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Importance vs. Performance: Evaluating the Implementation of Learning from Incidents in the Indonesian Construction Industry

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ABSTRACT The construction industry, recognized as one of the most hazardous sectors globally, continues to face escalating challenges, particularly in Indonesia. This sector experiences a yearly increase in workplace accidents, which significantly disrupts economic stability at both micro and macro levels. These incidents lead to substantial economic losses, reduced productivity, and increased medical and compensation costs. To address these risks, the adoption of Learning from Incidents (LFI) has emerged as a critical approach. LFI is a structured process that involves analysing and learning from past incidents to prevent future occurrences, offering a proven methodology to enhance workplace safety. However, despite its potential, the implementation of LFI in Indonesia encounters persistent obstacles. These include a weak safety culture, inadequate reporting systems, and insufficient enforcement of safety standards. Such challenges hinder the effectiveness of LFI and limit its capacity to drive meaningful improvements in construction safety. This study seeks to bridge the gap between the importance and current performance of LFI implementation in the Indonesian construction industry. The research methodology integrates a literature review, expert validation, and Importance-Performance Analysis. Through the literature review and expert validation, critical indicators for LFI implementation were identified, while the Importance-Performance Analysis assessed the alignment of expectations with actual performance as perceived by construction practitioners. Input from three construction safety experts and industry practitioners formed the basis of the analysis. The findings reveal that while Investigation Participation met or exceeded expectations, several other LFI implementation indicators–including Contextual Safety Engineering and Dissemination Reach–require substantial improvement. This consensus highlights significant discrepancies between intended outcomes and actual practices, underscoring the need for targeted strategies to enhance LFI processes. Addressing these gaps can better align LFI implementation with safety objectives, ultimately fostering a safer and more sustainable construction industry in Indonesia.

KEYWORDS Construction Safety; Learning from Incidents; Safety Improvement; Importance-Performance Analysis.

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1 INTRODUCTION

1.1 Background of The Study

The construction industry is known for its high-risk profile, significantly contributing to workplace accidents worldwide (Berglund et al., 2019). Dense working conditions and challenging environments elevate the risk (Guo et al., 2020), as reflected by the high percentage of accidents in the sector, with the construction and transportation industries in the United States accounting for 47.4% of workplace incidents in 2020 (OSHA, 2022). Similarly, in the United Kingdom, construction accounts for nearly a third of all fatal workplace accidents (Health and Safety Executive U.K., 2023). This backdrop sets the stage for a critical evaluation of safety measures, particularly through the lens of Learning from Incidents (LFI), a proactive approach aimed at understanding and mitigating the recurrence of workplace incidents (Chan et al., 2023; Williams et al., 2018).

In Indonesia, the escalating trend of construction accidents–265,334 cases reported in 2022 (Syaharani, 2023), nearly a third of which occurred in the construction sector–highlights an urgent need for strategic improvements in safety management (Machfudiyanto et al., 2020). The adoption of LFI can be instrumental in this context, offering a framework for analysing incidents and developing preventive strategies based on past accidents (Murphy et al., 2022). However, the effective implementation of LFI in Indonesia is often hindered by challenges such as a weak safety culture and systemic weaknesses in reporting (Rimawan et al., 2019; Wahyudi and Sari, 2021). Furthermore, the success of infrastructure projects–including those employing LFI–requires robust regulations and institutional frameworks to ensure a structured and coordinated approach to safety management (Shodiqi et al., 2024). Addressing these issues is crucial not only for improving safety outcomes but also for enhancing the nation's overall competitiveness, as high accident rates can negatively impact a country's global standing (Machfudiyanto et al., 2017). Thus, integrating LFI practices offers a pathway toward safer construction environments and reduced economic burdens associated with workplace accidents.

1.2 State of The Art

This research focuses on the implementation of Learning from Incidents (LFI) in the context of construction safety in Indonesia. To support this, it is crucial to explore the theories and concepts of LFI as established in prior studies. Additionally, a thorough review of previous research on construction safety–including an analysis of conditions specific to Indonesia–is necessary to provide a comprehensive foundation and identify the gaps this study aims to address.

1.2.1 Construction Safety

The construction industry is one of the most hazardous sectors globally, with significant risks to workers, resources, and the environment (Berglund et al., 2019; Guo et al., 2020). In Indonesia, construction safety is regulated by comprehensive frameworks, including Minister of Public Works Regulation No. 10/2021, which defines construction safety as a series of engineering activities ensuring compliance with Safety, Security, Health, and Sustainability standards throughout all construction phases (Manurung, 2020). These standards encompass engineering safety, occupational health and safety, public safety, and environmental protection, aiming to create a secure and compliant construction environment.

