Scientific Research Publishing

Journal of Service Science and Management, 2026, 19(1), 29-62
https://www.scirp.org/journal/jssm
ISSN Online: 1940-9907
ISSN Print: 1940-9893

Safety Leadership and Safety Performance: An Integrative Model for Ghanaian Construction Industry

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How to cite this paper: Simpson, K. B., Kheni, N. A., & Boateng, I. (2026). Safety Leadership and Safety Performance: An Integrative Model for Ghanaian Construction Industry. *Journal of Service Science and Management, 19,* 29-62.
https://doi.org/10.4236/jssm.2026.191003

Received: December 11, 2025
Accepted: January 31, 2026
Published: February 3, 2026

Abstract

This study introduces Ghana's first context-specific model for construction safety performance, including leadership behaviour, leader-member exchange (LMX), the safety climate, safety culture, and worker behaviour. It analyses shortcomings in understanding the impact of leadership on safety outcomes in a regulated, hierarchical construction sector. A pragmatic mixed-methods design rooted in critical realism was used, employing a convergent parallel approach that integrated quantitative surveys (n = 534) and qualitative interviews (n = 36) across large (D1K1/A1B1—highest contractor rating for buildings and roads) and medium (D2K2/A2B2—second-tier classification) construction projects in five regions of Ghana. The categorisations align with Ghana's official contractor ranking system, defined by financial and technical capacity. All hypotheses were statistically significant, confirming the model's robustness (CFI = 0.917, TLI = 0.901, RMSEA = 0.079, SRMR = 0.071, χ^2 = 98.320) and explaining 62.8% of the variance in safety performance. Leadership exerted the most substantial influence on LMX (β = 0.543), highlighting trust as an essential mechanism, whereas safety culture impacted overall performance (β = 0.412). Worker compliance (β = 0.287) exceeded participation (β = 0.245). Qualitative findings revealed that mentoring, role modelling, coaching, and open communication serve as tools for converting leadership into safer practices. Limitations include a cross-sectional design, and emphasis on key sites (82.6%). The model offers pragmatic suggestions for incorporating trust, culture, and proactive behaviour to sustainably improve construction safety in Ghana and beyond.

Keywords

Safety Leadership, Worker Behaviour, Safety Performance, Integrative Model, Ghanaian Construction Industry

1. Introduction

Occupational health and safety (H&S) continue to be a significant global issue in the construction industry. Despite advancements in legislation, technology, and training, the construction sector continues to have a disproportionately high rate of accidents, injuries, and fatalities (Fang et al., 2020). Structural characteristics include disjointed supply chains, transient workgroups, extensive subcontracting, and variable site conditions that create inherently high-risk scenarios (Wu et al., 2015; Xia et al., 2020). These dangers have considerable human and economic repercussions, such as reduced production, legal disputes, reputational damage, and fatalities (Debela et al., 2022; Rezagholi, 2023; Roche et al., 2024).

Leadership is widely recognised as a key determinant of safety outcomes. Effective leaders not only ensure compliance with regulations but also model safe behaviours, encourage engagement, and cultivate a positive safety culture (Lingard et al., 2019). Such leadership fosters accountability, trust, and proactive safety behaviour; whereas weak leadership is associated with disengagement, low compliance, and elevated accident rates (Mullen et al., 2011; Wu et al., 2022). However, the specific processes via which leadership affects measurable safety outcomes—particularly through mediators such as LMX, the safety climate, and organisational culture—remain insufficiently investigated across many settings (e.g., Shen et al., 2017; He et al., 2021; Sun et al., 2022).

Ghanaian construction industry significantly contributes to national development; however, it is characterised by hazardous practices, inadequate regulatory enforcement, and insufficient institutional oversight (Kheni & Afatsawu, 2022). Cultural and socio-institutional factors—such as hierarchical authority, significant power distance, and collectivist norms—may further hinder the effectiveness of safety leadership, as workers often demonstrate superficial compliance and are hesitant to report hazards (Danso et al., 2023; Kheni et al., 2007; Sherratt & Aboagye Nimo, 2022).

Recent research on safety leadership in Ghana has mostly concentrated on non-construction sectors (e.g., Addo & Dartey-Baah, 2020; Dartey-Baah et al., 2021; Ansong et al., 2025; Adotey et al., 2025), thereby creating a gap in understanding leadership-mediated safety performance in the construction industry. Although substantial evidence highlights safety shortcomings in SMEs, empirical knowledge of safety performance on large, high-risk building sites remains limited. This research explores leadership trajectories across different contractor tiers in Ghana.

Global studies on leadership and construction safety often draw generalised conclusions that presuppose stable regulations and uniform enforcement—characteristics that are not applicable in Ghana. Empirical research indicates that safety results in Ghana are influenced by inadequate institutional monitoring and elevated power-distance cultural norms that affect leadership dynamics (Kheni & Afatsawu, 2022; Danso et al., 2023). These circumstances promote surface compliance rather than deeply internalised safety practices (Sherratt & Aboagye Nimo, 2022), thereby constraining the efficacy of conventional safety interventions—

such as compliance-based inspections, rule-driven safety training and top-down enforcement in resource-limited and disjointed construction settings (Fang et al., 2020; Wu et al., 2015; Xia et al., 2020).

This study develops and validates an integrative, Ghanaian-centric model that integrates leadership behaviour (LB), leader-member exchange (LMX), safety climate (SC), safety culture (SCult), and worker safety behaviour (WSB) to address these shortcomings. The model directly connects these dimensions to leadership's influence on safety performance (HSP), therefore identifying practical strategies for enhancing compliance, participation, and overall safety in high-risk construction settings. Against this background, the study was conducted based on the following objectives:

1) To examine the influence of LB and LMX on employee HSP.

2) To evaluate the impact of LB on SCult. and SC, including intermediary impacts on HSP.

3) To validate an integrative model linking LB, LMX, SC, SCult., and WSB to construction safety performance in Ghana.

This study explicitly contextualises LB and its mediators within Ghana's sociocultural and institutional framework, generating novel insights into the mechanisms that translate leadership actions into measurable safety outcomes; thus, it offers both theoretical contributions and practical guidance for improving construction safety performance.

2. Literature Review

2.1. Theoretical Framework

This research synthesises leadership, relational, motivational, and cultural theories to elucidate the influence of leadership on safety performance in Ghana's construction industry. Transformational and transactional leadership theories serve as the fundamental processes within the framework, illustrating how leaders affect employee safety behaviour via role modelling, communication, feedback, and enforcement. Transformational leadership elucidates discretionary, proactive safety behaviours that go beyond basic standards, whereas transactional leadership pertains to compliance-driven acts facilitated by incentives and remedial measures (Bass, 1985; Clarke, 2013; Kelloway et al., 2012). Collectively, these ideas establish leadership behaviour (LB) as a crucial precursor to the model.

Ethical leadership emphasises moral and relational dimensions. By prioritising justice, accountability, and employee wellness, ethical leadership cultivates trust, enhances leader-member exchange (LMX), and creates a safe climate, therefore encapsulating the relational aspect through which leadership influences behaviour (Brown & Treviño, 2006). Social Exchange Theory (SET) clarify the connection between leadership and Leader-Member Exchange (LMX) in relation to voluntary employee safety participation, demonstrating how supportive leadership fosters reciprocal safety engagement instead of enforced compliance.

Motivational theories, such as expectancy theory, planned behaviour theory, and social cognitive theory, illustrate individual-level processes. They elucidate how leadership and relationship dynamics influence employees' motivation, self-efficacy, outcome expectations, and perceived control over safety behaviours (Vroom, 1964; Ajzen, 1991; Bandura, 1986). These theories validate the inclusion of workers' safety behaviour (WSB) in the model as an outcome indicative of both compliance and proactive participation.

Cultural and identity-based theories contextualise behaviour within Ghana's sociocultural framework. Social Identity Theory expounds how leadership and safety climate foster a collective safety identity, thereby reinforcing norms and communal commitment, while Human Capital Theory emphasises the significance of skill development in facilitating safe behaviour (Tajfel, 1972; Becker, 1964; Fang et al., 2022). These ideas support safety culture (SCult) as a higher-order concept that encompasses shared norms and competencies.

This integration connects leadership behaviour (LB) to relational quality (LMX), perceptual context (safety climate), cultural norms (SCult), and individual safety behaviour (WSB), offering a multi-level elucidation of safety performance. This framework is particularly relevant in Ghana's hierarchical and resource-constrained construction industry, where insufficient enforcement and superficial compliance necessitate relational trust, collective identity, and intrinsic motivation to attain effective safety outcomes (Danso et al., 2023; Kheni et al., 2007; Sherratt & Aboagye Nimo, 2022).

