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SAFETY AND HEALTH RISK ANALYSIS WITH HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL METHOD AT WORKSHOP OF FACULTY OF ENGINEERING

Aditya Fakhri[1], Muhammad Izzul Fikri [2], Whydiantoro[3]
[1,3 2]Industrial Engineering Faculty of Engineering, University of Majalengka
[2]Faculty of Engineering, University of August 17, 1945 Banyuwangi
[1]adifakh17@gmail.com

Abstract
Occupational Safety and Health (K3) is an effort to ensure the optimal fulfillment of workers' physical and spiritual needs. The implementation of K3 in the workplace aims to create a safe and comfortable working environment by reducing the risk of accidents and occupational diseases. One method used to manage K3 risks is the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method. This method involves hazard identification, risk assessment, and risk control, which can help minimize workplace accidents. This study was conducted at the Workshop of the Faculty of Engineering, University of Majalengka, with the aim of analyzing K3 risks using the HIRARC method. The research used a qualitative approach with data collection through observation, documentation, and interviews. The results of the study revealed various potential hazards in the workshop environment that could lead to accidents. Based on the risk assessment, a risk scale was developed to determine the priority of hazards that need to be addressed first. This study provides recommendations for risk control measures that can be implemented to improve occupational safety and health in the workshop environment of the Faculty of Engineering, University of Majalengka.

Keywords: Occupational Safety and Health (K3), HIRARC, Workshop, Risk Assessment, Risk Control.

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Introduction

Occupational safety and health (K3) is a thought and effort to ensure the perfect fulfillment of physical and spiritual needs. The implementation of K3 in work activities is expected to allow the parties to work safely and comfortably. Work is considered safe when the risk of occupational accidents or illnesses can be avoided. Meanwhile, work is said to be comfortable if workers feel at home and comfortable in carrying out their duties.

Regulation of the Minister of Manpower NO.03/MEN/1998, states that Work Accidents are unwanted and unexpected events which can cause human casualties and property losses. Meanwhile, Occupational Diseases are diseases caused by work and the work environment.

According to Government Regulation of the Republic of Indonesia Number 50 of 2012 concerning the Implementation of the Occupational Safety and Health Management System, SMK3 is an inseparable part of the company's overall management system in order to control the risk of hazards related to work activities in order to create a safe, efficient and productive workplace. Every company is required to prepare SMK3 in its company, especially for companies that employ at least 100 (one hundred) workers or companies that have a high level of risk. The implementation of SMK3 includes several points, namely, policy determination, K3 planning, implementation of K3 plans, monitoring and evaluation of K3 performance, review, and improvement of SMK3 performance. To carry out SMK3 in a company, it is necessary to identify with the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.

Hazard Identification, Risk Assessment and Risk Control (HIRARC) is a method of a process to describe the possibility of hazards which include frequency, severity to evaluate the consequences of each potential loss and injury that will occur. Based on OHSAS 18001:2007, the implementation of HIRARC is carried out in 3 (three) stages, namely: Hazard identification, Risk assessment and

Risk control in implementing the implementation of Occupational Safety and Health in the work environment [1].

Hazard is a condition or activity that has the potential to cause an accident. Hazards can come from the surrounding environment, but they are often difficult to realize, especially due to a lack of human knowledge or awareness of the risk of accidents. Therefore, various efforts are made to suppress and reduce work accidents in various places and times, including in laboratories or workshops on campus. Workshops or laboratories function as a means to improve knowledge, understanding of scientific concepts, and theories[2], [3].

Occupational Safety and Health (K3) is an important aspect in every work environment, including in educational institutions such as the Faculty of Engineering, University of Majalengka. In practicum and workshop activities, there are various potential hazards that can threaten the safety of students and teaching staff. Therefore, the application of OSH risk analysis is urgently needed to identify, evaluate, and control possible risks.

The Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method is a systematic approach used to assess risks and determine appropriate preventive measures. By identifying hazards, assessing risks, and controlling risks, it is hoped that work accidents can be minimized and a safer work environment can be created. This study aims to analyze the risks of K3 in the workshop of the Faculty of Engineering, University of Majalengka using the HIRARC method, so that it can provide useful recommendations in improving occupational safety and health in the environment.

