

Work Accident Analysis at PT. Sinergi Perkebunan Nusantara Using Analytic Hierarchy Process Method (AHP)

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ABSTRACT

Occupational safety and health is important to be applied to every line of the company, because it aims to avoid and prevent work accidents in the company. Work accidents occur if there are unsafe acts and unsafe conditions. If an accident occurs in the company, further analysis is needed to find out the main factors that cause work accidents. Therefore, PT. Sinergi Perkebunan Nusantara will be analyzed for work accidents using AHP method. This is done, because there are equipment and machines that dangerous in the process of processing palm oil into CPO. Based on AHP method, the main factor of work accidents is caused by human factors. Through the human factor, it can also lead to other factors, such as: workers who do not apply occupational safety and health, can affect their focus in paying attention to the condition of work equipment and the workplace environment. Government Regulation Number 88 (2019), defines that the workplace in the form of a field or space, open or closed, can move or stay. This means, all workplaces have a source of danger. Therefore, there is a need for further analysis on other lines of the company, so work accidents can be avoided.

Keywords: *Analytic Hierarchy Process, safety, unsafe act, unsafe condition*

1. INTRODUCTION

Indonesia is the first largest country as a producer of Crude Palm Oil (crude palm oil) outperformed Malaysia, Central Sulawesi was one of the provinces that produce Crude Palm Oil. Palm oil is one of the plantation commodities that has high value and its industry including labor-intensive and is an important and strategic commodity in Sulawesi region because of its significant role in encouraging people's economy, especially for plantation farmers. Area growth rate oil palm plantations are marked by an increase in crude production Palm Oil (CPO). Countries that can cultivate palm oil well can get very profitable results from this commodity industry. (Parlina, 2013). In the crude palm oil (CPO) production process, of course, the company also implement the OHS system, so that the production process runs well.

Occupational Health and Safety (OHS) is a statutory requirement with a legal basis and all aspects of both the workforce, employers and other related parties must comply. Government Regulation Number 88 The year 2019 defines the workplace in the form of a field or an open space or closed, movable or fixed. Which covers the whole The workplace is a place of work, both the formal sector and the informal sector, including government agencies and micro, small and medium enterprises.

Work safety is safety related to machines, aircraft, work tools, materials, and processing processes on the basis of the workplace and the environment and ways of doing their jobs. Work safety seen as the primary means of preventing accidents, disability, and death as a result of work accidents. According to Tarwaka [1] Safety is safety related to machines, aircraft, work tools, materials and processing processes, work base and work environment and ways of doing work and production processes. Good work safety is the gateway to security workforce, work safety concerns the entire production process and distribution, both goods and services Suma'mur [2]. Based on the above definition, it can be concluded that work safety is something that must be prioritized when carrying out a job.

Generally in all workplaces there are always sources of danger. Almost no workplace is completely free from sources of danger (Syukri Sahab, 1997). Resources only need to be controlled to reduce work-related accidents and illnesses. To control sources of danger, it must be able to find the sources of danger the. As for the things that must be done to find and determine locations of potential hazards that can result in accidents and consequent illnesses work, it is necessary to identify potential sources of hazards that exist in the workplace work. Control of hazard factors carried out to minimize even eliminating work-related diseases and work accidents is to technical and administrative control methods, but many companies refuse to carry out these controls on the grounds of high costs

At this time the role of industry in the world of work demands to get superior and competitive human resources so it is very necessary workers who have high professional expertise to deal with development and global competition both now and in the future. Job Training is one of the compulsory subjects taken by every student students of the Faculty of Industrial Technology, Institute of Science and Technology AKPRIND Yogyakarta as one of the requirements to take the Design course Industrial Systems (PSI). Through practical work, students are expected to be able to broaden knowledge and understanding of scientific disciplines accompanied by its real implementation. Job Training is a student activity carried out in the community and in the company to apply knowledge obtained and see its relevance in the world of work and get feedback feedback from the development of science from society and through self-development by exploring a particular field of science and its application. With all the facilities provided by PT. Archipelago Plantation Synergy, this practical work is expected

to be a medium for students in implement the knowledge gained and also add insight and experience about the industry beyond the theory that has been gained so far.