2.2. Empirical Review

Leadership is recognised as a critical determinant of safety performance in construction, impacting outcomes through communication, trust, engagement, and compliance (Wu et al., 2018; Lingard et al., 2019). Transactional leadership enhances compliance via regulations, oversight, and corrective measures, but transformational leadership—particularly when bolstered by a high-quality LMX—fosters profound behavioural change that transcends mere conformity to rules (Shen et al., 2017).

Global studies indicate contextual variations in the operation of these processes. In mainland China, strong leader-member exchange (LMX) enhances safety behaviour by positively affecting both the safety climate and employees' psychological capital (He et al., 2021; Zhang et al., 2018). Similarly, evidence from the China-Hong Kong region, which functions under a unique administrative and occupational safety regulatory framework distinct from mainland China, demonstrates that supervisors' safety-related behaviours substantially impact workers' safety performance and their perceptions of the safety climate (Zhang et al., 2017). Research from Iran underscores management commitment as a cornerstone of organisational safety culture, highlighting the need for ongoing leadership engagement (Tehrani et al., 2019; Ardeshir & Mohajeri, 2018). In South Africa, transformational leadership also enhances safety culture and compliance (Skeepers & Mbohwa, 2015). Evidence from Ghana indicates that safety climate modulates the impact of leadership on employee behaviour (Novieto, 2023).

Research from other high-risk industries corroborates these tendencies. Transformational leadership regularly improves engagement and safety performance, whereas passive supervision detracts from results (Mullen et al., 2011; Prinsloo & Hofmeyr, 2022). Relational and cultural factors, including organisational norms and psychological resources, also promote compliance and performance (Gracia et al., 2020; Supardi et al., 2021).

LMX is pivotal in enhancing staff engagement, influencing safety climate, and bolstering psychological capital (Bentoy et al., 2022; He et al., 2021; Sun et al., 2022). The climate and culture enhance performance via supervisory signals, peer impact, and collective norms (Gao et al., 2016; Xia et al., 2020; Fang et al., 2022; Adzivor et al., 2024).

Safety performance is eventually affected by the interplay of leadership, relationship quality, safety perceptions, safety values, and workers' actions within the construction system, as shown in **Table 1**.

Table 1. Key constructs, definitions, levels, references and expected influences.

Construct/ Variable	Definition/Description	Level of Analysis	Key References	Expected Influence on Safety Performance
Leadership Safety Behaviours	Enhance safety through communication, exemplification, oversight, mentoring, and assistance.	Organisational/ Supervisor	Fang et al. (2020), Lingard et al. (2019), Wu et al. (2022).	Direct beneficial impact; indirect influence via LMX, Climate, and culture
LMX	The quality of leader-worker relationships, founded on trust, respect, and mutual support, facilitates the expression of safety concerns.	Dyadic (Supervisor-Employee)	Graen & Uhl-Bien (1995), He et al. (2021), Bentoy et al. (2022).	Exerts a more pronounced influence on participation than on compliance, and it modulates the dynamics of leadership.
Safety Climate	The collective views of employees reflect the management's emphasis and dedication to safety.	Group/ Organisational	Zohar (2002), Gao et al. (2016), Xia et al. (2020)	Direct beneficial impact by facilitating leadership and enhancing LMX.
Safety Culture	Fundamental ideals and standards directing shared duty and accountability for safety.	Organisational	Cooper (2000), Fang et al. (2022), Adzivor et al. (2024).	The role of the distal mediator is to support sustained performance throughout time.
Workers' Safety Behaviours	Occupational Safety Practices require strict adherence to regulations and active participation in voluntary initiatives such as reporting, peer assistance, and proactive measures.	Individual	Neal & Griffin (2006), Sun et al. (2022), Wu et al. (2018)	A direct predictor serves as a conduit for leadership, climate, and culture.
Safety Performance	Include accident reduction, regulatory compliance, proactive involvement, and site enhancements.	Organisational/Site	Ta et al. (2022), Khan et al. (2018), Novieto (2023).	All other constructs influence the dependent variable.

Ghana garners less academic attention, but worldwide data underscores the high-risk characteristics of its construction industry. This study emphasises the need for context-specific research that incorporates leadership dynamics, LMX, SC, SCult., and employee behaviour. It contends that leadership and organisational culture influence essential safety conditions—such as equipment availability and regulatory compliance—that promote behavioural transformation. The study offers practical insights by investigating the relational and contextual factors that affect safety outcomes; therefore, it addresses a notable gap in the current literature.

2.3. Hypotheses Development

Leadership influences construction safety through relational, cultural, and behavioural channels. Leaders who articulate standards, exemplify safe behaviours, and exhibit dedication cultivate trust, improve team collaboration, and integrate safety as a collective value, thereby reinforcing the underpinnings of safety performance (Fang et al., 2022; Lingard et al., 2019). Consequently:

- H1: Safety leadership positively influences LMX.
- H2: Safety leadership positively influences safety climate.
- H5: Safety leadership positively influences overall safety performance.
- H6: Safety leadership positively influences safety culture.
- H7: Safety leadership positively influences workers' safety compliance behaviour.
- H8: Safety leadership positively influences workers' safety participation behaviour.

LMX assesses the quality of leader-subordinate relationships via trust and reciprocal support. Superior exchanges promote transparency and voluntary participation (He et al., 2021; Sun et al., 2022), especially within hierarchical settings such as Ghana's construction sector.

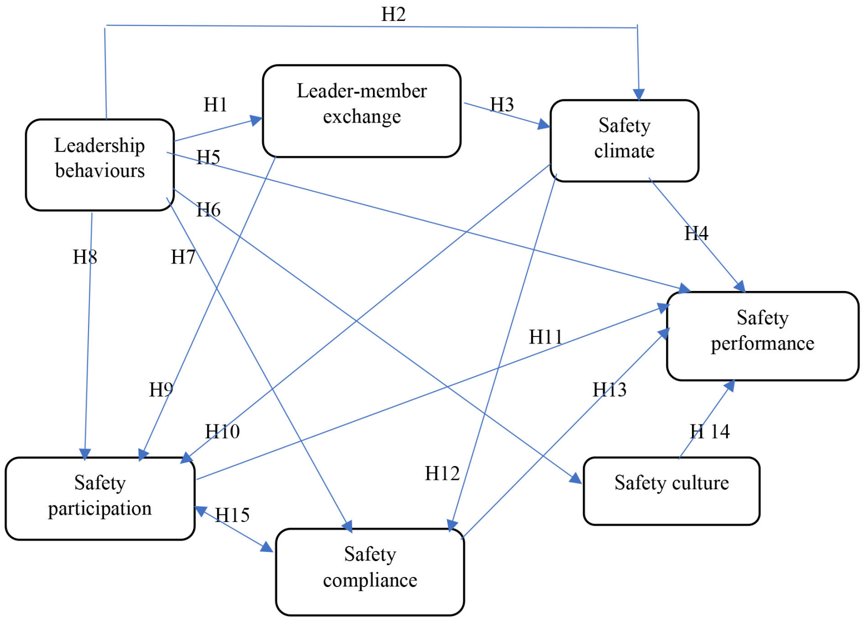
- H3: LMX positively influences safety climate.
- H9: LMX positively influences workers' safety participation behaviour.

Safety climate represents workers' impressions of management's safety goals, while safety culture signifies persistent norms that govern behaviour (Zohar, 2002; Gao et al., 2016; Adzivor et al., 2024). A favourable climate and a developed culture enhance compliance, promote participation, and maintain performance.

- H4: Safety climate positively influences overall safety performance.
- H10: Safety climate positively influences workers' safety participation behaviour.
- H12: Safety climate positively influences workers' safety compliance behaviour.
- H13: Safety climate positively influences workers' safety performance.
- H14: Safety culture positively influences overall safety performance.

Employee compliance and engagement serve as behavioural conduits via which leadership, LMX, the organisational environment, and culture influence performance (Neal & Griffin, 2006; Wu et al., 2018). Compliance guarantees obedience to procedures, while participation signifies proactive enhancement of safety.

- H11: Workers' safety participation behaviour positively influences overall safety performance.
- H15: Workers' safety participation behaviour positively influences workers' safety compliance behaviour.



Source: Authors' work.

Figure 1. Conceptual framework for the study.

Figure 1 illustrates the proposed integrative safety leadership model, showing leadership as the central driver influencing safety performance directly and indirectly via LMX: safety climate, culture, participation, and compliance, summarising the hypothesised pathways for subsequent SEM and qualitative analyses.

3. Methodology

This research was performed in six regions of Ghana—Greater Accra, Ashanti, Central, Western, Northern, and Upper East—to include varied construction circumstances, worker profiles, and safety protocols. Greater Accra (91.7% urbanised, 154,357 workers) and Ashanti (106,902) are significant centres, whilst Central, Western, Northern, and Upper East (59,613; 29,738; 20,444; 11,578) exhibit moderate to smaller rural labour forces with inadequate safety infrastructure (GSS, 2021). The inclusion of Accra and Kumasi, crucial construction hubs, enhanced representativeness (Simpson & Sam, 2020).