Research Method

This research was conducted at the Workshop of the Faculty of Engineering, University of Majalengka. The method used is a qualitative method, with data collection through observation, documentation, and interviews using HIRARC (Hazard Identification, Risk Assessment, and Risk Control) tools. The HIRARC method includes: hazard identification, risk assessment and risk control. This qualitative research aims to describe and explain social phenomena and human problems from the perspective of informants[4].

Risk management analysis starts from the hazard identification stage. At this stage, it can be known what problems have the potential to be dangerous from a tool, material, or dangerous condition or environment in this workshop of the Faculty of Engineering[5]. The next stage is to conduct a risk assessment. At this stage, the most important thing is to determine the risk rating of the identified hazards[6]. In this stage, there are two parameters used, namely the probability of the danger occurring and the severity if the danger occurs. The risk level of both parameters can be seen in Table 1. And Table 2. Then from the results of the risk assessment, then an analysis was carried out with a risk matrix scale as seen in the Table 3. The risk matrix used in this study refers to the AS/NZS Method 4360:2004.

After the results of the risk scale are obtained from Table 3, then determine the hazard factors to be resolved first, based on how often the hazard occurs and how severe the impact will be if the hazard occurs. Hazards that have a high rating are priority factors that must be resolved first, followed by lower hazard factors, which are characterized by extreme, high, moderate, and low levels.

Tabel 1 Probability scale

Level	Description	Information
1	*Rare* (sangat jarang)	Almost never, very rarely
2	*Unlikely* (jarang)	Rare
3	*Possible* (sedang)	Can happen once in a while
4	*Likely* (sering)	Frequent occurrence
5	*Almost Certain* (sangat sering)	Can happen at any time

Tabel 2 Severity scale

Level	Descriprtion	Information
1	Insignificant	No injuries, little financial loss
2	Minor	Minor injuries, little financial loss
3	Moderate	Moderate injury, requiring medical treatment, major financial loss
4	Major	Serious injury > 1 person, major loss, production disruption
5	Catastrophic	Fatal > 1 person, the loss was very large and the impact was very wide, the cessation of all activities

Tabel 3 Risk matrix scale

Risk Frequency (probability)	Risk Impact (severity)				
	1	2	3	4	5
5	M	H	H	E	E
4	M	M	H	H	E
3	L	M	H	H	H
2	L	L	M	M	H
1	L	L	M	M	H

The third stage is the risk control stage. Risk control aims to minimize the level of risk of a potential hazard that exists to the lowest level or at a tolerable level. Here are some ways to control risk:

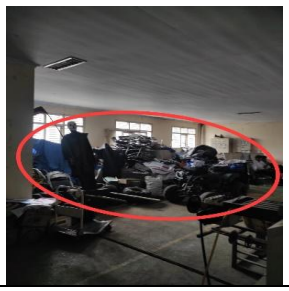
a. Elimination
   It is to eliminate the source of danger (hazard). This step is the most ideal, because there are efforts to eliminate the impact of the hazards that arise.
b. Subtitution
   It is to replace the source of risk that is considered high with a lower one.
c. Engineering
   It is to change the design of tools, machinery, infrastructure engineering, environment, and buildings to make them safer. Some of them are modifying equipment, combining activities, changing procedures, and reducing the frequency of high-risk activities.
d. Administration
   It is the creation of procedures, rules, installation of signs (sofety signs), warning signs, and labeling as a step to reduce the level of risk.
e. Personal Protective Equipment (PPE)
   It is the use of personal protective equipment (PPE) that is appropriate to the type of work carried out to reduce the severity of the hazard caused.

Results and Discussion (10pt)

The analysis of occupational safety and health risk management at the Workshop of the Faculty of Engineering, University of Majalengka will be carried out through stages according to the HIRARC method. The first stage is hazard identification, followed by risk assessment, and the last stage is risk control.

