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Abstract

The Nigerian construction sector still suffers from excessive work-related injuries and fatalities because of inadequate health and safety (H&S) measures. H&S training is the main method for preventing workplace incidents; however, its success depends on several interconnected elements. The research investigates how critical success factors (CSFs) determine the effectiveness of H&S training programs in Nigeria's construction sector. The research adopted a quantitative design and used a well-structured questionnaire to collect information from H&S managers in medium- and large-sized construction firms in Abuja, Nigeria. The study gathered 58 valid responses from 94 distributed questionnaires, which represented a 61.7% response rate. The data were analysed using descriptive statistics, which included percentages, means, and standard deviations, and the results were presented in tables. The results demonstrate that the use of personal protective equipment (PPE) (mean = 4.38) is the most aware factor amongst the H&S managers. In addition, the results showed that H&S managers are at least slightly aware of all the CSFs as established. Use of PPE (4.20), firm size (4.10), and leadership (3.96) represent the primary CSFs that determine H&S training effectiveness, while gender (2.02) and age (2.16) are perceived by H&S managers as the least impactful CSFs on H&S training effectiveness. Human behavioural factors, project and firm-related factors, and motivational factors showed the strongest influence as CSF groups with group means of 4.08, 3.64, and 3.59, respectively. The research concludes that human behavioural factors are the most salient and impactful factors that determine H&S training effectiveness. Therefore, policymakers, construction firms, and safety managers should develop and execute effective H&S training programs by focusing on essential factors, especially those related to human behaviour.

Keywords: Construction Industry, Critical Success Factors, H&S Training, Nigeria, Personal Protective Equipment.

Introduction

The construction industry remains one of the most hazardous economic sectors globally, characterised by elevated rates of fatal and non-fatal occupational accidents (Oni et al., 2019; Umeokafor et al., 2014a). In developing nations, including Nigeria, the situation is particularly concerning, with H&S performance consistently falling below acceptable standards (Awolusi et al., 2019). The Nigerian construction industry faces persistent H&S problems, resulting in continuous workplace accidents (Eze et al., 2020; Shuaibu and Kolawale, 2023; Oguchi and Habu, 2024). The industry has an accident rate of 2 incidents per 100 workers and an injury rate of 5 cases per 100 workers according to current epidemiological research (Adeagbo et al., 2019). The current H&S problem persists because people still do not understand how to implement H&S practices, a situation that should have become clearer over the last 40 years (Mojidi and Fidelis, 2019; Umeokafor et al., 2014b). The research shows that organisations lack H&S policies, which translates to workers' understanding of their H&S responsibilities (Olotuase, 2014; Kiran and Fonceca, 2024). H&S training has been widely acknowledged as a fundamental intervention for improving workers' hazard recognition capabilities, risk perception, and overall H&S performance (Namian et al., 2016; Loosemore and Malouf, 2019). The construction industry must prioritise training and retraining of operatives in H&S practices, because extensive research shows that construction site operative training effectively reduces accidents (Oni et al., 2019; Agumba and Haupt, 2018; Wang et al., 2025a; Lin et al., 2023). H&S training

transforms workers into active safety participants. By raising awareness of specific hazards, employees can spot potential dangers before they lead to injuries or illnesses. This understanding allows staff to apply preventive protocols and advocate for hazard elimination. (Charles, 2024; Jeelani *et al.*, 2017; Pandit *et al.*, 2019). The effectiveness of H&S training programs depends on several factors that either facilitate or impede the successful transfer of training content into workplace practices (Tezel *et al.*, 2021; Hussain *et al.*, 2023; Freitas *et al.*, 2017). The key areas, known as Critical Success Factors (CSFs), require effective performance to achieve training effectiveness, leading to better H&S results (Othman *et al.*, 2020; Buniya *et al.*, 2021).

Despite growing recognition of the importance of CSFs for the effectiveness of safety training, research examining these factors in the Nigerian construction context remains conspicuously absent. Existing studies have predominantly focused on developed economies (Chai *et al.*, 2022; Demirkesen and Arditi, 2015) or emerging economies such as Turkey (Tezel *et al.*, 2021), Iraq (Buniya *et al.*, 2021; Buniya *et al.*, 2023) and Saudi Arabia (Al-Haadir and Panuwatwanich, 2011; Casey *et al.*, 2021). The Nigerian construction industry, characterised by unique institutional arrangements, cultural norms, and resource constraints, requires context-specific investigation to identify the factors most critical to the success of safety training. This study addresses this gap by providing empirical evidence from the Nigerian context. The study, therefore, investigates how CSFs affect H&S training effectiveness in the Nigerian construction industry by using empirical data to examine the relationship between CSFs and safety training effectiveness with a view to enhancing H&S training methods and improving the overall site H&S performance. This was achieved through the following objectives;

1. To determine the level of awareness of these CSFs amongst construction practitioners.
2. To determine the effect of these CSFs on H&S training effectiveness.

