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Application of Proposed Equipment and Design of Occupational Safety and Health Systems

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ABSTRACT: *The abstract should summarize the content of the paper. Try to keep the abstract below 200 words. Do not make references nor display equations in the abstract. UD. X is a company engaged in the production of supporting equipment for rice milling machines such as APC / grain cleaners, elevators / spoons, skin breaking bodies, inflatable and suction blowers, groats, sieves and conveyors. This company uses machines and equipment that have the possibility of causing accidents for its workers. Problems that often occur in this company are work accidents where in the period (July 2020 - July 2021) there have been 52 work accidents, caused by worker negligence in carrying out their work such as not using Personal Protective Equipment (PPE/APD), lack of employee awareness regarding occupational safety and health, and the absence of a good K3 system implementation. This study is to identify potential hazards that can occur using the Health Failure Modes and Effects analysis (HFMEA) method and design an OHS system. The purpose of this study is to identify potential hazards and design an OHS system. The results of the identification of potential hazards of work accidents obtained 21 activities in the sub-process that have the potential to occur and 45 hazards that can occur with the effect of injuries on several body parts, the hazard scoring matrix assessment with the highest value of 12 and the lowest value of 2.33 potential hazards obtained hazard score 8 or higher, existing control measure is No, detectability is Yes so the process stops at this point. A total of 12 potential hazards that get a hazard score below 8, a single point weakness is worth No, the process stops here too. With the design of the K3 system as a solution for improving working conditions, including employee policies and regulations, procurement of supporting equipment, K3 facilities, safety of machine operation*

Keywords - *HMFEA, K3, system plan, work accidents*

I. INTRODUCTION

In the era of globalization and also rapid technological advances, competition in the business world is unavoidable. With increasingly tough competition, companies are required to be creative and innovative in facing the market competition. The emergence of new companies is certainly a challenge for companies that have been around for a long time. So that the old company can worry about the competition. Incumbent companies will fear that their market share will be taken by emerging competitors. With increasingly fierce competition, companies compete with each other in providing improvements to the products produced to service to consumers. This is done to maintain the existence of their business. Occupational Health and Safety (K3) is an effort or action in providing protection to employees from the possibility of work accidents and diseases due to work activities.

Therefore, to ensure the safety and health of workers, the government requires all industrial sectors including the Small and Medium Industry (MSME) sector to implement an OHS (K3) system in the workplace. Occupational Safety and Health (K3) is very important to be applied, especially to companies that are directly related to the production sector so that employees can feel safe, comfortable, healthy and safe in doing their jobs, so that work productivity can be achieved optimally. Many companies consider occupational safety and health issues to be minor issues that do not need to focus on implementing a good OHS (K3) system. Whereas by implementing the OHS system, the company has provided safety guarantees, provided a sense of security

from work accidents, and guaranteed the health of workers or employees. UD. X is a company engaged in the production of components for rice milling machines such as APC / grain cleaners, elevators / spoons, skin breaker bodies, inflatable and suction blowers, groats, sieves and conveyors. This company uses machines and equipment that have a potential occupational accident hazard for its workers, such as grinding machines, drilling machines and welding machines. The problem that often occurs in this company is work accidents where in the last 1 year period (July 2020 - July 2021) there have been 52 work accidents, including cut hands (40.38%), swollen eyes (11.53%), bumped foot (32.69%), finger affected by grinding wheel (15.38%), skin peeled off (7.69%). The average occurrence of work accidents in each month is 4 cases. caused by the negligence of workers in carrying out their work such as not using Personal Protective Equipment (PPE), lack of employee awareness about occupational health and safety, and the absence of a good K3 system implementation.

