



REDEFINING ORGANIZATIONAL SAFETY AND HEALTH IN THE CONSTRUCTION INDUSTRY CONTEXT: A SCALE DEVELOPMENT APPROACH

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Abstract:

This study presents a comprehensive analysis of Organizational Safety and Health (OSH) systems within construction companies, integrating quantitative exploratory and confirmatory factor analysis (with all 300 respondents being professionals in the construction industry) with qualitative thematic analysis. Data was gathered through administering an adapted survey tool with 31 close-ended responses. Data collected in the initial phase will lay the foundation for the identification of the factors as well as the appropriate items that should be loaded into the factors on OSH in the construction industry via EFA, followed by another data gathering procedure intended to verify whether the results of EFA are valid. This is done through CFA. The research identifies vital internal, external, and technical factors influencing OSH implementation, emphasizing the critical role of internal factors such as "Regular Safety Practices," "Robust Safety Policies," and "Employee Involvement" (Huang *et al.*, 2018; Neal *et al.*, 2021). Findings from both EFA and CFA highlight the identified factors as valid and reliable, with the third model emerging as the most representative of the hypothesized OSH model. Statistical results indicate high factor loadings and favourable model fit indices across various measures, including Chi-Square (CMIN), Root Mean Squared Residuals (RMR), and Goodness of Fit Index (GFI) (Zohar, 2010). The study's significant findings underscore the importance of a holistic approach to OSH, with internal factors being primary drivers and external and technical factors playing supportive roles. Recommendations for construction companies include tailored OSH program development, strategic leadership engagement, investment in training and continuous improvement, enhanced communication and reporting mechanisms, collaborative industry benchmarking, and incorporation of multicultural perspectives. These recommendations address key indicators such as organizational commitment, competence, effective communication, and safety culture enhancement (Clarke & Ward,

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2016; Tam *et al.*, 2017). Further research directions may emphasize the need for specific interventions and broader population sampling to enhance OSH systems comprehensively across the construction sector.

Keywords: business administration, construction industry safety, organizational safety and health, scale development, factor analysis, safety culture

1. Introduction

The construction industry is a pivotal sector in economic growth and job creation in developing nations (Abas *et al.*, 2020). In the Philippines, the "Build, Build, Build" initiative under President Duterte aims to boost construction activities, contributing significantly to the economy and labor market (Toyado, 2021; Meng & Chan, 2022). However, this sector also faces substantial challenges in terms of safety and health, leading to a high incidence of fatalities (Abas *et al.*, 2020; Sauzo & Jaselskis, 1993).

The United Nations' Sustainable Development Goals (SDGs) emphasize the necessity of protecting the planet, eliminating hunger and poverty, and ensuring prosperity by 2030. The construction industry intersects with several SDGs, particularly Goals 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), and 11 (Sustainable Cities and Communities). These goals stress the importance of promoting safe, inclusive, and sustainable development within the construction sector.

Industrial risks and fatalities in construction have significant implications for individuals, society, and the economy (Shafique & Rafiq, 2019). Construction workers face a higher mortality rate compared to other sectors, especially in hazardous tasks (Abas *et al.*, 2015). For instance, Malaysia has seen numerous fatal accidents in the construction sector in recent years (Abas, 2015; Chong & Low, 2014; Ayob *et al.*, 2017). Effective safety management is crucial to mitigating these risks, which include industry-specific hazards, human error, substandard working conditions, and risky practices (Charehzehi & Ahankoob, 2012). Poor safety management not only endangers worker well-being but also disrupts operations and reduces productivity (Abas, 2020; Enshassi *et al.*, 2007).

In the Philippines, organizational health and safety (OHS) in construction firms is a critical area of concern, given the persistent challenges and frequent accidents (Toyado, 2021). Despite efforts to improve safety and health training, the overall accident rate remains high. Addressing this gap involves developing a reliable scale for assessing factors impacting OHS in the construction industry (Rahmi & Ramdhan, 2021). This scale will be created using confirmatory factor analysis (CFA) and exploratory factor analysis (EFA), aiming to redefine and reevaluate OHS indicators. By understanding these factors, organizations can implement measures to protect workers effectively. The study also seeks to explore the challenges faced by supervisors and workers in implementing OHS

and to investigate the relationships and influences between various OHS system factors based on workforce experiences.

