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Analysis of Workplace Accident Risk Using The Hazard Identification Risk Assessment and Determining Control (HIRADC) Method in PMKS PT. Sisirau

Latifa Ummarah [1*], Defi Irwansyah [1], Bakhtiar [1]

[1] *Industrial Engineering Study Program, Malikussaleh University, North Aceh, Indonesia*
** Corresponding Author E-mail: latifa.210130010@mhs.unimal.ac.id*

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Abstract

Work accidents are one of the serious problems that have a direct impact on worker safety and company productivity. This study was conducted at PMKS PT. Sisirau located in Aceh Tamiang. This research aims to explore potential sources of danger, evaluate the degree of associated threats, and formulate strategic preventive measures through the structured framework of Hazard Identification, Risk Assessment, and Control Determination (HIRADC) method. The focus of this study was on three work stations, namely loading ramp, boiling (sterilizer station), and tipler. The data used were in the form of work accident reports from January 2021 to February 2025, as well as the results of observations and interviews in the field. The results of the study showed that there were a total of 18 work activities identified as hazardous, consisting of 8 activities at the loading ramp station, 5 activities at the boiling station (sterilizer), and 5 activities at the tipler station. The results of the risk assessment showed that at the loading ramp station there were 5 activities with One activity presented moderate risk; three others showed low-risk potential. At the boiling station (sterilizer) there were 4 activities with a moderate risk and 1 activity with a low risk. Meanwhile, at the tipler station, among the evaluated activities, one was determined to involve a significant risk factor, whereas two others presented comparatively lower levels of risk, and 2 activities with low risk. Recommended risk control includes 7 activities with engineering control, 9 activities with administrative control, and 10 activities with mandatory Application of individual safety gear.

1. INTRODUCTION

Occupational Safety and Health (K3) is an effort to ensure safe, healthy, and comfortable working conditions for workers in order to reduce the likelihood of incidents and work-induced health conditions. According to the International Labor Organization (ILO), K3 plays an important role in protecting workers from various risks in the workplace and improving worker welfare. K3 Intends to elevate and sustain peak physical well-being, mental, and social health of all workers in all Committed to strengthening and protecting top physical capability. Work accidents not only affect workers but can also cause a decrease in company productivity(Parentai et al., 2025).

PMKS PT. Sisirau is a private business entity engaged in the processing of palm oil (CPO). This company also produces kernels (fruit cores) and shells. PMKS PT. Sisirau is located in Sidodadi Village, Vocational Youth District, Aceh Tamiang Regency. PMKS PT. Sisirau has 12 interconnected work stations starting from the fruit receiving station (weight bridge station), sorting station, loading ramp station, boiling station (sterilizer station), tipler station, threshing station, pressing station, purification station (clarification station), kernel processing station, water treatment station, boiler station, and waste station. PMKS PT. Sisirau has a production capacity of 30 tons of FFB/hour(Subandri & Prabowo, 2020).

The work stations that are the focus of this study are the loading ramp station, the boiling station (sterilizer station) and the tipler station, where all three have high potential risks to occupational safety and health (K3).

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Based on work accident data from January 2021 to February 2025, there have been 30 cases of work accidents spread across the three stations, namely, 13 cases at the loading ramp station, 9 cases at the boiling station (sterilizer station), and 8 cases at the tipler station. These work accidents occur due to several causes such as being hit by TBS when pouring into a lorry, being hit by a rope sling, being caught by a bucket loader, burns due to steam spray from the sterilizer, being bounced by a broken rope and falling while climbing stairs to open the hydraulic door. In addition to the accidents that have occurred, observations in the field also show that there are working conditions that can cause accidents such as Staff members who ignore PPE usage, inadequate infrastructure such as sloping stairs without handrails, and uneven rail conditions because they are stacked with new rails. From the problems above, the author aims to analyze the occupational safety and health risks that occur in the work area using The HIRADC approach to identifying hazards, assessing risks, and establishing controls. HIRADC is a systematic method used to identify hazards, assess the level of risk posed by the hazard, and determine the most appropriate control to reduce or eliminate the risk, with the aim of creating a safer and healthier work environment. Based on the existing problems, the author is interested in conducting a study entitled "Analysis of Work Accident Risks Using the Hazard Identification Risk Assessment and Determining Control (HIRADC) Method at PMKS PT. Sisirau."