The study focused on medium and large construction firms that engage in building construction and civil engineering works. These categories of construction firms were considered due to the nature of the construction projects they execute, which are mostly complex and technical, requiring the use of heavy machinery and therefore more likely to practice H&S training for their employees, thereby minimising, reducing, or eliminating accidents on construction sites. The study is limited to the opinions of well-experienced H&S managers who provide H&S training. The Federal Capital Territory of Nigeria, Abuja, was used as the study area because it has a high level of construction activity.

Theoretical Foundations of Safety Training Effectiveness

The theoretical underpinnings of H&S training effectiveness draw on multiple established frameworks, including training transfer theory, social cognitive theory, and the theory of planned behaviour (Casey *et al.*, 2021). Raesinafchi *et al.* (2025) extended their foundational meta-analytic research on safety training effectiveness, which showed that training methods with high engagement, including behavioural modification and realistic practice in actual settings, delivered superior results when compared to training methods that required only passive watching of videos or reading materials. These claims were also supported by Dang *et al.* (2024), Bhagwat *et al.* (2020) and Muneeb *et al.* (2021) in their research findings. Hussain *et al.* (2023), Freitas *et al.* (2017), and Combong and Lelis (2025) refer to training transfer as how well employees use their trained knowledge and skills at their job, which functions as the main factor that determines how well H&S training programs work accordingly. They further mentioned that the factors that affect training transfer include trainee characteristics, which consist of cognitive ability, motivation, and training design elements (Bell *et al.*, 2017; Burke-Smalley and Mendenhall, 2022; Kauffeld *et al.*, 2025; Marowa and Fusire, 2024; Hamzah and Hassim, 2017).

The Nigerian Construction Industry: H&S Context

The Nigerian construction sector displays specific traits which determine the methods used to train workers and their resulting safety performance. The industry structure consists of multiple components which

include public and private clients, main contractors and subcontractors, one-man firms and international companies, and low-technology firms and sophisticated specialists (Adamu *et al.*, 2015; Boadu *et al.*, 2020). The different types of organisations face challenges in H&S management because their H&S management abilities and training assets differ from each other. The industry shows H&S problems despite its economic significance, which accounts for about 3.35% in Q3 2024 of the National Gross Domestic Product (GDP) and provides employment to more than 6.9 million workers (National Bureau of Statistics, 2024). Workers commonly engage in unsafe practices, including working without shoes, using bamboo as scaffolding, handling concrete with their bare hands, and carrying cement bags on their heads (Oguchi and Habu, 2024; Eze *et al.*, 2020; Shuaibu and Kolawale, 2023). Nigeria requires a Construction Industry Training Board (CITB) because this organisation would establish a training system which delivers H&S training (Awolusi *et al.*, 2019; Kolo, 2015). The institutional gap between organisations leads to different standards of H&S training, which affects both the quality and distribution of training materials throughout the industry.

H&S Training in Construction: Types and Characteristics

Construction H&S training today uses various methods, which all maintain specific functions for their different learner groups. The updated typology from Lanjewar (2025) establishes four main training categories which include induction/orientation training for new employees, job-specific training for task-related hazards, supervisory and management training for safety leadership and oversight functions, and specialist training which applies to dangerous work like scaffold erection, crane operation, and first aid delivery. The development of recent technological advancements enables organisations to implement H&S training programs which now use three new methods, namely immersive environment-based training, virtual reality (VR) applications, and augmented reality (AR) systems (Amit, 2020; Kabiesz *et al.*, 2025; Vercelli *et al.*, 2025; Wang *et al.*, 2025b; Sabir *et al.*, 2025; Cordeiro *et al.*, 2025). The new methods provide big benefits compared to the old ways because they create actual danger situations which workers can experience without real danger; they make students more involved in learning; and they help students remember information better (Dang *et al.*, 2024; Bhagwat *et al.*, 2020; Muneeb *et al.*, 2021).