The study's objectives include:

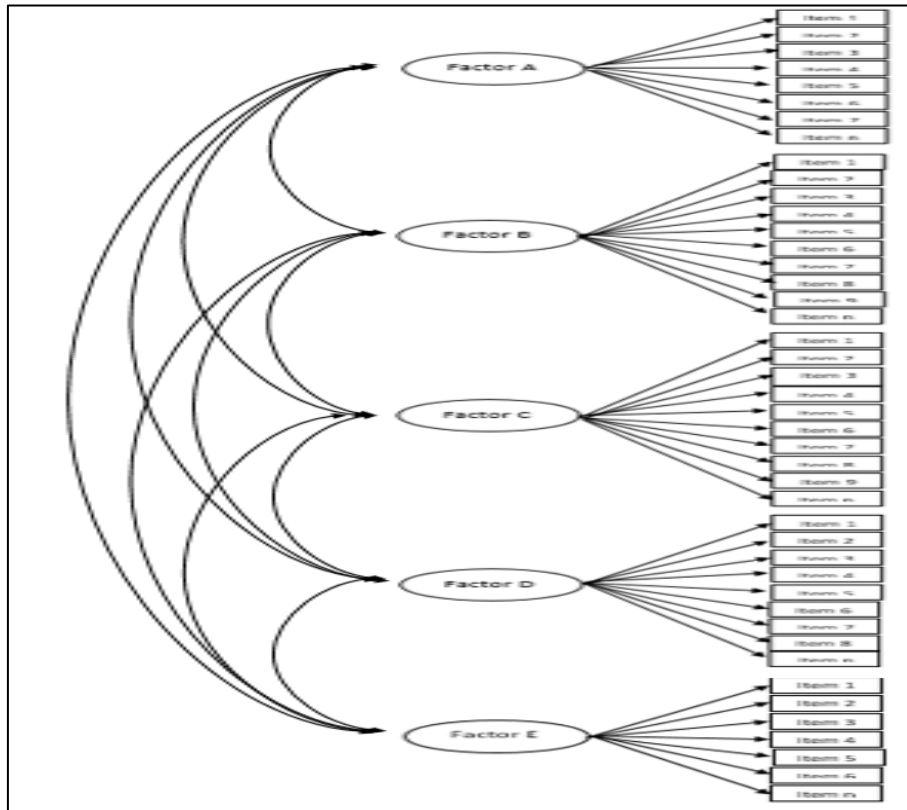
- Identifying factors influencing the effective application of OHS in the construction industry and understanding their impact on safety performance and compliance.
- Developing dimensions or constructs related to OHS in the construction industry through the EFA process.
- Conducting a thematic analysis to align respondents' insights with identified factors from the EFA.
- Sociotechnical Systems (STS) theory, based on the work of Carayon *et al.* (2015) and Rahmi and Ramdhan (2016), provides the theoretical foundation for this study. Originally developed by the Tavistock Institute, STS theory aims to enhance work quality by viewing organizations as sociotechnical systems composed of people, technology, settings, tasks, and routines working together toward common goals. Mumford (2006) describes a sociotechnical system as comprising technological (machinery, software, business structure) and social (people, groups, communication) subsystems.

STS theory emphasizes the need to optimize both technical and social systems within a larger system by considering interactions with internal and external environments. Workers not only respond to but also influence their sociotechnical environment, highlighting a symbiotic relationship (Carayon *et al.*, 2015). Systems theory, developed in response to traditional analysis methods' limitations, recognizes that complex systems exhibit emergent characteristics resulting from component interactions, which cannot be captured by analyzing individual components in isolation.