A mixed-methods approach based on pragmatism, supplemented by critical realism (CR), was used. Pragmatism facilitated actionable insights while recognising diverse realities (Creswell, 2008; Greene, 2007, p. 20, as cited in Leavy, 2017: p. 168), whereas critical realism offered an ontological perspective to investigate how outcomes arise from institutional, organisational, and behavioural mechanisms, employing the empirical-actual-real framework and context-mechanism-outcome heuristic (Park & Peter, 2022; Tennant et al., 2020).

A convergent parallel design of equal status simultaneously gathered quantitative surveys and qualitative interviews (see **Table S2** and **Appendix 7-9** for the details of the quantitative and qualitative data items), analysed them separately, and merged them to improve triangulation, complementarity, and analytical thoroughness (Creswell & Plano Clark, 2018; Greene et al., 1989). Integration occurred at both methodological and interpretative levels (Schoonenboom & Johnson, 2017), guaranteeing stringent cross-validation.

The analytical methodology integrates induction, deduction, and abduction. Induction facilitated the organic emergence of themes from qualitative data (Strauss & Corbin, 1998), deduction evaluated hypotheses using SEM based on theoretical frameworks (McAbee et al., 2017), and abduction explicates unforeseen outcomes by connecting empirical evidence to conceptual rationale (Thomas, 2022; Timmermans & Tavory, 2012). This hybrid logic improved theory development and encapsulated intricate behavioural processes.

A cross-sectional approach offered an overview of safety perceptions and behaviours across 79 sites, appropriate for exploratory research when experimental manipulation is unfeasible (Allen, 2017; Thompson, 2022). The target population consisted of professionals and labourers engaged in large (D1K1/A1B1—the highest contractor rating for buildings and roads) and medium-sized (D2K2/A2B2—the second-tier classification) construction projects across six regions of Ghana, as per the official contractor ranking system that categorises firms based on financial and technical capabilities (Ayarkwa et al., 2012). The participants were engineers, architects, project managers, safety officials, supervisors, consultants, and artisans. Non-probability sampling methods—purposive, expert, maximum variation, convenience, and snowball techniques—were used owing to obsolete records, inaccessible locations, and the need to engage key informants (Emmel, 2013; Etikan & Bala, 2017; Parker et al., 2019). Sites were chosen based on operational activity, project magnitude, and observable safety protocols, with participant's participation requiring a minimum of six months of site experience.

The data collection utilised structured, validated questionnaire items from Clarke and Ward (2006), Wu et al. (2018), Zhang et al. (2020), Sun et al. (2022), Ni et al. (2020), Wang et al. (2021), Zahoor et al. (2017), Christian et al. (2009), and Yu et al. (2021) to evaluate LB, LMX, WSC, WSP, SC, SCult., and HSP (see **Table 2** for the items). All questions were evaluated using 7-point Likert scales (Yaddanapudi & Yaddanapudi, 2019), with a range from 1 = strongly disagree to 7 = strongly agree. The biodata and personal records section initiated the questionnaire, documenting respondents' gender, age range, educational attainment, employment position, business classification and type, firm/site location, and years of experience with both the present employer and the broader construction sector. The semi-structured interview guide (**Appendix 8** and **Appendix 9**), formulated in accordance with Kallio et al. (2016) for both management and employees, included sections addressing the interviewee's biographical details, leadership behaviours, their impact on employees, satisfaction levels, principal challenges, and suggestions. Both instruments included preambles stating the study's purpose, focus, expected outcomes, respondent's role and ethical assurances.

Reliability and validity were established via pretesting, pilot testing, Cronbach's alpha, composite reliability, and AVE ≥ 0.5 (Jackson, 2003; Pallant, 2011; Ghazali, 2016), while qualitative credibility was enhanced through triangulation, member checking, systematic coding, and peer validation (Sandelowski, 2008).

Data were obtained from six regions; however, no interviews were performed in the Northern Region. During the survey data collection, the Northern Region had just one active construction site that satisfied the study's inclusion requirements, resulting in a restricted number of questionnaire respondents. Therefore, data from surveys conducted in the Northern and Upper East areas were amalgamated for analysis to guarantee analytical rigour. Quantitative data (n = 534, mostly in-person surveys) were processed in SPSS version 26, with confirmatory factor analysis (CFA) and structural equation modelling (SEM) executed in Python 3.13.5, using Factor Analyser and Semopy with maximum likelihood estimation. Model fit was assessed using χ^2/df, CFI, TLI, RMSEA, and SRMR (Kline, 2023; Meshcheryakov et al., 2021). Qualitative data (n = 36 interviews) were examined with thematic analysis and grounded theory (Braun & Clarke, 2006; Birks & Mills, 2015; Ju & Rowlinson, 2014), corroborated by triangulation, member validation, and peer review for credibility (Elo et al., 2014; Creswell, 2015). Findings were synthesised by triangulation (**Table 3**) to ascertain convergence, complementarity, and divergence (Creswell, 2015). The department review committee verbally authorised the instruments.

This methodology assessed the interactions among LB, LMX, SC, SCult., and WSB in shaping safety outcomes, yielding empirically validated, context-specific insights that enhance construction safety research in underdeveloped nations, particularly within the unique context of Ghana. Ethical standards were upheld in accordance with the Nuremberg Code, ensuring informed permission and secrecy (Shuster, 1997; Leavy, 2017; Pillay et al., 2023). Although constrained by a cross-sectional, non-probability design, the mixed-methods approach reduced bias and yielded a thorough, mechanism-sensitive comprehension of safety performance in Ghanaian construction projects.

4. Findings

4.1. Quantitative

This study evaluated a holistic safety leadership framework for Ghana's construction industry by integrating structural equation modelling (SEM) with grounded theory (GT). SEM constituted a significant portion of the variation in safety performance (R^2 = 0.628), (**Figure 2**), while GT illuminated the contextual, social, and environmental mechanisms behind these effects (**Table 3**, **Figure 3**). The results together demonstrate how leadership, relationship dynamics, attitudes, and culture influence safety outcomes in Ghana's hierarchical and resource-limited construction environment.

4.1.1. Instrumentation and Demographics

Out of 650 questionnaires sent, 540 were returned, resulting in a response rate of 83.1%. After addressing the 44 item-level missing data points through modal imputation (Wright et al., 2015). 24 were retained whereas 20 were discarded. In all, 534 valid responses were analysed, including 38 online submissions through google form (Bhalerao, 2015). Thirty-six interviews were analysed using grounded theory, since one interview was removed due to incompleteness, resulting in comprehensive contextual insights. This combination ensured robust empirical and qualitative triangulation.

The predominant demographic of survey participants was male (89.7%), with ages ranging from 26 to 33 years (38.2%), and possessing either a bachelor's degree (35.8%) or a senior high school/WASSCE/Diploma (31.1%). Roles included managers (35.8%), engineers (21.7%), and artisans (29.0%), mostly within large firms (82.6%) located in Greater Accra (67.2%). The predominant proportion of responders (78.1%) possessed fewer than five years of tenure. Moreover, local construction companies employed 50.2% of the respondents, multinational construction companies employed 42.5%, and foreign construction companies employed 7.3% (**Table S1**).

4.1.2. Evaluation and Assessment of Structural Model and Hypotheses

1) Validation of the measurement model

The measuring model exhibited robust reliability and validity. Internal consistency was validated using Cronbach's α, composite reliability, and omega coefficients, ranging from 0.830 to 0.947. Convergent validity was shown by factor loadings ranging from 0.555 to 0.872 and AVE values between 0.470 and 0.664. Discriminant validity was confirmed using HTMT ratios under 0.90 and adherence to the Fornell-Larcker criterion (Fornell & Larcker, 1981). KMO values (0.762 - 0.938) and a significant Bartlett's test ($p < 0.001$) confirmed sample adequacy and model appropriateness. The findings affirm the alignment of leadership, relational, perceptual, and behavioural components pertinent to safety performance in Ghana's construction industry (see **Tables S2-S6** for the details).

2) Validation of the structural model

The structural model demonstrated satisfactory fit indices: Comparative Fit Index (CFI) = 0.917, Tucker–Lewis Index (TLI) = 0.901, Root Mean Square Error of Approximation (RMSEA) = 0.079, standardised Root Mean Square Residual (SRMR) = 0.071, and chi-squared (χ^2) = 98.320. This signifies that the suggested structural linkages sufficiently reflect the observed facts (Hu & Bentler, 1999). Leadership had the most significant impact on LMX ($\beta = 0.543$, $p < 0.001$), underscoring its crucial role in influencing relationship dynamics within construction teams. SCult. emerged as the foremost predictor of HSP ($\beta = 0.412$, $p < 0.01$), highlighting the essential influence of shared norms and values in promoting safe work practices. The SC, WSC, and WSP were highly interconnected, indicating that leadership influences safety performance both directly and indirectly via many channels.