The problems found at UD. X are, one of the causes is implementing the OHS system. To discuss these problems, the author will first analyze the potential for workplace accidents using the Health Failure Modes and Effects analysis (HFMEA) method to get a solution for repairing the potential hazards. The term HFMEA was adopted from FMEA which is a systematic approach by applying a tabular method to assist the thought process that will be used to modify potential failure modes and their effects (Luckyta & Partiwi, 2012; Sugiarto, 2014). by designing an occupational health and safety system. Based on the results of previous research Luckyta & Partiwi (2012) at PT. X with the theme Evaluation and Design of Occupational Health and Safety Management Systems (SMK3) in the Context of Improvement of Worker Safety Behavior. From the results of his research, it can be concluded that by using the Health Failure Modes and Effects analysis (HFMEA) method, the results of the identification of potential risks and making corrective action solutions are obtained. Another study by William & Panjaitan (2014) at PT. SPINDO 1 with the theme of designing an occupational health and safety system (SMK3) at PT. SPINDO 1. From the results of his research, the results of risk identification using the HIRARC method are used to improve K3.

II. RESEARCH PROBLEM

The formulation of the problem in this study is as follows:

1. How to identify occupational safety and health risks?
2. How to propose an occupational safety and health system design?

III. RESEARCH OBJECTIVES

The objectives of this study are as follows:

1. To find out the risks of occupational safety and health.
2. To design an occupational safety and health system.

IV. RESEARCH METHODS

Data analysis uses the Health Failure Mode and Effects analysis (HMFEA) method which is used to identify potential hazards of work accidents.

1. The Health Failure Mode and Effects analysis (HMFEA) method analyzes the probability of a hazard that can occur. The following are the stages of HFMEA: (1) describe the process graphically, (2) analyze potential hazards, and (3) create repair solutions and measure parameters.
2. K3 system design, designing on occupational safety and health (K3) system based on the analysis of the potential hazards of work accidents that can occur using the failure mode and effect analysis (HMFEA)

V. RESULTS AND DISCUSSION

1. Data collection and processing

UD. X is a company engaged in the production of supporting equipment for rice milling machines. This company uses machines and equipment that have the possibility of causing accidents to its workers. From the results of interviews with the head of production, The company, which has been carried out, obtained data on work accidents that have occurred in the company in the period July 2020 to July 2021. UD. X has 28 workers, 8 of whom work in the process of making elevators/spoons. The following table 4.1 table of work accident data has occurred as many as 56 cases of work accidents in the last 1 year period with the types of work accidents being cut hands, swollen eyes, bumped feet, grinding fingers and peeling facial skin.

Table 1. Work Accidents (July 2020 - July 2021)

Types of Accidents	Number of Accidents (times)	Percentage (%)
Sliced hands	21	40.38
Eyes swollen	6	11.53
Leg bump	17	32.69
Fingers hit by grinding wheels	8	15.38
Facial skin exfoliated	4	7.69
Total	56	100

HMFEA method to identify the potential hazards of work accidents.

a. Potential Hazards (HMFEA)

Data processing will be carried out using the Health Failure Modes And Effect Analysis (HMFEA) method which consists of Failure Mode, Effect Mode, and Repair solution. In processing this data, there are several stages that are carried out, namely describing the process graphically in the elevator production process which is carried out through the interview process. Analyzing potential hazards and determining severity and probability values then using a decision tree shown in Table 2. and Figure 1. and making improvement solutions in Table 4. The interview process begins with identifying the stages of work in the elevator production process and then proceeds with hazard identification, analyzing hazards (Asih et al., 2021), the consequences of these hazards. The next step is the assessment of the severity and probability of each potential hazard, making a decision tree. The assessment is carried out by the Head of company. Furthermore, identification of hazards that can occur in all activities in the sub-process of making elevators/spoons is carried out whether these activities have potential hazards or do not have potential hazards.