One of the parameters used to measure workplace safety in construction is construction safety performance (Prasetio et al., 2020). Construction safety performance refers to the overall effectiveness of safety measures and practices implemented in projects (Azmi et al., 2020). This performance is influenced by various factors, including regulations, financial aspects, and the safety management system (Rivera et al., 2021). Key elements include the frequency and severity of workplace incidents, compliance with safety protocols, and the implementation of risk mitigation strategies (Abdalfatah et al., 2023).

The Construction Safety Management System plays a critical role in addressing these challenges. As outlined in Indonesian Government Law No. 14/2021 and Law No. 11/2021, this system involves structured management processes to meet health, safety, security, and sustainability standards. Both construction service providers and users are required to adhere to these regulations (Manurung, 2020; Rimawan et al., 2019). Despite the robust regulatory frameworks, Indonesia continues to face challenges in implementation, including low compliance, limited safety awareness, and insufficient integration of proactive safety measures (Machfudiyanto et al., 2017).

Previous studies on incident analysis within Indonesia's construction sector highlight frequent accidents caused by unsafe worker behaviour, inadequate use of personal protective equipment (PPE), and weak safety management systems. Ghuzdewan and Damanik (2019) noted that electrical shocks and falls from height were common, primarily resulting from unsafe acts and conditions. Suyitno et al. (2025) reinforced these findings, identifying labour indiscipline, PPE refusal, and the lack of standardized Occupational Health and Safety (K3) systems as critical risks.

However, unlike these prior works, the current study evaluates the effectiveness of Learning from Incidents (LFI) using Importance-Performance Analysis (IPA), providing targeted strategies for improved incident learning and proactive safety management–addressing a clear gap in practical safety improvement.

1.2.2 Learning from Incidents

Learning From Incidents (LFI) has emerged as a vital framework for enhancing construction safety. It is defined as a systematic approach to analysing past incidents in order to prevent recurrence and improve workplace safety (Lukic et al., 2012). The LFI process comprises seven phases: reporting, investigation, formulating findings, disseminating results, team reflection, implementing changes, and evaluating those changes (Drupsteen et al., 2013). Effective LFI implementation not only improves safety but also enhances organisational productivity (Zhang et al., 2023).

However, the success of LFI is influenced by multiple factors. Organisational culture, trust, and psychological safety are critical for encouraging transparent reporting and active participation in investigations (Littlejohn et al., 2017). Furthermore, effective LFI relies on robust knowledge systems, encompassing learning inputs, processes, and outcomes, all of which are essential for translating lessons into actionable safety improvements (Lin and Zhong, 2024). Technological advancements, such as incident databases and data analysis tools, further enhance the capacity of LFI to identify risk patterns and develop targeted mitigation strategies (Murukannaiah et al., 2017).

1.3 Gap Analysis

While existing studies highlight the theoretical and practical importance of LFI, significant gaps remain in its application within developing countries such as Indonesia. The current literature primarily focuses on qualitative assessments or individual phases of the LFI process, with limited exploration of quantitative analyses related to LFI indicators. Moreover, few studies address the integration of LFI within Indonesia's regulatory frameworks.

This research introduces a novel approach by aligning Indonesia's construction safety regulations with a comprehensive evaluation of the LFI phases. By employing both qualitative and quantitative methods, it assesses the alignment between expectations and the actual performance of LFI indicators–bridging the gap between theoretical frameworks and real-world application. These approaches not only advance the understanding of LFI but also contribute to developing more effective strategies for reducing workplace accidents in Indonesia's high-risk industries. An illustrative explanation of this research novelty is provided in Figure 1.