3) Explained variance

The structural model accounted for significant variation in essential constructs: LMX ($R^2 = 0.295$), safety climate ($R^2 = 0.487$), safety culture ($R^2 = 0.472$), participation ($R^2 = 0.498$), and compliance ($R^2 = 0.531$). It represented 62.8% of the variance in overall safety performance ($R^2 = 0.628$), demonstrating substantial predictive capability. The findings underscore LB and SCult. as essential factors for improving compliance and proactive engagement and, therefore, augmenting safety outcomes on construction sites in Ghana.

4) Hypotheses testing

All fifteen proposed hypotheses (Table 2) were validated, indicating leadership's significant influence on relational, perceptual, and behavioural processes. Leadership had the greatest significant impact on LMX (β = 0.543), while SCult. emerged as the primary predictor of HSP (β = 0.412). The relationship between SC, WSC, and WSP showed both direct and indirect effects of leadership. The link from LB to LMX and SC to WSP was very strong. Leadership, culture, climate and employee behaviour accounted for 62.8% of the variation in safety performance, highlighting the significance of leadership and cultural interventions in Ghanaian construction sites.

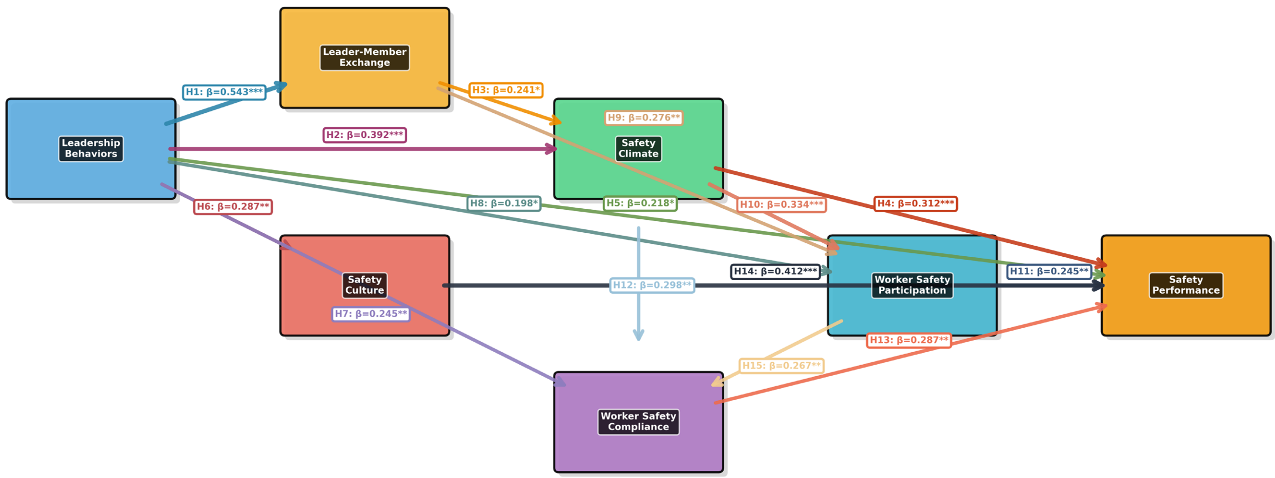
Table 2. Hypotheses testing result.

Hypothesis	Path	β	SE	*p*-value	Result
H1	LB → LMX	0.543	0.078	<0.001	Strongly Supported
H2	LB → SC	0.392	0.091	<0.001	Strongly Supported
H3	LMX → SC	0.241	0.094	0.010	Supported
H4	SC → HSP	0.312	0.086	<0.001	Strongly Supported
H5	LB → HSP	0.218	0.095	0.021	Supported
H6	LB → SCult.	0.287	0.088	0.001	Supported
H7	LB → WSC	0.245	0.092	0.008	Supported
H8	LB → WSP	0.198	0.096	0.039	Supported
H9	LMX → WSP	0.276	0.089	0.002	Supported
H10	SC → WSP	0.334	0.082	<0.001	Strongly Supported
H11	WSP → HSP	0.245	0.093	0.008	Supported
H12	SC → WSC	0.298	0.088	0.001	Supported
H13	WSC → HSP	0.287	0.089	0.001	Supported
H14	SCult. → HSP	0.412	0.084	<0.001	Strongly Supported
H15	WSP → WSC	0.267	0.090	0.003	Supported

4.1.3. Structural Equation Model Interpretation

The SEM (Figure 2) validates LB as the primary upstream determinant of safety performance in Ghanaian construction. LB is the most significant predictor of LMX (β = 0.543), highlighting relational qualities as the principal means by which leaders influence employees' attitudes and behaviours. It also improves SC (β =

0.392) and SCult. (β = 0.287), as well as WSP (β = 0.198) and WSC (β = 0.245), indicating that leadership influence functions via both relational and operational channels. The SC serves as a fundamental mediator, substantially forecasting WSP (β = 0.334), WSC (β = 0.298), and HSP (β = 0.312). The SCult. has the most significant direct impact on performance (β = 0.412), suggesting that ingrained standards surpass transient views. Behavioural pathways are significant: WSP (β = 0.245) and WSC (β = 0.287) both directly influence performance, with WSP also enhancing WSC (β = 0.267). The model explains 62.8% of the variation in safety performance, indicating an interconnected system in which leadership influences results via relationship exchanges, safety attitudes, cultural integration, and behavioural processes. Enhancing safety in the industry requires coordinated actions across many paths rather than standalone initiatives.



Source: Authors' work.

Figure 2. Structural equation model.

4.2. Qualitative Findings

4.2.1. Demographic and Occupational Characteristics of Participants

A total of 37 interviews were conducted; however, one (SO18) was terminated after 14 minutes, and its corresponding data was eliminated. The sample was mostly male (94.44%), illustrating the gender disparity in the construction sector, and primarily included those aged 30 - 39 (47.22%), followed by those aged 20 - 29 (25%) and 40 - 49 (22.22%), suggesting that construction sites are mainly manned by young to mid-career professionals. Educational achievement was elevated: over half (52.78%) of participants had bachelor's degrees, 13.89% held master's degrees, 11.11% had diplomas, and 8.33% obtained other tertiary credentials, with a minimal number owning NVTI certificates. Significantly, almost all individuals in safety-related positions (28 participants) had professional certificates such as either NEBOSH, OSHA, ISO, EOSH, IOSH, or HSE, highlighting considerable proficiency in occupational safety.

Employment roles were mostly held by safety management jobs, with safety officers (76.92%) and safety managers (15.39%) being most common, in addition to coordinators, assistants, artisans (8.33%), engineers (5.56%), and project managers or supervisors (13.89%). The construction experience varied from one to 30 years, with an average of 7.8 years. The majority of participants (77.78%) had one to ten years of experience, while 5.56% had between 11 and 20 years, creating a balance between novice and experienced experts. Interview lengths varied from 25 to 35 minutes, indicating the level of participation. Telephone interviews constituted 55.56% while the remaining took place in person at various locations or site offices. Interviews were sometimes arranged during evening hours to suit participants.

Participants primarily included local companies (over 50%), while multinationals represented about 25%, along with a smaller percentage from foreign companies, facilitating a comparative analysis of safety performance across Ghana's contractor levels. The majority were linked to prime contractors (75%), while others were subcontractors (19.44%) and project management consultants. The projects exemplified the diversity of Ghana's construction sector, encompassing residential (apartments, houses), commercial (offices, multipurpose facilities), institutional (hospitals, lecture halls, stadiums, sports complexes), industrial (factories, data centres), and infrastructure developments (harbours). These projects were in different phases: foundation, superstructure, finishing, and completion. Geographically, 78% were situated in Greater Accra, with supplementary projects in Ashanti (11.11%), Central (5.56%), Northern (2.78%), and Western (2.78%), confirming Greater Accra's status as the preeminent centre of construction activity.

4.2.2. Safety Leadership's Influence on Safety Performance

The qualitative data indicates leadership is a critical element in enhancing safety performance at construction sites in Ghana. Leaders establish safety standards, enforce regulations, educate and inspire employees, balance production requirements, and promote open communication and trust via their behaviours and strategies. These measures foster a robust safety culture that promotes adherence to safe procedures and decreases accidents. Participants, for example, made the following remarks and are categorised as follows:

Leadership and Establishing Safety Protocols: Leaders serve as essential exemplars by continually exhibiting safe behaviours. One participant said, "Leaders don personal protective equipment… Our leaders inspire and motivate us to perform" (A1), while another highlighted, "They exemplify best practices, assist in inspections and training… act as role models and mentor employees" (SM3). This observable dedication motivates employees to emulate, establishing a culture of safety adherence.