Critical Success Factors for H&S Training

The CSFs concept originated from management information systems research, which was developed by Rockart (1979) and now serves as a critical element for construction management applications encompassing H&S management system operations. According to Tezel *et al.* (2021), Othman *et al.* (2020) and Buniya *et al.* (2021), CSFs represent the limited number of areas in which satisfactory results will ensure successful competitive performance for the organisation. Tezel *et al.* (2021) conducted comprehensive research which identified 25 CSFs for H&S training in the Turkish construction industry and grouped these into six factor categories, which include project and firm-related factors, demographic factors, practical implementation factors, organisational factors, motivational factors, and human-related and behavioural factors. The current study uses this framework to establish its theoretical foundation. These factors and their categories are summarised in Table 1 for better understanding and appreciation of previous research efforts as adapted from (Tezel *et al.*, 2021);

Table 1: Summary of CSFs for H&S Training Effectiveness

Factor Groups	Success Factor Variables	Source
Project and Firm Related Factors	i. Project Type	Bhattacharjee <i>et al.</i> (2024); Love <i>et al.</i> (2018); Al-Bayati (2021); Karamoozian <i>et al.</i> (2023).
	ii. Project Size	
	iii. Project Duration	
	iv. Firm Size	
Demographic Factors	i. Age	Khosravi <i>et al.</i> (2014); Loosemore and Malouf (2019); Khodabandeh <i>et al.</i> (2016); Ranasinghe <i>et al.</i> (2023); Wang <i>et al.</i> (2019); Hasan and Kamardeen (2022); Bamgbade <i>et al.</i> (2019); Chellappa <i>et al.</i> (2025);
	ii. Gender	
	iii. Country of Origin	
	iv. Educational Background	
	v. Language	

Practical and Implementation Factors	i. Work Experience ii. Perception of Training iii. Hands-on Training iv. Methods and Materials	Oswald <i>et al.</i> (2019); Guan <i>et al.</i> (2024); Keng and Razak (2014); Jesus-Rivas <i>et al.</i> (2016). Hare <i>et al.</i> (2013); Alruqi <i>et al.</i> (2026); Mushayi <i>et al.</i> (2018); Demirkesen and Arditi (2015); Raesinafchi <i>et al.</i> (2025); Dang <i>et al.</i> (2024); Jeelani <i>et al.</i> (2017); Vercelli <i>et al.</i> (2025); Wang <i>et al.</i> (2025b). Hussain <i>et al.</i> (2023); Freitas <i>et al.</i> (2017); Alruqi <i>et al.</i> (2026); Jide <i>et al.</i> (2017); Agumba and Haupt (2018); Wang <i>et al.</i> (2025a); Lin <i>et al.</i> (2023); Permana <i>et al.</i> (2025); Fadhillah <i>et al.</i> (2023); Wu <i>et al.</i> (2017). Ghasemi <i>et al.</i> (2015); Pandit <i>et al.</i> (2019); Loosemore and Malouf, (2019); Demirkesen and Arditi (2015); Hussain <i>et al.</i> (2023); Freitas <i>et al.</i> (2017); Jesus-Rivas <i>et al.</i> (2016). Yap and Lee (2020); Sensah <i>et al.</i> (2020); Wu <i>et al.</i> (2017); Senthamizh and Anandh (2024).
Organizational Factors	i. Safety Awareness and Motivation ii. Number of Unsafe Acts and Accidents iii. Effectiveness of Training iv. Coordination and Collaboration v. Feedback vi. Management Support	
Motivational Factors	i. Training Satisfaction ii. Incentives for Safety iii. Training Language iv. Training Frequency	
Human Behavioural Factors	i. Use of Personal Protective Equipment ii. Leadership	

Research Methodology

This study adopted a quantitative research approach, deemed appropriate for achieving the research aim and objectives. The quantitative approach facilitated the systematic measurement of awareness levels and criticality ratings for the identified success factors across a representative sample of construction firms. The study population comprised large construction firms registered with the Federation of Construction Industry (FOCI). According to the FOCI (2026) online database, 94 large construction firms maintain registered business addresses in Abuja and Lagos. These locations were selected as the study area due to their high concentration of construction activity, with most indigenous and multinational construction firms having established their headquarters in these cities (Kadiri *et al.*, 2014). The unit of analysis was H&S managers, selected because these professionals play pivotal roles in H&S training sessions and actively develop and implement methods to control workplace hazards (Abikenova *et al.*, 2023).