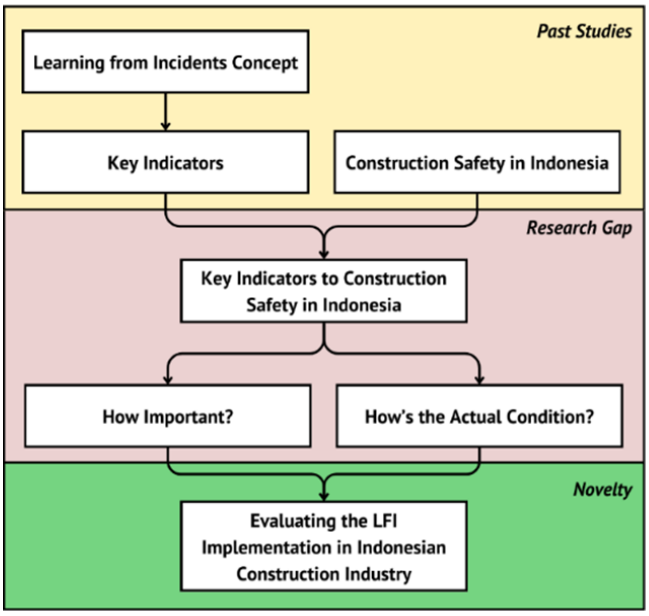

Figure 1 The Relation Between Past Studies, Research Gap, and Novelty of The Study.

1.4 Aim of The Study

This study aims to bridge the gap between the perceived importance and actual performance of Learning from Incidents (LFI) implementation in the Indonesian construction industry. By examining critical indicators across each phase of LFI, the research evaluates the extent to which LFI implementation aligns with the expectations and needs of construction industry practitioners in Indonesia.

The findings are intended to contribute to both academic literature and practical safety management by advancing the understanding of LFI's role in construction safety. Additionally, the study seeks to promote the development of a more proactive and effective safety culture in Indonesia's construction sector, ensuring that LFI is not merely a theoretical framework but a transformative tool for reducing workplace accidents and fostering sustainable industry practices. As such, this research represents a significant step towards narrowing the gap between theory and practice in construction safety management.

2 METHODS

This study employed a mixed-methods approach comprising a literature review, expert validation, and Importance-Performance Analysis (IPA). The literature review and expert validation were used to identify key indicators for implementing Learning from Incidents (LFI), while the IPA was applied to compare the perceived importance and actual performance of these indicators. This methodological combination provides a robust and comprehensive evaluation of the effectiveness and perception of LFI within the Indonesian construction sector.

2.1 Literature Review

The literature review was conducted systematically to ensure comprehensive coverage of studies and regulations relevant to Learning from Incidents (LFI) and construction safety. Sources included peer-reviewed journal articles, conference proceedings, technical reports, and regulatory documents such as ministerial regulations that hold direct relevance to the Indonesian context. The review aimed to identify indicators required for the effective implementation of LFI based on prior research. The application of LFI was categorised into several phases, following the framework proposed by Lukic et al. (2012), namely: incident reporting, investigating, developing incident alerts, disseminating, contextualising, and implementing actions. For each of these phases, supporting indicators were identified through research published within the last ten years. This approach ensured that each LFI phase is underpinned by relevant, evidence-based indicators, which were subsequently validated by industry experts to assess their applicability and effectiveness.

2.2 Experts Validation

Expert validation was conducted to confirm the relevance of the indicators identified in the literature review by engaging experienced professionals as respondents. A minimum of three experts (with an odd number required to facilitate consensus) participated in the validation process. Selection criteria included a minimum of 15 years of professional experience in the construction sector, at least a bachelor's degree, and a proven track record in construction safety. During this phase, experts were invited to review, provide feedback, and validate the proposed indicators influencing the implementation of LFI in Indonesia. Their input was used to reassess the relevance of the existing indicators, eliminate those considered less pertinent, and introduce new variables deemed important in the current context.

The analysis applied the Delphi method, which leverages expert knowledge and experience to build consensus on complex issues. This technique is particularly effective in avoiding the dominance of individual opinions in group settings, thereby producing more objective results. In this study, the Delphi method was used to validate the risk indicators derived from the literature. An indicator was retained for further analysis only if at least two out of the three experts agreed on its validity and importance, ensuring a sound basis for subsequent evaluations.

2.3 Importance-Performance Analysis

Importance–Performance Analysis (IPA) is a tool designed to evaluate how an attribute or factor is perceived in terms of its actual performance and its importance to respondents (Wyród-Wróbel and Biesok, 2017). In this research, the IPA method is applied to assess respondents' perceptions of the implementation of Learning from Incidents (LFI) within the Indonesian construction industry. Statements were distributed using a Likert scale and analysed through the IPA approach.