The objective of this study is to establish the identification of occupational accident hazards at the loading ramp station, boiling station (sterilizer station) and tipler station at PMKS PT. Sisirau. To determine the results of the assessment of occupational accident risks at the loading ramp station, boiling station (sterilizer station) and tipler station at PMKS PT. Sisirau. To determine the efforts to control occupational accident risks that can be applied at the loading ramp station, boiling station (sterilizer station) and tipler station at PMKS PT. Sisirau.

Maintaining a safe and healthy work environment is an approach used to improve overall working conditions. The goal of this effort is to ensure employees stay physically fit, mentally stable, and socially balanced to handle all forms of occupational tasks effectively(Kurnia & Apsari, 2023). Occupational health in general can be defined as a condition in which workers are in good health without experiencing illness, injury, or damage to body parts while in the work environment(Ahnaf, 2024).Risk is defined as how often a hazardous incident or exposure occurs that can cause injury or health problems of a certain severity due to an event. Risk is an event or condition that can hinder the achievement of company goals and targets(Anizar & Fandya, 2022). A job-site accident is considered an unanticipated and unpredictable event that can result in material and physical losses for the individuals involved. These accidents often occur when several factors interact simultaneously in the work environment or in the production process. Thus, work accidents do not occur in isolation, but rather as a result of a combination of several existing factors.(Sulistyaningtyas, 2025).

2. METHOD

2.1 Data Types and Sources

Primary data is information obtained through direct observation in the field. In this study, the primary data used is data from direct observation and interviews with workers. Secondary data is data obtained directly collected from several sources.

In this study, the secondary data used were work accident recapitulation data, production processes, and literature studies.(Ariana et al., 2025).

2.2 Analysis Method

The analysis method is the steps taken to study and process data. In this study, the analysis method used is as follows:

1. Identifying hazards that can cause work accidents during the production process in the worker's environment.(Gufron & Rusindiyanto, 2025). The hazard identification process was carried out through direct field observations, interviews with experienced workers, and consultations with the K3 (Occupational Health and Safety) team. A structured checklist based on ISO 45001 and standard operating procedures from the company was used to ensure consistency and objectivity in identifying potential

hazards. Validation of findings was conducted jointly with the supervisor and safety officer to minimize bias and subjectivity (Farras et al., 2025).

2. Risk assessment of work accidents with a likelihood scale that shows the frequency with which an accident might occur and the level of harm it could result in. The values of likelihood and severity will then be used to compile the risk matrix.(Saputro & Lombardo, 2021). The risk assessment process in this study uses a risk matrix based on the product of Likelihood (L) and Severity (S) values. Likelihood refers to the probability of a hazard occurring, while Severity indicates the potential impact of the incident. The scoring scale adopted in this study is based on the Occupational Safety and Health Administration (OSHA) guidelines and Indonesian Ministry of Manpower Regulation (Permenaker No. 5/2018), as follows:
   a. Likelihood
      Indicates how likely an accident is to occur. According to the AS/NZS 4360 standard, likelihood is categorized within a range from risks that are rare to those that may occur at any time. Likelihood refers to the frequency or probability of a hazardous event occurring. The scale of possible values can be seen in Table 1 as follows:

Table 1 Likelihood Values

Values	***Likelihood***	**Information**
5	A *Almost Certain*	Occurs in almost all circumstances, for example, occurs once a day in a year
4	B *Likely*	Very likely to happen, for example once a week in a year
3	C *Possible*	It can happen at any time, for example once a month in a year.
2	D *Unlikely*	It may happen at any time, for example once every six months of the year.
1	E *Rare*	It can only occur under certain circumstances, for example, it occurs more than once every six months in a year.

Source: AS/NZS Standard 4360

   b. Severity
      Severity indicates the level of severity or consequences resulting from a risk. Severity or consequence indicates the severity of the impact of the accident. Severity is a measure of the possible consequences or impact of a work accident. This severity scale helps determine the overall risk level by combining it with the likelihood of the incident occurring. The results are used to prioritize risk control. The severity scale can be seen in Table 2 below:

Table 2. Severity Values

Mark	*Severity*	Information
1	*Insignificant*	The incident did not result in any physical loss or injury, and did not result in any lost work days.
2	*Minor*	Incidents can result in minor injuries, sprains, bruises and require first aid, but can still work the same day.
3	*Moderate*	Incidents can result in moderate injuries, lacerations, burns and require medical treatment, loss of 3 days of work time.
4	*Major*	Incidents can result in serious injury, severe cuts, broken bones, blisters, loss of more than 3 days of work.
5	*Catastrophic*	Resulting in physical disability, death, loss of long or even permanent work days.

