



Original Article

## Assessing the Construction Safety Management System (CSMS) Implementation in the SAMSAT Samarinda City Office Building Project

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**Abstract:** The construction industry is widely recognized as one of the most hazardous sectors due to the complexity of activities, dynamic site conditions, and the use of heavy equipment and high-risk operations. To address these risks, the Indonesian government introduced the Construction Safety Management System (CSMS) to ensure systematic safety planning, risk control, and continuous safety improvement in construction projects. This study aims to evaluate the implementation of CSMS in the Office Building Construction Project of SAMSAT Samarinda City. The research adopts a qualitative descriptive case study approach using triangulated data collection methods, including field observations, document analysis, and semi-structured interviews with project management personnel and safety officers. The analysis focuses on five key dimensions of CSMS implementation: leadership and safety commitment, safety planning, safety resource support, construction safety operations, and safety performance evaluation. The results indicate that CSMS has been implemented in a structured and systematic manner, reflected in the establishment of a safety organizational structure, routine safety meetings, regular occupational health and safety inspections, and hazard identification and risk assessment for major construction activities. The project also recorded zero occupational accidents during the monitoring period from August to December 2025, indicating effective safety management practices. Overall, the implementation of CSMS in this project complies with applicable regulations and demonstrates good safety performance, although strengthening safety culture, consistency in supervision, and documentation practices remains necessary to further enhance the effectiveness of construction safety management.

**Keywords:** Construction Safety Management System (CSMS); Occupational Health and Safety (OHS); Construction Safety Performance; Hazard Identification and Risk Assessment; Construction Project Management.



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## 1. Introduction

The construction industry plays a strategic role in national economic growth and public service development, particularly through the provision of infrastructure and public facilities. Office buildings, transportation facilities, and public service centers are critical assets that support administrative efficiency and socio-economic development. Despite its economic importance, the construction sector remains one of the most hazardous industries worldwide. Accident rates in construction consistently exceed those of many other economic sectors due to the complexity of activities, temporary organizational structures, exposure to dynamic site conditions, and the extensive use of heavy machinery and high-risk operations. According to systematic reviews on occupational health and safety management systems (OHSMS), the construction industry continues to record disproportionately high levels of injuries and fatalities, particularly in developing countries where implementation challenges persist (Kineber et al., 2023). Construction activities involve structural works, work at heights, lifting operations, excavation, formwork dismantling, and equipment mobilization each of which presents significant safety hazards. Research indicates that accidents on construction sites not only cause injuries and fatalities but also lead to project delays, cost overruns, quality degradation, and productivity losses (Khalid et al., 2021). These consequences highlight that Occupational Health and Safety (OHS) is not merely a compliance requirement but a strategic component of project management that directly influences project performance and sustainability.

To address safety risks, many countries have institutionalized safety management frameworks. In Indonesia, occupational safety is constitutionally protected under the 1945 Constitution and further regulated through Law No. 1 of 1970 on Occupational Safety, Law No. 13 of 2003 on Manpower, and Government Regulation No. 50 of 2012 concerning Occupational Health and Safety Management Systems. Specifically in the construction sector, the Ministry of Public Works and Housing issued Ministerial Regulation No. 10 of 2021 on the Construction Safety Management System (CSMS/SMKK). This regulation mandates integrating safety planning, hazard identification, risk control, supervision, and continuous improvement into construction project execution. Empirical evidence in Indonesia demonstrates that the structured implementation of CSMS improves safety governance. For instance, Arifuddin et al. (2023) emphasize the importance of compliance with standard safety procedures and continuous review mechanisms as key determinants of CSMS effectiveness. Similarly, Asyiah et al. (2025) show that systematic risk identification using structured tools can classify hazards into measurable risk levels, strengthening preventive actions. However, studies also reveal that compliance alone does not guarantee effective safety outcomes. Constraints such as weak safety culture, insufficient field-level evaluation, and limited enforcement mechanisms remain significant barriers in Indonesian construction projects (Ahadian et al., 2021).

International research further indicates that organizational and behavioral factors play a decisive role in the effectiveness of safety management. Okonkwo and Wium (2023) found that accountability mechanisms, subcontractor management, and employee competence significantly influence the adequacy of safety management systems. From a systems-thinking perspective, safety performance emerges from interactions among organizational practices rather than isolated procedures (Bridi et al., 2021). Additionally, implementation effectiveness is shaped by internal factors such as leadership commitment and communication, as well as external pressures including client demands and regulatory enforcement (Kunodzia et al., 2024). In parallel with regulatory and organizational developments, the construction industry is undergoing digital transformation. Technologies such as Building Information Modeling (BIM), drones, artificial intelligence, Internet of Things (IoT), and sensor-based monitoring systems have demonstrated potential to enhance hazard detection, real-time monitoring, and predictive safety management (Akinlolu et al., 2022; Parsamehr et al., 2023). Nevertheless, adoption remains limited in many developing contexts due to cost concerns, technological readiness issues, and resistance to change (Yap et al., 2022; Matti & Zahid, 2024). This indicates that safety management in construction is increasingly positioned at the intersection of regulatory compliance, organizational behavior, risk control systems, and technological readiness.

