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OHS Risk Analysis in Autoclave Room Renovation Project at PT Ajinomoto Mojokerto

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Abstract
The construction sector is one of the industries with a high rate of workplace accident risk; therefore, the implementation of Occupational Health and Safety (OHS) is an important aspect of project execution. In the autoclave room renovation project at PT Ajinomoto Mojokerto, various potential hazards were identified in almost every stage of work. This study aims to identify work activities with the highest risk levels and determine risk control measures for the highest-risk categories using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) approach method. The study employed a quantitative descriptive method with data collected through field observations and questionnaires distribution to parties involved in the project. The results showed four work activities categorized as high risk, namely ACP installation work with a fall-from-height risk value of 15.96, scaffolding work with a fall-from-height risk value of 15.2, frame and ceiling installation work with a fall-from-height risk value of 13.6, and epoxy floor grinding work with a respiratory hazard risk value of 11.52. Recommended risk controls include the use of personal protective equipment (PPE), installation of safety nets and safety lines, utilization of scaffolding catwalks, implementation of work permits, workers' health examinations, additional exhaust fans, and the use of gas/vapor detectors.
Keywords: *OHS, HIRARC, Risk Assessment, Risk Control, Construction*

INTRODUCTION

Infrastructure development in Indonesia has shown significant growth in recent years. Construction projects, as the main component of development activities, involve various stages of work, ranging from site preparation, structural work, equipment installation, to final completion. These activities generally involve a large workforce, the use of heavy equipment, hazardous materials, confined working areas, and work at heights, which may increase the risk of workplace accidents[1]. Therefore, the implementation of Occupational Health and Safety (OHS) is very important in the construction industry to support worker safety from various potential hazards and reduce the possibility of workplace accidents[2]. However, the implementation of Occupational Health and Safety (OHS) aspects in Indonesia is still not optimal, particularly in the construction sector, which is known to have a relatively high level of workplace accident risk [3]. Data from BPJS Ketenagakerjaan and the Ministry of Manpower indicate that the number of workplace accident cases has increased from year to year, highlighting the need for more effective control measures through the implementation of an OHS management system [4]. Based on Law Number 1 of 1970 concerning Work Safety, occupational safety refers to all efforts aimed at protecting workers and other parties within the workplace environment from workplace accidents [5]. One of the methods frequently used in risk control for construction projects is Hazard Identification, Risk Assessment, and Risk Control (HIRARC). This method is used to identify potential hazards, assess risk levels, and determine appropriate control measures to minimize the possibility of workplace accidents [1]. Risk can be defined as a combination of the likelihood of a hazardous event occurring and the impact resulting from that event [6]. By applying the HIRARC approach, each stage of work can be analyzed more systematically. The identification results are then used to determine risk levels so that high-risk categories can be prioritized in the control process through engineering controls, administrative controls, and the use of personal protective equipment (PPE) [6].

Several previous studies have shown that the implementation of the HIRARC method can help reduce workplace accident risks in construction projects [7]. The use of this method is considered effective in identifying potential hazards and determining appropriate control measures so that occupational risk levels can be minimized [8]. The control stage is only carried out to determine appropriate control programs. Therefore, the HIRARC method is widely used as one of the approaches in implementing Occupational Health and Safety (OHS) management systems in construction projects. The autoclave room renovation project in the QA area at PT Ajinomoto Mojokerto is one of the projects that has various occupational hazard potentials. Project activities include scaffolding work, ceiling and ACP installation, equipment installation, epoxy work, and work in confined areas that have relatively high-risk levels. If these potential hazards are not properly identified and

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controlled, they may result in workplace accidents, material losses, project delays, and decreased work productivity. Therefore, hazard identification and occupational risk analysis are required to improve the effectiveness of OHS implementation in the project[9]. Based on these conditions, this study was conducted to identify work activities with the highest risk levels in the autoclave room renovation project in the QA area at PT Ajinomoto Mojokerto using the HIRARC method. In addition, this study also aims to determine appropriate risk control measures to reduce the potential for workplace accidents in activities with the highest risk levels. Specific studies regarding Occupational Health and Safety (OHS) risks in autoclave room renovation projects involving various high-risk activities, such as working at heights and handling hazardous chemicals, are still limited; therefore, this study aims to fill that research gap.