Applying STS theory to the construction industry, internal elements are divided into organizational (management commitment, OHS rules, cost allocation, financial success, firm size, incentives, resources), individual (OHS education, staff involvement, OHS culture, employee morale, managerial skill, proactive behavior, fear of repercussions, employee pressure, trade unions), and technical (promotion, system integration, continuous improvement, risk reduction, uncertainty reporting, OHS communication, rules, procedures, risk control strategies) components. Figure 1 illustrates the various indicators encompassing OHS, depicting logical sequences of internal, external, and technical factors, which construction companies can use to strive for effective OHS compliance and employee well-being. These factors align with legal requirements and integrate management information systems to facilitate OHS compliance (Cartelli, 2007).

Recognizing the interdependence of subsystems within a system is crucial for achieving optimal performance (Cartelli, 2007). This principle is particularly relevant in the construction sector, where the goal is to provide a safer, more comfortable, and risk-free work environment. Groups and Communities of Practice (CoPs) emerge when individuals with shared interests come together to develop and exchange knowledge, emphasizing the societal construction of knowledge through human interaction. The

broader societal impact of workplace health and safety underscores OHS's social relevance. The construction sector's inherent hazards can also affect society by causing injuries to the public.



The figure above shows the hypothetical observed factors measuring the OHS system in the construction sector. The observed variables correspond to item statements derived from research participants' responses, with interrelationships among latent variables shown by two-headed arrows and single arrows indicating the influence strength of these variables (Carayon *et al.*, 2015; Rahmi & Ramdhan, 2021).

Confirmatory factor analysis (CFA) is used to verify the relationship between observable variables and their latent constructs (Suhr, 2006). The researcher makes a priori assumptions about expected relationship patterns based on existing theory or empirical studies, and then conducts statistical tests to validate these assumptions (Suhr, 2006; Carayon *et al.*, 2015). CFA confirms whether the proposed indicators/constructs discovered during EFA accurately reflect the underlying models within the actual dataset (Suhr, 2006; Carayon *et al.*, 2015).

This research aims to create a validated scale for effective OHS implementation in the construction sector, particularly in the Philippines. It addresses the needs of various stakeholders: promoting safety awareness and training for construction workers; highlighting the importance of a safe work environment for construction companies' management; and guiding construction companies in enhancing their OHS structures and training plans. It also provides valuable insights for future research in OHS system

management. Using a mixed-method approach, combining quantitative methods like EFA and CFA with qualitative interviews, the study analyses factors affecting safety and OHS implementation. While not providing a conclusive framework, its outputs offer significant guidance for the industry. With a sample population of 318 individuals, including seven purposively selected participants for qualitative interviews within construction companies in Caraga, the study ensures a structured approach to data collection through adapted questionnaires and researcher-made interview guides.

2. Material and Methods

This study investigates the determinants of effective organizational safety and health systems within the construction industry. The research design encompasses both quantitative and qualitative methods to provide comprehensive insights into the factors affecting safety performance and the implementation of safety systems.

2.1 Research Design and Methodology

The study adopts a mixed-methods approach divided into two main phases. The first phase is quantitative, utilizing an adapted Likert-type survey to gather preliminary data. This phase involves pilot testing and actual data collection for Exploratory Factor Analysis (EFA). In the second phase, Confirmatory Factor Analysis (CFA) is employed to validate the findings from the EFA, using responses from a targeted set of respondents within the construction industry (Dawadi *et al.*, 2021).

2.2 Quantitative Phase: EFA and CFA

EFA is utilized to identify latent variables within the data and to reduce the number of variables by determining unique factors that contribute to the structural model of the study. EFA helps in understanding the underlying constructs that are not directly measurable (Suhr, 2023). CFA, on the other hand, tests the hypothesis concerning the relationship between latent constructs and their observable indicators. The approach involves statistical testing to confirm whether the predefined model fits the data, considering factors like outliers, missing data, and model fit indices (Schumacker & Lomax, 1996).

2.3 Qualitative Phase: Thematic Analysis

The qualitative phase complements the quantitative findings by exploring the underlying factors influencing the application of safety and health systems in construction. This phase involves semi-structured and unstructured interviews to provide deeper insights and validate quantitative data. Thematic analysis is used to identify recurring patterns and themes within the qualitative data, offering a comprehensive understanding of construction workers' experiences and perspectives.