PT. Sinergi Perkebunan Nusantara is a company engaged in in the industrial sector in processing palm oil into Crude Palm Oil (CPO). In implementation of production, PT. Synergy for Nusantara Plantation is supported by professional and experienced experts in the field of palm oil processing, with modern equipment and work equipment, the palm oil processing process to become CPO must be more careful, because in the palm oil processing process using machines and tools that are very dangerous if exposed to machines or the tool. Therefore, in the palm oil processing process, workers must: Knowing what risks can lead to work accidents and must behave OHS.

What is even worse is the management system or management that bad. Losses as a result of work accidents can be in the form of injury to employees, supporting facilities and infrastructure, and even the environment as a whole. Employees are the main asset in a palm oil company, therefore every Employees must pay attention to safety at work.

2. METHODS

a. Research Object

This research was conducted at PT. Sinergi Perkebunan Nusantara

b. Data Sources and Types

The data obtained include:

- 1) Company history
- 2) Number of employees
- 3) Type of product produced
- 4) Factory location and marketing location
- 5) Organizational structure of the company
- 6) General data

c. Data Collection Method

1) Primary Data Collection Method

a) Interview Method

Conduct in-person interviews in the form of questions to respondents, in this case are employees and staff who directly related to the object of research.

b) Observation Method

Direct data collection by observing and take notes on the object of research to find out the process.

2) Secondary Data Collection Method

Data obtained indirectly. This data source can be obtained from literature, magazines, publications and other sources related to the issues discussed.

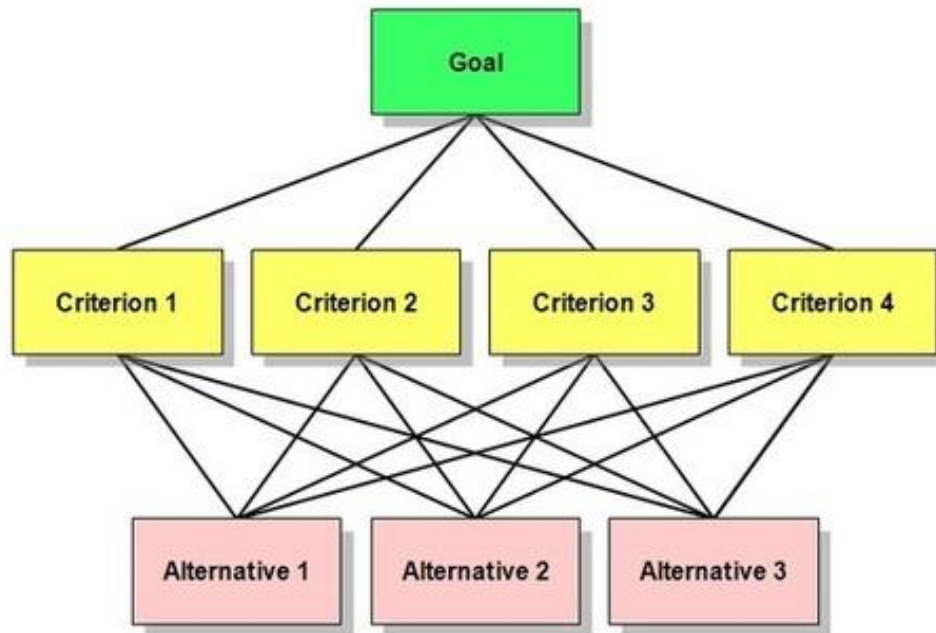
3. RESULTS AND DISCUSSION

Analysis of the factors of work accidents in PT. Sinergi Perkebunan Nusantara so that companies can minimize work accidents, especially in workers to know and also be able to prevent work accidents

a. *Analytic Hierarchy Process* (AHP)

The AHP method is a decision-making method that structure complex problems in a hierarchy consisting of several levels that contain objectives, several aspects and or criteria considerations and a number of alternative solutions. These aspects, criteria criteria, and alternatives are hereinafter referred to as decision elements. These elements are compared with

each other in pairs and their respective relative priority weights are determined to get the overall priority as the final result of AHP using AHP can make it easier for users to find a result complex decisions or criteria easily and get results of each accurate criterion or by weighting the results.