The Office Building Construction Project of SAMSAT Samarinda City represents a public-sector infrastructure initiative involving multiple high-risk activities, particularly structural works, work at heights, scaffolding operations, and material lifting. Given these risk characteristics, implementing CSMS is not only a regulatory obligation but also a critical determinant of project safety performance. However, limited empirical research has examined CSMS implementation at the project level by integrating regulatory compliance, organizational dynamics, and structured risk control mechanisms within Indonesian office building projects. Therefore, this study aims to evaluate the implementation of the Construction Safety Management System (CSMS) in the Office Building Construction Project of SAMSAT Samarinda City. By situating the analysis within the broader discourse on regulatory frameworks, organizational behavior, risk management methodologies, and evolving safety paradigms, this research seeks to contribute both

practically, through project-level evaluation, and theoretically by bridging fragmented research streams in construction safety management literature.

## 2. Literature Review

### 2.1. Regulatory Framework and CSMS/SMKK Implementation

The implementation of the Construction Safety Management System (CSMS), known in Indonesia as SMKK, is fundamentally grounded in regulatory compliance. The Indonesian Ministry of Public Works and Housing formalized SMKK implementation through Ministerial Regulation No. 10 of 2021, making safety management an integral component of construction project planning and control. Empirical studies in Indonesia demonstrate that regulatory alignment significantly strengthens structured safety planning and hazard identification processes. For example, Asyiah et al. (2025) show that systematic risk identification using the IBPRP method improves hazard classification and prioritization, while Arifuddin et al. (2023) emphasize the importance of compliance with standard safety procedures and continuous review mechanisms as dominant drivers of CSMS effectiveness. Similarly, comparative reviews across ASEAN countries indicate that government policies and enforcement mechanisms strongly influence the maturity of construction safety management systems (Fern & Masirin, 2021). These findings suggest that regulatory frameworks provide the formal structure necessary for CSMS implementation. However, regulation alone does not guarantee effective safety performance. Several studies report persistent gaps between documented compliance and practical implementation at project sites. Therefore, within the context of CSMS, the regulatory compliance should be examined not merely as administrative fulfillment, but as an operationalized management process embedded in daily project activities.

### 2.2. Organizational and Behavioral Determinants of Safety Performance

Beyond regulatory requirements, organizational and behavioral dimensions significantly influence CSMS effectiveness. Research consistently shows that safety culture, leadership commitment, accountability systems, and employee competence are critical determinants of safety outcomes. Okonkwo & Wium (2023) found that deficiencies in accountability, subcontractor management, and employee training weaken the effectiveness of health and safety management systems (HSMS). Similarly, Ahadian et al. (2021) identified the absence of field-level evaluation, weak safety culture, and lack of enforcement mechanisms as primary constraints in OHSMS implementation in Indonesian construction projects. From a strategic management perspective, Kunodzia et al. (2024) demonstrate that both internal factors (risk control strategies, senior management commitment, communication channels) and external pressures (client demands, legislative enforcement, reputation concerns) shape the effectiveness of OHSMS implementation. These findings reinforce the view that safety performance emerges from organizational dynamics rather than compliance documents alone. Furthermore, adopting a systems thinking lens, Bridi et al. (2021) argue that safety and accidents should be understood as emergent phenomena arising from interactions among multiple safety practices within an organizational context. This perspective challenges reductionist approaches and emphasizes the need to assess *how* CSMS elements interact at the project level. In relation to the Samsat Samarinda office building project, this body of literature suggests that CSMS implementation should be evaluated using organizational behavior indicators, such as leadership engagement, safety communication, enforcement mechanisms, and worker participation.

### 2.3. Risk Assessment and Performance Measurement Approaches

Effective CSMS implementation requires structured risk identification and performance evaluation tools. Analytical methods such as the Analytic Hierarchy Process (AHP), IBPRP, and PDCA frameworks have been widely used to prioritize hazards and evaluate system performance. Arifuddin et al. (2023) applied AHP to determine priority factors influencing CSMS implementation, highlighting the importance of compliance and corrective action mechanisms. Asyiah et al. (2025) used IBPRP to categorize construction risks into low, medium, and high levels, demonstrating the practical relevance of structured risk matrices in Indonesian projects. The PDCA cycle, as emphasized by Kunodzia et al. (2024), provides a continuous improvement model that links planning, execution, monitoring, and corrective actions. Meanwhile, Khalid et al. (2021) propose a comprehensive Safety Management System (SMS) framework that integrates leadership, risk assessment, safety planning, compliance, inspection, performance measurement, and safety culture into a coherent system. Collectively, these studies suggest that CSMS effectiveness depends not only on identifying risks but also on integrating them into continuous improvement cycles supported by measurable performance indicators. However, empirical studies often assess isolated elements rather than evaluating how these components function holistically at the project level. Thus, the proposed Samsat Samarinda study contributes by examining the operational coherence between regulatory compliance, risk assessment tools, and performance monitoring mechanisms within a single construction project.

