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# Analysis of Work Accident Risk in Production Section Using Hazard Analysis and Operability Study (HAZOP) and Analytical Hierarchy Process (AHP) (Case Study: PT XYZ)

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**A B S T R A C T**

PT XYZ is a company that produces plywood. During the production process activities, there are potential risks that arise and can affect the safety and health of field workers. Therefore, this study aims to determine the risk analysis that occurs during the production process activities, determine the risk level and look for alternative improvement proposals on risks that have extreme levels. The method used to analyze the risk level in the production process is the HAZOP (Hazard Analysis And Operability Study) method and to determine the best improvement proposal using the AHP (Analytical Hierarchy Process) method. Based on the results of the analysis using the HAZOP method, there is a risk analysis of 35 risks with a total of 14 machine activities of which 57% for low risk with a total of 20 risks, 17% for moderate risk with a total of 6 risks, 17% for high risk with a total of 6 risks and 9% for extreme risk with a total of 3 risks. The proposed improvements were selected based on the weighting results using the AHP method. In the AHP method, criteria in the form of priority risks are used, namely the risk on the rotary machine (workers' feet are injured when changing the rotary knife) with the highest weight of 0.665 with the selected alternative, namely the socialization of K3-related training and SOPs in changing knives in rotary machines with a weight of 0.512.

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## 1. INTRODUCTION

Indonesia still has a low level of occupational safety when compared to developed countries that have realized the importance of occupational safety and health regulations and regulations. According to Tyas (2011), these regulations are very important to be implemented and complied with in the world of work because they can bring positive benefits to increase worker productivity and can increase the possibility of a company's employee's working life to be longer. The government itself

has issued strict and clear regulations regarding occupational safety and health regulations to be implemented by companies operating in Indonesia. Occupational Safety and Health (K3) has been stated in Article 86 paragraph 2 number 31 of Law Number 13 of 2003 as written in Yuliandi and Ahman (2019) which states that every worker or laborer has the right to receive protection for occupational safety and health. health to protect the safety of workers or laborers in order to realize optimal work productivity in carrying out occupational safety and health efforts.

PT XYZ is one of the companies that produces plywood in Samarinda. Production activities go through several stages starting from log pool activities (log selection process) to the packing process. in this company there is data on work accidents during production activities that can affect occupational safety and health. so it is necessary to carry out an analysis of the K3 control risk as an anticipatory step to minimize the occurrence of work accidents. Therefore, a risk assessment is carried out on production process activities using the Hazard and Operability Study (HAZOP) method because this method is more complex to determine the possibility of work accident hazards and determine the level of danger in the production process. The advantages of the HAZOP method are that it has a complete assessment such as risk assessment, analyzing the causes of risk, risk deviations that occur, and knowing the impact of the risks that occur. the use of the HAZOP method uses the criteria for the possibility of risk and the severity of the risk to determine the risk level assessment. in determining the proposed improvements using the Analytical Hierarchy Process (AHP) method which is a decision-making method. The AHP method is used to determine the results of selecting the proposed improvement decision from several alternative work accident risk strategies at extreme risk levels. alternative proposed improvements are weighted using paired comparisons based on criteria and alternatives. The weight with the highest value is the selected alternative for the proposed improvement of the extreme risk criteria.

## 2. LITERATURE REVIEW

### Occupational Safety and Health (OHS)

Budiono (2003) in Jumanto and Nasution (2017), occupational safety is defined as a thought or effort to guarantee the integrity and perfection of both the physical and spiritual of workers in particular as well as their work and culture.

Technological advances in the industrial sector have grown rapidly, so that in order to face tight competition, it is necessary to increase the controlling situations that have the potential to cause work accidents by preparing standard quantity and quality of production by utilizing resources efficiently, as a consequence companies need to emphasize the role of Occupational Safety and Health (OHS). Occupational safety and health are important for companies because the impact of accidents and occupational diseases is not only detrimental to workers but also to companies both directly and indirectly. According to Casban (2018), occupational safety means the process of planning and
operating procedures that serve as a reference for work.

### Work accident

Work accidents can be caused by human factors (unsafe action) and environmental factors (unsafe condition). Unsafe action factors can be caused by various things such as physical imbalance of workers (disability), lack of education, carrying excessive loads, working beyond working hours. According to Casban (2018), unsafe condition factors are caused by various things, namely equipment that is no longer suitable for use, fires in dangerous places, substandard building security, noise exposure, radiation exposure, lack of lighting and ventilation, dangerous temperature conditions, excessive warning systems and the nature of the work that contains potential hazards. According to Ramli (2010), accidents occur due to contact with energy sources such as mechanical, chemical, kinetic which can cause injury to humans, equipment, or the environment.