METHODS

The approach used in this study is a quantitative descriptive approach. This approach provides an overview of the object being studied using numerical data without making universally generalized conclusions [10]. The quantitative approach was selected because this study focuses on processing numerical data obtained from respondents' assessments regarding the likelihood of risks occurring and the severity of impacts caused by each potential workplace hazard identified during project execution.

The study was carried out at the Autoclave Room Renovation Project in the QA Area of PT Ajinomoto Mojokerto. Data were collected through direct field observations and questionnaire distribution to several parties involved in the project, including HSE personnel, Site Managers, and Surveyors who have knowledge and experience regarding the implementation of Occupational Health and Safety (OHS) within the project environment. The research utilized both primary and secondary data sources. The risk identification process was performed through field observation activities and work scenario approaches at each stage of project execution to identify hazard sources, potential workplace accidents, and possible impacts that could affect workers during project activities.

The analysis method used in this study was Hazard Identification, Risk Assessment, and Risk Control (HIRARC). The initial stage of the research involved identifying hazard sources in each work activity, and the identification results were then validated by the HSE department to ensure that the identified risks were consistent with actual field conditions. Subsequently, a risk assessment questionnaire based on likelihood and severity values was distributed to five respondents involved in the Autoclave Room Renovation Project in the QA Area at PT Ajinomoto Mojokerto. The determination of the number of respondents was conducted using purposive sampling based on the respondents' involvement and understanding of the implementation of Occupational Health and Safety (OHS) in the project. The respondents assessed each risk using a scale of 1–5 to measure the levels of severity and likelihood in determining the risk level of each work activity [11]. The risk value was obtained from the multiplication of likelihood and severity values, resulting in risk level categories based on the risk matrix used in this study[12]. Risk level classification was carried out using a risk matrix to determine whether a risk was categorized as low, moderate, or high[13].

Table 1 Severity dan Likelihood Scale

Scale	Severity Description	Likelihood Description
1	Insignificant / very minor injury	Rarely occurs
2	Minor injury	Occasionally occurs
3	Moderate injury / requires medical treatment	Possible to occur
4	Serious injury / permanent disability	Frequently occurs
5	Fatality / death	Very frequently occurs

(Source: Researcher Data, 2026)

Table 2 Risk Matrix

Likelihood	Severity				
	1	2	3	4	5
1	L	L	L	L	M
2	L	L	M	M	H
3	L	M	M	H	H
4	L	M	H	H	VH
5	M	H	H	VH	VH

(Source: Researcher Data, 2026)

Once the risk levels have been identified, the determining control stage was conduct to define suitable control measures for work activities classified as high risk. The risk control measures were established based on the hierarchy of controls, which includes engineering controls, administrative controls, and the use of Personal Protective Equipment (PPE)[14]. In addition, the selected control measures were adjusted in accordance with findings from previous studies and applicable Occupational Health and Safety (OHS) regulations. The first- and

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third-stage questionnaires were validated by the project HSE personnel to ensure that the risk variables, hazard sources, and proposed control measures were consistent with actual work conditions and applicable Occupational Health and Safety (OHS) standards.

RESULT AND DISCUSSION

Result

Based on the initial identification results, 69 risk variables were identified as having the potential to occur in the project. The study involved five respondents with various job positions. The risk analysis results for each autoclave room renovation activity were obtained based on the implementation of the HIRARC method. Each work activity was assessed using Severity and Likelihood scales as presented in Table 1. The risk assessment results were then combined with a risk matrix to determine the risk level of each identified hazard in every work activity. Table 2 only presents the top 10 risks to simplify the interpretation of the risk assessment results.