IPA was selected for this study due to its effectiveness in visually identifying gaps between stakeholders' expectations (importance) and actual practices (performance) of key attributes or indicators (Wyród-Wróbel and Biesok, 2017). It offers a clear and intuitive matrix-based visualisation, facilitating rapid interpretation and prioritisation of critical factors requiring improvement (Pratiwi, 2018). Unlike methods such as the Analytical Hierarchy Process (AHP), which primarily focuses on determining relative importance through pairwise comparisons and hierarchical structuring of criteria (Saaty, 2008), IPA directly captures respondents' perceptions of both the current and desired states of specific indicators. This makes it particularly suitable for identifying areas requiring immediate action in practical contexts such as construction safety management (Mandalia, 2019).

Previous studies in construction safety and related management fields have validated the effectiveness of IPA in pinpointing strengths and critical deficiencies, thereby supporting managerial decision-making in resource allocation and strategic improvement (Wyród-Wróbel and Biesok, 2017; Zhang et al., 2023). The availability of supporting evidence in similar research contexts was fundamental to its selection for this study.

For the analysis, random sampling was used to select 20 respondents, each with a minimum of five years' professional experience in the construction industry–whether as contractors, consultants, or project supervisors. Additionally, respondents were required to hold at least a bachelor's or applied bachelor's degree. These criteria ensured that participants had sufficient knowledge and practical experience to evaluate the proposed indicators accurately and reliably.

The level of congruence in IPA is calculated by comparing each respondent's actual performance score with their corresponding importance score. This comparison identifies service or performance priorities based on how well expectations are met, ranging from highly aligned to poorly aligned (Pratiwi, 2018). The resulting ratio determines the priority order of services or attributes requiring improvement or maintenance to better meet user needs. The formula for calculating IPA congruence level is presented in Equation (1):

$$T_{ki} = \frac{\sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} Y_i} \times 100\% \quad (1)$$

Where, T_{ki} is IPA level of congruence (%); X_i is the actual performance rating by a respondent; and Y_i is the indicator importance rating by a respondent.

If the IPA congruence level exceeds 100%, the actual performance of the indicator surpasses expectations. Conversely, if the level is below 100%, it indicates that the indicator's actual performance does not meet respondents' expectations.

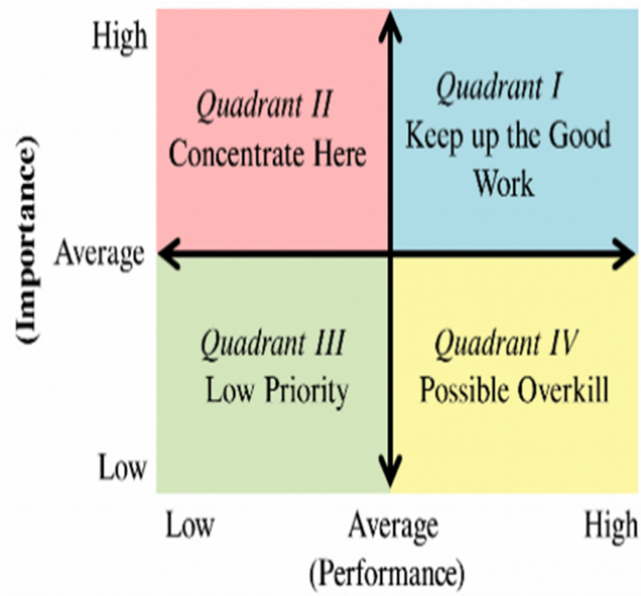

Figure 2 Importance-Performance Analysis Quadrant Matrix (Mandalia, 2019).

This analysis maps attributes into four quadrants that depict the relationship between satisfaction and importance levels. These quadrants offer insights into which aspects require prioritisation, maintenance, or even reallocation of resources. As such, they help identify strategies to enhance LFI implementation in line with practitioners' expectations and operational needs.

The IPA approach is highly relevant to this study, as it provides an intuitive visual map of respondents' perceptions. This is especially valuable for evaluating and improving workplace safety performance through targeted strategies. The quadrant-based analysis, as illustrated in Figure 2, supports the identification of priority actions for effective LFI implementation.

3 RESULTS

After the outlined methodologies were applied appropriately, the research findings were obtained. Key indicators relevant to the implementation of Learning from Incidents (LFI) in the Indonesian construction industry were identified through a literature review and expert validation process. Furthermore, the results of the Importance-Performance Analysis (IPA) were presented in the form of congruence levels and the distribution of each indicator within the quadrant matrix.

3.1 Key Indicators

Based on the literature review conducted for each phase of Learning from Incidents (LFI), several indicators were identified to support the successful implementation of each phase. Specifically, five indicators were identified for the reporting phase, four for the investigating phase, three for the developing incident alerts phase, four for the disseminating phase, three for the contextualising phase, and three for the implementing actions phase. Each indicator reflects the essential components needed in each phase to achieve effective construction safety outcomes.

