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ORGANISATIONAL BARRIERS TO RESILIENT CONSTRUCTION SAFETY MANAGEMENT SYSTEMS

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ABSTRACT

Purpose: This study explores the organisational barriers to implementing resilient safety management systems (RSMS) in the Ghanaian construction industry.
Study Design/Methodology/Approach: A quantitative research approach involving a structured questionnaire survey was utilised. The survey included 144 members of the Ghana Association of Building and Civil Engineering Contractors. A purposive sampling method was used. The analysis employed was exploratory factor analysis.
Findings: The research identified significant barriers to implementing resilient safety management systems, including inadequate training and awareness, fragmented communication, and financial constraints. These barriers contribute to the Ghanaian construction industry's reactive rather than proactive safety culture.
Research Limitations: The study's geographic restrictions to Ghana could make its conclusions less applicable to other areas. Furthermore, depending solely on self-reported data can introduce response bias.
Practical Implication: The findings suggest that addressing these barriers requires targeted interventions, such as enhanced training programs, improved communication channels, and financial support for safety initiatives. These measures can help construction firms in Ghana build a more resilient safety culture.
Social Implication: Enhancing the resilience of safety management systems can reduce workplace accidents and injuries, improving construction workers' overall health and safety. This aligns with broader societal goals of promoting safe and sustainable working environments.
Originality/Value: This study provides new insights into the specific organisational barriers to RSMS in the Ghanaian construction sector. It contributes to the limited literature on resilience in construction safety management in developing countries and offers practical recommendations for overcoming these barriers.

Keywords: *Barriers. management. resilience. safety. system*

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INTRODUCTION

The construction sector poses a considerable risk to occupational safety and health in developed and developing nations, resulting in several accidents and instances of injuries globally (Man et al., 2019). Safety management is a crucial component of risk management for firms worldwide. According to the International Labour Organisation (ILO), in 2017, a staggering 2.7 million employees succumbed to work-related mishaps and diseases, while a significant 374 million individuals experienced non-fatal injuries due to accidents. The anticipated escalation of these accidents can be attributed to the challenges posed by new knowledge and administrative intricacy (Dethlefsen et al., 2022). While wealthy countries have demonstrated a solid commitment to minimising the frequency of accidents in industrial settings, the same level of attention is not evident in developing states, particularly those in Sub-Saharan Africa. The incidence of accidents in these emerging economies is deemed unacceptably elevated. Projections suggest a correlation between the rate of industrialisation and the expected rise in the incidence of accidents within the construction sector (Sayed, 2016).

The conventional Health and Safety (H&S) approach has helped lower the number of workplace incidents; however, there are shortcomings with the traditional system of managing safety (SMSs) (Bugalia et al., 2020). Most studies on safety have focused on the reactive nature of the sector and have examined safety practices, safety measures, safety issues, and safety operations (Asah-Kissiedu et al., 2021; Mohammadi et al., 2018). One of the conventional safety system's shortcomings is implementing proactive methods for managing these intricate, dynamic, and unstable systems. Conventional safety management methods are not entirely compatible with the increasing complexity of contemporary organisations since they are often institutionalised through system guidelines, strategies, procedures, and methods (Mullins-Jaime et al., 2021; Kontogiannis et al., 2016).

Conventional safety systems cannot guarantee ongoing gains in safety performance even with great efforts to attain high safety management (Cuppen et al., 2016; Mohammadi et al., 2018). Therefore, a more thorough and practical approach to safety management is required, and resilience is considered a more proactive and practical approach. Resilience, a relatively new idea, is applied in several academic fields. Nonetheless, resilience in the management of safety in construction requires further understanding, making it a worthwhile topic to research (Aidoo et al., 2022). Resilience in construction SMSs is industrialisation crucial for building a proactive safety system, particularly in developing nations where construction is a significant industry. The notion of resilience is acknowledged as a possible remedy for the shortcomings of conventional safety management and a means of adapting to the evolving and unanticipated safety hazards linked to the more intricate structure of sociotechnical systems.