Table 3 Risk Assessment

No	Hazard Source	Hazard Potential	Risk Potential	Severity	Likelihood	Risk Value
1	Working at heights (more than 2 m)	Falling from height	Fractures	3,8	4,2	15,96
2	Working at heights (more than 2 m)	Falling from height	Fractures	3,8	4	15,20
3	Working at heights (more than 2 m)	Falling from height	Fractures	3,4	4	13,60
4	FRP Dust	Inhalation of FRP / epoxy dust	Respiratory disorders	3,2	3,6	11,52
5	Working at heights (more than 2 m)	Falling from height	Fractures	2,8	3,2	8,96
6	Workers not wearing complete PPE while working	Contact with hot materials	Burns	2,6	3,4	8,84
7	FRP Dust	Dust entering the eyes	Eye irritation	2,6	3,4	8,84
8	Working at heights (less than 2 m)	Falling from height	Bruises	2,6	3	7,80
9	Careless material handling	Struck by 15 kg frame / ceiling material	Bruises / lacerations on the head	2,4	2,8	6,72
10	Workers not wearing complete PPE while working	Exposure to sparks	Minor injuries	2,2	3	6,60
(Source: Researcher Data, 2026)						

Based on the risk assessment table and figure using the HIRARC method, it was identified that there were top 10 high and moderate-risk hazards with various hazard sources. The highest risk level originated from working at heights with the hazard potential of falling from height, which could result in fractures, as shown in Table 2 numbers 1 to 3. The highest risk obtained a risk value of 15.96 with a severity value of 3.8 and a likelihood value of 4.2. These values indicate that working at heights has a high probability and impact of workplace accidents, therefore requiring stricter risk control measures. In addition, other work-at-height activities also obtained high-risk values of 15.20 and 13.60. Another risk categorized as high originated from exposure to FRP and epoxy dust with a risk value of 11.52. Meanwhile, several other risks were categorized as moderate risks, such as contact with hot materials, exposure to sparks, dust entering the eyes, and being struck by materials during material handling processes.

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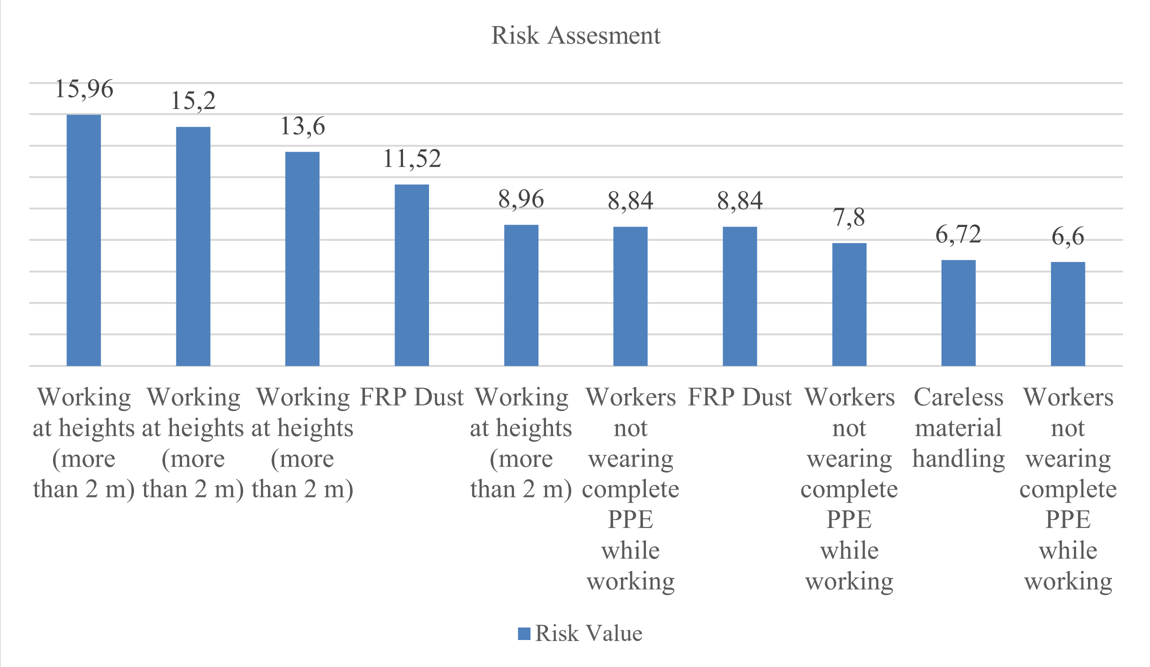
Figure 1 Risk Assessment



(Source: Researcher Data, 2026)

High-Risk Category

The analysis results showed that there were four sub-variables with the highest risk levels affecting the effectiveness of Occupational Health and Safety (OHS) implementation in the project. Risk classification was carried out to facilitate the identification of high-risk activities and determine risk priorities.