Source: AS/NZS Standard 4360

To obtain the risk value, it is calculated using the following risk assessment formula:
Formula:
Risk = L x S
Information:
R : Accident Risk
L : The probability of an accident occurring
S :Severity of accident

c. Risk Value Matrix

*Risk matrix*is a value that indicates the level of risk based on a scale of likelihood and severity. The grouping according to the level of risk value can be seen in Table 3 as follows:

Table 3. Risk Level Grouping

Risk Level	Action
Extreme	15-25 Disasters, require the involvement of leaders for control in accordance with the control hierarchy.
High	10-14 Unacceptable risks involving work units
Medium	5-9 Risk is acceptable, monitoring is carried out up to the head of the department
Low	1-4 Monitoring is required to ensure existing controls are maintained and implemented (control with routine procedures)

Source: AS/NZS Standard 4360

3. Determining risk control To eliminate and respond to hazards to stop repeated occurrences. Risk control can be done via the hierarchy of controls eliminating and substituting risks, employing engineering designs, administrative protocols, and PPE usage.(Ramadhania et al., 2021).

2.3 Limitations on Data Availability

This study relied primarily on recorded work accident data from January 2021 to February 2025 at PMKS PT. Sisirau. However, near-miss incidents, unsafe conditions, and behavior-based safety (BBS) observations were not systematically documented during the study period. The absence of such data introduces potential bias, since the risk profile is based only on incidents that were formally reported. As a result, the analysis may underestimate hazards that occur frequently but do not result in recordable accidents.

To address this limitation, future research should integrate near-miss reporting systems and structured safety observations into the HIRADC process. Collecting such data over a 3–6 month period would provide a more comprehensive picture of workplace risks and improve the accuracy of the risk assessment. The implementation of behavior-based safety (BBS) monitoring is also recommended to capture unsafe acts and conditions that might otherwise be overlooked.

2.4 Assessor and Reliability

The risk assessment was conducted by three assessors consisting of one researcher and two safety officers from PMKS PT. Sisirau. Prior to the assessment, a short briefing session was conducted to ensure that all assessors applied the same interpretation of likelihood and severity scales. To improve consistency, the assessors carried out the scoring independently and then discussed discrepancies until consensus was achieved.

Although formal statistical measures of inter-rater reliability such as Cohen's Kappa were not calculated, this consensus approach helped to reduce subjective bias in risk ranking. In future studies, the use of structured reliability metrics is recommended to quantitatively evaluate the level of agreement among assessors(Subandri & Prabowo, 2020).

3. RESULTS AND DISCUSSION

3.1 Hazard Identification Risk Assessment And Control At Loading Ramp Station

The results of hazard identification, risk assessment and risk control at the loading ramp station can be examined in Table 4 as follows:

Table 4. Results of Hazard Identification, Assessment and Control at Loading Ramp Stations

No	Work Activities	Hazard	Risk	L	S	Risk Value	Determining Control
1	Opening and closing the Hydraulic Door of loading ramp	Hit by TBS that fell from a crane	Broken neck	2	4	8	*Administrativ,* PPE
2	Climb the ladder to open the hydraulic door	Fell down the stairs because there was no handrail	Bruises on the legs	1	2	2	*Engineering*
3	Passing through the rail area to monitor the lorry	Stumbled upon an uneven rail	Laceration on the leg	2	3	6	*Engineering*

4	New lorry replacement process	Stuck in loader bucket while unloading lorry	Fracture of the arm	1	4	4	*Administrative*
5	Attach the swing rope to the capstan post	Tripped over capstan safety pole	Laceration on the leg	2	3	6	*Administrative*
6	The process of inserting fallen fruit using a tojok tool into the lorry	Hit by a corner while loading TBS into a truck	Broken leg, laceration on the leg	2	4	8	*Administrative*
7	Attachment of rope to lorry hook	Hands trapped while adjusting the rope to the lorry hook	Bruises on the hands	1	2	2	PPE
8	Pulling out the stuck TBS	Affected by TBS	Laceration on the arm	2	3	6	PPE