This study is distinctive in three ways. The study offers novel perspectives on the elements and circumstances that discourage and impede the implementation of resilient safety management

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systems in the building industry. Although there is increasing scholarly interest in barriers to implementing RSMS in Ghana, the challenges faced by the construction industry have not received sufficient attention. It further explores the features and components of the barriers that serve as the foundation for conceptualising the barriers to adopting safety measures in Ghana's construction industry. By adopting this approach, professionals in the sector and government officials may formulate plans to execute the concept of resilience effectively. The report offers comprehensive insights into the barriers that hinder the implementation of RSMS in Ghana's construction sector. By revealing the obstacles, professionals and governing bodies may devise more efficient tactics to tackle the underlying reasons for the sluggish implementation. However, as far as the authors know, no research has explored the causative role of the barriers to applying RSMS in the Ghana building sector. Finally, while addressing the barriers alone does not ensure the effective adoption of RSMS, it does lay the groundwork for creating interventions that would motivate stakeholders to use RSMS in the construction industry of Ghana.

LITERATURE REVIEW

Conceptualising Resilience in Construction Safety Management

Resilience in the context of construction safety management is increasingly recognised as a critical factor for improving safety performance amid the complexities and inherent risks of construction projects. Trinh, Feng, and Mohamed (2019) define resilient safety culture as a construction organisation's capability to anticipate, monitor, respond, and learn from disturbances to maintain safety standards. This definition aligns with broader resilience theories, which suggest that resilience is not merely about recovery from setbacks but also involves proactive measures to foresee and mitigate potential risks (Kurth et al., 2019).

Penaloza, Saurin, Formoso, and Herrera (2020) extend this view by incorporating a resilience engineering perspective. This perspective assesses safety performance measurement systems (SPMSs) from a systems-oriented view, highlighting the low adoption of resilience guidelines in traditional SPMSs. This suggests a gap between theoretical advancements in resilience and their practical application in construction safety management.

Resilience Theory as Opined by Hollnagel

Hollnagel’s resilience theory emphasises organisations' ability to adapt to and recover from unexpected disruptions, maintaining their core functions and stability. According to Hollnagel (2017), resilience encompasses four essential capabilities: the ability to respond, the ability to monitor, the ability to anticipate, and the ability to learn.

1. **Ability to Respond**: This involves an organisation's capacity to react effectively to both internal and external disturbances. It requires differentiating between critical and non-

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critical issues and responding promptly to maintain safety and productivity (Hollnagel, 2017).

2. **Monitoring Capability**: This refers to the organisation's ability to observe and identify deviations that might impact ongoing operations continuously. A resilient system must focus on the relevant aspects of current activities to ensure safety and efficiency (Hollnagel, 2021).
3. **Anticipate Capability**: A resilient organisation should be able to foretell potential future challenges beyond the scope of current operations. This includes anticipating changes in technology, regulations, and market demands that could affect the organisation's ability to function effectively (Patriarca et al., 2018).
4. **Learning Capability**: Learning from past experiences and mistakes is crucial for resilience. Organisations must draw the right conclusions from these experiences to improve future performance and avoid repeating errors (Hollnagel & Nemeth, 2022).

Hollnagel's resilience engineering framework addresses the shortfalls of conventional safety management systems by focusing on these proactive and adaptive capabilities. This framework has been applied in various fields to improve the robustness and adaptability of organisational systems, making it highly relevant for construction safety management.

Barriers to Implementing Resilient Safety Management Systems

The literature identifies multiple organisational barriers to implementing resilient safety management systems in the construction industry. Harvey, Waterson, and Dainty (2019) discuss the challenges posed by the project-based nature of construction, a transient workforce, and financial pressures, which limit opportunities for consistent safety practices and learning from past incidents. These factors contribute to a reluctance or inability to invest in comprehensive safety management practices that embody resilience principles.

Further, the findings of Abubakar et al. (2022) in the Nigerian construction context reveal similar barriers. Traditional safety management practices fail to anticipate or react adequately to emerging safety risks. This is exacerbated by a lack of resources dedicated to safety management, leading to reactive rather than proactive safety cultures.

Inadequate Training and Awareness

One significant barrier to implementing resilient safety management systems is inadequate training and awareness among construction workers and managers about resilience principles. The complexity of modern construction projects requires a workforce that is not only skilled in technical aspects but also in understanding and applying resilience principles to safety management. Unfortunately, many construction firms do not prioritise comprehensive resilience

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training, leading to an ill-prepared workforce for unexpected safety challenges. The gap in training extends to understanding how to anticipate risks and implement preemptive measures, which are key components of a resilient safety culture (Harvey et al., 2019).