Enforcement and Accountability: Leaders uphold safety standards via vigilant monitoring and rectification of hazardous activity. For example, a worker said, "Our safety officer prohibits unsafe actions…" and issued a nonconformance to a supervisor" (A2). Another emphasised point is, "Reporting nonconformance on the WhatsApp platform… provides corrective measures and deadlines" (SM2), illustrating how accountability systems bolster safety regulations.

Continuous Safety Education: Continuous safety education is essential for augmenting workers' knowledge and awareness. Participants acknowledged the leadership's responsibility in delivering training and coaching: "They participate in safety meetings, deliver safety presentations, educate, motivate, and assess tasks" (SO12), and "Supply PPEs, perform regular inspections, and engage in safety coaching" (OD). These exercises enable employees to identify and alleviate threats.

Motivation and Positive Reinforcement: Leaders cultivate motivation via encouragement and rewards, thereby enhancing positive safety behaviour: "Most senior managers reward employees for exemplary safety behaviour" (SM4), and "I consistently remind employees about safety, encourage and educate them, and occasionally impose penalties" (SS). Positive reinforcement fosters dedication to safe habits.

Balancing Safety and Production Demands: Certain participants underscored the difficulties in reconciling safety with productivity pressures: "Leadership prioritises production over safety… They perceive insistence on safety as a hindrance to progress" (HSSC), whereas others accentuated the importance of effective leadership by stating, "Integrating transformational and transactional leadership styles is essential for ensuring safety at our site" (OD). This equilibrium is essential to avoid jeopardising safety for production objectives.

Communication, *Collaboration, and Trust Development*: Leaders promote transparent communication and collaboration, thereby augmenting shared safety accountability: "Integrating sanctions, incentives, dialogue, respect, and training… This method has improved safety adherence and performance" (SM2), and "Synchronise activities, mobilise resources, engage in open communication and collaboration" (SO4). Such inclusive methodologies enhance the safety culture on-site.

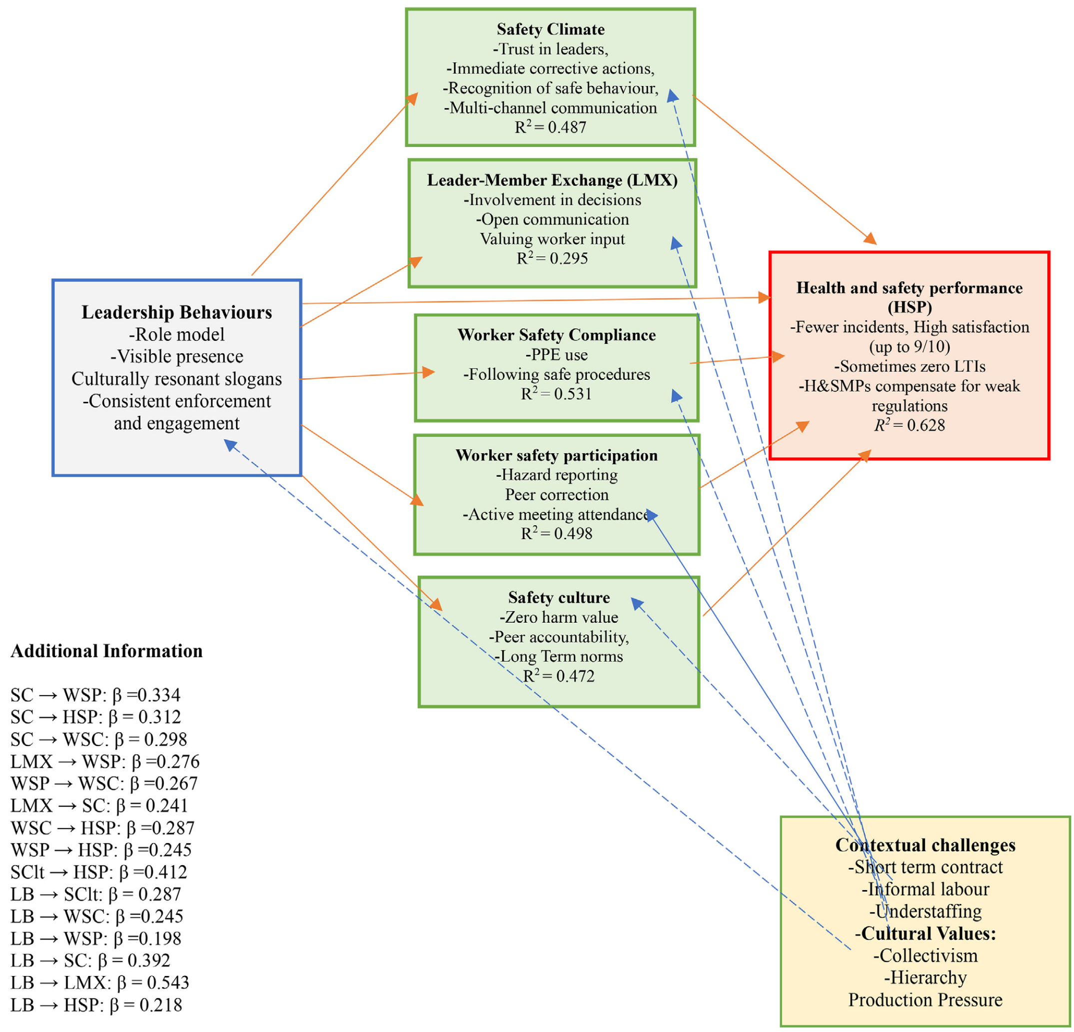
4.3. Triangulation of Results

Triangulation (**Table 3**) substantiates that leadership is the primary determinant of safety performance; it influences relational (LMX), perceptual (climate and culture), and behavioural (compliance and participation) processes. Quantitative findings indicate that all leadership channels are relevant; however, qualitative insights demonstrate how leaders exemplify safety, enforce regulations, communicate transparently, mentor employees, and offer ongoing training. SCult. and SC serve as essential mediators, strengthening collective norms and fostering situations that encourage WSP and WSC. WSC and WSP subsequently transform these organisational circumstances into quantifiable safety results. The comprehensive data indicates that leadership stimulates interrelated relational, cultural, and behavioural pathways that jointly improve safety performance in Ghana's construction industry.

Table 3. Triangulation of quantitative hypotheses and qualitative insights.

Quantitative Relationship (Hypothesis)	Statistical Outcome	Supporting Qualitative Themes/Evidence	Integrated Interpretation
H5: LB → HSP ($\beta = 0.218$)	Confirmed	The positive behaviours of leaders (role modelling, enforcement, encouragement) significantly impact employee safety behaviour and performance.	Leadership is the fundamental catalyst for safety performance via demonstrable commitment and the implementation of safety standards.
H6: LB → SCult. ($\beta = 0.287$)	Confirmed	Leaders create a strong safety culture by honest communication, teamwork, consequences, incentives, discussion, and respect.	Leadership cultivates a culture of collective accountability and compliance with safety protocols.
H14: SCult. →HSP ($\beta = 0.412$)	Strongly Confirmed	A culture of safety fosters adherence to regulations and decreases accidents. Employees assimilate safety rules via the reinforcement of leadership.	An effective safety culture acts as a conduit connecting leadership to safety results.
H2: LB→SC ($\beta = 0.392$)	Strongly Confirmed	Leaders serve as exemplars by using PPE, enforcing regulations, doing inspections, supplying PPE, and mentoring employees.	Leadership distinctly influences the workplace atmosphere (safety climate) by exemplifying and upholding safety norms.
H7: LB → WSC ($\beta = 0.245$)	Affirmed	Theme of Enforcement and Accountability: Leaders oversee, restrict hazardous behaviours, and generate nonconformance reports.	Leadership mandates adherence to regulations and responsibility, hence promoting safer behaviours on-site.
H12: SC → WSC ($\beta = 0.298$)	Affirmed	A favourable environment fostered by consistent leadership behaviour promotes adherence.	Employees replicate the attitudes of their leaders, thereby converting the organisational into compliance with regulations.
H13: WSC → HSP ($\beta = 0.287$)	Affirmed	Sanctions, incentives, and training improve compliance with safety protocols and results.	Compliance functions as a behavioural mechanism that converts leadership and organisational climate into performance.
H1: LB → LMX ($\beta = 0.543$)	Strongly Confirmed	Relational leadership involves the equitable treatment of employees, fostering care, providing motivation, and cultivating trust.	Superior leader-member connections improve communication and foster mutual respect for safety.
H3: LMX → SC ($\beta = 0.241$)	Confirmed	The amicability, communication, and mentorship of leaders foster trust and collective safety standards.	LMX functions as a social mechanism that connects leadership style to a favourable safety climate.
H8: LB → WSP ($\beta = 0.198$)	Affirmed	Leaders promote and incentivise engagement by acknowledgement, education, and transparent communication.	Motivational leadership fosters proactive employee engagement in safety initiatives.
H10: SC → WSP ($\beta = 0.334$)	Strongly Confirmed	A supportive environment fosters employee participation in idea generation and safety measures.	An affirmative environment promotes psychological safety and proactive participation.
Continuous Training and Education (Cross-disciplinary)	—	Leaders provide training sessions, toolbox discussions, and safety mentorship.	Ongoing education maintains awareness and enhances climate, compliance, and performance.
Production Pressure (Contextual Nuance)	—	Leaders sometimes prioritise output above safety.	Emphasises the need for a harmonious blend of transformational and transactional leadership to ensure safety integrity.