## 2.4. Digital Transformation and Safety Technology Integration

Recent literature highlights the transformative potential of digital technologies in construction safety management. A bibliometric analysis by Akinlolu et al. (2022) shows increasing research attention to BIM, IoT, UAVs, automation, and visualization technologies for safety enhancement. Similarly, Parsamehr et al. (2023) argue that BIM-based decision-support systems can improve safety monitoring alongside cost, quality, and schedule management. Empirical investigations in Sweden demonstrate that digital tools such as AI, drones, VR, AR, digital twins, and sensor technologies can enhance hazard detection and monitoring (Matti & Zahid, 2024). However, adoption remains constrained by cost concerns, cultural resistance, and perceived risks, particularly in developing countries (Yap et al., 2022). While these studies emphasize digital innovation, the integration of traditional CSMS regulatory frameworks with digital safety technologies remains underexplored, particularly in Indonesian construction contexts. Therefore, the Samsat Samarinda CSMS study presents an opportunity to assess whether traditional safety management practices are aligned with emerging digital safety readiness, even if technology adoption is not yet fully implemented.

## 3. Materials and Methods

This study adopts a case study design using a qualitative descriptive approach to examine the implementation of the Construction Safety Management System (CSMS) in the Office Building Construction Project of SAMSAT Samarinda City. The case study method is appropriate because it enables an in-depth investigation of safety management practices within a specific project context, allowing the researcher to analyze how regulatory requirements are translated into actual site implementation. The qualitative descriptive approach facilitates a comprehensive understanding of field conditions, organizational behavior, and compliance processes, grounded in direct evidence and documentation. The population of this study includes all construction activities and stakeholders involved in the project, such as project management personnel, safety officers, site supervisors, subcontractors, and workers. Purposive sampling was used to select respondents directly involved in occupational safety implementation, including project managers, HSE officers, and workers engaged in core construction activities. This sampling technique ensures that the collected data reflect informed perspectives on CSMS implementation and operational safety practices.

Data were collected through triangulated methods comprising field observation, document review, and interviews. Field observations were conducted to assess the practical application of CSMS elements on site, including the use of personal protective equipment (PPE), adherence to standard operating procedures, safety signage, scaffolding conditions, lifting operations, and overall workplace safety conditions. Documentation review involved examining project safety records, including OHS policies, construction safety plans, hazard identification and risk assessment documents, safety induction and toolbox meeting records, inspection reports, and monthly OHS reports. In addition, semi-structured interviews with safety officers and project management representatives were conducted to obtain deeper insights into leadership commitment, safety culture, implementation challenges, and continuous improvement mechanisms.

The main variable analyzed in this study is the implementation of CSMS, which is operationalized into five key dimensions derived from the Regulation of the Minister of Public Works and Housing No. 10 of 2021 concerning CSMS and aligned with Government Regulation No. 50 of 2012 on OHSMS. These dimensions include leadership and safety commitment, construction safety planning, safety resource support, construction safety operations, and evaluation and continuous improvement. Each dimension was examined for its compliance with regulatory standards and its practical effectiveness in managing construction risks. Data analysis was conducted using qualitative descriptive analysis. Information obtained from observations, documentation, and interviews was systematically categorized according to the five CSMS dimensions and then compared with applicable regulatory standards. This comparative approach was used to assess compliance levels, identify implementation gaps, and analyze factors influencing the effectiveness of occupational safety management in the project. Through this method, the study provides a structured evaluation of CSMS implementation while maintaining sensitivity to the specific organizational and operational context of the construction project.

## 4. Results

The data analyzed in this study were obtained from the monthly Occupational Safety and Health (OSH) reports of the Office Building Construction Project of SAMSAT Samarinda City covering the period from August to December 2025. The analysis primarily focuses on evaluating the implementation of the Construction Safety Management System (CSMS). Specifically, it examines several key aspects, including construction safety performance, hazard and risk identification, the implementation of safety operational procedures, and the organizational structure supporting construction safety management.

#### 4.1 Construction Safety Performance Results

**Table 1.** Recapitulation of Construction Safety Performance.

Period	Safety Meeting	OHS Inspection	Work Accidents
August–September 2025	Routine	Implemented	0
September–October 2025	Routine	Implemented	0
October–November 2025	Routine	Implemented	0
November–December 2025	Routine	Implemented	0
December 2025	Routine	Implemented	0

Table 1 presents the recapitulation of construction safety performance during the period of August to December 2025. The data highlight three key indicators of occupational safety management in the construction project, namely the implementation of safety meetings, occupational health and safety (OHS) inspections, and the occurrence of work accidents. Overall, the table demonstrates a consistent and structured implementation of safety management practices throughout the observed period. First, regarding safety meetings, the table indicates that routine meetings were held in every reporting period from August–September 2025 through December 2025. Routine safety meetings play an important role in reinforcing safety awareness among workers, supervisors, and project managers. These meetings typically function as a platform for communicating safety procedures, reviewing previous safety incidents or near misses, reminding workers of potential hazards, and ensuring that all personnel understand the required safety standards before carrying out construction activities. The ongoing implementation of routine safety meetings suggests that the project management team maintained a proactive approach to fostering a safety-oriented work culture. By regularly engaging workers in safety discussions, the organization likely strengthened workers' understanding of safe work practices and increased their vigilance toward potential risks in the construction environment.