**Risk Analysis**

According to Misra et al. (2020), risk is always associated with the possibility of something bad happening that is not expected or not expected. Thus, this risk has the nature of uncertainty about the occurrence of an event and is an uncertainty that if it occurs will cause losses. According to Ponda and Fatma (2019), there are three processes in risk analysis, namely hazard analysis, risk assessment, and risk control. The following is an explanation of each analysis.

1. Hazard Identification

Hazard analysis refers to things that can cause harm to humans or damage to equipment or the environment.

2. Risk Assessment

Risk Assessment is an assessment process used to analyze potential hazards that may occur.

3. Risk Control

Risk control is a step in overall risk management. The control hierarchy is a hierarchy that is carried out sequentially until the level of risk or danger is reduced to a safe point. The risk control hierarchy consists of Elimination, Substitution, Engineering, Administrative Control and Personal Protective Equipment.

**Hazard and Operation Study (HAZOP)**

According to Rama and Bhaskara (2022), Hazard and Operability Study (HAZOP) is a method used in analyzing and analyzing potential hazards. This technique is qualitative based on the results of the analysis found several sources of potential hazards consisting of extreme, high, medium and low risks. Analysis using the HAZOP (Hazard and Operability Study) method is by analyzing analysis data based on interviews with informants and respondent assessments using a questionnaire in the form of an assessment of likelihood and severity.

According to Nugroho (2021), HAZOP analysis has advantages over other methods in analyzing risks comprehensively. Risk analysis with this method is more systematic so that the resulting analysis is more complete. The steps taken at the stage of collecting and processing data with the HAZOP (Hazard and Operability Study) method are as follows: (1) Knowing the sequence of processes in the research area. (2) Analyze the hazards found in the research area. (3) Complete the criteria on the HAZOP worksheet such as: (a) Classify the potential or sources of danger found. (b) Describes deviations or deviations that occur during production process activities. (c) Explains the causes of risk or deviation. (d) Explain what deviations can cause. (e) Determining actions or safeguards that can be taken by companies in the research area. (f) Risk assessment arises by establishing the likelihood assessment criteria (Table 1) and the severity assessment criteria (Table 2). (g) After the probability and severity values are obtained, the value is then calculated by multiplying the probability value and the severity value to obtain the hazard level which is used to determine the priority of hazards that are prioritized for repair. Risks will be grouped according to the risk level (Table 3). To calculate the risk score is as follows:

Risk Rating Number(RRN) = L (Probability) x S (Severity)

Information

L = Probability or probability of frequency of occurrence

S = Severity (Consequences) or consequences (severity)

**Table 1**. Likehood criteria (UNSW Health and Safety, 2008)

| Level | Criteria | Qualitative | Semi Qualitative |
|---|---|---|---|
| 1 | Rare (very rare) | It can be considered but not only in extreme circumstances | Less than 1 time per 10 years |
| 2 | Possible occurrence (rare) | Not yet happened but could appear at some point | Occurs once every 10 years |
| 3 | Maybe (medium) | It should have happened and may have happened here or elsewhere. | occurs once every 5 years to once a year |
| 4 | Most likely (often) | Can happen easily, probably appears in the most common circumstances | More than 1 time per year to 1 time per month |
| 5 | Almost certainly (very often) | frequently occurring, expected to appear in the most frequently occurring circumstances | More than 1 time per month |

**Table 2.** Consequences criteria (UNSW Health and Safety, 2008)

| Level | Description | Severity of Injury | Working days |
|---|---|---|---|
| 1 | Not Significant (Very light) | The incident did not result in any loss or injury to humans. | Does not cause lost work days |
| 2 | Small (Light) | Causes minor injuries, minor losses and does not cause serious impacts | Can still work on the same day or shift |
| 3 | Currently | Serious injury and hospitalization, no permanent disability, moderate financial loss | Lost work days under 3 days |
| 4 | Heavy | Causing serious injury and permanent disability as well as major financial losses and causing serious impacts on business continuity. | Missed work days of 3 days or more |
| 5 | Disaster (Very Severe) | Resulting in fatalities and severe losses and can even stop production activities forever. | Lost days of work forever |