2.4 Research Locale and Respondents

The study is conducted in Caraga, Region XIII, in the Philippines, a region with a significant population involved in the construction industry. The respondents include 300 construction workers from selected companies, with a proportional allocation to ensure a representative sample. Additionally, nine individuals are purposively selected for in-depth qualitative interviews based on specific inclusion criteria, such as employment duration and experience within the industry.

2.5 Sampling Techniques

Both probability and non-probability sampling techniques are employed. Stratified random sampling is used to select construction companies, while purposive sampling identifies individual construction workers who can provide valuable insights. The sample size of 300 is chosen based on recommendations for conducting EFA, ensuring a robust analysis of the data (Koyuncu & Kiliç, 2019).

2.6 Instruments and Data Collection

The study utilizes a Likert-type survey questionnaire adapted from previous studies (Rahmi & Ramdhan, 2021; Abas *et al.*, 2020), alongside open-ended questions to capture qualitative data. The questionnaire assesses various factors influencing the effectiveness of organizational safety and health systems. Demographic information is collected to contextualize the responses, and informed consent is obtained from all participants to ensure ethical standards are maintained.

2.7 Validity and Reliability

The reliability of the survey is evaluated using Cronbach's Alpha, ensuring internal consistency of the survey items. CFA and EFA are conducted to validate and refine the measurement scales, respectively. The hypothesized factor structure is tested through CFA, confirming the relationships between latent constructs and observable variables (Suhr, 2023).

2.7 Data Analysis

Quantitative data is analyzed using statistical methods like EFA and CFA to identify and validate factors influencing organizational safety and health systems. The qualitative data is analyzed through thematic analysis, coding responses to identify significant themes and patterns.

2.9 Ethical Considerations

Ethical considerations are paramount in this study. Informed consent is obtained from all participants, ensuring they understand the purpose of the research and their rights. Confidentiality is maintained throughout the study, adhering to ethical guidelines and data privacy laws (Fouka & Mantzourou, 2011; Cacciattolo, 2015).

This study employs a robust mixed-methods approach to investigate the factors influencing the implementation of organizational safety and health systems in the construction industry. By combining quantitative and qualitative methodologies, the research provides a comprehensive understanding of the determinants of safety performance, offering valuable insights for enhancing safety measures in construction projects. The integration of EFA and CFA ensures the validity and reliability of the findings, while thematic analysis enriches the understanding of workers' experiences and perspectives. This holistic approach supports the development of effective safety and health systems, ultimately contributing to improved safety performance in the construction industry.

3. Results and Discussion

3.1 Exploratory Factor Analysis

The table below shows the factor loadings corresponding to each of the original 31 items, as well as the factors each item should fall under:

Item	Factor Loading	Classified Under Factor	Uniqueness
Active promotion of organizational safety and health contributes to the successful implementation of the system. (SCALE ITEMS)	0.446	1	0.745
Maintaining the efficacy of the OSH system depends in large part on worker morale.	0.438	1	0.734
The OSH system is subject to the influence of labour unions and workers.	0.429	1	0.603
The efficacy of the system is increased when there are explicit OSH policies.	0.424	1	0.715
The OSH system's performance is greatly enhanced by proactive and proactive behaviour.		None	0.621
The efficacy of the OSH system is directly impacted by the company's financial performance.		None	0.712
Internal incentives positively contribute to the effectiveness of the OSH system.		None	0.791
The OSH system's effectiveness is greatly influenced by system integration.		None	0.721
Sustaining a favorable company reputation is beneficial to the OSH's efficacy.		None	0.79
Efficient hazard identification and risk reduction processes are crucial for the effective implementation of the system.		None	0.731
The effectiveness of the OSH system is increased when employees are involved.		None	0.734
Management commitment significantly influences the effective implementation of the OSH system.		None	0.715
A strong OSH culture positively influences the effectiveness of the system.		None	0.722