The Sample size adopted for the research is a census. A census strives to measure every single eligible element within a specified population or geographic area. It attempts to cover the entire population to avoid sampling error. This is particularly applicable to small populations less than 100 (Bell *et al.*, 2023; Cantwell, 2008). A structured questionnaire served as the primary data collection instrument, developed based on a comprehensive literature review and specifically the CSFs framework established by Tezel *et al.* (2021). The questionnaire comprised three sections:

Section A: Demographic and organisational characteristics, including respondents' years of experience and types of safety training practices employed.

Section B: Assessment of awareness levels for 25 success factor variables, measured on a 5-point Likert scale where 1 represented "not at all aware" and 5 represented "extremely aware."

Section C: Assessment of criticality levels for the same 25 variables, measured on a 5-point Likert scale where 1 represented "very low" criticality and 5 represented "very high" criticality.

Data were analysed using descriptive statistics, such as frequency distributions, percentages, mean scores, and standard deviations, computed using the Statistical Package for Social Sciences (SPSS) for Windows version 23, and results were presented in tables.

Results

Response Rate and Respondent Profile

A total of 94 questionnaires were administered; 66 were returned, 58 were valid for analysis, yielding an effective response rate of 61.7%. This response rate exceeds the 60% threshold recommended by Fincham (2008) for face-to-face survey research, confirming adequacy for analysis.

Table 2: Years of Experience of Respondents

Years of Experience	Frequency	Percentage (%)
0 – 5 years	10	17.2
6 – 10 years	13	22.4
11 – 15 years	17	29.3
16 – 20 years	8	13.8
Above 20 years	10	17.2
Total	58	100

Table 2 showed that the majority of the respondents (82.8%) had at least 5 years of construction experience. This experience profile indicates that respondents possessed adequate industry knowledge to provide informed responses regarding H&S training practices.

Awareness of Critical Success Factors

The level of awareness of these CSFs was determined using a 5-point Likert scale of 1 (Not aware) to 5 (Fully aware) while adapting Adenike *et al.*'s (2021) decision rules for interpreting mean scores as follows; 1.00 to 1.44 = Not Aware; 1.45 to 2.44 = Slightly Aware; 2.45 to 3.44 = Somewhat Aware; 3.45 to 4.44 = Moderately Aware; 4.45 to 5.00 = Fully Aware

Group mean scores were computed for each CSF category by averaging the mean scores of constituent variables.

Table 3: Level of Awareness of CSFs for Safety Training

Rank	Variable	Mean	Standard Deviation	Interpretation
1	Use of PPE	4.38	0.901	Moderately Aware
2	Leadership	4.22	0.840	Moderately Aware
3	Firm Size	4.12	0.918	Moderately Aware
4	Work Experience	4.06	0.956	Moderately Aware
5	Project Size	3.64	1.225	Moderately Aware
6	Incentives for Safety	3.54	1.446	Moderately Aware
7	Training Frequency	3.48	0.953	Moderately Aware
8	Management Support	3.46	1.182	Moderately Aware
9	Effectiveness of Training	3.40	0.782	Somewhat Aware
10	Training Satisfaction	3.40	1.429	Somewhat Aware
11	Educational Background	3.36	0.827	Somewhat Aware
12	Project Type	3.36	1.064	Somewhat Aware
13	Safety Awareness and Motivation	3.12	1.223	Somewhat Aware
14	Project Duration	3.12	1.365	Somewhat Aware
15	Perception of Training	3.04	1.195	Somewhat Aware
16	Language	2.98	1.152	Somewhat Aware
17	Training Language	2.98	1.301	Somewhat Aware
18	Hands-on Training	2.90	0.839	Somewhat Aware
19	Coordination and Collaboration	2.76	1.153	Somewhat Aware
20	Methods and Materials	2.60	1.143	Somewhat Aware
21	Age	2.58	1.108	Somewhat Aware
22	Country of Origin	2.56	1.264	Somewhat Aware

23	Feedback	2.48	1.344	Somewhat Aware
24	Number of Unsafe Acts and Accidents	2.32	1.285	Slightly Aware
25	Gender	2.16	1.076	Slightly Aware

Table 3 indicates that H&S managers in the Nigerian construction firms demonstrate moderate awareness of PPE use (4.38), leadership (4.22), firm size (4.12), and work experience (4.06) as factors influencing safety training success. Conversely, demographic variables like gender (2.16), age (2.58), and country of origin (2.56) exhibit the lowest awareness levels, suggesting that H&S practitioners may underestimate the influence of workforce demographic composition on H&S training outcomes.