**Table 3.** Risk matrix (UNSW Health and Safety, 2008)

| Risk Level | | | | | | |
|---|---|---|---|---|---|---|
| Possibility (Likelihood) | 5 | 5 | 10 | 15 | 20 | 25 |
| | 4 | 4 | 8 | 12 | 16 | 20 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 1 | 1 | 2 | 3 | 4 | 5 |
| Scale | | 1 | 2 | 3 | 4 | 5 |
| | | Severity (Consequences) | | | | |

**Information :**

| | | | |
|---|---|---|---|
| | Low Risk | | High Risk |
| | Medium Risk | | Extreme Risk |

**Analytical Hierarchy Process (AHP)**

The Analytical Hierarchy Process (AHP) method developed by Saaty (1980) is one of the decision-making methods used to prioritize and select the best alternatives for a complex problem. According to Satriani et al. (2018), AHP involves several main steps, including: hierarchy formation, pairwise comparison, priority synthesis, and consistency testing. In the pairwise comparison stage, elements in the hierarchy are compared in pairs (e.g., a scale of 1-9) to determine the relative level of importance. The comparison results are then processed to produce priority weights. The consistency of the comparisons made needs to be tested to ensure that the results obtained are reliable. The advantages of AHP are its flexibility and ability to combine qualitative and quantitative factors. However, AHP also has limitations, namely subjectivity in assessment and complexity of calculation.

**Table 4.** Paired comparison scale (Satriani, et al., 2018)

| Intensity of Interest | Information |
|---|---|
| 1 | Both elements are equally important |
| 3 | One element is slightly more important than the other element. |
| 5 | One element is more important than the other elements |
| 7 | One element is clearly more absolutely important than the other elements. |
| 9 | One element is absolutely essential over the others |
| 2, 4, 6, 8 | Values between two adjacent consideration values |
| The opposite | If activity i gets one number compared to activity j, then j has the opposite value compared to i. |

Steps in using the AHP method:

1. Define the problem and determine the desired solution, then compile a hierarchy of the problems faced.
2. Determine element priorities by creating a pairwise comparison matrix filled with numbers to represent the relative importance between elements.

3. Matrix normalization
   a. Add up the values from each column in the pairwise comparison matrix shown in the equation below.
      n = ij$\sum_{i=0}^{z} x$
      *With:*
      *n* = the result of adding each column
      z = many alternatives
      *i = 1, 2, 3, ..., z*
      *x = value of each cell*
   b. Divide each column value by the total of the corresponding column to obtain the normalized matrix shown in the equation below.
      m = $\frac{Xij}{n}$
      With*:*
      *m* = normalization result
      *x* = value of each cell
      n = the sum of each column
4. Calculating priority weight
   Add up the values from the rows and divide the sum by the number of elements to get the average value or priority weight shown in the equation below.
   bp = $\frac{\sum_{i=0}^{z} x\text{ij}}{n}$
   With*:*
   *bp* = average result or priority weight
   n = many criteria
   *j* = 1, 2, 3, …, n
   *x* = value of each cell
5. Calculating the maximum eigenvalues
   In decision making, it is important to know how good the consistency is because it is not expected that decisions are based on considerations with low consistency. Things that are done in this stage are:
   a. Multiply each value in the first cell by the first priority weight, the value in the second column of cells by the second priority, and so on,
   b. Add up the results for each row in the matrix,
   c. The result of the row sum is divided by the corresponding relative priority element, and
   d. Add up the lambda results for each criterion divided by the number of elements present, the result is called*λmax*which is shown in the equation below.
      λmax=$\frac{\sum \lambda}{n}$
      *With:*
      *λmax* = maximum eigenvalue
      N = many criteria
6. Calculate the consistency index (CI) shown in the equation below.
   CI = λmax - 1 n - 1 x 100
   With: *λmax* = maximum eigenvalue
   n = many criteria
7. Calculate the consistency ratio or Consistency Ratio (CR) shown in the equation below.
   CR = CHARACTERISTIC
   With: *RI = Index Ratio*
   *CI = Consistency Ratio*
8. Check hierarchy consistency and provide recommendations for improvement
   If the CR value > 0.1 then the data judgment assessment is inconsistent and must be corrected. If the CR consistency ratio ≤ 0.1 then the data calculation is consistent and correct. RI is the random index value shown in Table 5.