Table 2. Hazard Identification

No.	Activity	Hazard assessment
1.	Ordering material	No potential hazard
2.	Arriving material at the production site	No potential hazard
3.	Checking material (quality & quantity)	Hazard potential
4.	Lifting material to storage	A potential hazard occurs
5.	Selecting materials to be used Potential	Potential danger
6.	Checking the quality of the material to be used	There is a potential hazard
7.	Lifting the material to the measurement place	A potential hazard occurs
8.	Measuring the material	There is no potential hazard
9.	Marking the material	There is no potential hazard
10.	Making sure the material has been marked	There is no potential hazard
11.	Lifting the material to the processing site cutting	There is a potential hazard
12.	Cutting the material using a grinding machine and plate cutting tool	A potential hazard occurs
13.	Sure the material has been marked	There is no potential hazard
14.	Lifts to the forming process	A potential hazard occurs
15.	Forms the material according to size	There is a potential hazard
16.	Checks the shape of the Components	No potential hazard occurs
17.	Ensures that materials are marked	No potential hazard occurs
18.	Lifts components to the place of punching process	A potential hazard occurs
19.	Punches the material using a hand drill machine and a seated drill machine	There is a potential hazard
20.	Lifts components to the assembly process	A potential hazard occurs
21.	Performs assembly of components using a welding machine with iron clamping tools	There is a potential danger
22.	Installing bolts	There is a potential hazard
23.	Cleaning the rest of the assembled welds	A potential hazard occurs

24.	Smoothing sharp parts	There is a potential hazard
25.	Cleaning up dust and rust on the product	There is a potential hazard
26.	Lifting the productpaint	There is a potential hazard
27.	With pertalite according to the color ordered	There is a potential hazard
28.	Adding paint to the spray	There is no potential hazard
29.	Starting the compressor engine	There is a potential hazard
30.	Painting	A potential hazard occurs
31.	Drying	There is no potential danger

Further processing is carried out by identifying the types of hazards that can occur and the effects of these hazards and conducting risk assessments.

Table 3. Risk Assessment

No	Activity	Potential Danger	Efek	Risk assment matrix		
				Severity	Probability	RR
1	Check the material (quality & quantity)	Cut scratched hands	wounded	moderate (2)	Frequent (4)	8
2	Lift the material to the storage place	Foot hit	Injured/bruised	moderate (2)	Frequent (4)	8
		Cut scratched hands	wounded	moderate (2)	Frequent (4)	8
		the leg was material hit	wounded	moderate (2)	Frequent (4)	8
		Back and arm injuries	Muscle Injuries	minor (1)	uncommon (2)	3
3	Choose the material to be used	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
4	Check the quality of the material to be used	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
5	Lift the material to the measurement place	Foot hit	injured/bruised	moderate (2)	Frequent (4)	8
		scratched hands	wounded	moderate (2)	Frequent (4)	8
6	Lift the material to the cutting process	feet hit something	injured/bruised	moderate (2)	Frequent (4)	8
		Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
7	Cut the material using a grinding machine and plate cutting tools	hit by a fire	Burns	moderate (2)	Frequent (4)	8
		grinding machine hands	injured/cut	major (3)	Frequent (4)	12
		Noise	hearing disorders	moderate (2)	Frequent (4)	8
		foot hit	injured/bruised	moderate (2)	Frequent (4)	8
8	Lift to the forming process	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
		pinched finger	injured/broken bones	moderate (2)	remote (1)	2
9	Forming the material according to size	hit by ballast	injured / bumped body	major (3)	remote (1)	3
		foot hit	injured/bruised	moderate (2)	Frequent (4)	8
10	Lifting the component to the place where the process of	Tangan teriris/tergores	wounded	moderate (2)	Frequent (4)	8
		got electric shock	get electrocuted	catasthropic (4)	remote (1)	4
11	Punching holes in the material using a hand drill machine and a sitting drill machine	got splashed by the remnants of the drill	wounded	moderate (2)	Frequent (4)	8
		hands hit by drill bits	injured/cut	major (3)	uncommon (2)	6
		hit by material	injured / bumped body	moderate (2)	uncommon (2)	4
		foot hit	injured/bruised	moderate (2)	Frequent (4)	8
12	Lifting the component to the assembly process	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
13	Carrying out the assembly of components using a welding machine with an iron clamp tool	exposed to welding light	peeling facial skin irritation to the eyes	moderate (2)	Frequent (4)	8
		hit by a fire	Burns	moderate (2)	Frequent (4)	8
		got electric shock	electrocuted	catasthropic (4)	remote (1)	4
		Fall	wounded	moderate (2)	Frequent (4)	8
14	Installing bolts	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
15	Cleaning the rest of the weld assembly results	grinding machine hands	injured/cut	major (3)	Frequent (4)	12
		Noise	hearing disorders	moderate (2)	Frequent (4)	8
		terkena percikan api	Burns	moderate (2)	Frequent (4)	8
	Smoothing the sharp parts	grinding machine hands	injured/cut	major (3)	Frequent (4)	12