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Strict enforcement of organizational safety and health regulations is essential for the effectiveness of the system.		None	0.765
Pressure from customers influences the effectiveness of the OSH.	0.536	2	0.629
Adequate OSH support and authority positively influence the effectiveness of the system.	0.532	2	0.609
The development and implementation of risk control strategies significantly contribute to the effectiveness of the OSH system.	0.464	2	0.676
Fear of punishment affects the effectiveness of the OSH system.	0.41	2	0.7
External incentives are an important factor in guaranteeing the efficacy of the OSH system.		None	0.665
Staying informed about international trends is crucial for the effective implementation of the organizational safety and health system.		None	0.689
Market competition affects the effectiveness of the OSH system.		None	0.719
The availability of sufficient resources is crucial for the effective implementation of the OSH system.		None	0.721
OSH training plays a significant role in the effectiveness of the system.	0.508	3	0.703
Manager competence is essential for the successful implementation of the OSH system.	0.486	3	0.695
Continuous improvement initiatives positively impact the effectiveness of the OSH system.	0.431	3	0.722
The degree to which the OSH system is implemented effectively depends on the size of the business.	0.401	3	0.663
Clear OSH policies and guidelines improve the system's efficacy.		None	0.739
Adequate allocation of resources for safety and health contributes to the successful implementation of the system.		None	0.835
Effective organizational safety and health communication is critical for the successful implementation of the system.	0.567	4	0.571
Uncertainty in the reporting system affects the effectiveness of the organizational safety and health system.	0.462	4	0.693
External audit certification enhances the effectiveness of the organizational safety and health system.	0.453	4	0.614

Based on the results of Exploratory Factor Analysis (EFA), four factors were extracted and identified as critical to developing a proposed scale for safety and health in organizations. These factors are detailed as follows:

A. Factor 1: Organizational Commitment to Safety and Health

This factor encompasses internal drivers that cultivate a strong safety culture within an organization. The critical components include:

- Active Promotion of OSH: Enhances the successful implementation of safety systems.
- Worker Morale: Essential for the effectiveness of OSH systems.
- Pressure from Labour Unions and Employees: Influences the functioning of OSH systems.
- Clear OSH Policies: Improves system effectiveness.

B. Factor 2: External Influences on Safety Performance

This factor addresses external pressures that enhance safety improvements. Key elements are:

- Customer Pressure: Affects the effectiveness of OSH systems.
- Adequate Safety Support and Authority: Positively impacts system effectiveness.
- Creation and Application of Risk Control Methods: Crucial for enhancing OSH system effectiveness.
- Fear of Punishment: Affects system effectiveness.

C. Factor 3: Competence of People Implementing Safety

This factor highlights the importance of a competent workforce. Components include:

- OSH Training: Key for effective OSH systems.
- Manager Competence: Essential for successful OSH application.
- Continuous Improvement Initiatives: Positively impact OSH effectiveness.
- Company Size: Influences the effectiveness of the OSH system.

D. Factor 4: Effective Communication and Reporting for Safety

This factor underscores the importance of clear and open communication within a safety management system. Critical aspects are:

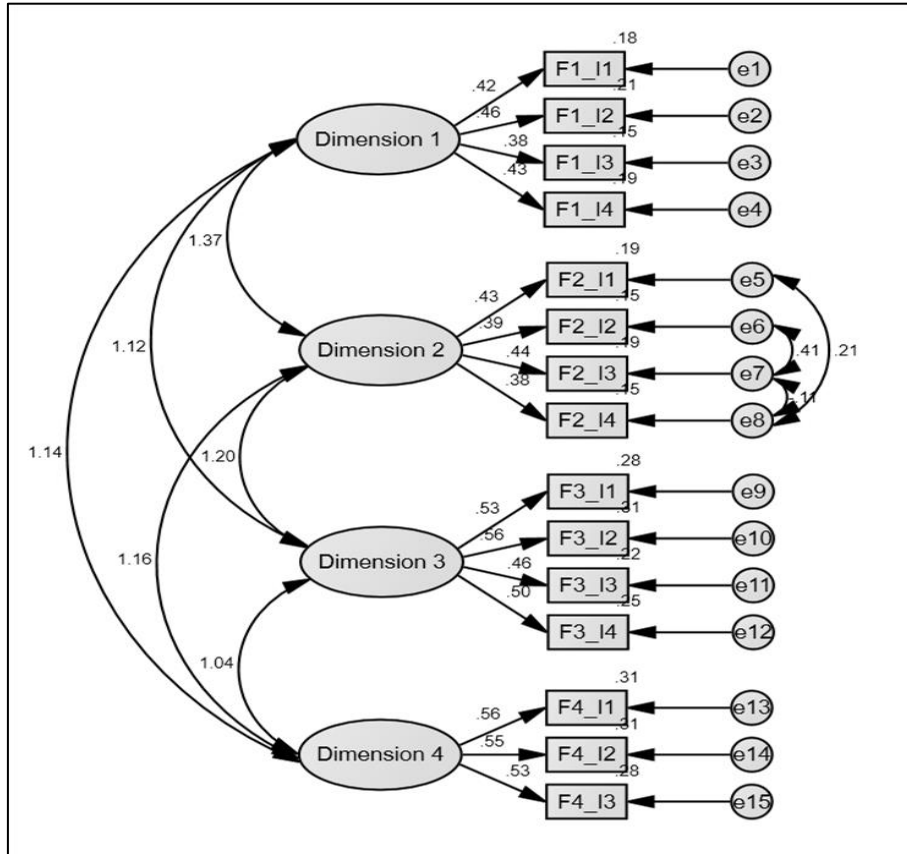
- Effective Safety Communication: Crucial for successful OSH system application.
- Uncertainty in Reporting Systems: Affects OSH system effectiveness.
- External Audit Certification: Enhances system effectiveness.

3.2 Confirmatory Factor Analysis (CFA)

CFA was conducted to verify the alignment of the identified factors with the proposed scale items. Data from 300 independent participants was analyzed to validate the model. Three models were tested, and Model 3 was identified as the best fit based on various indices.

The diagram below shows the extent of direct effect, as shown by the solid arrows, the latent (extracted) factors/constructs that were identified during the EFA has on the observed (scale items) variables represented by the model with the most ideal Model Summary Indices (Model 3). The values tied up for each arrow (path coefficients) are

interpreted the same way as how the factor loadings during the EFA were done. The double-headed arrows, on the other hand, represent the pairwise correlations among the latent factors. The error terms (circles) are intended to capture the unexplained variances in the measurements performed by the observed variables.



3.2 Model Fit Summary

Index	Criteria	First Model	Second Model	Third Model
P-Close	> 0.05, asterisk indicates significance at 95% confidence	0.166*	0.849*	0.865*
CMIN/DF	0 < value < 2	1.749	1.3	1.289
RMR	< 0.08	0.019	0.016	0.016
GFI	> 0.95	0.914	0.941	0.942
CFI	> 0.95	0.896	0.961	0.961
NFI	> 0.95	0.794	0.853	0.856
TLI	> 0.95	0.870	0.948	0.950
RMSEA	< 0.05	0.59	0.037	0.037
AIC	Relatively Lowest Value	218.942	184.689	182.386
BIC	Relatively Lowest Value	340.285	322.885	313.841
ECVI	Relatively Lowest Value	1.023	0.863	0.852
HOELTER	Sample size recommended at 95% level of confidence	155	210	212

The study involved a sample size of 300 and examined the fit of three different models using several statistical measures. The CMIN p-values indicated statistical significance at a 95% confidence level, suggesting poor model fit when scale items were loaded onto their corresponding factors. The Root Mean Squared Residuals (RMR) and the Goodness of Fit Index (GFI) were within acceptable thresholds for all three models, indicating good model fit in terms of these measures. The Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) values above 0.90 also suggested a good fit for Model 3, highlighting its superior performance. The Normed Fit Index (NFI) similarly indicated that Model 3 fit the data better than the other models. The Root Mean Squared Error of Approximation (RMSEA) showed that Models 2 and 3 met the threshold for acceptable fit. Lower values in the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) pointed to Model 3 as having the best fit. The Expected Cross-Validation Index (ECVI) favored Model 3 due to its lower values, indicating good predictive performance. Hoelter's Critical N provided ideal sample sizes for reliable estimates, suggesting sample sizes of 155 for Model 1, 210 for Model 2, and 212 for Model 3 dictates the sample size required for reliable estimates, with Model 3 showing the best fit.