**Table 5.** Random index value

| Matrix Size (N) | RI Value | Matrix Size (N) | RI Value |
|---|---|---|---|
| 1.2 | 0 | 9 | 1.45 |
| 3 | 0.58 | 10 | 1.49 |
| 4 | 0.9 | 11 | 1.51 |
| 5 | 1.12 | 12 | 1.48 |
| 6 | 1.24 | 13 | 1.56 |
| 7 | 1.32 | 14 | 1.57 |
| 8 | 1.41 | 15 | 1.59 |

## 3. RESEARCH METHODS

The research was conducted at the company PT Kayu Lapis Asli Murni (KALAMUR) located in Loa Buah Village, Sungai Kunjang District, Samarinda City, East Kalimantan. Data collection was carried out through observation and interviews with related parties involved in the company. The data used relates to data on risks that occur, deviations, causes, effects and security. The research steps used are explained in detail in the research framework, as in Figure 1.

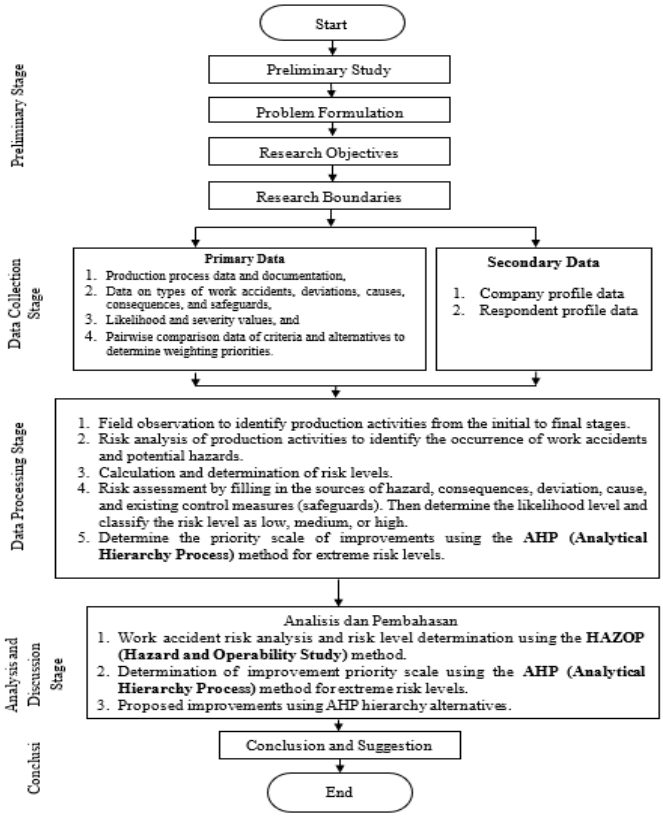


**Figure 1**. Research framework

Risk analysis of production process activities is carried out using the HAZOP and AHP methods. The results of the analysis include risk identification in the production process, risk level assessment using the HAZOP method, and evaluation of the best alternative with the highest score using the AHP method to obtain recommendations for improvement that can minimize the risk of work accidents.

## 4. RESULTS AND DISCUSSION

### HAZOP ANALYSIS

Identification of risk levels in production activities at PT. XYZ is grouped based on criteria using the HAZOP (Hazard and Operability Study) method. Risk assessment data is obtained through interviews with informants. The risk value is calculated using the average multiplication of likelihood and severity, resulting in RRN as an indicator of risk level. The results of risk level identification obtained 35 risks during the production process. There are 57% for low risk, 17% for medium and high risk, and 9% for extreme risk. This indicates that the level of reliability is quite high in the production process so that most production activities have low risk. However, it still requires special attention and more comprehensive mitigation actions for medium and high risks. Although, extreme risks are identified only a little, they still require immediate action to reduce the potential for their very large impact on operations. The following are the results of risk identification for high and extreme levels.

**Table 6.** Identification of high level and extreme level risks

| No. | Production Machines | Risk | Hazard Source | Consequences | L | S | Risk Level |
|---|---|---|---|---|---|---|---|
| 1. | Log Pond | Worker's hands or feet are trapped in the log | Piles of wood are not neatly arranged | Minor to serious injuries | 3 | 3 | High |