Fragmented Communication and Information Sharing

Effective communication and information sharing are crucial for fostering a resilient safety culture within construction organisations. However, the transient and project-based nature of the industry often leads to fragmented communication channels across different levels of the organisation and among various project stakeholders. This fragmentation can result in critical safety information not being adequately communicated to all relevant parties, impeding the ability to respond swiftly and effectively to safety incidents or anticipate potential risks. This barrier is particularly challenging in large-scale projects involving multiple subcontractors and partners, where coordination of safety practices and policies must be managed across diverse organisational cultures and operational practices (Wehbe et al., 2016).

Financial Constraints

Financial constraints represent a critical barrier to implementing resilient safety management systems in the construction industry. Developing and maintaining a resilient safety culture requires significant investment in training, technology, and system improvements, which can be prohibitively expensive, especially for small to medium-sized enterprises. Many construction firms operate on tight margins and may prioritise immediate financial goals over long-term investments in safety resilience. This short-term financial focus can deter organisations from adopting advanced safety management practices that require upfront costs for potential long-term benefits.

Moreover, economic pressures can lead to cost-cutting measures compromising safety, such as reducing spending on safety training, using cheaper materials, or understaffing projects to lower operational costs. These practices undermine the resilience of safety management systems by weakening the organisation's ability to anticipate, respond to, and recover from safety incidents effectively. Focusing on cost efficiency at the expense of resilient practices can also stifle innovation in safety management, as firms may be reluctant to invest in new technologies or methodologies that could enhance their resilience but require substantial initial investment (Harvey et al., 2019).

Addressing this financial barrier requires a shift in how construction firms perceive the costs and benefits of resilient safety management. It involves recognising that investments in resilience can significantly reduce accident rates and associated costs, ultimately leading to greater financial stability and competitiveness in the long run. Additionally, policy interventions, such as providing financial incentives for adopting resilient practices or supporting public-private partnerships, could

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help alleviate the financial burden on companies and encourage wider implementation of resilient safety management systems.

MATERIALS AND METHODS

This study used a quantitative approach to inquiry. A critical assessment of the relevant literature was conducted to determine the organisational barriers to construction safety management systems in the Ghanaian construction industry. The questionnaire was created using the data acquired from the review and piloted among ten experts to validate the factors found in the literature. These specialists were chosen based on their familiarity with the participants. Safety experts evaluated the appropriateness and completeness of the listed variables. They choose to delete or increase the variables. Following the pilot study, a systematic questionnaire was created and distributed to experts involved in building safety. This research used a purposive sample of the member companies, D1/K1, D2/K2, D3/K3, and D4/K4 contractors.

According to the classifications and specifications provided by the Ministry of Water Resources, Works, and Housing of Ghana (MWRWH), contractors in Ghana are divided into eight groups (A, B, C, S, D, K, E, and G) depending on the sort of work they do (Mustapha et al., 2018; Agyekum et al., 2018). Roads, airports and related structures are categorised as (1), Bridges, culverts and other structures as (2); labour-based road works as (3); steel bridges and structures: construction, rehabilitation and maintenance as (4); general building works as (5), general civil works as (6), electrical works as (7) and plumbing works as (8). Four financial classes, 1, 2, 3, or 4, can also be applied to contractors in each category (Bamfo-Agyei et al., 2020; Kissi et al., 2019; Ministry of Water Resources, Works, and Housing). Building and civil engineering contractors with Financial Class 4 can bid on contracts worth up to USD75,000, Class 3 up to USD200,000, Class 2 up to USD500,000, and Financial Class 1 can bid on projects worth up to USD1,000,000).

The ten potential variables were measured. The initial part of the investigation was exploratory data analysis, which included some preliminary checks on the data. These checks include tests for the existence of outliers and missing items, as well as an assessment of the data's normality, data reliability and validity, and other assumptions controlling the application of the selected parametric tests. Descriptive statistics (such as mean and standard deviation) were calculated to find outliers in the data. The Shapiro-Wilk normality test was also employed to assess the normality of the data distribution. The scale was associated with five descriptive anchors (i.e., 1 – strongly disagree, 2 – disagree, 3 neither agree nor disagree; 4 – agree, and 5 – strongly agree) and produced satisfactory Cronbach's $\alpha \geq 0.7$ (Kelava, 2016).

The variables; "Restriction to the independence of safety professionals", "Safety procedures and guides are inaccessible and beyond the understanding of users", and "Shortage of safety managers" were the only variables with 0.7% missing data. However, we performed the exploratory data

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analysis with the missing values as they were less than 10% (of the data on them) and were randomly distributed (Larbi et al., 2024). We found no outliers in the data after using box plots to visualise the data distribution on all continuous variables. The varimax rotation approach was used, and factors with Eigenvalues of 1 or greater were extracted. A scree plot was created to display the factors or components recovered from the studies, and the results are presented in Figure 1. The SPSS 26 (IBM Inc., New York) will summarise and analyse exploratory data.

