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Integrating Safety Practices into the Supply Chain for Sustainable Development in Malaysia's Building Construction Sites

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Abstract: The construction industry plays a vital role in driving sustainable development in Malaysia. However, the sector is also associated with various safety risks and challenges. Safety practices on building construction sites are crucial not only for the well-being of workers but also for the overall success of construction projects. This research employs a quantitative approach with descriptive analysis to the extent of the Integration of Safety Practices into the Supply Chain. Utilizing mean and standard deviation calculations, the study analyses rates, compliance levels, and other key safety indicators across firms in the construction sectors. By addressing safety concerns at every stage of the supply chain, from sourcing raw materials to final project delivery, stakeholders can mitigate risks, minimize accidents, and create a secure working environment. In the context of sustainable development, incorporating safety practices into the supply chain aligns with Malaysia's commitment to achieving the United Nations' Sustainable Development Goals (SDGs). Specifically, it contributes to SDG 8 (Decent Work and Economic Growth) and SDG 11 (Sustainable Cities and Communities). By prioritizing safety, the construction industry can foster a culture of well-being and productivity, attract skilled workers, and promote responsible business practices. Key safety practices that can be integrated into the supply chain include rigorous supplier vetting, ensuring the use of certified and safe construction materials, implementing proper handling and storage procedures, and conducting regular safety training for all workers involved. Additionally, leveraging technology such as Internet of Things (IoT) devices, wearables, and real-time monitoring systems can enhance safety management and enable prompt response to potential hazards.

Keywords: *Safety Management Practices, Supply Chain Management, Sustainable Supply Chain, Construction.*

1. Introduction

The construction industry in Malaysia stands as a pivotal force propelling the nation towards sustainable development. While this sector significantly contributes to economic growth and infrastructure development, it is not immune to the myriad safety risks and challenges inherent in its operations (Suhaimi et al., 2021). The integration of safety practices into the supply chain of building construction sites emerges as a critical imperative to harmonize the dual goals of advancing sustainable development and ensuring the well-being of workers (Mellado & Lou, 2020). This paper delves into the quantitative exploration of the extent to which safety practices are integrated into the supply chain within Malaysia's building construction sector, employing a descriptive analysis to elucidate key dimensions of this integration.

Safety on building construction sites is not merely a prerequisite for fulfilling occupational health and safety standards; it is an indispensable factor for the overall success of construction projects (Razak et al., 2015). This research endeavors to unravel the nuances of safety practices across firms in the construction sector, utilizing metrics such as mean and standard deviation to gauge rates of compliance and other safety indicators. The examination spans the entire supply chain, from the initial sourcing of raw materials to the final delivery of construction projects, thereby providing a comprehensive understanding of the safety landscape in the industry (Sivan et al., 2022; Othman et al., 2015).

By addressing safety concerns at every stage of the supply chain, stakeholders have the potential to mitigate risks, minimize accidents, and cultivate a secure working environment (Komatina et al., 2021; Munir et al., 2018). Such an approach aligns seamlessly with Malaysia's commitment to achieving the United Nations' Sustainable Development Goals (SDGs). Specifically, it contributes to SDG 8 (Decent Work and Economic Growth) by fostering a workplace culture that prioritizes the well-being of workers and SDG 11 (Sustainable Cities and Communities) by promoting safe and sustainable construction practices (Osei-Asibey et al., 2021; Othman et al., 2023).

In this pursuit of integrating safety practices into the supply chain, the construction industry has the opportunity to cultivate a culture of well-being and productivity (Claxton et al., 2022). Moreover, by championing safety, the sector can attract skilled workers who are increasingly discerning about their workplace conditions and contribute to responsible business practices (Al Doghan & Sundram, 2023). This paper advocates for the incorporation of key safety practices throughout the supply chain, including rigorous supplier vetting, ensuring the use of certified and safe construction materials, implementing proper handling and storage procedures, and conducting regular safety training for all workers involved.

In tandem with these traditional practices, the integration of modern technologies such as the Internet of Things (IoT) devices, wearables, and real-time monitoring systems is explored as a means to enhance safety management (Muhamed et al., 2022). These technologies offer the potential for proactive hazard identification and prompt responses, elevating safety standards in the construction industry (Muhammad, Naidu, Sundram, Hussain, Chew, & Amirrudin (2023).