| No. | Production Machines | Risk | Hazard Source | Consequences | L | S | Risk Level |
|---|---|---|---|---|---|---|---|
| 2. | Log Pond | Worker slips while stacking logs | Slippery log pond area and irregular wood layout | Workers can drown, causing loss of life | 3 | 3 | High |
| 3. | Log Cleaning | Worker's hands hit and rub against wood while cleaning manually | The axe is not sharp enough | Injured or may cause injury | 3 | 4 | Extreme |
| 4. | Log Cleaning | Workers slip or fall due to work area (high and slippery footing) | The height and working area are slippery | Minor to serious injuries | 3 | 3 | High |
| 5. | Rotary | Worker's leg injured while changing rotary blade | Rotary knife fallout | Minor to serious injuries | 3 | 4 | Extreme |
| 6. | Rotary | Worker falls while manually repairing wood | When changing the blade and repairing the wood does not match the machine set up sop | Can be scratched and injured serious injury to death | 3 | 3 | High |
| 7. | Dryer | Worker's hand was caught in the roll machine when inserting veneer | Operating roll machine | Minor to serious injuries | 3 | 4 | Extreme |
| 8. | Glue Spreader | Worker falls from foothold | Unsafe footing | Minor injuries such as sprained ankles | 3 | 3 | High |
| 9. | Packing And Packing | Worker's hand injured or caught in plywood during manual checking in the grading section | Sharp plywood surfaces (plywood corners) | Causes minor injuries such as injured hands | 3 | 3 | High |

The HAZOP analysis yielded a number of risks with varying levels of severity. While there were moderate and low severity risks, extreme and high risks were considered to have the most significant impact on safety and operations. Therefore, the priority of improvement was focused on the extreme risks, where there were three extreme risks each with a Risk Rating Number (RRN) of 12.

The first risk was in the log cleaning section, where workers' hands were at risk of being hit and rubbed by wood when cleaning manually. The second risk was in the rotary section, with the potential for workers' feet to be injured when changing rotary knives. The third risk was in the dryer section, where workers' hands were at risk of being caught in the roll dryer machine when inserting veneer sheets.

## AHP ANALYSIS

At this stage, data processing is carried out using the Analytical Hierarchy Process (AHP) method using Expert Choice 11 software. Data processing in the AHP method is carried out to obtain the relative weight or priority of various criteria and alternatives in work accidents at extreme risk levels. The results of the risk assessment obtained 3 extreme level risks that will be a priority in the improvement alternatives, 3 alternative strategies were obtained based on each criterion obtained from the questionnaire assessment results, where there is only 1 alternative that is most appropriate for each risk based on the weighting obtained. The results of the AHP hierarchy are as follows.

**Pairwise Comparison Matrix**

At this stage, a pairwise comparison of each criterion is conducted to determine the priority order of proposed work accident improvements at extreme risk levels. The pairwise comparison matrix value is obtained from filling out a questionnaire by a resource person who is an expert from the P2K3 (Occupational Health and Safety Development Committee) department. The pairwise comparison matrix for selecting proposed work accident risk improvements based on the criteria that have been assessed can be seen in Table 7.

**Table 7.** Pairwise comparison of criteria

| Criteria | (A1) | (A2) | (A3) |
|---|---|---|---|
| Worker's hand is bumped and rubbed by wood when manually cleaning (Log Cleaning) (A1) | 1,000 | 0.250 | 3,000 |
| Worker injured foot while changing rotary blade (Rotary) (A2) | 4,000 | 1,000 | 5,000 |
| Worker's hand is pinched by roll dryer machine when inserting veneer sheet (Dryer) (A3) | 0.333 | 0.200 | 1,000 |
| **Total** | **5,333** | **1,450** | **9,000** |

**Normalization and Consistency Testing**

Consistency testing is performed on comparisons between elements obtained at each level of the hierarchy. This test aims to test the consistency of comparisons between criteria performed for the entire hierarchy and to show the priority of each element. The results of the normalization calculation and priority determination carried out between criteria can be seen in Table 8.

**Table 8.** Calculation of normalization and priority criteria

| Criteria | (A1) | (A2) | (A3) | Total row | Row/weigted average | Priority | Weighted sum vector | Consistency vector |
|---|---|---|---|---|---|---|---|---|
| Worker's hand is bumped and rubbed by wood when manually cleaning (Log Cleaning) (A1) | 0.188 | 0.172 | 0.333 | 0.693 | 0.231 | 2 | 0.709 | 3,068 |
| Worker injured foot while changing rotary blade (Rotary) (A2) | 0.750 | 0.690 | 0.556 | 1,995 | 0.665 | 1 | 2,109 | 3,171 |
| Worker's hand is pinched by roll dryer machine when inserting veneer sheet (Dryer) (A3) | 0.063 | 0.138 | 0.111 | 0.312 | 0.104 | 3 | 0.314 | 3,023 |
| **Total** | **1,000** | **1,000** | **1,000** | **3,000** | **1,000** | | **3,131** | **9,261** |

Then a hypothesis is made to test normalization, namely:

H0: consistent criteria, assessment results can be accounted for and can be justified

H1: inconsistent criteria, assessment results cannot be accounted for and justified and must be recalculated.