Second, the table shows that OHS inspections were consistently implemented across all observed periods. Regular OHS inspections are a crucial component of an effective safety management system, as they allow project supervisors or safety officers to monitor compliance with safety regulations and identify potential hazards at the construction site. Through these inspections, unsafe conditions—such as improper use of personal protective equipment (PPE), unsafe scaffolding arrangements, or hazardous material handling can be detected and corrected promptly. The consistent implementation of OHS inspections across reporting periods indicates that the project adopted a systematic monitoring mechanism to ensure safety standards were adhered to throughout the construction process. Such inspections not only help prevent accidents but also support continuous improvement in workplace safety management.

Third, the most notable finding presented in Table 1 is the absence of work accidents throughout the entire monitoring period. From August–September 2025 until December 2025, the number of reported work accidents remained at zero. This result suggests that the safety measures implemented on the construction site were effective in preventing occupational incidents. The absence of accidents may be attributed to several factors, including consistent safety communication through routine safety meetings, strict monitoring through OHS inspections, and the overall commitment of workers and management to follow established safety procedures. Maintaining zero accidents over several consecutive months is an important indicator of successful safety performance, particularly in the construction sector, which is widely recognized as one of the industries with higher occupational risk levels.

Furthermore, the alignment between routine safety meetings and regular OHS inspections likely contributed to the effective control of workplace hazards. Safety meetings may have enhanced workers' awareness and knowledge, while inspections ensured that safety practices were correctly implemented in the field. The combination of these preventive and monitoring strategies creates a comprehensive safety management approach that minimizes the likelihood of accidents. In addition, this consistent safety performance may also reflect effective coordination among project stakeholders, including safety officers, site supervisors, contractors, and workers. It means that construction safety performance during the August–December 2025 period was characterized by continuous safety meetings, systematic OHS inspections, and a zero-accident record. These findings indicate that the safety management practices implemented at the construction site were effective in maintaining a safe working environment. The consistency of these safety activities underscores the importance of regular safety communication, active supervision, and strict adherence to occupational safety standards to achieve sustainable safety performance in construction projects.

## 4.2. Hazard Identification and Risk Levels

**Table 2.** Hazard Identification and Risk Levels by Work Activity

Type of Work	Potential Hazard	Risk Level
Structural Work	Falling from a height	High
Excavation Work	Landslide/collapse	Moderate
Heavy Equipment Operation	Struck by equipment	High
Material Handling	Muscle injury	Moderate

Table 2 presents the identified hazards and the corresponding risk levels for the major construction activities carried out in the project. The table highlights four primary categories of work activities: structural work, excavation work, heavy equipment operation, and material handling, each with specific potential hazards and varying levels of occupational risk. The classification of risk levels into high and moderate categories provides a structured understanding of the safety challenges across different stages of construction activities and underscores the need for targeted preventive measures.

First, structural work is identified as high risk due to the potential for falling from height. Structural construction activities commonly involve work performed at elevated positions, such as installing formwork, reinforcing steel bars, and assembling structural components on upper floors or scaffolding platforms. These activities expose workers to significant fall hazards, particularly when working on unfinished structures, narrow platforms, or unstable surfaces. Falls from height are widely recognized as one of the leading causes of serious injuries and fatalities in the construction industry. Therefore, the classification of this hazard as high risk reflects its severity and the likelihood of accidents if adequate safety controls are not implemented. Preventive measures typically include installing guardrails, safety nets, and fall arrest systems, as well as requiring the use of personal protective equipment, such as safety harnesses and helmets. Additionally, proper worker training and strict supervision are essential to minimize fall-related risks during structural operations.

Second, excavation work is associated with the potential hazard of landslides or soil collapse, which is categorized as a moderate risk level. Excavation activities are necessary for foundation preparation, drainage installation, and underground utility works. However, these activities can create unstable soil conditions that may lead to trench collapses or landslides, especially when excavation is performed in loose or saturated soil. Workers operating within excavation zones face the risk of being trapped or buried if the surrounding soil structure fails. The classification of this hazard as moderate risk indicates that while the likelihood of occurrence may be controlled through appropriate safety procedures, the hazard still requires careful monitoring. Risk mitigation strategies typically include implementing proper trench support systems, such as shoring or shielding, conducting soil stability assessments, and restricting worker access to unstable excavation areas. Continuous inspection by safety personnel also plays a critical role in ensuring excavation safety throughout the construction process.

Third, heavy equipment operation is another high-risk activity due to the potential for workers to be struck by moving equipment. Construction sites often involve the operation of machinery, such as excavators, cranes, loaders, and trucks, for material transportation and site preparation. The movement of these large machines within confined construction spaces creates a high risk of collisions, particularly when visibility is limited or communication between operators and ground workers is insufficient. Being struck by heavy equipment can result in severe injuries or fatalities, which justifies its classification as a high-risk activity. Effective control measures include establishing designated equipment operation zones, implementing clear traffic management systems within the construction site, and ensuring that operators are properly trained and certified. In addition, the use of warning signals, spotters, and high-visibility personal protective equipment can significantly reduce the risk of accidents involving heavy machinery.

Finally, material handling activities pose a moderate risk of muscle injury. Material handling typically involves lifting, carrying, pushing, or pulling construction materials such as cement bags, steel components, and equipment tools. Repetitive manual handling or improper lifting techniques can lead to musculoskeletal disorders, including muscle strains, back injuries, and joint pain. Although such injuries may not always result in immediate severe accidents, they can accumulate over time and negatively affect workers' health and productivity. The moderate risk classification indicates that these hazards are relatively common but can be effectively managed through ergonomic practices and proper work procedures. Preventive measures include providing mechanical lifting aids, organizing team lifting for heavy materials, offering training on safe lifting techniques, and designing work processes that minimize excessive physical strain on workers.