This paper seeks to unfold the imperative of integrating safety practices into the supply chain of building construction sites in Malaysia, shedding light on its multifaceted benefits for sustainable development, worker well-being, and the overall success of construction projects. Through a comprehensive analysis of safety metrics, compliance rates, and industry practices, it aims to provide actionable insights that can inform policy, guide industry practices, and pave the way for a safer and more sustainable construction landscape in Malaysia.

2. Literature Review

Supply Chain Integration: Safety as a Key Component: The construction industry, renowned for its significant contributions to economic development, is concurrently notorious for its inherent safety challenges. Scholars such as Hinze and Gambatese (2003), and Jazayeri and Dadi (2017) have emphasized the need for a systemic approach to safety management, asserting that a comprehensive strategy must address safety concerns at every stage of construction. This holistic perspective underscores the critical role of integrating safety practices into the supply chain, acknowledging that the success of construction projects is intricately linked with the well-being of the workforce.

Supply chain integration in the construction industry is a pivotal aspect of efficient project management. Kumaraswamy and Palaneeswaran (2007) posit that the integration of safety measures into the supply chain positively influences project performance and stakeholder satisfaction. Their work accentuates the interconnectedness of safety and supply chain dynamics, urging industry stakeholders to extend safety considerations beyond traditional on-site practices to encompass the entire supply chain.

Sustainable Development: The Intersection with Safety Practices: The nexus between sustainable development and safety practices in the construction industry is increasingly recognized. Zou, Zhang, and Wang (2007) argue that safety practices are integral to sustainable development, with their study demonstrating that companies prioritizing safety contribute significantly to environmental and social sustainability. This underscores the importance of responsible business practices and aligns with Malaysia's commitment to achieving the United Nations' Sustainable Development Goals (SDGs) (Sundram et al., 2017).

The advent of modern technologies presents a paradigm shift in construction safety management. Lee, Hwang, and Lee (2018) delve into the adoption of wearable technologies and Internet of Things (IoT) devices in construction safety. Their findings underscore the transformative potential of technology in providing real-time monitoring, immediate responses to potential hazards, and a proactive approach to safety management.

Global Commitments and the Malaysian Context: Linking Safety Practices to SDGs: The global commitment to sustainable development, epitomized by the United Nations' SDGs, resonates with Malaysia's aspirations for responsible and sustainable construction practices (Ogunmakinde et al., 2022; Sundram et al., 2018b). Ahmad et al. (2019) investigate the alignment between construction practices in Malaysia and SDGs. Their empirical assessment underscores the importance of integrating safety into the construction supply chain as a means to achieve SDG 8 (Decent Work and Economic Growth) and SDG 11 (Sustainable Cities and Communities).

In conclusion, the comprehensive literature review illuminates the interconnectedness of safety practices, supply chain management, and sustainable development in Malaysia's building construction sector. The integration of safety practices into the supply chain emerges as not only a strategic imperative for worker well-being but also a catalyst for achieving broader goals of economic growth and sustainable urban development (Sundram et al., 2018a). The insights derived from these studies (Yusof & Ariffin, 2020; Moshood et al., 2020; Subramaniam et al., 2016) provide a foundation for industry stakeholders, policymakers, and practitioners to forge a path toward a safer, more sustainable future for Malaysia's construction industry.

3. Methodology

The research methodology for this study adopts a quantitative approach with a focus on providing a comprehensive analysis of safety practices integrated into the supply chain for sustainable development in Malaysia's building construction sector. Employing a descriptive research design, the study utilizes key metrics such as mean and standard deviation to quantify and interpret the extent of safety integration across diverse construction firms.

The data collection process involves a stratified random sampling strategy, ensuring representation across various dimensions such as project size, geographical location, and the nature of construction activities. Primary data is gathered through structured surveys distributed to construction firms, suppliers, and other stakeholders within the supply chain. Additionally, secondary data is sourced from industry reports, government publications, and academic literature to complement and enrich the primary dataset (Sundram et al., 2020).

The research variables encompass safety practices and supply chain integration. Safety practices are measured through factors such as supplier vetting processes, material certification protocols, handling and storage procedures, and the effectiveness of safety training programs. On the other hand, supply chain integration is assessed by considering collaboration levels among stakeholders, communication effectiveness, and the degree of integration of safety considerations into procurement and logistics processes.

Ethical considerations are paramount in the methodology, with informed consent obtained from all participants and measures in place to ensure confidentiality (Zetty Zahureen et al., 2020). Despite efforts to mitigate biases, limitations such as sampling bias and reliance on self-reported data are acknowledged. Rigorous steps, including content validity checks and pilot testing, are taken to enhance the validity and reliability of the study (Rozilah et al., 2020). This methodology provides a robust foundation for the quantitative analysis of safety practices in Malaysia's construction supply chain, aiming to contribute meaningful insights to the industry.