4. Thematic Analysis of Open-Ended Responses

Open-ended survey responses were analyzed to identify themes related to OSH programs in the construction sector:

Question 1: OSH Program Rating and Rationale

- Positive Themes: Regular safety practices, robust safety policies, and high employee involvement.
- Neutral Themes: Average safety practices, moderate adherence to protocols, periodic training.
- Concerns and Improvement Areas: Inconsistent adherence, insufficient training, and need for program overhaul.

Question 2: Experiences in OSH Implementation

- Collaboration and Industry Insights: Effective strategies include industry collaboration and employee involvement.
- Investment in Safety Measures: Positive contributors include state-of-the-art equipment and open reporting systems.
- Benchmarking and Performance Metrics: Improvements through benchmarking and performance metrics.
- External Assessment and Audits: Value in impartial assessments.
- Knowledge Transfer and Training: Emphasis on training programs and mentorship initiatives.
- Leadership Engagement: Engaging senior leadership and conducting surveys.

- Safety Software and Incident Tracking: Benefits of using software for tracking and analysis.
- Committees and Diverse Input: Implementing committees and valuing diverse input.
- Safety Budget and Targeted Investments: Importance of a dedicated budget and targeted investments.
- Incorporating Safety into Values: Integrating safety into core values.

Question 3: Factors Influencing Successful OSH Implementation

- Regular Training and Communication: Importance of regular training and effective communication.
- Employee Involvement and Forums: Mechanisms for feedback and information dissemination.
- Investment in Safety Measures: Essential investments in safety equipment and technology.
- Audits and Metrics: Importance of audits and performance metrics.
- Safety Culture and Integration: Key factors include a strong safety culture and alignment with objectives.
- Recognition and Incentives: Motivation through incentive programs.
- Fundamental Safety Practices: Importance of hazard identification and clear roles.
- Transparency and Benchmarking: Positive influence of transparency and benchmarking.

Question 4: Effective Safety Communication and Challenges in Large Projects

- Effective Communication: Use of mobile technology, printed materials, interactive training, and daily meetings.
- Challenges in Large Projects: Consistency across sites, multicultural workforce, high turnover rates, funding constraints, effectiveness of safety committees, stakeholder communication, aligning subcontractors, project management complexities, regulatory compliance, unique safety challenges, budget constraints.
- Mapping Themes to EFA Factors

A. Factor 1: Organizational Commitment to Safety and Health:

- Matching Themes: Incorporating safety into values, employee involvement, leadership engagement, transparency.
- Partially Matching Themes: Regular training and communication.

B. Factor 2: External Influences on Safety Performance:

- No Directly Matching Themes: Focused on internal factors, but external pressures could emerge from other responses.

C. Factor 3: Competence of People Implementing Safety:

- Matching Themes: Regular training, investment in measures, audits, knowledge transfer.
- Partially Matching Themes: Proactive hazard identification.

D. Factor 4: Effective Communication and Reporting for Safety:

- Matching Themes: Effective communication, open reporting, audits.

The CFA results suggest that Model 3 is the most suitable for representing the hypothesized model, aligning with earlier research on OSH initiatives in the construction industry (Bavafa *et al.*, 2018; Dillon *et al.*, 2017; Jin *et al.*, 2019). The thematic analysis of open-ended responses supports the identified factors, emphasizing the importance of safety culture, training, communication, and external audits. The mapping of themes to EFA factors shows alignment with organizational commitment, external influences, competence, and communication in safety management.