Table 4: Awareness of CSF Groups

Factor Group	Group Mean	Interpretation
Human Behavioural Factors	4.30	Moderately Aware
Project and Firm Related Factors	3.55	Moderately Aware
Motivational Factors	3.35	Somewhat Aware
Practical Implementation Factors	3.15	Somewhat Aware
Organizational Factors	2.92	Somewhat Aware
Demographic Factors	2.73	Somewhat Aware

Human behavioural factors (group mean = 4.30) demonstrate the highest awareness level among H&S managers as seen in Table 4, while demographic factors (group mean = 2.73) exhibit the lowest awareness. This pattern suggests that Nigerian construction practitioners recognise the importance of leadership and PPE compliance but may overlook how worker characteristics influence training effectiveness.

Criticality of Success Factors

The impact of these CSFs on H&S training effectiveness was determined using a 5-point Likert scale of 1 (Very low) to 5 (Very high), while adapting Adenike *et al.*'s (2021) decision rules for interpreting mean scores as follows;

1.00 to 1.44 = Very Low; 1.45 to 2.44 = Low; 2.45 to 3.44 = Medium; 3.45 to 4.44 = High; 4.45 to 5.00 = Very High.

Group mean scores were computed for each CSF category by averaging the mean scores of constituent variables.

Table 5: Impact of CSFs on H&S Training effectiveness

Rank	Variable	Mean	Standard Deviation	Interpretation
1	Use of PPE	4.20	1.195	High
2	Firm Size	4.10	0.931	High
3	Leadership	3.96	1.009	High
4	Incentives for Safety	3.92	0.900	High
5	Training Frequency	3.62	0.753	High
6	Work Experience	3.60	1.178	High
7	Project Size	3.56	1.163	High
8	Perception of Training	3.52	0.974	High
9	Project Type	3.48	1.035	High
10	Training Satisfaction	3.44	0.861	Medium
11	Management Support	3.44	1.431	Medium
12	Project Duration	3.40	1.294	Medium
13	Training Language	3.38	1.193	Medium
14	Educational Background	3.30	0.814	Medium
15	Effectiveness of Training	3.28	1.011	Medium
16	Hands-on Training	3.28	1.031	Medium
17	Safety Awareness and Motivation	3.08	1.192	Medium
18	Language	2.90	1.182	Medium
19	Methods and Materials	2.82	1.024	Medium
20	Feedback	2.74	1.192	Medium

21	Number of Unsafe Acts and Accidents	2.66	1.206	Medium
22	Coordination and Collaboration	2.58	1.126	Medium
23	Country of Origin	2.48	1.313	Medium
24	Age	2.16	1.076	Low
25	Gender	2.02	1.000	Low

The most critical success factors for H&S training effectiveness as perceived by practitioners in the Nigerian construction industry are use of PPE (4.20), firm size (4.10), leadership (3.96), and incentives for safety (3.92). These factors all fall within the "High" criticality category (mean scores 3.45-4.44). In contrast, demographic variables such as gender (2.02), age (2.16), and country of origin (2.48) exhibit the lowest criticality ratings as seen in Table 5.

Table 6: Impact based on CSF Groups

Factor Group	Group Mean	Interpretation
Human Behavioral Factors	4.08	High
Project and Firm Related Factors	3.64	High
Motivational Factors	3.59	High
Practical Implementation Factors	3.31	Medium
Organizational Factors	2.96	Medium
Demographic Factors	2.57	Medium

Table 6 shows that human behavioral factors (4.08) emerge as the most impactful CSF group, followed by project and firm-related factors (3.64) and motivational factors (3.59). Demographic factors (2.57) demonstrate the lowest criticality among the six factor groups.