Thus, the result demonstrates that construction activities entail diverse safety risks, varying in severity by type of work. Structural work and heavy equipment operations are categorized as high-risk activities due to the potential for severe accidents, while excavation work and material handling present moderate risks

that still require systematic safety management. This hazard identification and risk classification provides an important foundation for implementing appropriate risk control strategies within the Construction Safety Management System (CSMS). By systematically identifying potential hazards and evaluating their risk levels, project management can prioritize preventive measures, allocate safety resources effectively, and ensure construction activities are conducted in a safe, controlled environment.

### 4.3. Construction Safety Operations

Table 3 presents the implementation schedule for construction safety operations throughout the project. The table outlines four key safety management activities, including Safety Morning sessions, Safety Meetings, Occupational Health and Safety (OHS) inspections, and OHS evaluation meetings and their respective frequencies. These activities represent the operational mechanisms through which the Construction Safety Management System (CSMS) is implemented on site, ensuring that safety practices are consistently communicated, monitored, and evaluated throughout the construction process. First, the table indicates that Safety Morning activities are conducted daily. Safety Morning, often called a daily safety briefing or toolbox talk, serves as a routine communication forum among supervisors, safety officers, and workers before construction activities begin each day. During these sessions, workers are reminded of the potential hazards associated with the tasks they will perform, and supervisors provide guidance on safe work procedures and the correct use of personal protective equipment (PPE). Daily Safety Morning briefings also provide an opportunity to review incidents or near misses from previous workdays and to reinforce safety awareness among workers. The daily implementation of this activity demonstrates a proactive approach to safety management, as it helps ensure that all workers remain alert to potential risks and adhere to established safety standards before commencing their work.

**Table 3.** Implementation of Construction Safety Operations

<b>Safety Activity</b>	<b>Frequency</b>
Safety Morning	Daily
Safety Meeting	Weekly
OHS Inspection	Weekly
OHS Evaluation Meeting	Monthly

In addition, Safety Meetings are held weekly. Unlike the daily Safety Morning briefings, weekly Safety Meetings generally involve a more comprehensive discussion of safety issues within the construction project. These meetings typically involve project managers, safety officers, supervisors, and, sometimes, subcontractor representatives. The purpose of these meetings is to review ongoing safety performance, discuss challenges encountered during the week, evaluate compliance with safety procedures, and plan improvements for future work activities. Weekly Safety Meetings also provide a platform for addressing worker feedback, clarifying safety responsibilities, and strengthening coordination among different teams working on the project. Through regular discussions and evaluations, the project management team can ensure that safety policies and procedures are consistently applied across all construction activities.

Third, the table shows that OHS inspections are carried out weekly. Occupational Health and Safety inspections are systematic assessments conducted by safety officers or authorized personnel to evaluate the safety conditions of the construction site. These inspections involve examining various aspects of site operations, including the use of PPE, the condition of scaffolding and temporary structures, the operation of heavy equipment, housekeeping practices, and the presence of safety signage. Weekly inspections allow safety officers to identify potential hazards and unsafe behaviors before they lead to accidents. Any deficiencies identified during inspections can then be corrected through immediate corrective actions or by implementing additional safety measures. Regular OHS inspections are therefore essential for maintaining compliance with safety regulations and ensuring that construction activities are conducted within acceptable safety standards.

Finally, OHS Evaluation Meetings are held monthly. These meetings serve as a strategic review mechanism for assessing the overall effectiveness of safety management practices implemented during the project. Monthly evaluation meetings typically involve higher-level management personnel, including project managers, safety managers, and relevant stakeholders who oversee occupational safety performance. During these sessions, safety reports, accident statistics, inspection findings, and safety improvement initiatives are reviewed comprehensively. The purpose of these meetings is to evaluate the effectiveness of existing safety policies, identify recurring safety issues, and formulate corrective or preventive actions for future project phases. This periodic evaluation also supports continuous improvement in safety management by ensuring that lessons learned from previous incidents or observations are incorporated into updated safety procedures.

Figure 1 illustrates the distribution of construction work risk levels using a risk assessment matrix that combines two key dimensions: hazard effect severity and likelihood of occurrence. This matrix is commonly used in occupational safety and risk management frameworks to assess the risk associated with specific work activities and support the prioritization of preventive measures. By integrating severity and probability factors, the matrix provides a systematic approach for identifying which hazards require immediate control and which can be managed through routine monitoring. The vertical axis of the matrix represents the severity of the hazard effect, ranging from insignificant to catastrophic. Level 1 (insignificant) indicates minimal impact, with potential incidents causing negligible harm and not significantly disrupting work activities. Level 2 (minor) represents hazards that may result in small injuries or minor operational disturbances that can be easily managed without serious consequences. Level 3 (moderate) reflects hazards that may cause injuries requiring medical attention or moderate operational disruptions. Level 4 (significant) refers to more serious hazards that may lead to severe injuries, major operational disruptions, or substantial financial losses. Finally, Level 5 (catastrophic) represents the most severe category, indicating hazards that could result in fatalities, large-scale project disruption, or significant environmental and economic damage. The classification of severity provides a framework for assessing the magnitude of potential harm associated with construction activities.