Decision, H0 accepted if CR< 0.1

After that, the consistency index (CI) and consistency ratio (CR) calculations are carried out as follows:

$\lambda max = 3.068 + 3.171 + 3.0233$

$= 9,2613$

$= 3,087$

CI $= 3.087\text{-}33\text{-}1$

$= 0.043$

CR $= 0.0430.58$

$= 0.075$

The value obtained from the CR calculation results is 0.075. If the paired matrix CR value ≤ 0.100 then it can be said to be consistent, accountable and the calculation results can be justified.

**Determining Alternative Strategies Based on Root Problems**

The work accident risk improvement strategy at PT KALAMUR is determined based on risk priorities from the Risk Rating Number (RRN) results using a fishbone diagram, which helps identify the root cause of the problem and supports decision making for alternative risk improvement strategies.

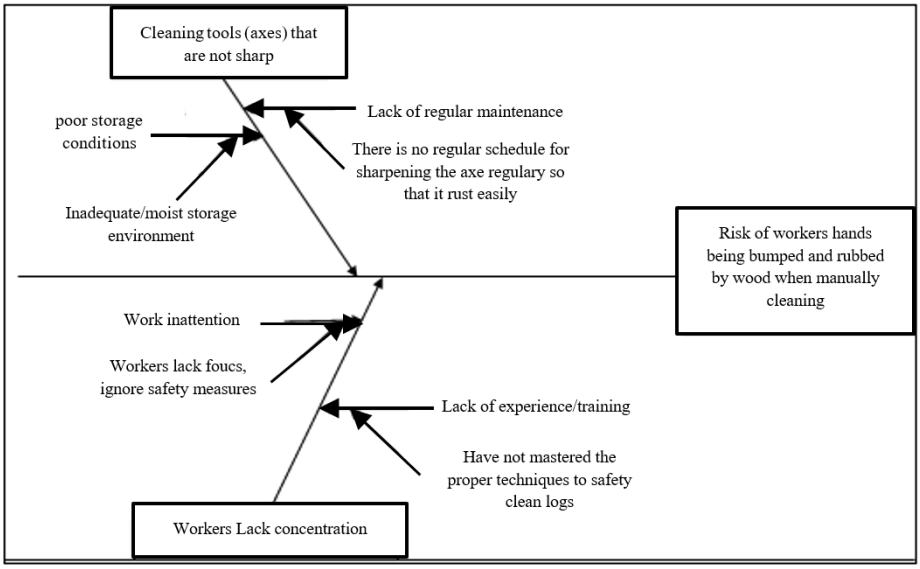


**Figure 2.** Risk of workers' hands being bumped and rubbed against wood when cleaning manually fishbone diagram

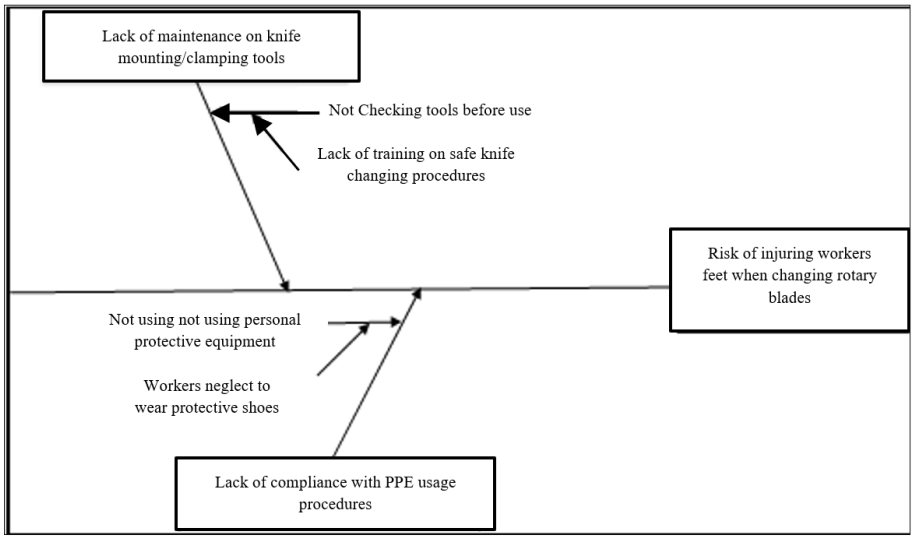


**Figure 3.** Risk of injuring workers' feet when changing rotary blades fishbone diagram

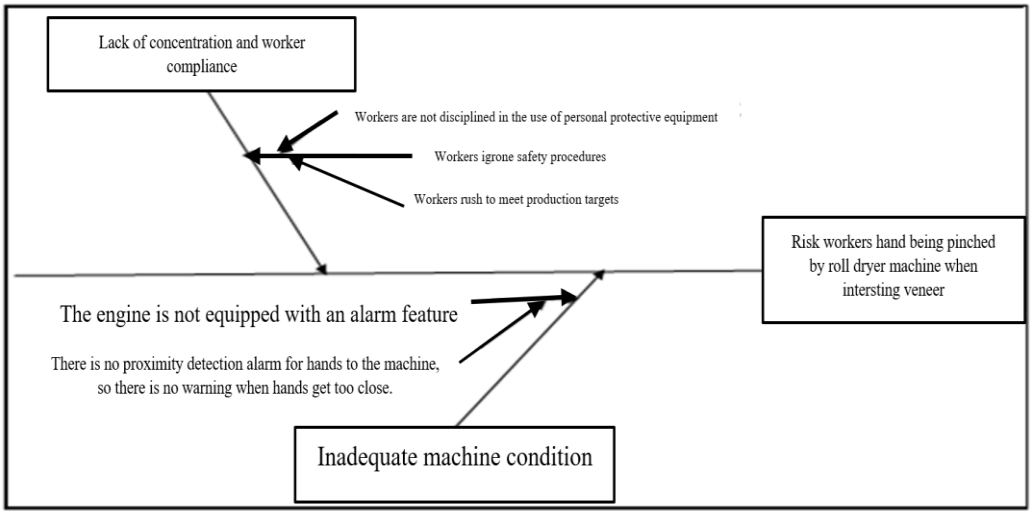


**Figure 4.** Risk of worker's hand being pinched by roll dryer machine when inserting veneer fishbone diagram

Figure 2 explains there are several causes of risk, first, namely the cause of cleaning tools (axes) that are not sharp enough, two factors and root causes are found, namely the first factor, poor storage conditions and the root cause is due to an inadequate storage environment or in a humid state, then the second factor, lack of routine maintenance and the root cause is that there is no routine schedule for sharpening axes regularly so that they rust easily. The second cause of risk, workers' lack of concentration, has two factors and root causes: the first factor is workers' inattention and the root cause is workers' lack of focus and neglect of safety