16		Noise	hearing disorders	moderate (2)	Frequent (4)	8
		hit by a fire	Burns	moderate (2)	Frequent (4)	8
17	Cleaning in the form of dust and rust	exposed to dust	eye irritation, disturbance respiration	moderate (2)	Frequent (4)	8
18	Lift the product to the painting site	Cut/scratched hands	wounded	moderate (2)	Frequent (4)	8
		back and arm injuries	muscle injury	minor (1)	uncommon (2)	2
19	Mix the paint with pertalite according to the color	cigarette fire is exposed to pertalite	burns/fires	catasthropic (4)	remote (1)	4
20	Start the compressor machine	got electric shock	electrocuted	moderate (2)	uncommon (2)	4
21	Do the painting	exposed to the smell of paint	respiratory tract infection	minor (1)	uncommon (2)	2
		exposed to the sun	Disturbed health	minor (1)	Frequent (4)	4

Based on table 3, there are 45 potential hazards of work accidents that can occur which can cause injury to several body parts. With a hazard scoring matrix with the highest score of 12 and the lowest score of 2.

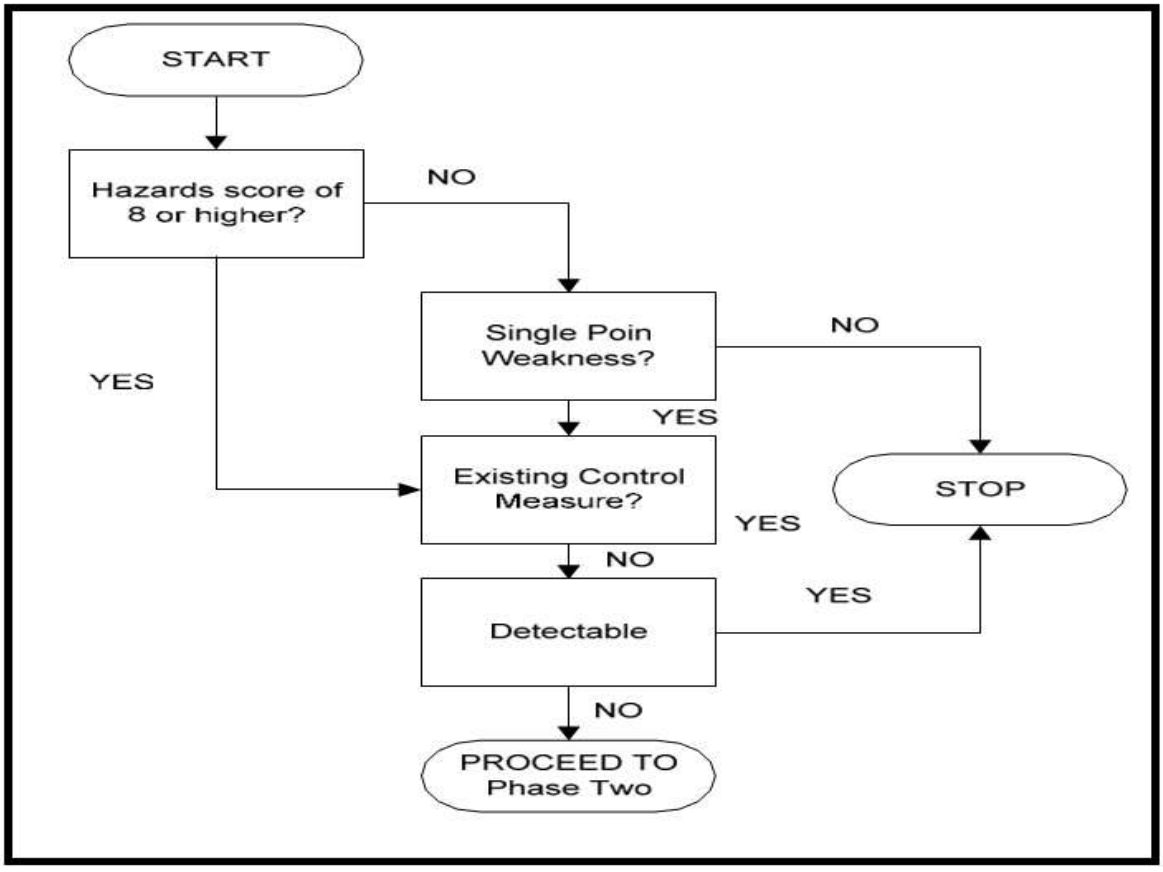

Fig.1 Desicion Tree

Furthermore, it is entered into a decision tree based on Figure 1., from the results of the hazard matrix, of a total of 45 potential hazards that can occur, 33 of them get a hazard score of 8 or higher, the existing control measure is worth No, detectability is worth Yes so that the process continues to take corrective action. A total of 12 potential hazards that get a hazard score below 8, single point weakness is worth Yes, existing control measure is worth No and detectability is worth No , then the process continues to corrective action. Next, make corrective action solutions from 45 potential hazards that can occur.

Table 4. Corrective Action

No.	Activities	Potential Hazards	Causes	Repairings
1	Checking Materials (quality & quantity)	Cut/scratched	hands Not wearing gloves	Using gloves
2	Lifting the material to the storage area	Cut/scratched	hands Not wearing gloves	Using gloves
		Feet	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all materials, components, tools that are no longer used