		LIKELIHOOD				
		1	2	3	4	5
		0% ≤ X < 20% <10 <sup>-1</sup> per year	20% ≤ X < 40% 10 <sup>-1</sup> to 10 <sup>-2</sup> per year	40% ≤ X < 60% 10 <sup>-2</sup> to 10 <sup>-3</sup> per year	60% ≤ X < 80% 10 <sup>-3</sup> to 1 per year	80% ≤ X ≤ 100% >1 per year
HAZARD EFFECT SEVERITY	LEVEL					
	5 Catastrophic	5	10	15	20	25
	4 Significant	4	8	12	16	20
	3 Moderate	3	6	9	12	15
	2 Minor	2	4	6	8	10
1 Insignificant	1	2	3	4	5	

Figure 1. Distribution of Construction Work Risk Levels

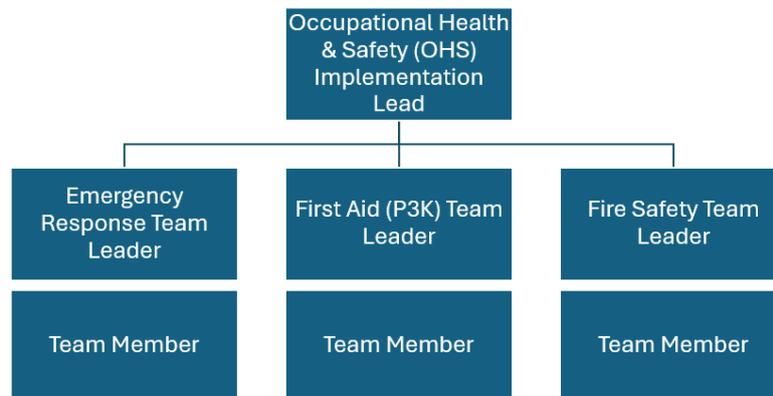
In addition, the horizontal axis of the matrix represents the likelihood of hazard occurrence, also categorized into five levels. Level 1 corresponds to a very low probability of occurrence, with a likelihood of 0% to 20% or 10<sup>-1</sup> incidents per year. Level 2 represents a low probability, ranging from 20% to less than 40%, with a frequency between 10<sup>-1</sup> and 10<sup>-2</sup> incidents per year. Level 3 indicates a moderate probability, ranging from 40% to less than 60%, corresponding to a frequency between 10<sup>-2</sup> and 10<sup>-3</sup> incidents per year. Level 4 represents a high probability, between 60% and 80%, with an expected occurrence ranging from 10<sup>-3</sup> incidents to 1 incident per year. Finally, Level 5 indicates a very high probability of occurrence, ranging from 80% to 100%, with an expected frequency of more than one incident per year. These probability classifications enable safety managers to estimate how often a hazard may occur under typical working conditions.

By combining severity and likelihood, the matrix generates a numerical risk score ranging from 1 to 25. The intersection between the severity level and the likelihood level determines the risk value of a particular hazard. For instance, a moderate-severity hazard (Level 3) with a likelihood level of 3 would yield a risk score of 9, while a catastrophic hazard with the highest likelihood level would yield the maximum risk score of 25. These numerical scores are further represented using a color-coded system to facilitate easier interpretation and decision-making. Green zones indicate low risk, suggesting that the hazard is acceptable and can be managed through routine monitoring. Yellow zones indicate moderate risk and require preventive actions and monitoring to ensure the hazard remains under control. Orange zones indicate high risk levels that require corrective measures and enhanced supervision. Red zones represent extreme risk levels that demand immediate intervention, strict safety controls, or the suspension of the activity until adequate mitigation measures are in place.

The use of this risk matrix is particularly relevant in construction projects where multiple work activities present varying degrees of hazards. Activities such as structural work at height or heavy equipment operation often fall into higher-severity and higher-probability categories, thereby generating higher risk

scores. In contrast, activities with lower potential impacts or lower probabilities of occurrence may fall within moderate or low-risk categories. By applying this matrix, project managers and safety officers can systematically evaluate construction hazards, prioritize safety interventions, and allocate resources effectively to areas with the greatest risk exposure. Thus, the result provides a visual representation of how risk levels in construction work are classified based on the interaction between hazard severity and likelihood of occurrence. This framework supports the implementation of structured hazard identification and risk assessment procedures within the Construction Safety Management System (CSMS). By using such analytical tools, construction projects can better identify high-risk activities, implement appropriate control measures, and maintain a safer working environment for all personnel involved in project operations.

Figure 2 presents the organizational structure for occupational health and safety (OHS) implemented in the Office Building Construction Project of SAMSAT Samarinda City. The figure illustrates the distribution of safety-related roles and responsibilities within the project organization, from project management to safety officers and site workers. This structure clarifies the hierarchy of authority and communication for safety management on the construction site.