Table 4 High-Risk Category

Work Activity	Hazard Potential	Risk Value (R)	Risk Level
Scaffolding Work	Falling from height	15,96	High
Frame / Ceiling Instalation		15,20	High
ACP Installation		13,60	High
Floor grinding	Inhalation of FRP / Epoxy Dust	11,52	High

(Source: Researcher Data, 2026)

Based on table 4, the highest risks were identified in scaffolding work, frame and ceiling installation, ACP installation, and floor grinding during the epoxy process. Scaffolding work, frame/ceiling installation, and ACP installation were influenced by the potential hazard of workers falling from heights, which could result in fractures. Meanwhile, the floor grinding process generated dust and exposure that could cause respiratory disorders.

Risk Control

Risk assessment in this study was performed using a risk matrix that evaluates the severity and likelihood of workplace accidents. The analysis findings indicated that four identified hazards were classified within the high-risk category. Through this classification process, suitable mitigation measures could be determined to minimize the possible impacts arising from occupational hazards. The implementation of risk classification also helped prioritize hazards requiring immediate attention, particularly those with the potential to cause serious injuries, health disorders, or fatal accidents to workers. The determination of risk control measures was developed not only by referring to findings from previous studies but also by considering applicable Occupational Health and Safety (OHS) standards and regulations to ensure that the proposed controls were relevant and effective for project conditions.

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Table 5 Control for Highest Risks Level

<table>
<tr><th>Work Activity</th><th>Hazard Source</th><th>Potential Hazard</th><th>Control</th><th>Regulations or Requirements</th></tr>
<tr><td>Scaffolding Work</td><td rowspan="6">Working at height (more than 2 m)</td><td rowspan="6">Falling from height</td><td>PPE: Using full body harness and safety rope</td><td>UU No 1 / 1970 about Work Safety, Permenaker No. 08/MEN/VII/2010</td></tr>
<tr><td>Frame / Ceiling Instalation</td><td>Adminitrative: Ensuring work permit</td><td>Permenaker No. 09 Tahun 2016</td></tr>
<tr><td rowspan="4">ACP Installation</td><td>Administrative: Provide safety signs dan safety lines within project</td><td>Permenaker No. 08/MEN/VII/2010</td></tr>
<tr><td>Administrative: Conducting health cek-ups</td><td>Permenaker No. 09 Tahun 2016, UU No 1 / 1970 about Work Safety</td></tr>
<tr><td>Engineering Control: Installing additional safety nets and guardrails</td><td>Permenaker No. 09 Tahun 2016, Permenaker No. 01/MEN/1980</td></tr>
<tr><td>Engineering Control: Using built-in scaffolding catwalks</td><td>Supriyadi, 2023</td></tr>
<tr><td rowspan="4">Floor grinding</td><td rowspan="4">FRP Dust</td><td rowspan="4">Inhalation of FRP / Epoxy Dust</td><td>PPE: Using respirator masks, rubber gloves, safety goggles</td><td>UU No 1 / 1970 about Work Safety, Shaumarda, 2025</td></tr>
<tr><td>Administrative: Using gas/vapor detector</td><td>Xue Yalong, 2021</td></tr>
<tr><td>Administrative: Conducting Medical Checkup</td><td>UU No 1 / 1970 about Work Safety, Shaumarda, 2025</td></tr>
<tr><td>Engineering Control: Adding ventilation or exhaust fan</td><td>Permenaker No. 08/MEN/VII/2010, Shaumarda, 2025</td></tr>
<tr><td colspan="5">(Source: Researcher Data, 2026)</td></tr>
</table>

Based on table 5, risk control efforts implemented in this project consisted of three primary approaches, namely administrative controls, engineering controls, and the use of personal protective equipment (PPE). Administrative controls included the installation of safety signs and safety lines in work areas, implementation of work permits, periodic medical check-ups for workers, and the use of gas/vapor detectors to monitor hazardous substances in the workplace. These administrative measures were intended to improve workers' awareness and understanding of occupational safety procedures so that all project activities could be carried out in accordance with established safety standards. Through the consistent application of these measures, the possibility of workplace accidents and occupational illnesses is expected to be significantly reduced during project execution.

