Safety Risk Management Analysis At PT. XYZ Using The HIRADC And FMEA Approach

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Abstract

PT. XYZ is one of the manufacturing companies engaged in manufacturing oil and gas, which in the production process for the manufacture of pumps is inseparable from all the risks that exist. Implementing Occupational Health, Safety and Environment (HSE) in the production process did not run as smoothly as desired, causing several cases of work accidents, such as being exposed to material fragments caused by the production machine process. By using HIRADC and FMEA analysis methods, several causes of work accidents were found. The solution that can be delivered is to conduct a briefing regarding the importance of Occupational Health and Safety, put supervisors in every part of the production process, and provide rewards and punishments for employees who commit or violate Occupational Health, Safety and Environmental regulations. After identifying and analyzing with HIRADC, Why to why analysis, and FMEA, several solutions were found, such as conducting briefings regarding the importance of Occupational Health and Safety and placing supervisors in every part of the production process and providing rewards and punishments for employees who commit or violate regulations. Occupational, Health and Safety.

Keywords
PT. XYZ, HSE, HIRADC, FMEA

1. Introduction
So many activities that humans can do. But basically, each of these activities must contain a risk of danger, especially with industrial sector players or factories who carry out production processes every day that convert raw materials or raw materials into a product that will be marketed. Seeing all the problems that occur, practical work is carried out and the preparation of reports to understand the concept of the production process, quality control process, organizational structure, occupational health and Safety, and all matters relating to the production

process in a factory or company. Occupational Health and Safety need to be known and applied in the production process to create a workplace that meets ENASE requirements, namely Effective, Comfortable, Safe, Healthy, and Efficient. That way, the possibility of accidents for workers can be reduced.

Each has its divisions with different accident risks in a manufacturer depending on the department. PT. XYZ is one of the pipe assembly manufacturing industries that manufacture oil drilling in collaboration with the Pertamina company. The implementation of practical work in this industry is based on the attention of PT. XYZ in the field of Occupational Health and Safety. And also, many workers from PT. XYZ use large machines that use sharp tools and work that produces a certain odour to increase the risk of work accidents. Therefore, this report will look at Occupational, Health, and Safety implemented and review whether there have been worked accidents and how they are handled and guided by the Health Safety and Environment division. The objective of this research is to analyse XYZ in the implementation of Occupational Health and Safety in the production process of

2. Literature Review

2.1 Health, Safety and Environment

Safety can be interpreted as a condition where a person is free from accidents or good dangers that can cause material and spiritual losses. Work safety is related to safety equipment, workplace and environment, and ways of doing work (Afianiyah, 2017). The meaning and purpose of work safety ensure the condition, integrity and perfection of both physical and spiritual human beings and the results of their work and culture, aimed at the welfare of society in general and humans in particular (Purnama, Rosdja, 2003; Ilvani et al., 2013).

2.2 Waste Management

Waste is the residue from a business or activity containing hazardous or toxic materials that, due to their nature, concentration, and quantity, can directly or indirectly endanger the environment, health, and survival of humans and other living creatures (Andriyana et al., 2017; Damanhuri.2005; *).*

2.3 Hazard Identification, Risk Assessment, Determine Control (HIRADC)

Hazard Identification, Risk Assessment, Determine Control (HIRADC) is one of the methods following OHSAS 18001:2007, which each company in general use this method to establish, implement, and maintain procedures. This method can identify existing hazards, assess or control risks, and minimize hazards associated with the activities carried out by the Company (Prihatiningsih et al., 2014; Shamsuddin, 2014).

2.4 Failure Mode Effect Analysis

Failure Mode Effect Analysis is an analysis carried out to find effects or impacts that are likely to make errors in a product or the production process. With this FMEA method, we can analyze problems later on a product made or a process carried out (Yolanda et al.,2014; Octavial, 2010; Octavia, 2010, Stamatis, 2003; Reza et al.,2017; Gozali et al., 2019; Gozali et al.,2020).

3. Methods

Research begins with a literature review to identify and find out the various variable problems of Health, Safety and Environment incorporate. After doing a literature review, several aspects are analyzed. A field survey was conducted to see firsthand the problems of work safety in the field. When conducting a field survey, the necessary data is collected, such as photographs and the necessary data. After the required data is sufficient, data processing is carried out using the HIRADC and FMEA methods to determine the biggest causes of accidents. After that, an analysis is carried out to provide a solution or a way out of the problems found. After that, make conclusions from this research. The flowchart of the methods can be seen in Figure 1.