4. Data Analysis

Data analysis is the process of inspecting, cleaning, transforming, and modeling data to discover useful information, conclude, and support decision-making (Sundram et al., 2016). The results of this study's data analysis can be seen in Table 1 and Table 2. This study's respondent profile is obtained from 25 usable questionnaires out of the overall 30 distribution. Therefore, the response rate for the respondents' and company's background is 83%.

Table 1: Respondents' Background

Respondents' Background	Total Respondent	Percentage (%)
GENDER:		
Male	18	72
Female	7	28
AGE:		
20 – 29 years	14	56
30 – 39 years	11	44
YEARS OF EXPERIENCE IN THE INDUSTRY:		
0 – 5 years	17	68
6 – 10 years	8	32
POSITION:		
Managing Director	4	16
Project Manager	3	12
Contract Manager	11	44
Contract Executive	5	20
Others	2	8

Table 1 shows more than half of the respondents are male with a percentage of 72%, while the rest of the respondents are female with a percentage value of 28%. Almost half of the respondents are between the ages of 30 to 39 years old with a percentage of 44%, while the other more than half respondents are between the ages of 20 to 29 years old with a percentage of 56%. Furthermore, the majority of respondents have a working experience in the industry of 5 years or less with a percentage of 68%, while those with working experience of 6 to 10 years have a lesser percentage value of 32%. Among the total of 25 respondents, almost half of them with a percentage of 44% are Contract Managers, 20% are Contract Executives, 16% are Managing Directors, 12% are Project Managers, and the remaining 8% are from other working positions of their respective companies.

Table 2: Company Background

Company Background	Total Respondent	Percentage (%)
YEARS OF THE COMPANY'S ESTABLISHMENT:		
< 5 years	6	24
≥ 5 years	19	76
GRADE OF CIDB:		
G4	4	16
G5	2	8
G6	5	20
G7	14	56
TYPES OF PROJECTS MAINLY UNDERTAKEN:		
Building	17	68
Infrastructure	3	12
Civil Engineering	5	20
NUMBER OF EMPLOYEES:		
0 – 10 employees	7	28
11 – 20 employees	3	12
21 – 30 employees	5	20
More than 30 employees	10	40
VALUES OF CONTRACT UNDERTAKEN:		
Not more than RM 1,000,000	4	16
RM 1,000,001 – RM 3,000,000	5	20
RM 3,000,001 – RM 5,000,000	2	8
RM 5,000,001 – RM 7,000,000	6	24
RM 7,000,001 and above	8	32

The result from Table 2 shows the company's background data. Firstly, the year of the company's establishment maximum value is 5 years or more with a percentage of 76%, while the minimum value is less than 5 years with a percentage of 24%. Secondly, the maximum value for the grade of CIBD is G7 with a percentage of 56%, while the minimum value is G5 with a percentage of 8% from the total respondents' company background. Next, the type of project that the respondents' company undertakes is building with a maximum value percentage of 68%, while infrastructure projects have the minimum value with a percentage of 12% from the total respondents' company background. Furthermore, most of the companies have more than 30 employees with a maximum value percentage of 40%, while the minimum value percentage is companies with 11 to 20 employees with 12% of the total respondents' company background. Lastly, the values of the contract undertaken by the respondent's company with the largest percentage is 32% representing an amount of RM7,000,001 and above, while the amount of RM3,000,001 to RM5,000,000 have the minimum value with a percentage of 8% from the total respondents' company background.

Table 3: Safety Practices across the Construction Supply Chain

Dimensions	Mean	Rank
Safety practices are considered when selecting and vetting suppliers for construction materials.	5.67	8
Certified and safe construction materials are consistently used throughout the supply chain.	6.12	2
Safety performance is a key criterion when evaluating suppliers in the construction supply chain.	5.82	5
There is a dedicated safety team responsible for overseeing safety practices throughout the supply chain.	5.18	12
Safety culture is prioritized and promoted throughout the supply chain.	4.70	15
Suppliers are required to provide documentation proving compliance with safety standards.	5.84	4
Risk assessments are conducted to identify potential safety hazards in the supply chain.	5.74	6
Safety practices are integrated into the design phase of construction projects.	5.67	9
Technology such as IoT devices, wearables, and real-time monitoring systems are utilized to enhance safety management and response to potential hazards.	6.19	1
Safety guidelines and protocols are communicated to all stakeholders in the supply chain.	5.03	13
Contractors and suppliers actively collaborate to improve safety practices in the supply chain.	5.29	10
Adequate resources and investments are allocated towards safety initiatives in the supply chain.	4.91	14
Safety communication channels are established to ensure the effective sharing of safety information.	5.84	3
Safety training programs are tailored to address specific risks in the construction supply chain.	5.67	7
The supply chain actively collaborates with regulatory bodies to ensure compliance with safety regulations.	5.29	11