Following the literature review, expert validation was conducted with three recognised construction safety experts. One expert is a member of a regulatory body for construction safety, another is the HSE General Manager at a construction service company, and the third is the Chairperson of a construction safety expert organisation in Indonesia. All three experts possess over 30 years of experience in construction safety, ensuring a high degree of credibility in the validation process.

The expert validation confirmed that the indicators identified from the literature review are indeed supportive of each LFI phase in enhancing construction safety in Indonesia, as shown in Table 1. However, one expert noted that Project Team Knowledge of Reporting Systems (Indicator 1.2.) and Speed of Developing Inci-

Table 1. Indicators of LFI Phases

LFI Phase	Indicator	Description	References
1. Reporting	1.1. Awareness of Reporting Actions(3)	The awareness and courage of the project team and workers to promptly report incidents in accordance with company procedures.	Littlejohn et al. (2017); Wu et al. (2016)
	1.2. Knowledge of Reporting Systems(2)	Provision of knowledge to the project team and workers regarding the reporting procedures in case of an incident.	Littlejohn et al. (2017); Ismail et al. (2012)
	1.3. Ease of Reporting Systems(3)	The ease of the reporting system and administration for all project team members and workers to implement.	Littlejohn et al. (2017); Phimister et al. (2004)
	1.4. Speed of Reporting Actions(3)	The promptness of the project team and workers in reporting incidents immediately after they occur.	Littlejohn et al. (2017); Hale and Heijer (2006)

LFI Phase	Indicator	Description	References
	1.5. Integrity of Reporting(3)	The responsibility of the project team and workers to report all types of incidents accurately based on the facts on the ground.	Littlejohn et al. (2017); Hopkins (2009)
2. Investigating	2.1. Investigation Methodology (3)	The effectiveness of the methods used in field investigations to uncover all information related to the incident.	Littlejohn et al. (2017); Hallowell and Gambatese (2009)
	2.2. Investigation Participation (3)	The willingness and involvement of the entire project team and relevant stakeholders in the investigation process.	Littlejohn et al. (2017); Antonsen (2009)
	2.3. Completeness of Information (3)	The completeness of the information provided to the investigator.	Littlejohn et al. (2017); Le Coze (2013)
	2.4. Analytical Techniques (3)	The accuracy of the analytical techniques used to identify the root causes of the incident.	Littlejohn et al. (2017); Paté-Cornell (1993)
3. Developing Incident Alerts	3.1. Alert Development Methods(3)	The effectiveness of evaluation and development methods for existing alerts.	Littlejohn et al. (2017); Van der Schaaf (1995)
	3.2. Speed of Alert Developments(2)	The speed of delivering incident alert developments to the project team and workers.	Littlejohn et al. (2017); Van der Schaaf (1995)
	3.3. Level of Understanding of Alerts(3)	The project teams and workers' understanding of the content of the developed incident alerts.	Littlejohn et al. (2017); Van der Schaaf (1995)
4. Disseminating	4.1. Frequency of Dissemination(3)	The frequency of disseminating lessons learned from incidents to all project components and the company.	Littlejohn et al. (2017); Phimister et al. (2004)
	4.2. Dissemination Methods(3)	The method implemented to disseminate lessons learned from incidents to all project components and the company.	Littlejohn et al. (2017); Phimister et al. (2004)
	4.3. Quality of Dissemination Materials(3)	The impact of learning materials from incidents on workplace safety.	Littlejohn et al. (2017); Phimister et al. (2004)
	4.4. Dissemination Reach(3)	The widespread dissemination of lessons learned from incidents to all components of the project team and the company.	Littlejohn et al. (2017); Phimister et al. (2004)

LFI Phase	Indicator	Description	References
5. Contextualizing	5.1. Contextual Safety Engineering(3)	Further safety engineering conducted based on lessons learned from incidents.	Littlejohn et al. (2017); Hopkins (2009)
	5.2. Adaptation of Lessons to Context(3)	The adaptability of fieldwork based on lessons learned from incidents.	Littlejohn et al. (2017); Hopkins (2009)
	5.3. Development of Contextual Regulations(3)	The development of regulations and/or company procedures tailored to the lessons learned from incidents.	Littlejohn et al. (2017); Hopkins (2009)
6. Implementing Actions	6.1. Commitment to Preventive Actions(3)	The commitment of all company components and project workers to implementing incident prevention measures.	Littlejohn et al. (2017); Hallowell and Gambatese (2009)
	6.2. Monitoring the Implementation(3)	The implementation of a monitoring and supervision system for incident prevention measures at the project site.	Littlejohn et al. (2017); Hallowell and Gambatese (2009)
	6.3. Effectiveness of Corrective Actions(3)	Corrective actions for incidents are implemented effectively with minimal losses.	Littlejohn et al. (2017); Hallowell and Gambatese (2009)