4.4. Mixed Methods Model



Source: Authors' work.

Figure 3. Integrated conceptual model for the influence of health and safety leadership practices on health and safety performance.

The mixed-methods model (**Figure 3**) indicates that LB is the principal determinant of HSP in Ghanaian construction industry and functions via several mediating mechanisms. LB significantly influences LMX (β = 0.543), corroborating the qualitative findings that employees perform optimally when supervisors exhibit transparency, maintain constant communication, and acknowledge contributions. LB also influences SC (β = 0.392), indicating employees' trust in leadership, assessment of remedial actions, and acknowledgement of safe procedures. SC impacts WSP (β = 0.334) and WSC (β = 0.298), demonstrating that perceived leadership commitment fosters safe behaviour. Aside from SC, SCult—the collective standards of zero harm and mutual accountability—exerts the most significant direct influence on HSP (β = 0.412). WSP and WSC convert these views and norms into action, substantially influencing performance (β = 0.245 and 0.287).

The quantitative SEM exhibits significant explanatory power ($R^2 = 0.628$), whereas qualitative insights augment the robustness and application of these projections by contextualising leadership and safety dynamics throughout routine organisational practice. Dashed routes underscore contextual issues highlighted qualitatively—temporary contracts, informal employment, understaffing, hierarchical frameworks, and production pressures—that may undermine LB, restrict SC and SCult, and obstruct WSP or WSC. The model indicates that leadership influences safety via relational, perceptual, cultural, and behavioural processes, all of which are influenced by Ghana's distinct sociocultural and institutional setting (**Figure 3**).

5. Discussion

The findings indicate that LB is the principal factor influencing HSP in Ghanaian construction projects and functions via relational, perceptual, cultural, and behavioural processes. Quantitatively, LB had the most significant impact on LMX, $\beta = 0.543$, suggesting that relationship quality is the primary mechanism by which leaders influence employees' safety perceptions and behaviours. Qualitative data supports this, with findings demonstrating that leaders actively coach staff, exemplify safe behaviours, enforce standards, and cultivate trust, thereby inspiring compliance with safety regulations. These results correspond with findings from Mainland China region, China-Hong Kong region, Iran, South Africa, and other high-risk sectors, indicating that superior LMX improves compliance, participation, and safety outcomes (He et al., 2021; Zhang et al., 2017; Skeepers & Mbohwa 2015; Mullen et al., 2011).

SC and SCult. have emerged as crucial mediating categories. SC significantly impacted WSP ($\beta = 0.334$) and WSC ($\beta = 0.298$), but SCult. had the most substantial direct influence on health and safety performance (HSP, $\beta = 0.412$). Qualitative data indicate that leaders strengthen norms by continuous training, feedback, coaching, and acknowledgement, cultivating collective attitudes of safety and a healthy corporate culture. The results are consistent with global studies showing that climate affects short-term perceptions and actions, while culture promotes long-term adherence through established norms and shared responsibility (Zohar, 2002; Fang et al., 2022; Adzivor et al., 2024).

Behavioural mechanisms—WSP and WSC—convert perceptions and cultural norms into action. WSP enhances WSC ($\beta = 0.267$), suggesting that active participation strengthens compliance to rules. Qualitative results substantiate that positive reinforcement, coaching, supervisory oversight, and mentoring enhance both participation and compliance, corroborating findings from transformational and transactional leadership studies (Shen et al., 2017; Lingard et al., 2019).

The study furthermore revealed other secondary results that explain the context-specific dynamics of safety leadership in Ghana. Initially, participants saw the difficulty of reconciling safety with production pressures, since operational objectives may contradict compliance with safety regulations ("Leadership prioritises production over safety… insistence on safety as an impediment"—HSSC). This study indicates a moderating effect, in which production goals may diminish leadership's impact on SC, SCult., and WSB, aligning with global findings from rapid construction settings (Wu et al., 2015; Xia et al., 2020).

Secondly, motivation and positive reinforcement surfaced as a pivotal process. Leaders promote participation and compliance by acknowledging outstanding safety behaviour, offering rewards, and occasionally enforcing penalties ("Most senior managers reward employees for exemplary safety behaviour"—SM4), in alignment with transformational leadership theories that highlight discretionary safety engagement (Lingard et al., 2019; Shen et al., 2017).

Third, communication, cooperation, and cultivating trust were emphasised as essential relationship practices. Leaders foster transparent communication, collaboration, and the strategic implementation of rewards and penalties, thereby augmenting trust and collective responsibility (SM2, SO4), which aligns with international research that demonstrates the importance of engagement and relational quality in influencing safety outcomes (Mullen et al., 2011; Bentoy et al., 2022).

Fourth, continuous safety education was considered essential for improving workers' knowledge, attitudes, and actions. Leaders engage in safety meetings, provide information, offer coaching, and guarantee the accessibility of personal protective equipment ("They participate in safety meetings, deliver safety presentations, educate, motivate, and assess tasks"—SO12). These approaches correspond with global data that demonstrates the importance of continuous education in converting leadership into quantifiable safety results (Fang et al., 2022; Gao et al., 2016).

The study identifies structural and institutional limitations that hinder leadership effectiveness, such as short-term contracts, informal labour arrangements, understaffing, hierarchical norms, and inadequate enforcement. These challenges affect leadership's impact on safety performance, aligning with literature on high-risk, resource-constrained environments where structural support and institutional enforcement are crucial (Wu et al., 2015; Xia et al., 2020; Kheni & Afatsawu, 2022).

The SEM indicated that leadership behaviour significantly influences safety climate, culture, and worker behaviour, collectively accounting for 62.8% of the variance in safety performance. The qualitative data clarifies this relationship by detailing how relational quality, climate, culture, and worker behaviours impact safety outcomes in Ghana's construction sector. Overall, these findings underscore the crucial role of leadership in improving construction safety.

Research Contributions

This study enhances construction safety research by developing and verifying a context-specific safety leadership model for Ghana, which includes LB, LMX, SC, SCult., and WSB. This study situates these constructs within Ghana's hierarchical and socio-institutional framework, thereby enhancing global leadership-safety literature and addressing deficiencies in comprehending how leadership correlates with quantifiable safety outcomes in construction settings of developing countries

(Danso et al., 2023; Sherratt & Aboagye Nimo, 2022). The results indicate that relational, perceptual, cultural, and behavioural mechanisms collectively mediate the impact of leadership on safety performance, offering empirical validation for SET, transformational and transactional leadership, and motivational frameworks (Bass 1985; Kelloway et al., 2012; Blau, 1964; Ajzen, 1991). The amalgamation of SEM data with qualitative insights provides a sophisticated viewpoint seldom documented in previous studies (e.g., Addo & Dartey-Baah, 2020; Dartey-Baah et al., 2021).

The research identifies critical leverage points—LB, LMX, SC, SCult, and WSB—those organisations may affect via mentorship, coaching, training, recognition, and structured feedback to enhance compliance, participation, and overall safety performance. The results underscore the need for harmonising safety and production goals, guaranteeing that operational efficiency does not undermine compliance. Construction managers and safety officers in Ghana must therefore emphasise leadership development, foster a strong safety culture, promote peer engagement, provide regular feedback, and ensure ongoing monitoring to translate organisational policies into enhanced site safety outcomes.

Insights on policy and institutions are also apparent. Structural and regulatory limitations—temporary contracts, informal employment, hierarchical norms, and inadequate enforcement—diminish leadership efficacy, indicating areas that need improvement. Policymakers and regulators may improve safety by intensifying enforcement, formalising employment contracts, and enhancing the capabilities of supervisors and safety authorities. Incorporating leadership-focused safety protocols into legislation may enhance compliance and encourage proactive worker involvement, hence cultivating safer construction workplaces (Kheni & Afatsawu, 2022; Novieto, 2023).

This research presents evidence from a low-resource, hierarchical, and collectivist construction environment, with findings that align broadly with previous studies conducted in high-risk contexts such as Mainland China region, China Hong Kong region, Iran, and South Africa (He et al., 2021; Zhang et al., 2017; Skeepers & Mbohwa, 2015; Mullen et al., 2011). The findings clarify relational, perceptual, cultural, and behavioural processes, providing insights for other developing countries with analogous socio-cultural and institutional contexts and a framework for cross-contextual benchmarking.