RESULTS AND DISCUSSION

Demographic Information

From Table 1, respondents had considerable experience in their respective fields of work:13.9% were safety managers, 9% were Managing Directors, 16.7% were Project Managers, 20.1% were Site Engineers, approximately 17% (n = 25) were construction managers, and approximately 22% (n = 31) were other jobs in their businesses. Most respondents had first-degree education. Furthermore, approximately 26% (n = 37) had worked for less than 6 years, 22% (n = 32) for 6–10 years, 23% (n = 33) for 11–15 years, 18% (n = 26) for 16–20 years, and 11% (n = 16) for more than 20 years. The participants had a lot of work experience in general. Finally, 43% (n = 62) of the companies from which participants were selected were classified as D1/K1 firms, 22% (n = 31) of the companies were classified as D2/K2 firms, 9% (n = 13) of the companies were classified as D3/K3 firms, 1% (n = 1) of the firms were classified as D4/K4 firms, and 26% (n = 37) of the firms were classified as non-classified. In other words, the D1/K1 category contains the largest number of companies. The study population was selected from the Ghanaian construction industry. The study focused on analysing the Ghanaian Contractors of D1K1, D2K2, D3K3, and D4K4 building organisations in the construction industry. The survey was conducted in the Greater Accra and Greater Kumasi regions. The purposive sampling approach was adopted, employing a five-point Likert scale and structured quantitative closed-ended questionnaire survey.

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Respondents' profile

Table 1: Background of Respondents

Variable	Group	Frequency	Percent
Position	Safety Manager	20	13.9
	Managing Director	13	9
	Project Manager	24	16.7
	Site Engineer	29	20.1
	Construction Manager	25	17.4
	Others	31	21.5
	Missing	2	1.4
	Total	144	100
Education	Doctorate	3	2.1
	Masters	45	31.3
	First Degree	50	34.7
	HND/Diploma	32	22.2
	Technician CTC1	3	2.1
	Technician CTC 2	6	4.2
	Missing	5	3.5
	Total	144	100
Experience	Less than 6 Years	37	25.7
	6-10 Years	32	22.2
	11-15 Years	33	22.9
	16-20 Years	26	18.1
	Over 20 Years	16	11.1
	Total	144	100
Categories	D1/K1	62	43.1
	D2/K2	31	21.5
	D3/K3	13	9
	D4/K4	1	0.7
	Non-classified	37	25.7
	Total	144	100

Source: Field data, 2024.

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Principal component analysis was used to determine the barriers to developing resilience in construction safety management systems within the Ghanaian construction industry. Data analysis followed the criteria and sequential arrangements suggested by Harrison et al. (2020), Ahmadu et al. (2015), and Adjei (2021).

Exploratory factor analysis was conducted on all barriers to further understanding. Principal Component Analysis (PCA) was used to determine the most critical variables to reduce significant quantifiable variables. PCA was used to reduce the size of the dependent variable and identify similar underlying effects. Specific requirements must be met before the PCA can be used. This was done by comparing the results of the sphericity test developed by Bartlett and the Kaiser-Meyer-Olkin (KMO) test to establish whether the sample was representative of the whole. Field (2009) states that a KMO statistic can range from 0 to 1, but 0.50 is appropriate. A KMO value of 0.89 was obtained, indicating that the sampling adequacy of the results was satisfactory (Ahmadu et al., 2015; Adjei, 2021).

All variables in Table 2 account for extraction values ≥ 0.5, suggesting that the variables can be treated as a composite representing barriers to developing resilience Safety Management Systems. Table 3 and Figure 1 show the two factors affecting the extracted barriers. The first factor contained the first eight items, which produced a variance of 62% and an eigenvalue of 6.2. The second factor was represented by the last two variables, which accounted for a variance of 11% and an eigenvalue of 1.1. The total variance extracted was 72.4%, larger than the enablers. This result indicates that the barriers are more strongly correlated. The first factor extracted can be called organisational barriers, representing items describing internal organisational situations. The second factor is national barriers, which include variables that describe national indicators. Based on the above findings, it can be concluded that all the factors listed in Table 2 are barriers to construction companies establishing safety management systems that are truly resilient.