(1): 1 of 3 experts agreed; (2): 2 of 3 experts agreed; (3): 3 of 3 experts agreed

dent Alerts (Indicator 3.2.) may no longer be fully relevant. Nevertheless, based on the Delphi method applied, these indicators were retained for analysis. The discussion regarding their perceived lack of relevance is revisited and elaborated upon in the Discussion section.

3.2 Importance vs. Performance Results

Once the key indicators were established, an Importance-Performance Analysis (IPA) was conducted for each LFI indicator. This analysis included the IPA Level of Congruence and the IPA Quadrant Matrix, providing insights into which LFI implementation indicators require further evaluation and improvement.

A total of 20 respondents, each with a minimum of five years' experience in large-scale construction projects in Indonesia, were selected through a random sampling process. Each respondent completed two questionnaires: one to assess the importance of each indicator, and the other to evaluate the current performance of those indicators. The results included average scores for importance and performance, which were then used to calculate the level of congruence. The detailed findings are presented Table 2.

The IPA congruence analysis revealed that only one LFI indicator–Investigation Participation (Indicator 2.2)–exceeded 100%. This finding highlights the alignment between actual performance and respondent expecta-

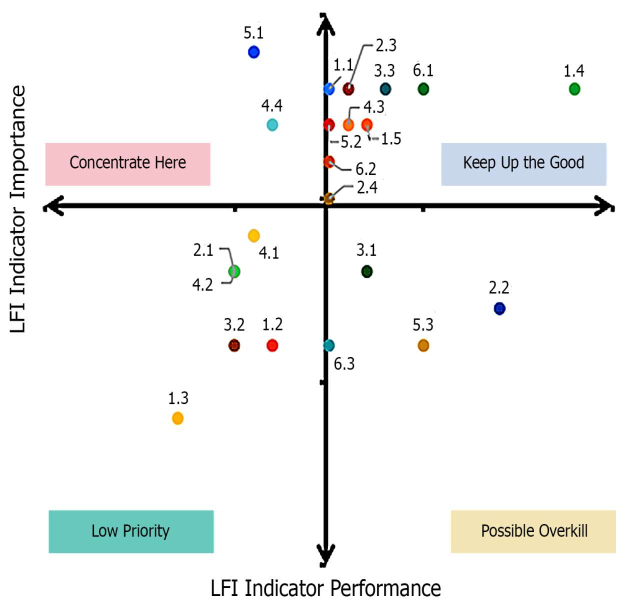

Figure 3 LFI Indicators IPA Quadrant Matrix Result.

Table 2. LFI Indicators Average IPA Scores & Level of Congruence

Indicator	Importance	Performance	Level of Congruence
1.1.	4.8	3.5	72.9%
1.2.	4.1	3.2	78.1%
1.3.	3.9	2.7	69.2%
1.4.	4.8	4.0	83.3%
1.5.	4.7	3.7	78.7%
2.1.	4.3	3.0	69.8%
2.2.	4.2	4.4	**104.8%**
2.3.	4.8	3.6	75.0%
2.4.	4.5	3.5	77.8%
3.1.	4.3	3.7	86.1%
3.2.	4.1	3.0	73.2%
3.3.	4.8	3.8	79.2%
4.1.	4.4	3.1	70.5%
4.2.	4.3	3.0	69.8%
4.3.	4.7	3.6	76.6%
4.4.	4.7	3.2	68.1%
5.1.	4.9	3.1	63.3%
5.2.	4.7	3.5	74.5%
5.3.	4.1	4.0	97.6%
6.1.	4.8	4.0	83.3%
6.2.	4.6	3.5	76.1%
6.3.	4.1	3.5	85.4%
Average	4.5	3.5	77.9%

Values in bold indicate the level of congruence > 100%

tions. However, to determine specific improvement strategies for each indicator, further analysis was conducted using the IPA Quadrant Matrix.