Engineering controls were implemented through the use of scaffolding catwalks, installation of additional safety nets and guardrails in work-at-height areas, and the addition of ventilation systems or exhaust fans. Through this approach, risks arising from technical factors can be reduced more effectively.

In addition to administrative and engineering controls, risk control was also carried out through the mandatory use of personal protective equipment (PPE) for all workers. The types of PPE used were adjusted according to the potential hazards of each work activity, such as full body harnesses, safety ropes, rubber gloves, safety goggles, and respirator masks. However, the implementation of PPE uses still faced obstacles due to workers' lack of awareness in using PPE properly and consistently. Therefore, stricter supervision and sanctions for workers who do not comply with PPE regulations are required. Thus, the OHS system in the project can continue to be improved in accordance with applicable occupational safety standards.

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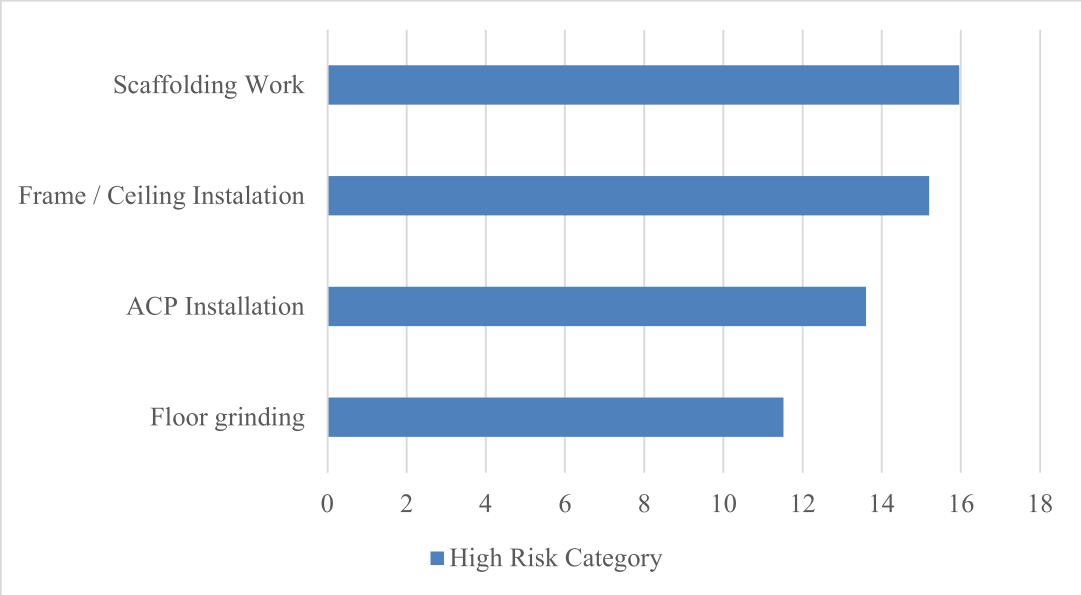
Discussion

High-Risk Category

Figure 2 High-Risk Category



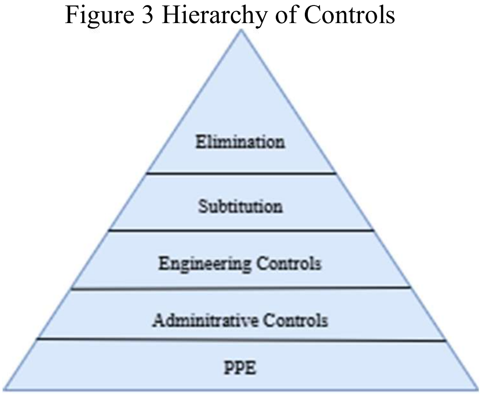
(Source: Researcher Data, 2026)