Hierarchy 3 levels

There are three levels of hierarchy in the picture above, namely:

- 1) The first level is the goal, namely determining the level of work accidents on construction projects.
- 2) The second level is the criteria where there are four kinds of factors, namely:
 - a) Human Factor.
 - b) Environmental Factors
 - c) Material Factor
 - d) Equipment Factor
- 3) The third level is a sub-criteria where there are 19 kinds of criteria, namely:
 - A1. Lack of expertise
 - A2. Inexperienced workforce
 - A3. Not using PPE
 - A4. There is a lack of coordination/communication among workers as well as workers with superiors above them
 - A5. Workers who experience fatigue and weakness of the immune system
 - B1. Lack of lighting
 - B2. Disturbance in the form of gas, vapor, dust, fog
 - B3. Noise, vibration due to the machine can cause stress and deafness
 - B4. Natural factors, wind, flood, lightning
 - B5. Too crowded/narrow area
 - C1. Inappropriate placement of materials
 - C2. Defective materials
 - C3. Material at risk of explosion
 - C4. Materials containing highly toxic substances
 - D1. There is a broken equipment

- D2. Incomplete signs/lack of safety facilities
- D3. Machine is old
- D4. Machine no protection
- D5. Maintenance, as well as inspection of bad equipment

b. Work Accident Factor Hierarchy Table

Elements and elements of work accident factors can be seen in Table 1. The hierarchy of work accident factors, dimensions and attributes can be seen in Table 1

Tabel 1. Work Accident Factor Hierarchy

No	Factor	Element
1	Human Factor	<ul style="list-style-type: none"> • Working in unhealthy conditions • Lack of communication • Lack of focus at work • Not following the procedure
2	Equipment factor	<ul style="list-style-type: none"> • Lack of safety in the machine area • Place the machine • No tool checking before starting work • Tool life
3	Environmental factor	<ul style="list-style-type: none"> • Hot room temperature • Noisy • Natural disasters (rare) • Slippery workplace due to oil spill

It is known that there are 3 criteria in the case of accident analysis work, that is:

- 1) Human factor
- 2) Equipment factor
- 3) Environmental factor

c. Weight Calculation

- 1) Determine the weight of each criterion
 - a) Human factor is more important than equipment factor
 - b) Human factors are slightly as important as environmental factors
 - c) Environmental factors are more important than equipment factors

Table 2. Comparison Scale

Intensity Interest	Definition
1	Equally important than the others
3	Slightly more important than others
5	Quite important than others
7	Very important compared to others
9	Extreme importance than others
2,4,6,8	The value between two adjacent assessments
Opposite	if the element I has one of the numbers in the number above compared to element j, then j has the value the opposite when compared with i

Source: Google, 2021

The following table 3 will show the weighting of each criterion.

Table 3 Weighting of Criteria

Human Factor	Equipment Factor	Environmental
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	Factor		
Human Factor	1/1	3/1	2/1
Equipment Factor	1/3	1/1	1/3
Environmental Factor	1/2	3/1	1/1
Amount	1,83	7	3,33

Table 4 Weighting of Criteria

	Human Factor	Equipment Factor	Environmental Factor	Amount	Average
Human Factor	1/1.83 =0.54	3/7 =0.42	2/3.33 =0.60	1.56	0.52
Equipment Factor	0.33/1.83 =0.18	1/7= 0.14	0.33/3.33 =0.09	0.41	0.13
Environmental Factor	0.5/1.83 =0.27	3/7 =0.42	1/3.33=0.30	0.99	0.33

- 2) Menghitung Rasio Konsistensi
 Comparison matrix between comparison matrices (in Table 4) and priority vectors (in Table 5).