Hazard Identification

Table 4. Hazard identification

No	Hazard Identification	Risk	Picture
1	The color of the floor where the machine is located which is a less safe area and the color of the floor area that is safe for people to cross is the same color, the color of the floor where the various machines are placed should be enough to be limited to yellow paint only and in the area does not need to be painted.	An accident when people do not know that the area is demarcated by the line not just anyone can enter the area, except with an expert companion	
2	Items that should not be in the workshop, even in the area where the machine is located.	Trips, stepped on, bumped feet and caused access to the engine area to be hampered.	 
3	Lighting facilities are not working (damaged).	Prone to accidents due to lack of lighting. For example: tripping, being hit, and can be a serious accident when using the engine in the dark.	

No	Hazard Identification	Risk	Picture
4	Machines/tools that are placed are not in place, but are placed in areas where people pass. The machine/tool should be placed in the area indicated by the green arrow.	Bumped and tripped over people when passing.	
5	The cable is not neatly arranged (Clutter), there are even some strands of protective rubber cable exposed.	Electrical short circuit, tripping feet, electrocuted.	  

No	Hazard Identification	Risk	Picture
6	The distance between the machines is too close.	Exposure to heat that results in burns and dust that results in shortness of breath, risk of being pinched and bumped.	 

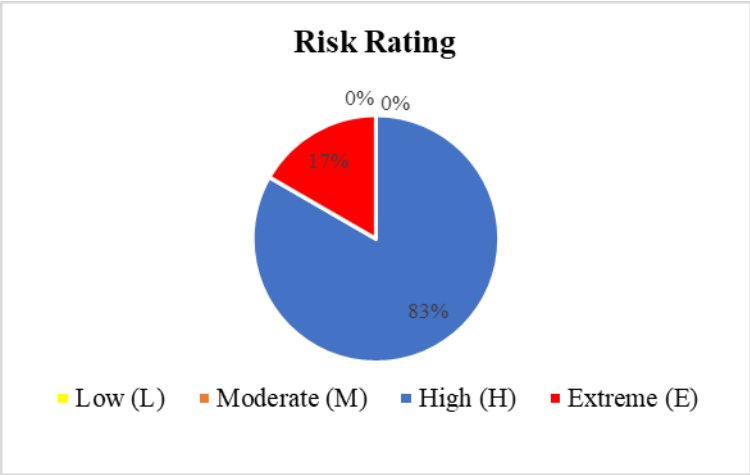
Risk Assessment

At this stage of risk assessment, the level of risk in terms of the probability of a work accident (probability) and the severity of the hazard (severity) can be known. The probability measurement parameters used in this study are how often activities that include unsafe acts and unsafe conditions that can have the potential to become work accidents. The impact of the potential hazards found in the previous stage was then analyzed using a risk matrix table to obtain a risk rating of each hazard by considering its probability and severity.

Table 5. Risk Assessment

No	Hazard Identification	Risk	Risk Rating (Scale)		Risk Rating
			Probability	Severity	
1	The color of the floor where the machine is located which is a less safe area and the color of the floor of the area that is safe for people to cross is the same color, the color of the floor where the various machines are placed should be enough to be limited to yellow paint only and in the area does not need to be painted.	An accident when people do not know that the area is delimited by the line is not just anyone, except with an expert companion.	Likely	Major	H (High)
2	Items that should not be in the workshop, even in the area where the machine is located.	Trips, stepped on, bumped feet and caused access to the engine area to be hampered.	Almost Certain	Minor	H (High)
3	Lighting facilities are not	Prone to accidents	Possible	Moderate	H (High)