4. Recommendations

Based on the integrated findings, the following recommendations are made for construction companies to enhance their OSH systems:

- **Tailored OSH Program Development.** Utilize insights from Model 3 to develop tailored OSH programs. This model encapsulates the multidimensional nature of OSH implementation, aligning with factors such as organizational commitment, competence, and effective communication.
- **Strategic Leadership Engagement.** Encourage active engagement of senior leadership in fostering a culture of safety. Align safety initiatives with organizational values and goals, as highlighted in both quantitative and qualitative analyses.
- **Investment in Training and Continuous Improvement.** Allocate resources towards regular safety training programs and initiatives aimed at enhancing competence and continuous improvement in safety practices. Prioritize investment in state-of-the-art equipment and knowledge transfer mechanisms.
- **Enhanced Communication and Reporting Mechanisms.** Implement robust communication and reporting systems to facilitate open dialogue, transparency, and timely incident reporting. Leverage technology and regular safety briefings to ensure effective communication across diverse project sites.
- **Collaborative Industry Benchmarking.** Foster collaboration with industry peers to benchmark safety performance metrics, share best practices, and encourage continuous improvement. Emphasize the importance of external assessments and audits for impartial evaluations.
- **Incorporation of Multicultural Perspectives.** Recognize and address the unique challenges posed by multicultural workforces. Implement strategies to overcome

language barriers, promote inclusivity, and ensure alignment with diverse cultural norms.

- **Longitudinal Evaluation and Adaptation.** Conduct longitudinal evaluations to test the effectiveness and sustainability of implemented interventions. Continuously monitor key performance indicators and solicit feedback to adapt OSH programs to evolving needs.

By adhering to these recommendations, construction companies can effectively enhance their safety performance, promote compliance with regulatory standards, and cultivate a culture of safety excellence conducive to the well-being and productivity of all stakeholders involved.

5. Conclusion

The results from both quantitative (Exploratory Factor Analysis [EFA] and Confirmatory Factor Analysis [CFA]) and qualitative analyses provide a comprehensive understanding of the Occupational Safety and Health (OSH) systems within construction companies. The EFA identified several critical internal factors with significant loadings, such as "Regular Safety Practices," "Robust Safety Policies," and "Employee Involvement," which are essential in influencing the OSH system. These factors were found to be more impactful compared to external factors like "Average Safety Practices" and "Moderate Adherence to Safety Protocols."

Technical factors such as "Inconsistent Adherence" and "Insufficient Training/Resources" also emerged from the EFA, highlighting specific challenges that need to be addressed to ensure effective OSH implementation. The CFA validated the EFA findings, confirming the reliability and strength of these factors. Internal factors displayed stronger associations with OSH outcomes than external and technical factors, with Model 3 emerging as the best fit for the hypothesized OSH model.

The comparative analysis of constructs revealed that internal factors have the greatest effect on the OSH system, followed by technical and external factors. This nuanced understanding underscores the importance of prioritizing internal factors to enhance organizational safety and health. The internal factors identified resonate with previous research emphasizing their significance in fostering a positive safety climate (Huang *et al.*, 2018; Neal *et al.*, 2021).

Model 3 was found to be the most representative of the hypothesized model, consistently demonstrating superior fit across various indices such as CMIN, RMR, and GFI. This validation aligns with recommendations from Zohar (2010) on the reliability and validity of safety climate measures. The thematic analysis of open-ended responses further highlighted the importance of internal factors, emphasizing the need for regular safety practices, robust policies, and high employee involvement. Addressing challenges such as inconsistent adherence and insufficient training/resources is crucial for effective OSH implementation.

The findings from the qualitative analysis complement the quantitative results by providing practical insights into the implementation of OSH systems in construction companies. Recommendations from previous literature on enhancing safety culture, such as investing in regular safety training and fostering a culture of employee involvement, support the study's conclusions (Clarke & Ward, 2016; Tam *et al.*, 2017).

The integration of findings from both model fit summaries and thematic analyses provides a coherent understanding of the factors influencing effective OSH implementation. Model 3 emerged as the most suitable representation of the hypothesized OSH model, with thematic analysis identifying key themes corresponding to factors identified in the EFA. This integration underscores the importance of a holistic approach in understanding OSH implementation, wherein quantitative assessments are complemented by qualitative insights.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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