Table 5. Priority Vector

	Human Factor (0,52)	Equipment Factor (0,13)	Environmental Factor (3,33)
Human Factor	1	3	2
Equipment Factor	0,33	1	0,33
Environmental Factor	0,5	3	1

Table 6. Priority Vector Results

	Human Factor	Equipment Factor	Environmental Factor	Amount
Human Factor	1	3	2	1,57
Equipment Factor	0,33	1	0,33	0,41
Environmental Factor	0,5	3	1	0,98

Table 7. Consistency Ratio

	Priority Vektor	Weighted Average	Results
Human Factor	1,57	0,52	2,09
Equipment Factor	0,41	0,13	0,54
Environmental	0,98	0,33	1,31

Factor

- 3) Find the eigenvalues of max with the following calculation:

$$\lambda_{maks} = \frac{2.09 + 0.54 + 1.31}{3} = \frac{3.94}{3} = 1.31$$

- 4) Calculate Consistency Index (CI) Value:

$$CI = \frac{\lambda_{maks} - n}{n-1} = \frac{1.31-3}{3-1} = \frac{-1.69}{2} = -0.845$$

- 5) Calculate the CR Consistency Ratio based on value Random Index (RI).

$$CR = \frac{CI}{RI} = \frac{-0.845}{0.58} = -1.456$$

The results of CR (≤ 0.10) concluded that the comparison process between the three criteria are carried out consistently. In general, it can be seen from the contents of the table 7 that:

- a) The human factor takes precedence over the equipment factor.
 - b) Environmental factors only take precedence over equipment factors.
 - c) Equipment factor is almost equal to environmental factor.
 - d) This filling shows the consistency of work accident factors. So the AHP method concludes that the highest priority of analysis of the factors of work accidents at PT. Sinergi Perkebunan Nusantara is the human factor followed by environmental factors Then the equipment factor.
- 6) The order of the factors causing the accident and the solution to the problem.
- a) Human Factor
Human factors as much as 1% of 10 workers experience or do this. First, workers work in conditions that are not healthy, the second lack of communication among workers, the three workers are not focus when carrying out work, and the four workers did not follow procedures set by the company. To address the cause this human factor, the company conducts health training and work safety as well as more supervision of employees.
 - b) Equipment Factor
First, the area around the machine is not protected. the second condition of the unit is unstable, the third is the service life of the machine, the fourth is the system the location of the machine is not ergonomic. This factor is due to poor worker supervision of equipment used. This equipment factor can arise through the human factor. To overcome the equipment factor can be done by taking into account the human factor as well as each unit used in the company. Vehicles such as heavy equipment can first daily equipment checks (P2H) before use.
 - c) Environmental Factor
Environmental factor. First, for the PT. Sinergi Perkebunan Nusantara to be further tidied up so as to provide a sense of comfort work for employees. Then for the palm oil spilled on work location to always be cleaned so that no employee slipped due to the oil. For environmental factors that caused by unmanageable natural conditions, rain, dust or wavy are environmental conditions that naturally may arise in the work environment. This can be anticipated by all employee.

4. CONCLUSION

Based on the objectives of the work practices carried out at PT Sinergi Perkebunan Nusantara, Londi, North Morowali, then the conclusion of this work practice is:

- a. Has fulfilled the undergraduate program curriculum for industrial engineering study program industrial architecture technology IST AKPRIND Yogyakarta.
- b. Palm Oil Industry is a company that utilizes palm fruit for processed into Crude Palm Oil which

has many benefits. PT. Sinergi Perkebunan Nusantara has the largest oil palm plantation in Indonesia Central Sulawesi. This company is a state-owned company.

- c. Work accident is an event that causes harm to employees, company and the environment around the company. Work accidents are an unwanted and unforgettable event.
- d. The factors causing work accidents that occurred at the location of PT. Sinergi Perkebunan Nusantara are human factors, equipment factors and factors environment.
- e. Through calculations using the AHP method, the main factors of workplace accidents infactory location is the human factor. Human factors can lead to other factors, such as: workers who cannot affect work safety

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