By combining SEM, which explains 62.8% of the variance in safety performance, with the qualitative data that offers contextual insight into the mechanisms through which leadership influences safety performance, the study demonstrates the methodological value of the mixed-methods approach. This integration strengthens knowledge of the statistical relationships and offers a strong foundation for future research and practical safety solutions.

6. Conclusions and Recommendations

6.1. Conclusions

This study illustrates that leadership behaviour is the primary determinant of safety performance in Ghanaian construction sector, functioning via relational, perceptual, cultural, and behavioural channels. High-quality LMX, a favourable SC, an entrenched SCult., and proactive WSP and WSC account for 62.8% of the variation in HSP. Qualitative findings demonstrate how mentoring, role modelling, coaching, and open communication convert leadership into quantifiable enhancements in safety behaviour. The findings underscore the difficulties in reconciling safety with production requirements, the essential importance of motivation and positive reinforcement, and the moderating influence of structural and institutional limitations. The study offers a sophisticated, contextually aware comprehension of leadership-influenced safety performance in a construction environment of a developing nation by amalgamating quantitative data with practical contextual insights.

Limitation

Notwithstanding its merits, the research had drawbacks. The cross-sectional methodology limits causal conclusions, whereas longitudinal research might more effectively explain the progression of leadership and safety policies over time. The emphasis on large- and medium-scale projects in Ghana may restrict their applicability to small-scale projects or other industries. Social desirability bias may influence self-reported survey and interview data; however, triangulation with qualitative evidence alleviates this issue. Employing purposive and snowball sampling may result in selection bias, limiting the generalisability of the results to a wider population of construction workers and managers in Ghana. Ultimately, while structural and institutional restrictions were qualitatively analysed, their quantitative moderating effects were not investigated, suggesting a potential avenue for future study.

6.2. Recommendations

Based on the study's empirical results and theoretical integration, the following suggestions are made to improve safety performance in Ghana's construction sector by focusing on leadership behaviours, institutional capabilities, and future research requirements:

- Construction organisations should prioritise visible, active, and supportive leadership that incorporates both transformational and transactional methodologies for practice.
- Leaders must actively teach and train staff, reward safety behaviours via recognition and feedback, and cultivate trust and open communication to improve compliance and participation.
- Policy and regulatory organisations, together with industry groups, should enhance enforcement mechanisms, formalise labour agreements, and provide capacity-building programmes for supervisors and safety officials. Policies that institutionalise leadership-driven safety interventions may guarantee that structural constraints—such as short-term contracts, understaffing, and hierarchical norms do not compromise safety performance.

- Future study should use longitudinal designs to examine causation and assess the moderating impact of contextual variables on leadership and safety outcomes. Broadening the study across various industries, project sizes, and cultural settings would improve generalisability and offer comparative perspectives on international construction safety practices.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data Availability

The data that support the findings for this study are available from the corresponding author upon reasonable request.

Declaration on Generative AI and AI-Enhanced Technology in the Writing Process

We used ChatGPT-5 and QuillBot to improve the wording and clarity in the preparation of this paper. Upon using these tools or service, we meticulously evaluated and revised the material as necessary and assume complete responsibility for the publication's content.

Conflicts of Interest

The authors report there are no competing interests to declare.

References

Addo, S. A., & Dartey-Baah, K. (2020). Leadership in the Safety Sense: Where Does Perceived Organisational Support Fit? *Journal of Management Development, 39,* 50-67. https://doi.org/10.1108/jmd-04-2019-0136

Adotey, P. B., Segbefia, E., Sampene, A. K., & O'Brien, C. (2025). Occupational Health and Safety Practices to Enhance Safety Behavior in Ghana's Mining Sector: The Moderating Effect of Transformational Leadership. *Journal of the Knowledge Economy, 16,* 18527-18558. https://doi.org/10.1007/s13132-025-02636-6

Adzivor, E., Emuze, F., Ahiabu, M., & Kusedzi, M. (2024). Scaling Up a Positive Safety Culture among Construction Small and Medium-Sized Enterprises in Ghana. *International Journal of Environmental Research and Public Health, 21,* Article 817. https://doi.org/10.3390/ijerph21070817

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 50,* 179-211. https://doi.org/10.1016/0749-5978(91)90020-t

Allen, M. (2017). *The Sage Encyclopedia of Communication Research Methods* (Vols. 1-4). Sage Publications Inc.

Ansong, A., Amadu, S. S., & Ahomka Yeboah, M. (2017). Ethical Leadership, Safety Climate, and Employee Health and Safety: Lessons from the Oil and Gas Industry in Ghana. *International Journal of Ethics and Systems, 41,* 392-410. https://doi.org/10.1108/ijoes-02-2023-0027

Ardeshir, A., & Mohajeri, M. (2018). Assessment of Safety Culture among Job Positions in High-Rise Construction: A Hybrid Fuzzy Multi Criteria Decision-Making (FMCDM) Approach. *International Journal of Injury Control and Safety Promotion, 25,* 195-206. https://doi.org/10.1080/17457300.2017.1416483

Ayarkwa, J., Agyekum, K., Adinyira, E., & Osei-Asibey, D. (2012). Barriers to Successful Implementation of Lean Construction in the Ghanaian Building Industry. *Journal of Construction, 5,* 3-11.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory.* Prentice-Hall.

Bass, B. M. (1985). *Leadership and Performance beyond Expectations.* Free Press.

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* Columbia University Press.

Bentoy, M., Mata, M., Bayogo, J., Vasquez, R., Almacen, R. M., Evangelista, S. S. et al. (2022). Complex Cause-Effect Relationships of Social Capital, Leader-Member Exchange, and Safety Behavior of Workers in Small-Medium Construction Firms and the Moderating Role of Age. *Sustainability, 14,* Article 12499. https://doi.org/10.3390/su141912499

Bhalerao, A. K. (2015). Application and Performance of Google Forms for Online Data Collection and Analysis: A Case of North Eastern Region of India. *Indian Journal of Extension Education, 51,* 49-53.

Birks, M., & Mills, J. (2015). *Grounded Theory: A Practical Guide* (2nd ed.). SAGE Publications Ltd.

Blau, P. M. (1964). *Exchange and Power in Social Life.* Wiley.

Braun, V., & Clarke, V. (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology, 3,* 77-101. https://doi.org/10.1191/1478088706qp063oa

Brown, M. E., & Treviño, L. K. (2006). Ethical Leadership: A Review and Future Directions. *The Leadership Quarterly, 17,* 595-616. https://doi.org/10.1016/j.leaqua.2006.10.004

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace Safety: A Meta-Analysis of the Roles of Person and Situation Factors. *Journal of Applied Psychology, 94,* 1103-1127. https://doi.org/10.1037/a0016172

Clarke, S. (2013). Safety Leadership: A Meta-Analytic Review of Transformational and Transactional Leadership Styles as Antecedents of Safety Behaviours. *Journal of Occupational and Organizational Psychology, 86,* 22-49. https://doi.org/10.1111/j.2044-8325.2012.02064.x

Clarke, S., & Ward, K. (2006). The Role of Leader Influence Tactics and Safety Climate in Engaging Employees' Safety Participation. *Risk Analysis, 26,* 1175-1185. https://doi.org/10.1111/j.1539-6924.2006.00824.x

Cooper, M. D. (2000). Towards a Model of Safety Culture. *Safety Science, 36,* 111-136. https://doi.org/10.1016/s0925-7535(00)00035-7

Creswell, J. W. (2008). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (3rd ed.). Pearson Education, Inc.

Creswell, J. W. (2015). *A Concise Introduction to Mixed Methods Research.* Sage Publications

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and Conducting Mixed Methods Research* (3rd ed.). Sage Publications.

Danso, F. O., Agyekum, K., Manu, P., Adinyira, E., Ahadzie, D. K., & Badu, E. (2023). Examining the Perception of Site Workers of Their Risk-Taking Behaviours on Construction Sites in Ghana. *Engineering, Construction and Architectural Management, 31,* 2997-3023. https://doi.org/10.1108/ecam-02-2022-0113

Dartey-Baah, K., Quartey, S. H., & Adotey, A. (2021). Examining Transformational and Transactional Leadership Styles and Safety Citizenship Behaviors in the Power Distribution Sector: Evidence from Ghana. *International Journal of Energy Sector Management, 15,* 173-194. https://doi.org/10.1108/ijesm-07-2020-0008

Debela, M. B., Azage, M., Deyessa, N., & Begosaw, A. M. (2022). Economic Costs and Predictors of Occupation-Related Injuries in Ethiopian Sugar Industries from the Employer's Perspective: Top-Down Approach and Friction Method: Top-Down Approach and Friction Method. *BMC Public Health, 22,* Article No. 2103. https://doi.org/10.1186/s12889-022-14519-5

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative Content Analysis: A Focus on Trustworthiness. *Sage Open, 4,* 1-10. https://doi.org/10.1177/2158244014522633

Emmel, N. (2013). *Sampling and Choosing Cases in Qualitative Research. A Realist Approaches*. Sage.