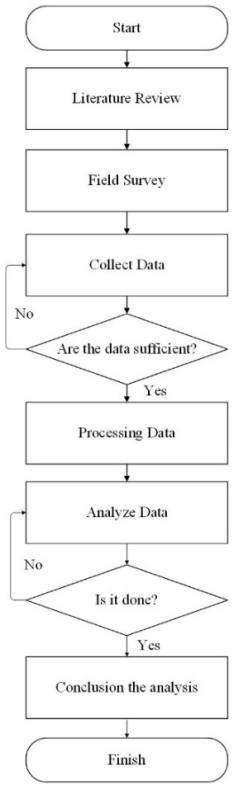

Figure 1. Flowchart of Methods

4. Data Collection

Based on the manufacturer's identity, the author collects data from the previous three years about work accidents that occurred in the Company. The data survey can be seen in Table 1.

Table 1. Table of Accidents Past 3 Years

Month	Year		
	2018	2019	2020
January	0	0	0
February	1 (light)	1 (light)	0
March	1 (light)	0	1 (medium)
April	0	0	0
May	0	1 (light)	0
June	2 (1 medium, 1 heavy)	0	0
July	1 (light)	1 (medium)	1 (light)
August	1 (medium)	0	0
September	1 (medium)	1 (light)	0
October	0	1 (medium)	1 (medium)
November	1 (heavy)	0	0

Month	Year		
	2018	2019	2020
December	0	0	0
Total	**8**	**5**	**3**

We can see how many work accidents have occurred in the last three years from the table above. The table 2-4 details the Company's accidents from 2018 until 2020 that occurred in the fields of the production process section.

Table 2. Table of Work Accident Chronology Year 2018

No.	Date	Part	Chronology	Type
1.	12/02/2018	Testing	When testing the pump, the worker accidentally touched the electrical panel, so the worker was shocked.	Light
2.	20/03/2018	Cleaning	A worker slipped while cleaning raw materials	Light
3.	06/06/2018	Finishing	When welding, a worker does not use complete PPE, so he is exposed to sparks when welding and causes burns	Medium
4.	21/06/2018	Finishing	When painting, a worker does not use complete PPE so that the paint hits the worker's skin and causes irritation	Heavy
5.	13/07/2018	Warehouse	While moving goods in the storage warehouse, a worker's leg sprained due to wrong-footing	Light
6.	28/08/2018	Assembling	Feet hit by assembled goods because they don't use safety shoes	Medium
7.	18/09/2018	Finishing	When smoothing the product, your hands are scratched by the grinding machine.	Medium
8	24/11/2018	Warehouse	A worker forgot to turn off the electricity during his break. And another worker happened to be washing his motorbike near the warehouse, so the worker was electrocuted to death	Heavy

Table 3. Table of Work Accident Chronology Year 2019

No.	Date	Part	Chronology	Type
1.	17/02/2019	Assembling	Workers put welding tubes carelessly to hit other workers and make them fall.	Light
2.	27/05/2019	Warehouse	When unloading goods from the trolley, workers park the trolley in the middle of the road, causing other workers to crash while passing through the road.	Light

No.	Date	Part	Chronology	Type
3.	05/06/2019	Cleaning	Chemicals used to clean raw materials accidentally hit the eyes of workers because they did not wear protective glasses	Medium
4.	22/09/2019	Finishing	Workers do not use sound protection equipment when using grinders, so the workers' ears become trapped	Light
5.	09/10/2019	Testing	A worker operates a forklift and doesn't see any other workers, so he bumps into the worker	Medium

Table 4. Table of Work Accident Chronology Year 2020

No.	Date	Part	Chronology	Type
1.	04/03/2020	Testing	When opening the electrical panel to operate the pump, workers are accidentally electrocuted	Medium
2.	24/07/2020	Warehouse	A worker slipped while putting things in the warehouse because the floor was very dusty and hadn't been cleaned for a long time	Light
3.	09/10/2020	Assembling	When the worker wants to change the drill bit on the milling machine, his fingers are scratched by the drill bit.	Medium

There have been various kinds of work accidents that have sprung up in several production line areas. From the work accident data, it can be seen that the Percentage of work accidents can be seen in Table 5

Table 5. Percentage of Work Accident Share

Part	Number of Work Accidents (person)	Percentage (%)	Cumulative Percentage (%)
Cleaning	2	12.5%	12.5%
Testing	3	18.75%	31.25%
Assembling	3	18.75%	50%
Finishing	4	25%	75%
Warehouse	4	25%	100%
Total	**16**	**100%**	

Based on the Percentage of Work Accident Share Table, the dominant percentages are Finishing and Warehouse. Both parts need improvement priority.

