pinched	Medium	*Administration Control* & PPE
	Heavy and long material	Foot injury	Medium	*Administration Control* & PPE
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control. Administration Control* & PPE
	Noise from the machine	Hearing impairment	High	*Engineering Control* & PPE
Welding	Operator negligence and lack of concentration	Injured, blindness	High	*Administration Control* & PPE
	Overheating of the welding machine	Fire or explosion	High	*Administration Control* & PPE
	Damaged welding machine cables or connectors	Electric shock or short circuit	High	*Substitution, Administration Control* & PPE
	Incorrect use of electrodes or welding wire	Electric shock, burns	Medium	*Administration Control* & PPE
	Improper welding parameters	Sparks causing fire	Medium	*Administration Control* & PPE
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control* & PPE
	High temperatures	Dehydration and heat related illness	Medium	*Engineering Control* & PPE

Activity	Potential Hazard	Hazard Risk	Category	HoC
	Welding fumes	Respiratory issues	Medium	*Administration Control* & PPE
Milling	Operator negligence and lack of concentration	Injured, scratched, or cut	High	*Administration Control* & PPE
	Sharp end mill	Injured or slashed	Medium	*Administration Control* & PPE
	Falling material	Foot injury	Medium	*Administration Control* & PPE
	Material dust	Respiratory issues	Low	*Administration Control* & PPE
	Spilled oil and coolant	Slipping and skin irritation	Extreme	*Elimination, Administration Control* & PPE
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control. Administration Control* & PPE
	Noise from the machine	Hearing impairment	High	*Engineering Control* & PPE
Turning	Operator negligence and lack of concentration	Injured, scratched, or cut	High	*Administration Control* & PPE
	Exposed cables	Electric shock, or fire	High	*Administration Control* & PPE
	Entanglement machine	Injured	Low	*Administration Control* & PPE
	Falling material	Foot injury	Medium	*Administration Control* & PPE
	Material dust	Respiratory issues	Low	*Administration Control* & PPE
	Spilled oil and coolant	Slipping and skin irritation	Extreme	*Elimination, Administration Control* & PPE
	Uncomfortable working posture	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control. Administration Control* & PPE
	Noise from the machine	Hearing impairment	High	*Engineering Control* & PPE
CNC	Operator negligence and lack of concentration	Injured, scratched, or cut	High	*Administration Control* & PPE
	Pinched by chuck	Injured	Low	*Administration Control* & PPE
	Sharp cutting tools	Cut	Low	*Administration Control* & PPE
	Falling material	Foot injury	Low	*Administration Control* & PPE
	Spilled oil and coolant with placed near the machine	Slipping and skin irritation	Extreme	*Elimination, Administration Control* & PPE
	Long waiting times	Muscle fatigue and musculoskeletal disorders	High	*Engineering Control. Administration Control* & PPE
	Noise from the machine	Hearing impairment	High	*Engineering Control* & PPE

Activity	Potential Hazard	Hazard Risk	Category	HoC
	Poor air circulation	Dehydration and heat related illness	Medium	*Engineering Control* & PPE

a. Elimination

- **Safe Arrangement for Hazardous and Toxic Materials (B3)**

Oil, coolant, grease, and diesel used in operations pose fire, health, and environmental risks. Storing oil and coolant near machines must be eliminated to prevent accidents.

Material Safety Data Sheets (MSDS) should be provided to inform operators about chemical hazards and precautions. According to Government Regulation Indonesia No. 74/2001, B3 materials must be stored separately from work areas, away from fire sources, with proper ventilation and precise labeling to ensure safe handling and reduce contamination risks.

b. Substitution

- **Replacement of Broken Parts and Preventive Maintenance**

Replacing broken parts with standard-compliant components is essential to prevent serious hazards like electric shock or fire. Preventive maintenance document helps detect machine issues early, allowing immediate repairs or shutdowns to reduce accident risks.

- **Replacing Manual Milling and Turning Machines with CNC Machines**

Switching to CNC machines improves safety and accuracy by reducing direct operator-machine interaction and minimizing human errors. CNC operations are more precise and consistent and carry lower injury risks than manual machining. This is a positive step toward preventing hazardous risks that may lead to workplace accidents.

c. Engineering Control

- **Provision of Ergonomic Chair**

The provision of ergonomic chairs aims to improve operator comfort, especially for those working long hours. Designed based on ergonomic principles, these chairs support balanced posture, distribute body weight evenly, and reduce excessive strain on the spine and joints. It helps minimize the risk of musculoskeletal disorders commonly experienced by operators.

- **Regular Noise Level Monitoring**

Periodic noise measurements are essential to control hearing risks, especially when levels exceed 85 dBa. Based on Government Regulation Indonesia No. 50/2012, protective measures like earplugs, earmuffs, or work time adjustments must be implemented to ensure worker safety and regulatory compliance.

d. Administrative Control

- **Development of SOPs, Work Instructions, and Safety Signs**

Standard Operating Procedure (SOP) is critical to maintaining quality, safety, and efficiency by providing structured guidelines for operators to perform tasks consistently and in compliance with regulations. Clear Work Instruction further detail specific steps to complete tasks safely and correctly, minimizing human errors and operational risks.

Figure 4. Safety Signs

Safety signs, as shown in Figure 4, designed based on ANSI Z535 standards are vital to warn and inform operators and visitors about workplace hazards. These include signs for pinch hazards, fire risks, hazardous materials, and high noise areas.

- **Optimization of 5R Culture and OHS Training**:

Optimization of the 5R culture and implementation of regular OHS training programs are essential to create a clean, organized, and safe workplace while ensuring workers are prepared for hazard prevention and emergency response.

e. PPE

Proper use of PPE, such as wearpacks, safety glasses, masks, gloves, safety shoes,

and hearing protection minimizes workplace injury risks and safeguards operator health.

4. Conclusion

Based on the results, the implementation of the HIRARC method in the manufacturing area of PT. XYZ has proven effective in identifying potential hazards using the STOP 6 approach and five factors, assessing risk levels, and designing structured risk control strategies. The risk assessment showed that 43.48% of hazards fall into the high-risk category, followed by medium (30.43%), low (19.57%), and extreme (6.52%). These risks are primarily caused by unsafe behavior, poor working conditions, and inadequate equipment. The control strategies were developed based on the hierarchy of control, including hazard elimination, substitution of manual machines with CNC machines, technical improvements such as noise reduction and ergonomic enhancements, as well as administrative measures and proper use of personal protective equipment (PPE).

This approach aligns with the requirements of the OHS Management System standard ISO 45001:2018, particularly in risk control and continuous improvement. Accordingly, it is recommended that operators improve their discipline in following safety procedures, using PPE correctly, and reporting potential hazards. The company is also advised to develop and implement a sustainable safety program to foster a strong safety culture and ensure full compliance with ISO 45001:2018 standards.

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