		Feet are crushed by material	Negligence of workers	Using safety shoes and workers
		Injury to the back muscles and	Lifting excessive loads	Procurement of tools transport goods
3	Choose the material to be used	Hand cut / scratched	Not wearing gloves	Using gloves
4	Materials to be used the	Cut/scratched hands	Not wearing gloves	Using gloves
5	Lifting the material to the measurement site	Cut/scratched	hands Not wearing gloves	Using gloves
		Feet hit	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all materials, components, tools that are not used
6	Lifting the material to the place of the cutting process	Hand sliced / scratched	Not wearing gloves	Using gloves
		Feet hit	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all unused materials, components, tools
7	Cutting materials using grinding machines and cutting tools	Exposed to sparks	Not using	Using work clothes and face shields
		Hands are exposed to grinding machine eyes	Workers are not concentrating	SOPs on grinding machines
		Noise	Not using APD	Using ear muffs
8	Lifting to the process of forming	Hands cut/scratched	Not wearing gloves	Using gloves
		Feet hit	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all materials, components, tools that are not used
9	Forming materials according to size	Pinched fingers	Worker not concentrating	Uses tongs, gloves and avoiding pinching points Being
		hit by weights on tools	Absence of K3	signs Making K3 signs
10	Lifting components to the place of the process of making holes	Cut/scratched	hands Not wearing gloves	Using gloves
		Feet hit	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all materials, components, tools that are not used
11	Punching holes in materials using a hand drill and a sitting drill machine	Electric shock	The cable is chipped	Perform periodic checks on the cable
		Exposed to sparks from the drill residue	Not using APD	Using a face shield
		Hand exposed to drill bit	Workers are not concentrating	SOPs on the drilling machine