3.2 Hazard Identification, Risk Assessment and Control at Boiling Station (Sterilizer Station)

The results of hazard identification, risk assessment and risk control at the boiling station (sterilizer station) can be seen in Table 5 as follows:

Table 5. Results of Hazard Identification, Assessment and Control at the Boiling Station (Sterilizer Station)

No	Work Activities	Hazard	Risk	L	S	Risk Value	Determining Control
1	Opening and closing the sterilizer door	Fell while opening the door because the floor was slippery	Laceration on the leg	2	3	6	*Engineering,*PPE
2	The process of checking TBS in the sterilizer	Exposure to hot steam (steam)	Burns on the skin	2	3	6	*Administrative*, PPE
3	Attaching the sling to the lorry that will enter the sterilizer	The rope bounced	Bruises on the body	1	2	2	*Administrative*, PPE
4	Opening the sterilizer door after the boiling process	Steam (hot steam)	Blisters, burns on the skin	2	4	8	*Administrative*, PPE

No	Work Activities	Hazard	Risk	L	S	Risk Value	Determining Control
5	Cleaning the sterilizer area after boiling	Stuck in a puddle of condensate water	Laceration on the leg	2	3	6	*Engineering*

3.3 Hazard Identification Risk Assessment And Control At Tipler Station

The results of Spotting workplace hazards, measuring associated risks, and enforcing control action at the Tipler station can be seen in Table 6 as follows:

Table 6. Results of Hazard Identification, Risk Assessment and Control at Tipler

No	Work Activities	*Hazard*	Risk	L	S	Risk Value	Determining Control
1	Operating the tipper machine	Exposed to hot steam from the lorry when it was being turned on the tipper	Burns on the skin	2	3	6	PPE
2	Pulling the rope	Hit by a rope	Laceration on the arm	2	3	6	*Engineering*, PPE
3	Controlling the tipler machine	Slipped while walking around the machine due to slippery floor	Sprained ankle	1	2	2	*Engineering*
4	Push/pull the lorry towards the transfer carriage	Body trapped between lorry and transfer carriage frame	Lacerations on the body	1	3	3	*Administrative*, PPE
5	Passing the work area while the lorry is moving	Hit by a lorry due to blind spot when the lorry was moving	Physical disability hit the spine	2	5	10	*Engineering, Administrative*

3.4 Risk Drivers per Workstation

The summarizes the main risk drivers identified in each workstation of the palm oil mill. The synthesis highlights not only the highest-ranked risks but also the dominant type of control applied at each location,can be seen in Table 7 as follows:

Table 7. Summarizes The Main Risks In Each Workstation

Workstation	Highest Risk Identified	Dominant Control Applied	Priority Level
Loading Ramp	Opening and closing the Hydraulic Door of loading ramp	*Administrative/*PPE	Medium
Sterilizer	Opening the sterilizer door after the boiling process	*Administrative/*PPE	Medium
Tipler	Passing the work area while the lorry is moving	*Engineering/Administrative*	High

The synthesis in Table 7 shows that the loading ramp and sterilizer stations both present medium-level risks. At the loading ramp, the highest risk arises from the activity of opening and closing the hydraulic door, which requires strict compliance with administrative measures and the consistent use of PPE to prevent potential crushing and falling hazards. Similarly, at the sterilizer, opening the door after the boiling process remains a critical task that also relies heavily on administrative control and PPE, particularly to protect workers from exposure to hot steam and pressurized equipment(Caesar et al., 2023).

In contrast, the tippler station demonstrates a higher priority level due to the danger of workers passing through the area while the lorry is moving. This mechanical hazard demands not only administrative controls but also engineering measures, such as improved traffic management and physical barriers, to reduce accident potential.

Overall, the findings indicate that while all stations require ongoing monitoring, the tippler station should be prioritized for risk control improvements, followed by strengthening of safe practices at the loading ramp and sterilizer stations(Nugraha & Yulia, 2021).

3.5 Control Options and Feasibility Considerations

For the prioritized risks identified, several options of higher-level control measures were considered. At the loading ramp, the use of mechanized unloading equipment (engineering control) could significantly reduce manual handling risks. However, this option is currently constrained by economic factors, as the investment cost for mechanization is relatively high compared to the current scale of operations. As an interim solution, administrative controls and consistent use of PPE remain the main strategies, while gradual implementation of mechanization can be planned for future upgrades.