The specific objective was to explore the organisational barriers to developing resilience capabilities. In this vein, frequencies were used to estimate the number of times respondents acknowledged some variables as barriers to resilience. These frequencies were associated with their percentage points. Factor analysis, specifically exploratory factor analysis (with principal components), was used to classify the barriers and understand whether they constitute a theory-based factor structure. The varimax rotation method was employed, and factors were extracted based on an eigenvalue of one or more. Exploratory factor analysis (principal components) was used instead of related tools because it is easy to interpret (Keleva, 2016). Moreover, this method is the only tool that can evaluate the factor structure of a construct (Keleva, 2016; Arpaci & Aslan, 2022). The first factor extracted was named **organisational barriers,** representing items describing internal organisational situations. The second factor, national barriers, includes variables that describe national indicators.

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Table 2: Extracted components of barrier and their variances, eigenvalues, and factor loadings.

Statistic/Barrier	Extraction	Component	
		1	2
Variance (total = 72.4)		61.6	10.8
Eigenvalue		6.2	1.1
Regulations that limit the level of safety allowed	0.562	**0.696**	0.278
Restriction to the independence of safety professionals	0.687	**0.821**	0.113
Reluctant to transition from the mindset of traditional safety (management reactive approach) to resilient safety management (management proactive approach)	0.709	**0.795**	0.276
Safety decisions restricted to only top management (not giving opportunities to non-management members to participate in safety meetings)	0.749	**0.856**	0.129
Organisations relying solely on external consultants rather than internal safety professional resources	0.744	**0.824**	0.256
Safety procedures and guides are inaccessible and beyond the understanding of users	0.748	**0.796**	0.338
Shortage of safety managers	0.702	**0.687**	0.479
Non-conformance to laws and regulations on safety	0.738	**0.776**	0.369
Rigid national and international safety standards	0.803	0.164	**0.881**
High cost of safety	0.800	0.305	**0.841**

KMO = 0.89; Chi-square = 1021.4; df = 45; p = 0.000
Source: Survey data, 2024

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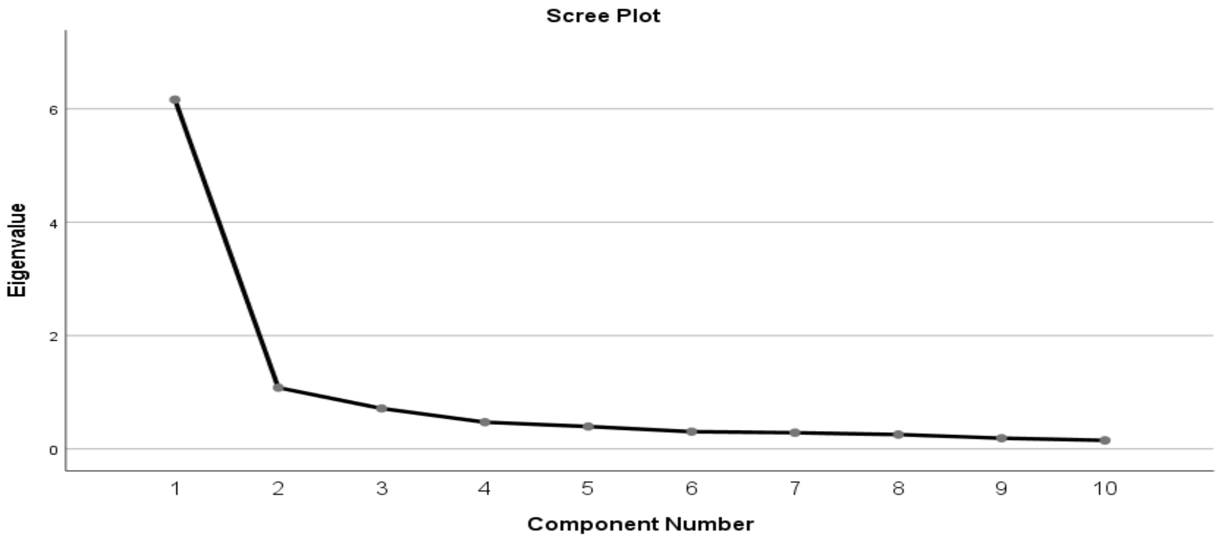

Figure 1. A scree plot showing the number of components of barriers extracted from Principal Component Analysis (with varimax rotation)
Source: Survey data, 2024

The first PCA was strongly correlated with eight of the original variables. The first PCA increased with increasing restrictions on the independence of safety professionals; safety decisions were restricted to only top management (not providing opportunities to non-management members to participate in safety meetings), and organisations relied solely on external consultants rather than internal safety professional resources. The absence of safety officers tasked with leading the implementation of the safety program and involving all stakeholders in the process is a symptom of the broader problem of inadequate safety and safety management governance (Yiu et al., 2019).