Discussion

Interpretation of Findings

The emergence of PPE use as the most CSF aligns with Yap and Lee's (2020) assertion that PPE utilisation represents the most critical variable for safety awareness. This finding reflects the tangible, observable nature of PPE compliance, which serves as a visible indicator of H&S culture and training effectiveness. Within the Nigerian context, where resource constraints may limit access to engineering controls, PPE assumes particular importance as a primary defense against workplace hazards (Sensah *et al.*, 2020; Oguchi and Habu, 2024). Firm size emerges as the second most critical factor, corroborating Tezel *et al.*'s (2021) findings from the Turkish construction industry and Al-Bayati's (2021) observations regarding the relationship between organisational scale and H&S performance. Larger firms typically command greater financial resources for comprehensive H&S programs, employ dedicated H&S professionals, and benefit from economies of scale in training provision (Othman *et al.*, 2020; Buniya *et al.*, 2021; Agumba and Haupt, 2018; Wang *et al.*, 2025a; Lin *et al.*, 2023). This finding has particular significance for Nigeria, where small firms predominate and may struggle to allocate adequate resources to H&S training (Awolusi *et al.*, 2019). Leadership ranks third, reinforcing Wu *et al.*'s (2017) demonstration that effective leadership positively influences construction H&S management. Leaders champion H&S initiatives, model safe behaviours, and create organisational climates conducive to H&S learning (Senthamizh and Anandh, 2024). The criticality of leadership in the Nigerian context reflects the hierarchical nature of construction organisations and the influence of supervisory figures on worker behaviour. Incentives for safety ranked fourth, consistent with Ghasemi *et al.*'s (2015) identification of incentives as crucial factors affecting construction site H&S. Incentive systems leverage positive reinforcement to motivate safe behaviours and enhance training effectiveness (Pandit *et al.*, 2019). In resource-constrained environments, well-designed incentive programs may offer cost-effective mechanisms for promoting H&S training transfer.

The Primacy of Human Behavioural Factors

The finding that human behavioural factors constitute the most impactful CSF group carries significant theoretical and practical implications. This result suggests that, despite technological advances in H&S training delivery, the fundamental human elements of H&S performance, individual behaviour, and

leadership influence remain paramount in determining training effectiveness (Wu *et al.*, 2017; Yap and Lee, 2020). This finding resonates with contemporary safety science literature emphasising the integration of behavioural and technical approaches to H&S management (Senthamizh and Anandh, 2024; Raesinafchi *et al.*, 2025). Effective H&S training must not only transmit knowledge but also shape attitudes, motivations, and behavioural intentions (Loosemore and Malouf, 2019; Alruqi *et al.*, 2026). The prominence of human behavioural factors in the Nigerian context underscores the importance of addressing psychological and social dimensions of H&S alongside technical training content.

The Subordinate Role of Demographic Factors

The relatively low criticality attributed to demographic factors contrasts with international literature emphasising the importance of workforce diversity for H&S training design (Khosravi *et al.*, 2014; Loosemore and Malouf, 2019). Several explanations may account for this finding within the Nigerian context. First, the Nigerian construction workforce may exhibit greater demographic homogeneity than multicultural workforces in developed economies, reducing the perceived relevance of demographic variables (Bamgbade *et al.*, 2019). Second, practitioners may lack awareness of how demographic factors influence learning and behaviour, as reflected in the low awareness scores for these variables (Table 3). Third, resource constraints may limit firms' capacity to tailor training programs to diverse demographic profiles, leading practitioners to prioritise more immediately actionable factors (Awolusi *et al.*, 2019).

However, the low criticality ratings for demographic factors should not be interpreted as evidence of their unimportance. International evidence consistently demonstrates that age, educational background, and language significantly influence H&S training outcomes (Ranasinghe *et al.*, 2023; Wang *et al.*, 2019; Jesus-Rivas *et al.*, 2016). The discrepancy between Nigerian practitioners' perceptions and established research findings suggests an opportunity for knowledge transfer and capacity building.

Implications for Practice

The findings carry several implications for construction firms, H&S managers, and policymakers in Nigeria:

Prioritisation of Human Behavioural Factors: Construction firms should prioritise interventions targeting human behavioural factors, particularly leadership development programs that enhance supervisors' ability to champion H&S and model safe behaviours (Wu *et al.*, 2017). Investment in leadership training may yield substantial returns through improved H&S climate and enhanced training transfer (Senthamizh and Anandh, 2024).

Strengthening PPE Programs: Given the primacy of PPE use as a critical success factor, firms should ensure that PPE programs encompass not only provision of equipment but also comprehensive training on proper selection, use, maintenance, and limitations (Yap & Lee, 2020; Sensah *et al.*, 2020). Regular monitoring and enforcement mechanisms should complement training to ensure consistent compliance.