Based on the research results using the HIRARC approach, ACP installation work was identified as the activity with the highest risk level, with a risk value of 15.96. The main hazard in this activity was falling from height because the work was carried out using scaffolding. These findings are consistent with the study conducted by Supriyadi (2024), which stated that ACP installation work at heights in construction projects has an extreme risk level and requires strict engineering, administrative, and PPE controls [4]. Scaffolding work obtained a risk value of 15.2 with the potential hazard of falling from height. Supriyadi (2024) also reported that scaffolding activities are among the high-risk activities in construction projects. Therefore, the control measures should be adjusted according to the hierarchy of controls [4].

Frame or ceiling installation work obtained a risk value of 13.6 with the potential hazard of falling from height. This activity was carried out in elevated areas with difficult working positions, increasing the possibility of losing balance. These findings are in line with Nugraha (2025), who stated that frame or ceiling installation work with fall-from-height hazards is categorized as high risk [15]. Furthermore, epoxy floor grinding work generated dust and exposure that could cause respiratory problems, resulting in a risk value of 11.52. This result is consistent with the study conducted by Irawan (2024), which stated that floor grinding work had a risk value of 67.7% and was categorized as high risk [13].

Risk Control

Figure 3 Hierarchy of Controls



(Source: Researcher Data, 2026)

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The mitigation strategy in this study was prioritized for work activities with the highest risk levels. The activities categorized as the highest-risk activities included ACP installation work, scaffolding work, frame or ceiling installation work, and epoxy floor grinding work. The high-risk values in these activities were influenced by high likelihood and severity values, indicating that workplace accidents had a relatively high probability of occurring and could cause serious impacts on workers. Based on the HIRARC analysis, scaffolding work was categorized as one of the highest-risk activities due to the potential for falling from height. Risk control measures recommended by Supriyadi (2024) included providing safety lines, safety signs, catwalks, and the use of full body harnesses [4]. Risk control recommendations from Ramadhan (2025) to reduce the possibility of workers falling included installing guardrails [16]. According to Indriyani (2025), work permits and safety net installations are also required as control measures [17]. Mahyudin (2025) added medical check-ups as part of administrative controls [18].

ACP installation work was also categorized as a high-risk activity because it involved the potential hazard of falling from height. Risk control measures recommended by Supriyadi (2024) included providing safety lines, safety signs, catwalks, and the use of full body harnesses [4]. Meanwhile, risk control in epoxy floor grinding work focused on reducing exposure to dust and chemical vapors that could affect workers' respiratory health. The controls included the use of respirators, safety goggles, and the addition of exhaust fans. In addition, workers were required to undergo periodic medical check-ups. These control measures are supported by Shaumarda (2025), who stated that ventilation systems and the use of PPE can reduce health risks in grinding work [19]. The controls are also supported by the study of Xue Yalong (2021), which stated that epoxy exposure in construction work may cause respiratory disorders; therefore, ventilation control and periodic air quality monitoring using gas/vapor detectors are required [20]. The results of the study also showed that the effectiveness of risk control measures was closely related to the probability or likelihood level of each risk. The higher the probability of a risk occurring, the stricter and more comprehensive the control measures that needed to be implemented. Fall-from-height hazards and respiratory disorders with high likelihood values could not be adequately controlled only through the use of Personal Protective Equipment (PPE), but also required a combination of administrative and engineering controls to minimize the probability of workplace accidents effectively. Therefore, risk control measures were implemented in multiple layers according to the hierarchy of controls approach.

CONCLUSION

The HIRARC method was effectively used to identify and prioritize high risks in the autoclave room renovation project. Risk control measures through the use of Personal Protective Equipment (PPE), engineering controls, and administrative controls are expected to reduce the potential for workplace accidents during project execution. Future studies are recommended to evaluate the effectiveness of the implementation of risk control measures directly in the field.

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