1. At the sterilizer station, eliminating or substituting the process of manual door opening is technically challenging due to the design of the existing facility. Installing automatic door systems (engineering control) would be an effective solution, but it requires substantial capital expenditure and downtime for retrofitting. Consequently, administrative controls, strict SOPs, and PPE are prioritized while a long-term plan for equipment modernization is proposed(Ilmi, 2025).
2. For the tippler station, engineering controls such as traffic management systems, physical barriers, and warning alarms can reduce hazards associated with moving lorries. While some measures are feasible, full implementation is limited by space constraints and the need to maintain production flow. Therefore, administrative controls are maintained alongside partial engineering solutions(Ihsan et al., 2025).
3. To ensure effectiveness, a monitoring framework combining leading indicators (eg, frequency of safety inspections, training participation rate, observation of unsafe acts/conditions) and lagging indicators (eg,

accident frequency rate, number of near-miss reports) will be applied. This dual approach enables early detection of unsafe conditions while also tracking the outcomes of implemented controls(Palaniandy et al., 2020).

3.6 Discussion

The analysis using A systematic method for identifying workplace dangers, assessing potential risks, and establishing appropriate controls (HIRADC) method at the loading ramp station, boiling station (sterilizer station) and tipler is as follows:

1. The discussion of this study focuses on interpreting the findings across three workstations loading ramp, sterilizer, and tipler by comparing the level of risk and the types of control required. The loading ramp station showed the highest number of hazardous activities eight, mostly related to physical hazards such as being hit by objects or slipping due to uneven surfaces. Meanwhile, the sterilizer station involved five hazardous activities, mainly associated with exposure to hot steam and slippery work conditions, resulting in a moderate risk level. The tipler station identified five hazardous activities as well, including one with a high-risk level due to the movement of heavy machinery and poor visibility blind spots.
2. These differences reflect how the nature of work activities and environmental factors influence the types and severity of risks in each station. For example, the loading ramp requires stronger engineering interventions, such as redesigning stairs and improving walkways, while the sterilizer station needs improved administrative control and consistent use of PPE due to the presence of heat and steam. The tipler station, where machinery is actively moving, must emphasize hazard awareness and engineering control, such as barriers and warning signs(Hasiany et al., 2024).
3. These findings are consistent with previous studies by(Ramadhania et al., 2021)who emphasized the importance of tailoring hazard control efforts to the specific context of each work activity. The application of the HIRADC method in this study provided a structured approach to identify hazards, evaluate their risks, and recommend relevant control measures aligned with occupational safety standards such as ISO 45001 and national K3 regulations(Ariana et al., 2025).
4. This study has some limitations. The risk assessment primarily focuses on reported accidents and field observations, which may not fully capture near-miss events or unsafe conditions that haven't resulted in incidents yet. Additionally, this research only focused on three workstations, and did not include other parts of the production process such as pressing or kernel processing stations. For future studies, it is recommended to incorporate real-time monitoring tools, involve more comprehensive hazard tracking, and evaluate psychological or ergonomic factors that might contribute to workplace risk(Budiman et al., 2025).

4. CONCLUSION

This study concludes that the application of the HIRADC method at PMKS PT. Sisirau successfully identified 18 hazardous work activities across three key workstations. The loading ramp station has five medium risk and three low risk activities. The sterilizer station recorded four medium-risk and one low risk activities, while the tipler station showed one high-risk, two medium-risk, and two low risk activities. The most common control measures recommended include engineering controls 7 activities, administrative controls 9 activities, and the use of personal protective equipment PPE in 10 activities. These findings demonstrate the need for targeted risk control strategies tailored to the nature of each workstation's hazard profile. The practical contribution of this research lies in its structured approach to workplace hazard identification, prioritization, and control planning using HIRADC. This framework provides clear guidance for palm oil mills in enhancing occupational safety performance and complying with national and international safety standards. The study has certain limitations. The assessment did not include near-miss events, and it focused only on three specific workstations. Broader research covering more operational units and incorporating ergonomic or psychological hazards would enhance the generalizability of the findings. Future

studies may also integrate real-time data collection methods and digital risk monitoring tools to support predictive safety management.

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