**Figure 2.** Organizational Structure of Occupational Health and Safety (OHS) in the Project

The organizational arrangement shown in Figure 2 reflects the project management's commitment to implementing occupational safety practices throughout the construction process. The presence of clearly defined safety roles supports effective coordination, supervision, and enforcement of safety procedures. In addition, periodic safety evaluations conducted within this organizational framework demonstrate the application of the continuous improvement principle, which constitutes a fundamental component of the Construction Safety Management System (CSMS).

## 5. Discussion

The findings of this study provide empirical insights into the implementation of the Construction Safety Management System (CSMS) within the Office Building Construction Project of SAMSAT Samarinda City. The results demonstrate that safety management practices within the project were implemented through structured operational activities, including routine safety meetings, hazard identification and risk assessment, systematic inspections, and a clearly defined organizational structure for occupational safety. These findings reinforce the argument presented in the introduction that effective safety management in construction projects requires integrating regulatory compliance, organizational commitment, and systematic risk control mechanisms. The zero-accident record observed during the monitoring period from August to December 2025 indicates that the implemented safety management practices were effective in preventing occupational incidents. This result aligns with previous research suggesting that structured safety management systems significantly improve safety performance in construction projects. Khalid et al. (2021) emphasize that construction safety management systems that integrate hazard identification, safety planning, and performance monitoring can substantially reduce accident risks and improve overall project performance. Similarly, the consistent implementation of routine safety meetings and daily safety briefings observed in this study supports the argument that continuous safety communication is crucial for maintaining worker awareness and preventing unsafe behaviors on construction sites.

The results also confirm the importance of regulatory frameworks in shaping construction safety management practices. The implementation of CSMS in this project reflects compliance with Indonesian safety regulations, particularly the Ministerial Regulation of the Ministry of Public Works and Housing No. 10 of 2021 concerning the Construction Safety Management System (SMKK). This finding is consistent with the literature, which suggests that regulatory frameworks provide the structural foundation for safety

management in construction projects. Fern and Masirin (2021) highlight that government policies and regulatory enforcement mechanisms significantly influence the maturity and effectiveness of safety management systems across construction sectors in ASEAN countries. In the Indonesian context, Arifuddin et al. (2023) further emphasize that compliance with standardized safety procedures and regular evaluation mechanisms is a critical driver of CSMS effectiveness. Hazard identification results presented in this study indicate that several construction activities pose significant safety risks, particularly structural work and heavy equipment operations, which were categorized as high-risk. Structural work involving activities at height poses a high risk of falls, while heavy equipment operations pose collision risks due to the movement of large machinery on construction sites. These findings are consistent with global construction safety research, indicating that falls from height and equipment-related accidents are among the most common causes of injuries and fatalities in construction projects. Kineber et al. (2023) note that the construction sector consistently records higher accident rates than other industries due to the presence of complex and high-risk operational activities. Therefore, classifying these activities as high risk in the project risk matrix reflects widely recognized safety challenges in the construction industry.

Meanwhile, excavation work and manual material handling were categorized as moderate-risk activities. Although these hazards may not immediately result in catastrophic incidents, they still require systematic monitoring and preventive measures. Excavation activities pose potential hazards, such as soil collapse or landslides, that can endanger workers operating in trenches or foundation areas. Similarly, material handling activities expose workers to musculoskeletal injuries resulting from repetitive lifting or improper ergonomic practices. These findings correspond with the structured risk identification approaches described by Asyiah et al. (2025), who demonstrate that risk classification frameworks can effectively categorize hazards into measurable risk levels and guide the prioritization of preventive safety measures. Another important finding of this study is the presence of a structured safety organizational framework within the project. The OHS organizational structure defined clear roles and responsibilities for safety management, ranging from project managers to safety officers and operational workers. This organizational clarity facilitates coordination, supervision, and accountability in the implementation of safety procedures. The importance of organizational factors in safety performance has been widely emphasized in the literature. Okonkwo and Wium (2023) argue that accountability systems, employee competence, and subcontractor management significantly influence the effectiveness of occupational health and safety management systems. Similarly, Kunodzia et al. (2024) highlight that leadership commitment, communication channels, and internal risk control mechanisms are critical determinants of successful safety management implementation.

From a systems perspective, the implementation of safety management practices in the project reflects the interaction between multiple safety components rather than isolated safety measures. Routine safety briefings enhance worker awareness, safety inspections monitor compliance with operational standards, and evaluation meetings provide opportunities for continuous improvement. This integrated approach is consistent with the systems-thinking perspective proposed by Bridi et al. (2021), which holds that safety performance is an emergent outcome resulting from interactions among organizational practices, management commitment, and operational safety procedures. The findings also reveal the importance of continuous monitoring and evaluation mechanisms in sustaining safety performance. Weekly safety inspections and monthly evaluation meetings provide opportunities to identify potential safety issues and implement corrective actions before accidents occur. This continuous improvement process reflects the Plan-Do-Check-Act (PDCA) approach commonly applied in safety management systems. Kunodzia et al. (2024) emphasize that safety management effectiveness depends not only on planning but also on consistent monitoring, evaluation, and adaptation of safety strategies throughout project implementation.