Based on Table 2, the average importance score of 4.5 and performance score of 3.5 were used as the axes in the quadrant matrix, with the $x-axis$ representing importance and the $y-axis$ representing performance. Figure 3 presents the distribution of the LFI indicators within the IPA Quadrant Matrix, offering a visual overview of which indicators require improvement, maintenance, or reallocation of attention and resources.

4 DISCUSSION

The results from the key indicator validation process underscore the importance of identifying relevant indicators for each phase of Learning from Incidents (LFI) to enhance construction safety practices in Indonesia. The indicators derived from the literature review were thoroughly validated by three experts with extensive experience in construction safety. Despite minor reservations expressed regarding Knowledge of Reporting Systems (Indicator 1.2) and Speed of Alert Development (Indicator 3.2), the Delphi method enabled expert consensus, allowing these indicators to be retained in the analysis. This process demonstrates the robustness of the validation methodology and highlights the practical relevance of the selected indicators in addressing real-world safety challenges. The validation also ensures that each indicator represents a critical aspect of LFI implementation, providing a solid foundation for further analysis.

4.1 The Debatable Issues Among Experts

The rationale behind the partial disagreement regarding Knowledge of Reporting Systems (Indicator 1.2) emerged during expert interviews. One expert argued that this indicator has limited relevance. According to this view, not all project workers need to understand the reporting system; rather, it is sufficient for HSE supervisors to possess this knowledge. This approach aims to minimise reporting bias from workers lacking a clear understanding of incident procedures and to prevent potential misuse of the system by irresponsible parties. Conversely, another expert strongly supported the notion that all project workers should be knowledgeable about the reporting system. This perspective emphasises inclusivity in promoting construction safety and underlines the importance of encouraging immediate responses to incidents. The divergence in opinions highlights an important area for future research–how to strike a balance between reporting precision and inclusivity while ensuring rapid response capabilities in the field.

Similarly, another point of contention involved the Speed of Alert Development (Indicator 3.2). One expert cautioned that speed should not be prioritised as a primary determinant of success criterion, as developing incident alerts requires sufficient time to ensure accuracy and thoroughness. Hastily prepared alerts, they argued, may lack maturity, potentially resulting in incomplete or misleading information for site workers. This, in turn, could lead to greater risks and further incidents due to communication failures. On the other hand, another expert advocated for timely alert development to prevent recurrence of similar incidents. This tension points to the need for future research exploring how to balance between timely development of incident alerts and the maturity of the information provided. Technologies such as artificial intelligence and advanced management systems may offer promising solutions to accelerate the development of incident alerts while maintaining their quality and reliability.

4.2 Evaluation for Each Indicator

The Importance-Performance Analysis (IPA) provides deeper insight into the relationship between the importance and current performance of LFI indicators in the Indonesian construction industry. According to the IPA congruence analysis, it was found that only one indicator–Investigation Participation (Indicator 2.2)–achieved a congruence level exceeding 100%. This indicates that this aspect of LFI meets or exceeds expectations, reflecting strong performance in engaging relevant stakeholders during investigations. The Development of Contextual Regulations (Indicator 5.3) also demonstrated a nearly perfect level of congruence, suggesting that respondents perceive their companies as consistently updating procedures and regulations based on lessons learned from incidents. This is a positive finding, highlighting agility within the Indonesian construction sector. However, most indicators had congruence levels below 90%, revealing significant gaps between perceived importance and current performance. These findings point to critical areas requiring targeted interventions to improve implementation.

Two indicators stand out as requiring special attention due to their low congruence levels. The largest gap was observed in Contextual Safety Engineering (Indicator 5.1). This indicator reflects the adaptability of construction service providers in updating the mandatory Construction Safety Plan (RKK), as outlined in Ministry of Public Works Regulation No.10/2021, to incorporate lessons learned from recent incidents. The second indicator of concern is Dissemination Reach (Indicator 4.4), which shows that, although expectations for the dissemination of lesson-learned information regarding incidents, which, unfortunately, remains inadequate in its current performance. Both indicators point to critical areas for improvement in aligning industry practices with safety objectives and ensuring the effective implementation of LFI in Indonesia's construction industry.