measures; the second factor is lack of experience or job training and the root cause is workers have not mastered the proper techniques to clean logs safely and workers lack focus and neglect of safety measures. Then, Figure 3 explains that there are several causes of risk, first, namely the cause of the lack of maintenance on the rotary knife installation/ clamping tool, the causal factor is found to be not checking the tool before use and the root of the problem is due to a lack of training related to safe knife change procedures. The second risk cause, namely lack of compliance with PPE usage procedures, was found to be a contributing factor, namely not using PPE and the root cause was that workers ignored the use of protective shoes. Figure 4 explains that there are several causes of risk, first, namely the cause of the lack of concentration and worker compliance, the causal factor is found to be that workers ignore safety and security procedures and the first root cause is that workers are in a hurry to meet production targets, then the second root cause is that workers are not disciplined in using PPE. The second risk cause, which is the inadequate condition of the machine, was found to be caused by the fact that the machine is not equipped with an alarm feature and the root cause is that there is no proximity detection alarm between the hand and the machine, so there is no warning when the hand is too close to the machine

**Determining Priorities of Alternative Strategies**

After the normalization calculation and acceptable consistency test are carried out, the next stage is to determine the priority of the proposed work accident risk improvement strategy. The results of the calculation of the weight of the criteria and sub-criteria of the alternative strategies obtained can be seen in the hierarchical structure providing work accident improvement proposals at extreme risk levels in Figure 5.