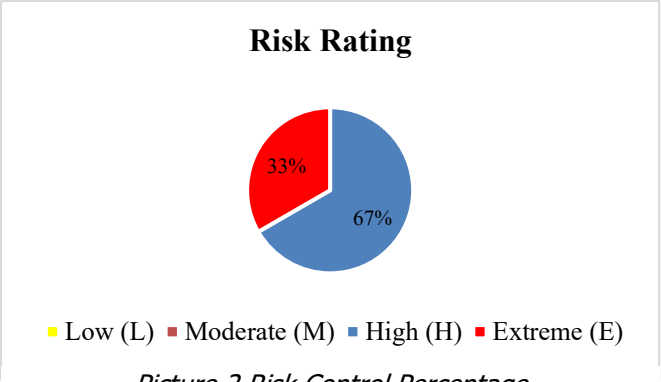
No	Hazard Identification	Risk	Risk Rating (Scale)		Risk
	working (damaged).	due to lack of lighting. For example: tripping, being hit, and can be a serious accident when using the engine in the dark			
4	Machines/tools that are placed are not in place, but are placed in areas where people pass.	Bumped and tripped over people when passing.	Almost Certain	Minor	H (High)
5	The cable is not neatly arranged (Clutter), there are even some strands of protective rubber cable exposed.	Electrical short circuit, tripping feet, electrocuted.	Likely	Catastrophic	E (Extreme)
6	The distance between the machines is too close.	Exposure to heat that results in burns and dust that results in shortness of breath, risk of being pinched and hit by fire.	Almost Certain	Minor	H (High)



Picture 1 Risk Assessment Percentage

Table 6. Risk Control

No	Hazard Identification	Risk	Risk Rating	Risk Control
1	Many cables peel off and are scattered on the floor.	It may result in a short circuit and electric shock.	E *(Extreme)*	1. Regarding electrical hazards based on SNI PUIL 2011, especially the handling of peeled cables, the recommended action is to replace the cables with new ones. This is important to eliminate risks that can endanger the safety of practice students (elimination). 2. In addition, the electrical installation system also needs to be repaired by planting cables so that they are not scattered on the floor, so that it can reduce the risk of accidents (engineering).
2	Lighting facilities are not working (damaged)	Prone to accidents due to lack of lighting.	H *(High)*	According to the Indonesian National Standard (SNI) 03-6575-2001 concerning Procedures for Planning Artificial Lighting Systems in Buildings, the recommended actions are • Damaged lights must be replaced immediately to ensure even distribution of light (engineering engineering). • Lighting systems must have an emergency lighting plan to anticipate sudden breakdowns (engineering engineering).
3	The color of the workshop floor is not in accordance with the rules for the application of K3 Standard rules.	Traffic accidents around the engine	H *(High)*	In accordance with SNI 6530:2016 standards. The action that needs to be taken is to repaint the floor with a color that is in accordance with the predetermined standards (engineering engineering).



Picture 2 Risk Control Percentage

Table 7. Potential For a Decrease In Risk Level

No	Hazard Identification	Risk rating (before)		Risk rating	Risk rating (after)		Risk rating
		Probability	Severity		Probability	Severity	
1	Many cables peel off and are scattered on the floor.	Likely	Catastrophic	E (Extreme)	Very rare (1)	Very light (1)	Low
2	Lighting facilities are not working (damaged).	Possible	Moderate	H (High)	Very rare (1)	Very light (1)	Low
3	The color of the workshop floor is not in accordance with the rules for the application of K3 Standard rules	Likely	Major	H (High)	Very rare (1)	Very light (1)	Low

Conclusion

The Faculty of Engineering Workshop has several machines that students use to practice certain courses. From the identification of hazards carried out, against the unsafe condition and unsafe act in the workshop room, it was found that six hazards occurred including the color of the floor where the machine is not in its proper place, items that are not in place, lighting facilities that do not function (damaged), machines/tools that are placed in the wrong place, cables that are not neatly arranged (messy) and peeled off, and the distance between machines is too close.

Of the six hazards, there are 83% of conditions or activities that have a high level of danger, followed by a percentage of 17% of conditions or activities that have extreme risks.

Risk control is prioritized for conditions and activities that have a very extreme level of danger. Some of the steps taken to control the risk of extreme danger levels are administrative control, elimination, engineering, and the use of PPE. After the risk control is carried out, it is hoped that the risk level that was previously extreme can be minimized to low and moderate.

The research opportunity that can be developed from this research is to conduct a K3 risk management analysis for the workshop room in the study program and other faculties at the University of Majalengka. From the development of the research, it is hoped that K3 risk management will be obtained more thoroughly and cover all workshop rooms at Majalengka University so that a safer and more comfortable workshop area will be realized for all students.

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