This conclusion is also supported by the results of the quadrant matrix analysis. The IPA quadrant matrix visually maps indicators based on their importance and performance levels. Indicators in Quadrant I (Keep Up the Good Work) show alignment between performance and expectations and should be maintained. Indicators in Quadrant II (Concentrate Here), such as Contextual Safety Engineering (Indicator 5.1) and Dissemination Reach (Indicator 4.4), require immediate improvement, as they are highly important yet underperforming. These should be prioritised for resource allocation. Quadrant III (Low Priority) contains indicators with both low importance and performance, suggesting that they are less critical and can be given minimal attention. Indicators in Quadrant IV (Possible Overkill) indicate areas that may be over-resourced and where efforts could potentially allow reallocation of resources to more critical areas.

Based on this study, the LFI indicators that need to be maintained, emphasised, or de-prioritised can be clearly identified. Future research should focus particularly on the two lowest-performing indicators: Dissemination Reach and Contextual Safety Engineering. For Dissemination Reach, future studies should investigate who should receive disseminated information, how it should be delivered, and what methods could improve its effectiveness. For Contextual Safety Engineering, strategies must be developed to strengthen collaboration among all stakeholders–service providers drafting safety plans, consultants overseeing them, project owners approving them, and regulators enhancing relevant legislation. By directing future efforts toward these areas, the effectiveness of LFI implementation in construction projects can be significantly improved, thereby raising overall safety standards in Indonesia.

In comparison to earlier studies on LFI, this research confirms that Investigation Participation is a critical success factor, as supported by Littlejohn et al. (2017) and Lukic et al. (2012), who highlight the value of stakeholder involvement in incident investigations. However, areas like Contextual Safety Engineering and Dissemination Reach, identified as underperforming in this study, reflect broader global challenges observed by Murphy et al. (2022) and Zhang et al. (2023), where dissemination and contextual adaptation remain weak. These findings also echo the concerns raised by Drupsteen et al. (2013) that poor dissemination can limit the full potential of LFI. Overall, this study reinforces existing literature while identifying specific areas requiring greater integration of lessons learned into safety management and broader, more effective dissemination practices.

5 CONCLUSION

This study presents a comprehensive evaluation of the implementation of Learning from Incidents (LFI) in the Indonesian construction industry, utilising a combination of literature review, expert validation, and the Importance–Performance Analysis (IPA) framework. By examining critical indicators across the six LFI phases, the research identifies significant gaps between expectations (importance) and current practices (performance).

The findings reveal that while some indicators–such as Investigation Participation and Development of Contextual Regulations–meet or even exceed respondent expectations, several others require urgent attention. Notably, Contextual Safety Engineering and Dissemination Reach emerged as the most critical areas for improvement, reflecting shortcomings in the adaptability of incident-based safety planning and the extent of information dissemination.

The quadrant matrix analysis reinforces these findings by categorising indicators into areas requiring focus, maintenance, or lower priority. For instance, Dissemination Reach underscores the need for more effective communication strategies, including identifying appropriate recipients, and optimising dissemination methods. Likewise, improving Contextual Safety Engineering demands collaborative efforts among service providers, consultants, project owners, and regulators to ensure safety engineering practices are well-aligned with real-world incident learnings.

This research highlights the importance of addressing these gaps to improve the overall effectiveness of LFI implementation in Indonesia. By prioritising these critical indicators, the construction industry can make meaningful progress in enhancing safety performance, mitigating risks, and fostering a proactive safety culture. Future research should explore innovative solutions–such as adopting emerging technologies and strengthening stakeholder collaboration–to facilitate the seamless integration of LFI practices across the sector.

Beyond its relevance to Indonesia, this study offers global insights into enhancing LFI processes, particularly in the domains of Contextual Safety Engineering and Dissemination Reach. The findings emphasise the universal need for stronger safety cultures, improved reporting systems, and more effective dissemination of lessons learned–issues relevant to construction industries worldwide. Moreover, the application of the Importance–Performance Analysis (IPA) framework provides a replicable model for assessing safety indicators that could be adapted across diverse regulatory and technological environments.

6 LIMITATION

This study is limited to the Indonesian construction industry, focusing primarily on large and medium-scale projects. As such, the findings may not be generalisable to smaller projects or to practices in other countries. While expert validation and literature review strengthen the study's credibility, the process inherently involves subjective perspectives. Additionally, the analysis is confined to current methodologies and technologies, without accounting for potential future innovations in LFI. Implementation of the study's recommendations may also be constrained by Indonesia's existing infrastructure and resource capacities. The limited research timeframe restricts the ability to assess long-term impacts, and varying levels of company participation may further affect the generalisability of results. These limitations should be taken into account when interpreting the study's findings and considering its applicability in broader contexts.

DISCLAIMER

The authors declare no conflict of interest.

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