The mean of all safety practices across the construction supply chain were summarized in Table 3. Based on the results, the mean value distribution for all items of safety practices ranges from 4.70 to 6.19. The result shows that technology utilization is at the very top and most important role in enhancing safety management and response to potential hazards across the construction supply chain. The second top criterion of safety practice is that certified and safe construction materials are consistently used throughout the supply chain. The third to sixth important factors are safety communication channels for sharing safety information, suppliers are required to provide documentation proving safety standards, safety performance in evaluating suppliers, and risk assessment in identifying safety hazards. The next three factors with the same mean value are safety training programs, safety practices when selecting suppliers, and the design phase for construction purposes. Follows after until the last factors are contractors' and suppliers' collaboration, supply chain members' collaboration with regulatory bodies for safety regulations, the existence of a safety team to oversee safety practices, safety guidelines and protocols to stakeholders, adequate resources and investment toward safety initiatives, and lastly, safety culture is prioritized and promoted throughout the supply chain.

5. Conclusion and Recommendations

In navigating the complex landscape of Malaysia's building construction industry, this paper has undertaken a comprehensive exploration of integrating safety practices into the supply chain for sustainable development. The literature review substantiates the critical role of safety practices in construction, emphasizing a holistic perspective that extends beyond on-site considerations to encompass the entire supply chain. The intersectionality of safety practices, supply chain integration, and sustainable development have been highlighted, providing a nuanced understanding of the multifaceted challenges and opportunities in the construction sector.

The research underscores the imperative of cultivating a safety-conscious culture at every stage of the construction supply chain. From sourcing raw materials to final project delivery, safety practices play a pivotal role in mitigating risks, minimizing accidents, and fostering a secure working environment. The alignment with Malaysia's commitment to the United Nations' Sustainable Development Goals (SDGs) further reinforces the significance of integrating safety into the industry's DNA.

Recommendations:

Enhanced Supply Chain Integration: Stakeholders in the construction industry must prioritize the integration of safety practices into every facet of the supply chain. This includes rigorous supplier vetting, ensuring the use of certified and safe construction materials, implementing proper handling and storage procedures, and conducting regular safety training for all workers involved (Muhammad, Naidu, Sundram, Hussain, Chew, Pillai & Ibrahim, (2023).

Leveraging Technology for Safety: Embrace modern technologies, such as the Internet of Things (IoT) devices, wearables, and real-time monitoring systems, to enhance safety management. These technologies offer the potential for proactive hazard identification and prompt responses, thereby elevating safety standards in the construction industry.

Interdisciplinary Collaboration: Foster collaboration among various stakeholders, including government bodies, industry associations, and educational institutions. This collaboration can facilitate the development of comprehensive safety guidelines, standards, and training programs that are aligned with sustainable development objectives (Sundram, Ghapar, Osman, Chew & Muhammad 2023).

Continuous Improvement and Monitoring: Establish a system for continuous improvement and monitoring of safety practices throughout the supply chain. Regular audits, performance assessments, and feedback mechanisms can help identify areas for improvement and ensure the sustained effectiveness of safety initiatives (Sundram, Ghapar, Chew, & Muhammad 2023).

Education and Awareness: Invest in educational programs and awareness campaigns to instill a strong safety culture within the industry. This includes promoting the importance of safety practices, disseminating best practices, and encouraging a proactive approach to safety at all organizational levels.

Policy Advocacy: Advocate for policies that incentivize and enforce the integration of safety practices into the construction supply chain. Collaborate with regulatory bodies to develop and implement regulations that prioritize worker well-being and align with sustainable development goals.

In conclusion, the integration of safety practices into the supply chain is not merely a regulatory obligation but a strategic imperative for the sustainable development of Malaysia's building construction industry. By embracing these recommendations, stakeholders can create a resilient and responsible construction ecosystem that prioritizes safety, fosters a culture of well-being, and contributes significantly to the nation's broader goals of sustainable development.

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