The second principal component increases with two variables: rigid national and international safety standards and a high cost of safety. These findings corroborate those of Buniya et al. (2021), which indicate a lack of safety standards, regulations, policies, and safety officers, all of which impede effective safety management. There cannot be an effective implementation of safety programs if managers and stakeholders do not know what to do without safety policies, rules, and regulations. In a study by Buniya et al. (2020), who referenced Aksorn and Hadikusumo (2008), a key impediment to implementing a safety program was the absence of safety regulations, policies, and standards.

This result also implies that both the cost of developing a health and safety program and the overall cost of construction will increase. This result is consistent with those of Okoye and Okolie (2014), Muhammad (2015), and Adekunle et al. (2020), who analysed the perceptions of construction

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stakeholders regarding the relationship between health and safety programs and the total cost of construction. They revealed that most construction workers felt that executing the H&S program significantly increased construction costs.

CONCLUSION

The concept of resilience has gained significant attention and research interest globally, particularly in enhancing safety management in the construction industry. Notably, this focus is more pronounced in developed countries, whereas developing countries like Ghana receive less attention. Research indicates that awareness and knowledge of resilience, key factors in enhancing safety commitment, are more prevalent in developed nations. In contrast, safety studies in developing countries often emphasise practices and processes without addressing resilience awareness or knowledge, particularly in Ghana.

This study aimed to identify the barriers to implementing resilient safety management systems within the Ghanaian construction industry. Utilising a comprehensive literature review and an empirical questionnaire survey of 144 stakeholders in the Ghanaian construction sector, the study revealed two primary obstacles: organisational and national barriers. Organisational barriers pertain to internal issues within companies, while national barriers encompass broader, systemic challenges.

The findings contribute to the existing body of knowledge on resilient safety management by spotlighting these barriers from the perspective of a developing country, using Ghana as a case study. This research provides insights for industry practitioners, policymakers, academics, and construction safety advocates. It underscores the importance of promoting resilience awareness, choosing appropriate safety management systems, and effective dissemination strategies to enhance commitment at the industry and national levels.

It is recommended that management intensify their commitment to safety to improve the implementation of resilient safety and health programs in construction companies. This includes allocating sufficient budgets to ensure the relevance and effectiveness of these programs.

This study is groundbreaking as it is the first to explore resilience and safety within the Ghanaian construction industry, incorporating perspectives from all categories of contractors (D1K1, D2K2, D3K3, and D4K4). The results are pertinent not only to Ghana but also to other developing countries with similar characteristics. Future research could benefit from focusing on specific contractor categories to analyse their unique perspectives and barriers and expanding the scope to include all stakeholders in the Ghanaian construction industry.

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Practical Implications

To effectively implement resilient safety management systems, the construction industry in Ghana should focus on developing comprehensive training programs that educate workers and managers on resilience principles and proactive safety management practices. This will equip the workforce with the necessary skills to anticipate and mitigate potential risks. Again, robust communication systems should be established to ensure critical safety information is effectively shared among all stakeholders. This includes regular safety meetings, technology for real-time information sharing, and clear communication protocols across all project levels. It further advocates for policy interventions that provide financial incentives for firms adopting resilient safety management practices. This could include government subsidies, tax incentives, or public-private partnerships to fund safety initiatives.

Social Implications

Implementing resilient safety management systems has profound social implications, including fostering a proactive safety culture, and the frequency and severity of workplace accidents and injuries can be significantly reduced. This not only protects the health and well-being of workers but also enhances their productivity and job satisfaction. Further, a resilient safety management system will create a safer working environment, a fundamental right of all workers. This aligns with global efforts to promote occupational health and safety standards. Reducing workplace accidents can lower the associated costs, such as medical expenses and lost workdays, thereby contributing to the economic stability of construction firms. This can lead to more sustainable business practices and long-term growth in the construction sector.

By addressing the identified barriers and implementing the recommended measures, the Ghanaian construction industry can enhance its safety management systems, leading to better safety outcomes and contributing to the sector's overall development and resilience.

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African Journal of Applied Research
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