Designing Effective Incentive Systems: The criticality of H&S incentives suggests that firms should develop structured incentive programs that reward safe behaviours and training participation (Pandit *et al.*, 2019). Incentives should be designed to avoid unintended consequences such as under-reporting of incidents and should emphasise positive reinforcement rather than punitive approaches.

Capacity Building for Small Firms: The high criticality of firm size underscores the need for interventions targeting small construction firms, which may lack resources for comprehensive H&S training (Othman *et al.*, 2020; Buniya *et al.*, 2021). Industry associations and government agencies should develop shared training resources, subsidised programs, and collaborative arrangements that enable smaller firms to access quality H&S training (Agumba and Haupt, 2018; Wang *et al.*, 2025a; Lin *et al.*, 2023).

Addressing Awareness Gaps: The discrepancy between awareness levels and established research regarding demographic factors suggests the need for continuing professional development programs that enhance practitioners' understanding of how workforce characteristics influence training effectiveness (Umeokafor *et al.*, 2014b).

Conclusion

This study evaluated the CSFs influencing the effectiveness of H&S training in the Nigerian construction industry, drawing on empirical data from 58 construction firms in Abuja. Based on the findings, the following conclusions are drawn:

1. Nigerian construction firms demonstrate moderate awareness of critical success factors for H&S training, with the highest awareness of human behavioural factors (PPE use and leadership) and the lowest awareness of demographic influences (age, gender, country of origin).
2. The use of Personal Protective Equipment, firm size, leadership, and incentives for safety constitute the most CSF for H&S training effectiveness in the Nigerian construction context.
3. Human behavioural factors represent the most influential category of CSFs, while demographic factors demonstrate the lowest relative importance as perceived by Nigerian practitioners.
4. A gap exists between Nigerian practitioners' awareness levels and the broader research evidence regarding the importance of demographic factors, suggesting opportunities for knowledge transfer and professional development.
5. The findings validate the applicability of Tezel *et al.*'s (2021) CSF framework within the Nigerian context while revealing context-specific variations in factor criticality that reflect Nigeria's unique institutional and resource environment.

Recommendations

Based on the findings, the following recommendations are proffered:

For Construction Firms

1. Prioritise leadership development programs that enhance H&S management competencies at supervisory and managerial levels.
2. Strengthen PPE programs through comprehensive training, adequate provision, regular monitoring, and consistent enforcement.
3. Develop structured incentive systems that positively reinforce safe behaviours and training participation.
4. Conduct workforce demographic assessments to identify potential barriers to training effectiveness related to age, educational background, and language.

For Industry Associations and Professional Bodies

1. Develop shared H&S training resources and collaborative arrangements that enable smaller firms to access quality training programs.
2. Establish continuing professional development programs addressing the full range of factors influencing H&S training effectiveness.
3. Promote awareness of how workforce diversity characteristics influence H&S training outcomes through publications, seminars, and workshops.

For Government and Regulatory Agencies

1. Consider establishing a Construction Industry Training Board (CITB) to provide systematic training and advisory services to the construction workforce.
2. Develop guidelines and standards for H&S training that address the CSFs identified in this study.
3. Provide targeted support and incentives for small and medium-sized construction firms to enhance their H&S training capabilities.

For Researchers

1. Conduct comparative studies across different regions of Nigeria to validate and extend these findings.

2. Investigate the specific mechanisms through which leadership influences H&S training effectiveness using qualitative methods.
3. Examine the moderating effects of organisational characteristics (size, project type, ownership structure) on the relationship between CSFs and training outcomes.
4. Develop and test intervention programs targeting the identified critical success factors.

Limitations and Future Research

This study has several limitations that should be acknowledged. First, the geographic focus on Abuja, while providing concentrated construction activity, may limit generalizability to other Nigerian regions with different characteristics. Second, reliance on self-reported data from safety managers may introduce response bias, although respondents' experience profiles mitigate this concern. Third, the cross-sectional design captures perceptions at a single point in time, whereas H&S training effectiveness may evolve over extended periods. Future research should address these limitations through multi-regional studies incorporating multiple stakeholder perspectives (workers, supervisors, managers), longitudinal designs tracking training outcomes over time, and mixed-methods approaches combining quantitative surveys with qualitative interviews to provide deeper insight into the mechanisms linking CSFs to training effectiveness.

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