5. Results and Discussion

5.1 HIRADC

In the first step, Identification is carried out on Hazard Identification, where efforts are made to discover the opportunities for hazards in the work environment. The results of the identification state that there are 3 potential hazards in the cleaning section, 2 potential hazards in the testing section, 4 cases in the finishing section, 4 potential hazards in the warehouse section, and 3 potential hazards in the assembly section. Identification is carried out on 5 production divisions in the factory. In total, from 5 production divisions, there are 16 potential hazards.
After carrying out the hazard identification (Hazard Identification), the next step is a risk assessment (Risk Assessment). The purpose of this risk assessment is to provide an overview of the hazard's impact and be used as material for evaluating the magnitude of work risk. This condition can be identified from 2 factors: the likelihood of occurrence (Likelihood) and the severity caused (Severity). The risk Value Table can be seen in Table 6.

Table 6. Risk Value of Each Risk Occurred by 5 Parts

Part	Hazard dan Risk	Risk Assessment Matrix		
		L	S	RR
Cleaning	Hands exposed to solvent chemicals and HCL	4	2	2 (Small Risk)
	Raw materials that can fall when cleaning because they are slippery	2	4	4 (Heavy Risk)
Testing	Shocked when going to operate the tester	1	4	4 (Heavy Risk)
	The item to be tested was hit when it was moved using a forklift	2	4	4 (Heavy Risk)
	Part of the Pump was thrown off during a test run	2	3	3 (Medium Risk)
Assembling	Leg hit by iron pipe	2	4	4 (Heavy Risk)
	Hit the milling machine drill bit	3	2	2 (Small Risk)
Finishing	Ears hurt when smoothing objects with a grinder	3	2	2 (Small Risk)
	Skin irritation when exposed to paint	3	3	3 (Medium Risk)
	Skin exposed to sparks while welding	3	2	2 (Small Risk)
Warehouse	Overwhelmed by raw materials	2	4	3 (Medium Risk)

Part	Hazard dan Risk	Risk Assessment Matrix		
		L	S	RR
	Got hit by a trolley of goods while loading goods	2	2	2 (Small Risk)
	Slipped while loading goods	2	2	2 (Small Risk)

The results of the risk assessment contained 13 work risks, consisting of 5 high risks (risks in each work section except for the finishing section); 2 moderate risks (1 risk in the testing section and 1 risk in the finishing section); and 6 minor risks (1 risk in the cleaning section, 1 risk in the assembly section, 2 risks in the finishing section, and 2 risks in the warehouse section).

After conducting a risk assessment, it is followed by risk control (Determine Control). Risk control efforts (Determine Control) that PT has carried out. PT. XYZ has been carried out based on the hazard control hierarchy in clause 4.3.3 of OHSAS 18001:2007, namely elimination, substitution, engineering, administrative control and Personal Protective Equipment (PPE). The Company implements a hierarchy of administrative hazard control and Personal Protective Equipment (PPE). The Company does not carry out hazard control by elimination, substitution and engineering control because it is impossible. This condition happened due to the potential hazards of materials, tools, machines and equipment in the work area. In addition, control using the three control hierarchies requires significant funds.

5.2 Fishbone

The cause of work accidents is also caused by several factors divided into 5 parts, namely, human factors, methods used, environmental factors, machine factors, and material factors. The following explains the causes of work accidents made with a fishbone diagram which can be seen in Figure 2 below

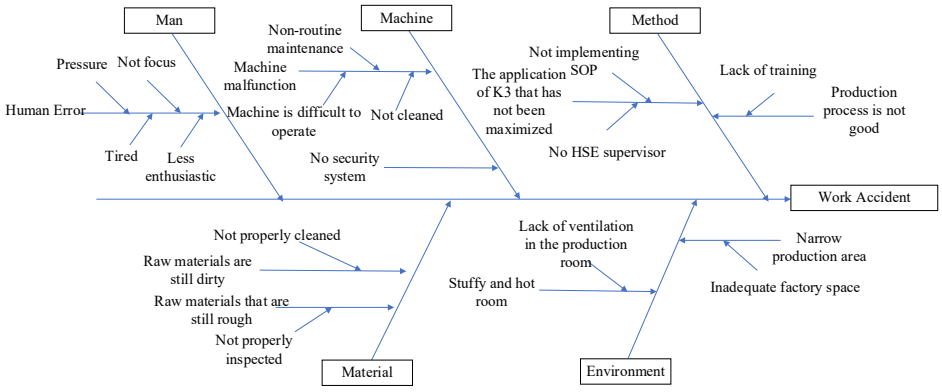

Figure 2. Fishbone Diagram

The following are problem-solving that can be done so that the causes/problems of work accidents on the five factors of the fishbone diagram do not arise again, as shown in Table 7