Although this study demonstrates the effective implementation of traditional safety management practices, it also highlights opportunities for future improvement by integrating digital safety technologies. Previous studies indicate that emerging technologies such as Building Information Modeling (BIM), sensor-based monitoring systems, drones, and artificial intelligence have significant potential to enhance hazard detection and real-time safety monitoring in construction environments (Akinlolu et al., 2022; Parsamehr et al., 2023). However, as noted by Yap et al. (2022) and Matti and Zahid (2024), the adoption of these technologies remains limited in many developing countries due to financial constraints, limited technological readiness, and resistance to organizational change. Therefore, while the current safety management practices in the SAMSAT Samarinda project appear effective, future projects could benefit from integrating digital safety tools to further enhance proactive risk management capabilities.

Thus, the findings of this study contribute to a broader understanding of the implementation of construction safety management in developing country contexts. The results demonstrate that effective safety performance can be achieved through a combination of regulatory compliance, systematic hazard identification, structured organizational roles, and continuous monitoring mechanisms. These findings support the argument presented in the introduction that construction safety management should be viewed as an integrated management system rather than a collection of isolated safety procedures. By linking

operational safety practices with regulatory frameworks and organizational behavior factors, the study provides empirical evidence that reinforces existing theoretical perspectives in construction safety management literature. From a practical perspective, the study provides valuable insights for construction project managers and policymakers seeking to improve safety performance in public infrastructure projects. The implementation model observed in the SAMSAT Samarinda construction project illustrates how structured safety management practices can effectively reduce occupational risks and maintain a safe working environment. Future research may expand this analysis by examining multiple construction projects or by incorporating quantitative safety performance indicators to further validate the effectiveness of CSMS implementation in different project contexts.

## 6. Conclusions

This study concludes that Occupational Health and Safety (OHS) implementation within this project has been carried out systematically and in a structured manner. The overall implementation demonstrates substantial alignment with applicable regulatory frameworks, particularly Government Regulation No. 50 of 2012 concerning Occupational Health and Safety Management Systems and the Regulation of the Minister of Public Works and Housing No. 10 of 2021 regarding the Construction Safety Management System. These findings indicate that the project has incorporated the key elements of effective safety management in construction activities. From the perspective of leadership and organizational commitment, project management has demonstrated strong support for occupational safety practices. This commitment is reflected in the establishment of formal OHS policies, the formation of a structured safety organization within the project, and the appointment of qualified, certified safety personnel to oversee safety implementation. In addition, the active involvement of project leadership in safety meetings, safety evaluations, and decision-making processes related to safety management indicates that safety considerations have been integrated into the broader project governance structure. Such leadership engagement contributes significantly to strengthening safety culture and ensuring consistent implementation of safety procedures at the operational level.

In terms of construction safety planning, the project has conducted systematic hazard identification and risk assessments for major work activities. Attention has been given to high-risk operations, including work at heights and heavy equipment operations, which represent critical sources of potential accidents in construction environments. The results of the risk assessment indicate that safety control measures have been designed in accordance with the hierarchy of risk control, incorporating administrative measures, safe work procedures, and appropriate personal protective equipment (PPE). This approach reflects the application of CSMS principles in developing preventive safety strategies that aim to minimize potential hazards before they result in occupational incidents. From the perspective of safety support and resource availability, the project has generally provided adequate safety facilities and supporting resources. Workers have been equipped with the necessary personal protective equipment, safety signage, and other safety devices required for construction activities. Furthermore, safety awareness and training initiatives have been implemented through safety meetings, toolbox meetings, and daily safety briefings. These initiatives serve as important mechanisms for strengthening worker awareness and promoting safe working behavior. Nevertheless, field observations indicate that some workers still exhibit inconsistent use of PPE, suggesting that continuous supervision, enforcement, and safety coaching remain necessary to enhance compliance with safety procedures.

Regarding construction safety operations, the implementation of safety procedures on site has generally been effective. Routine activities such as daily safety briefings (safety morning sessions), periodic site inspections, and internal safety monitoring have helped maintain a safe working environment and prevent occupational accidents. These operational safety activities support proactive hazard identification and ensure corrective measures can be implemented promptly. However, several minor nonconformities were still observed during field inspections, including issues with material organization and segregation of work areas. Although these findings do not represent critical safety violations, they highlight the need for greater consistency in implementing safety standards across all operational activities. From the perspective of safety performance evaluation and continuous improvement, the project has implemented periodic monitoring and evaluation mechanisms. Safety performance is reviewed through regular safety meetings, inspection reports, and internal audits, which allow project management to assess the effectiveness of existing safety measures. Identified findings or incidents are documented and followed up with corrective and preventive actions. This continuous improvement process reflects the core principle of CSMS implementation: safety management is an ongoing process aimed at progressively enhancing workplace safety rather than merely fulfilling administrative requirements.

Thus, the implementation of the Construction Safety Management System in the Office Building Construction Project of SAMSAT Samarinda City is considered good and generally compliant with applicable safety regulations. The project has successfully implemented key CSMS components, including leadership

commitment, safety planning, operational safety procedures, and safety evaluation mechanisms. Nevertheless, further improvements are still necessary to achieve optimal safety performance. Strengthening safety culture among workers, enhancing the consistency of on-site supervision, and improving the quality of safety documentation and reporting systems are important steps that should be considered in future project implementation. With these improvements, the application of CSMS in government building construction projects is expected to become more effective in reducing the potential for occupational accidents and in supporting the overall success and sustainability of construction project management.

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