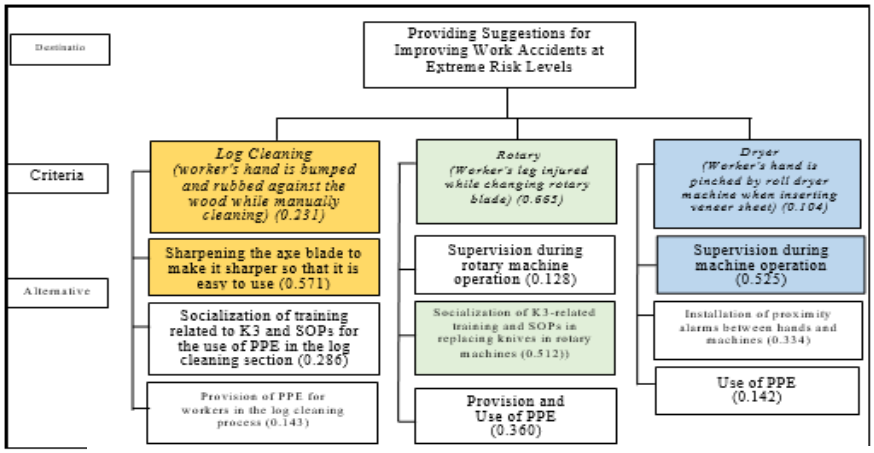


**Figure 5**. Calculated hierarchical structure

AHP analysis at PT. XYZ wood processing plant shows that the highest risk is worker leg injury when replacing rotary knives on production machines.Worker's leg injuries are the main threat in this production machine. Therefore, increasing worker knowledge and skills through K3 training and implementing clearer SOPs in the knife replacement process are the most effective improvement steps to

reduce the risk of accidents in production machine activities.

Implementing detailed SOPs, including the use of appropriate PPE such assafety shoes, gloves, helmets, use of masks and earplugs to minimize the risk of workers' feet being injured when replacing rotary knives. In addition, the risk of hand injuries tolog cleaning activities can be minimized by sharpening the axe blade regularly and using cut-resistant gloves. Meanwhile, to prevent workers from getting trapped in the dryer machine, namely by carrying out strict supervision during machine operation and installing additional safety sensors is very necessary. The results of this analysis are in line with researchWidjajati and Putri (2021) emphasized the importance of a combination of engineering and administrative controls to create a safe work environment. The rotary production process is one of the production stages that has a high potential risk of work accidents. To minimize this risk, the company has implemented various preventive measures. Specific work safety training for the rotary process is provided to all workers directly involved. In addition, the provision of appropriate personal protective equipment, such as heat-resistant gloves, safety glasses, and ear protection, is also mandatory. The implementation of clear and detailed standard work procedures for each stage of the rotary process is also very important to ensure that each worker understands the steps to be taken and the potential hazards that may arise. In addition, routine maintenance of the machines and equipment used in the rotary process is also carried out periodically to prevent damage or malfunctions that can cause accidents. One way to control risk is by using a risk control hierarchy. The control hierarchy is a hierarchy that is carried out sequentially until the level of risk or danger is reduced to a safe point. The control hierarchy includes elimination, substitution, engineering, administration and personal protective equipment (Widiastuti et al., 2019). Based on the results of the risk analysis, several control measures can be implemented to reduce the risk of accidents due to wood handling. Elimination measures can be taken by ensuring that wood is not placed at a height that could potentially cause a fall. Engineering control measures can include improving the condition of the work floor by coating it with cement to prevent slips and falls. In addition, administrative measures such as regular work safety training, supervision of SOP implementation, and monitoring the use of PPE also need to be carried out. The use of complete PPE, such as safety shoes, gloves, helmets, masks, and glasses, is very important to protect workers from exposure to sawdust and other hazard.

## 5. CONCLUSION

The level of work accident risk at PT XYZ identified using the HAZOP method shows that the majority of production activities are at a low risk level (57%), followed by moderate risk (17%), high risk (17%), and extreme risk (9%). There are three extreme risks that occur in the production section, namely in log cleaning, rotary, and dryer, each with a Risk Rating Number (RRN) value of 12. For mitigation, the proposed improvements provided include sharpening the axe used in log cleaning (AHP weight 0.571), socialization of K3 and improving SOP in the rotary process (AHP weight 0.512), and strict supervision during dryer machine operation (AHP weight 0.525).

This proposal focuses on improving work safety to minimize accidents in high-risk areas. Companies are expected to complete the K3 facilities used during the production process such as the use of glasses, aprons, gloves, masks that are appropriate for the production process section and safety shoes to minimize unwanted risks and provide routine K3 training. Further researchers are advised to expand the scope of research to other areas if they choose the plywood industry as the object of research, not limited to the production section only, for example in the quality control section and supporting facilities (laboratory equipment) which also have potential hazards that require further evaluation.

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