		Exposed to ejected material		
12	Lifting components to the assembly process	Hand cut/scratched	Not wearing gloves	Using gloves
		Feet hit	Materials, components, tools that are stored carelessly, do not use APD	Use safety shoes, tidy up all unused materials, components, tools
13	Assembling components using a welding machine with tools Iron clamps	Exposed to welding light	Not using APD	Using face shields
		Exposed to sparks		
		Electrocution	The cable is chipped	Performing periodic checks
		Falling	the cable is messy	Position the cable properly
14	Installing the bolt	Cut/scratched	hand Not wearing gloves	Wearing gloves
15	Cleaning the rest of the assembled weld	Hands are exposed to the grinding machine eyes	Workers are not concentrated	Soup made on the grinding machine
		Noise	Not using APD	Using ear muffs
		Exposed to sparks	Not using APD	Using work clothes and face shields
16	Smoothing sharp parts	Hands are exposed to grinding machine eyes	Workers are not concentrated	Soup made on grinding machines
		Noise	Not using APD	Using ear muffs
		Exposed to sparks	Not using APD	Wearing work clothes and face shield
17	Cleaning in the form of dust and rust	Exposure to dust	Not using APD	Using masks and eye protection
18	Lifting the product to the painting site	Cut/scratched	hands Not wearing gloves	Wearing gloves
		Injury to the back and arm	Lifting excessive weights	Procurement of goods transport equipment
19	Mixing paint with Pertalite according to color	Cigarette fire exposed to pertalite	Smoking in the production area	Prohibition of smoking in the area Production
20	Turning on the engine Compressor	Electric shock	The cable is chipped	Perform periodic checks on the cable
21	Doing painting	Exposure to paint odor	Not using APD	Using a mask
		Exposure to sunlight Painting	room does not have a roof	Making a roof on the process site

b. K3 System Design

From the results of corrective actions obtained in the process of analyzing potential hazards in the *elevator*/spoon manufacturing process, it is possible to design an K3 system that includes important elements in the work area at company is the company's K3 commitment, the provision of K3 facilities and the safety of machine operation.

Table 5. OHS (K3) system design

No.	K3 System Design	Contents	
1.	Company OHS Commitment	a.	OHS Policy
		b.	Organizational Structure
		c.	Employee Regulation

2.	Provision of K3 Facilities	a.	Provision of Personal Protective Equipment (APD)
		b.	Provision of a first aid kit
		c.	Provision of light fire extinguishers (APAR)
		d.	Provision of K3 signs
3.	Safety of operational machine	a.	Engine operating standard
		b,	Machine maintenance

HMFEA, based on the results of the analysis of potential hazards using the method of health failure mode and effect analysis (HMFEA) in the elevator/spoon production process, there are 45 types of potential hazards of work accidents that can occur. Make corrective action solutions based on the potential hazards of work accidents that can occur. K3 system design, based on the results of the design of the occupational health and safety system (Saputri, 2018), the results include the company's K3 commitment, the provision of K3 facilities and the safety of machine operation (Amalia, 2017). Proposed procurement of supporting equipment, based on the results of the identification of occupational accident hazards, it is proposed to procure supporting equipment to prevent work accidents caused by activities that still use human physical activity in lifting heavy goods such as raw materials and finished products.

VI. CONCLUSION

Based on the results of the identification of potential hazards of work accidents using the Health Failure Modes and Effects Analysis (HFMEA) method, 21 activities in the sub-process have the potential to occur. Based on activities that have potential hazards, 45 hazards that can occur with the effect of injury on several limbs are obtained, the hazard scoring matrix with the highest value of 12 and the lowest value of 2. The results of the hazard matrix have 33 potential hazards that obtain a hazard score of 8 or higher. , existing control measure is No, detectability is Yes, so the process stops at this point. A total of 12 potential hazards that get a hazard score below 8, a single point weakness is worth No, the process stops here too. Next, corrective action is made.

The design of the K3 nsystem is a solution for improving working conditions and improving health and safety in the workplace. The results of the design of the K3 system include the company's K3 commitment including employee policies and regulations. K3 facilities include the provision of personal protective equipment, first aid kits, light fire extinguishers (APAR), K3 signs. safety of machine operation includes standard machine operation and machine maintenance.

Proposed procurement of supporting equipment to prevent work accidents caused by activities that still use human physicality in lifting heavy goods such as raw materials and finished products which includeoverhead cranes, work chairs and manual hydraulic goods trolleys

Efforts to prevent the occurrence of potential hazards of work accidents really need to be considered to provide a sense of security, comfort and safety for workers. Thus, the authors hope that the proposed K3 system design above can be applied to the company, thereby minimizing the occurrence of work accidents.

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