Table 7. Problem Solving of the Five Factors

Factor	Cause/Problem	Problem Solving (Action)
Method	PPE is not up to standard	Revise the SOP according to the standard and conduct a briefing to everyone in the Company. And also placing supervisors from K3 in the branch office
	HSE procedures are still not good	
	There is no HSE supervisor at the branch office	

Factor	Cause/Problem	Problem Solving (Action)
Human	Lack of concern for applicable work safety	Provide training for employees on Occupational Health and Safety. And also a daily briefing before starting work to remind employees to always comply with the applicable Occupational Health and Safety procedures. As well as providing training for new employees about the machines used by the Company to carry out the production process
	Careless and less careful when doing something	
	Ignoring the HSE Procedures that the company has set	
	Employees who have not fully mastered the machines used by the company.	
Material	Materials that are not completely smooth	Wear complete PPE following standards to carry out the production process.
Machines	Machines don't do routine maintenance	Routinely perform inspections on the production machines used and provide a security function for each machine used
	The machine has no security features	
Environment	Hot temperature in the production room	Moving to a bigger and more suitable place to carry out the production process with a place that has more room openings and also exhaust on the tile and also places each part of the production with sufficient distance to make it easier for other people to pass through the production site
	Lack of air circulation in the production room	
	A place that tends to be just right for the production process	
	Annoying noises produced by other production processes	

5.3 FMEA

FMEA serves to identify failures in the production process which aims to calculate the RPN (Risk Priority Number) obtained from the calculation results of Severity x Occurrence x Detectability and existing failures. FMEA Table can be seen in Table 8 below.

Table 8. FMEA

No	Proses Machining	Potential Failure Mode	Potential Effect of Failure	S	Potential Cause of Failure	O	Current Process Prevention of Cause	D	RPN
1	Cleaning	Exposure to chemicals	Irritation to skin	7	Not using PPE	8	Reminding of existing SOP's and providing occupational Health and Safety	6	336

No	Proses Machining	Potential Failure Mode	Potential Effect of Failure	S	Potential Cause of Failure	O	Current Process Prevention of Cause	D	RPN
			Respiratory disorders	7	Don't use a mask and the room lacks air ventilation	8	signs in the cleaning area	6	336
			Irritation to the eyes	6	Not wearing work glasses	8		6	228
2	Testing	Shock while operating the electrical panel	Pain in hand in contact with the electrical panel	5	Not using gloves when operating electrical panels	6	Mandatory to wear gloves when operating electrical panels	4	120
3	Assembling	Legs hit by items to be assembled	My feet are bruised and sore	8	Not wearing safety shoes	6	Prepare several pairs of safety shoes for each part of the assembly process	5	240
4	Finishing	Hand got hit by the grinding blade	Wounds on hands	6	Don't use PPE and don't wear gloves	7	Conduct training for employees who use grinders, welding tools, etc.	4	168
5	Warehouse	Struck by raw material	The part of the body that is hit will become sore and bruised, or it can even lead to fractures	7	Workers are less focused when loading goods in the warehouse due to fatigue or distractions in the warehouse space	5	Get rid of any potential distractions and also replace the person who made the item when the first person is tired	4	140

6. Conclusion

As a result of this research, it can be concluded that several aspects of Occupational Health and Safety have not been carried out properly in the implementation of the production process. One of the most common is not using PPE completely. This condition happened because of the employees' losses, such as being exposed to sparks during welding, falling on their feet because they do not use safety shoes, grinding hands because they do not use complete PPE. After identifying the problem and conducting an analysis using HIRADC, Why to why analysis, and FMEA, several sources of problems were found, such as human resources, materials, machines, environment, and methods.

After analyzing with HIRADC, Why to why analysis, and FMEA, several solutions were found, such as conducting briefings regarding the importance of Occupational Health and Safety and placing supervisors in every

part of the production process and providing rewards and punishments for employees who commit or violate regulations. Occupational Health and Safety.

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Biographies

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Lina Gozali is a lecturer at the Industrial Engineering Department of Universitas Tarumangara since 2006 and a freelance lecturer at Universitas Trisakti since 1995. She graduated with her Bachelor's degree at Trisakti University, Jakarta - Indonesia. She got her Master's Degree at STIE IBII, Jakarta – Indonesia, and she recently got her PhD at Universiti Teknologi Malaysia, Kuala Lumpur – Malaysia, in 2018. Her apprentice college experience was in the paper industry at Kertas Bekasi Teguh, shoe industry at PT Jaya Harapan Barutama and

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