Etikan, I. (2017). Sampling and Sampling Methods. *Biometrics & Biostatistics International Journal, 5,* 215-217. https://doi.org/10.15406/bbij.2017.05.00149

Fang, D., Huang, Y., Guo, H., & Lim, H. W. (2020). LCB Approach for Construction Safety. *Safety Science, 128,* Article 104761. https://doi.org/10.1016/j.ssci.2020.104761

Fang, D., Wang, Y., Lim, H. W., Ma, L., Gu, B., & Huang, Y. (2022). Construction of a Bayesian Network Based on Leadership-Culture-Behavior Model to Improve Owner Safety Management Behavior. *Journal of Construction Engineering and Management, 149,* Article 04022177. https://doi.org/10.1061/jcemd4.coeng-12465

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research, 18,* 39-50. https://doi.org/10.1177/002224378101800104

Gao, R., Chan, A., Utama, W., & Zahoor, H. (2016). Multilevel Safety Climate and Safety Performance in the Construction Industry: Development and Validation of a Top-Down Mechanism. *International Journal of Environmental Research and Public Health, 13,* Article 1100. https://doi.org/10.3390/ijerph13111100

Ghana Statistical Service (GSS) (2021). *2021 Population and Housing Census (PHC) General Report, Vol. 3E: Economic Activity.*

Ghazali, N. H. M. (2016). A Reliability and Validity of an Instrument to Evaluate the School-Based Assessment System: A Pilot Study. *International Journal of Evaluation and Research in Education (IJERE), 5,* 148-157. https://doi.org/10.11591/ijere.v5i2.4533

Gracia, F. J., Tomás, I., Martínez-Córcoles, M., & Peiró, J. M. (2020). Empowering Leadership, Mindful Organizing and Safety Performance in a Nuclear Power Plant: A Multilevel Structural Equation Model. *Safety Science, 123,* Article 104542. https://doi.org/10.1016/j.ssci.2019.104542

Graen, G. B., & Uhl-Bien, M. (1995). Relationship-Based Approach to Leadership: Development of Leader-Member Exchange (LMX) Theory of Leadership over 25 Years: Applying a Multi-Level Multi-Domain Perspective. *The Leadership Quarterly, 6,* 219-247. https://doi.org/10.1016/1048-9843(95)90036-5

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis, 11,* 255-274. https://doi.org/10.3102/01623737011003255

He, C., McCabe, B., & Jia, G. (2021). Effect of Leader-Member Exchange on Construction

Worker Safety Behavior: Safety Climate and Psychological Capital as the Mediators. *Safety Science, 142,* Article 105401. https://doi.org/10.1016/j.ssci.2021.105401

Hu, L., & Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6,* 1-55. https://doi.org/10.1080/10705519909540118

Jackson, S. L. (2003). *Research Methods and Statistics, A Critical Thinking Approach.* Thomson Wadsworth.

Ju, C., & Rowlinson, S. (2014). Institutional Determinants of Construction Safety Management Strategies of Contractors in Hong Kong. *Construction Management and Economics, 32,* 725-736. https://doi.org/10.1080/01446193.2014.909048

Kallio, H., Pietilä, A., Johnson, M., & Kangasniemi, M. (2016). Systematic Methodological Review: Developing a Framework for a Qualitative Semi-Structured Interview Guide. *Journal of Advanced Nursing, 72,* 2954-2965. https://doi.org/10.1111/jan.13031

Kelloway, E. K., Turner, N., Barling, J., & Loughlin, C. (2012). Transformational Leadership and Employee Psychological Well-Being: The Mediating Role of Employee Trust in Leadership. *Work & Stress, 26,* 39-55. https://doi.org/10.1080/02678373.2012.660774

Khan, N., Ahmad, I., & Ilyas, M. (2018). Impact of Ethical Leadership on Organizational Safety Performance: The Mediating Role of Safety Culture and Safety Consciousness. *Ethics & Behavior, 28,* 628-643. https://doi.org/10.1080/10508422.2018.1427097

Kheni, N. A., & Afatsawu, K. P. (2022). A Study of Challenges Faced by Regulatory Authorities for Implementing Health and Safety Compliance in the Ghana Construction Industry Context. *International Journal of Management & Entrepreneurship Research, 4,* 315-333. https://doi.org/10.51594/ijmer.v4i7.353

Kheni, N. A., Dainty, A. R., & Gibb, A. G. (2007). Influence of Political and Socio-Cultural Environments on Health and Safety Management Within SMEs: A Ghana Case Study. In D. Boyd (Ed.), *Procs 23rd Annual ARCOM Conference* (pp. 159-168-5). Association of Researchers in Construction Management.

Kline, R. B. (2023). *Principles and Practice of Structural Equation Modeling.* Guilford Publications.

Leavy, P. (2017). *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches.* The Guilford Press.

Lingard, H., Zhang, R. P., & Oswald, D. (2019). Effect of Leadership and Communication Practices on the Safety Climate and Behaviour of Construction Workgroups. *Engineering, Construction and Architectural Management, 26,* 886-906. https://doi.org/10.1108/ecam-01-2018-0015

McAbee, S. T., Landis, R. S., & Burke, M. I. (2017). Inductive Reasoning: The Promise of Big Data. *Human Resource Management Review, 27,* 277-290. https://doi.org/10.1016/j.hrmr.2016.08.005

Meshcheryakov, G., Igolkina, A. A., & Samsonova, M. G. (2021). *Semopy 2: A Structural Equation Modeling Package with Random Effects in Python.* arXiv:2106.01140.

Mullen, J., Kelloway, E. K., & Teed, M. (2011). Inconsistent Style of Leadership as a Predictor of Safety Behaviour. *Work & Stress, 25,* 41-54. https://doi.org/10.1080/02678373.2011.569200

Neal, A., & Griffin, M. A. (2006). A Study of the Lagged Relationships among Safety Climate, Safety Motivation, Safety Behavior, and Accidents at the Individual and Group Levels. *Journal of Applied Psychology, 91,* 946-953. https://doi.org/10.1037/0021-9010.91.4.946

Ni, G., Zhu, Y., Zhang, Z., Qiao, Y., Li, H., Xu, N. et al. (2020). Influencing Mechanism of Job Satisfaction on Safety Behavior of New Generation of Construction Workers Based on Chinese Context: The Mediating Roles of Work Engagement and Safety Knowledge Sharing. *International Journal of Environmental Research and Public Health, 17,* Article 8361. https://doi.org/10.3390/ijerph17228361

Novieto, D. T. (2023). Safety Climate and Occupational Safety Behaviours: The Mediating Role of Psychological Ownership among Construction Professionals. *Engineering, Construction and Architectural Management, 30,* 853-868. https://doi.org/10.1108/ecam-06-2021-0539

Pallant, J. (2011). *SPSS Survival Manual: A Step-by-Step Guide to Data Analysis Using SPSS* (4th ed.). Allen and Unwin.

Park, L. S., & Peter, S. (2022). Application of Critical Realism in Social Work Research: Methodological Considerations. *Aotearoa New Zealand Social Work, 34,* 55-66. https://doi.org/10.11157/anzswj-vol34iss2id932

Parker, C., Scott, S., & Geddes, A. (2019). Snowball Sampling. In *SAGE Research Methods Foundations* (pp. 1-13). https://eprints.glos.ac.uk/view/journals/SAGE_Research_Methods_Foundations.html

Pillay, N., Ncube, N., Moopelo, K., Mothoagae, G., Welte, O., Shogole, M. et al. (2023). Translating the Consent Form Is the Tip of the Iceberg: Using Cognitive Interviews to Assess the Barriers to Informed Consent in South African Health Facilities. *Sexual and Reproductive Health Matters, 31,* Article 2302553. https://doi.org/10.1080/26410397.2024.2302553

Prinsloo, H., & Hofmeyr, K. B. (2022). Organisational Culture, Frontline Supervisory Engagement and Accountability, as Drivers of Safety Behaviour in a Platinum Mining Organisation. *SA Journal of Human Resource Management, 20,* 1-13. https://doi.org/10.4102/sajhrm.v20i0.1705

Rezagholi, M. (2023). The Economic Cost of Fatal Workplace Accidents in Sweden—A Methodology for Long-Term Decision Analysis. *Work, 75,* 75-84. https://doi.org/10.3233/wor-211120

Roche, N., Darzins, S., Oakman, J., & Stuckey, R. (2024). Worker Experiences of the Work Health and Safety Impacts of Exposure to Dying and Death in Non-Clinical Settings: A Qualitative Scoping Review. *Mortality, 30,* 189-214. https://doi.org/10.1080/13576275.2024.2315988

Sandelowski, M. (2008). Member Check. In L. Given (Ed.), *The Sage Encyclopedia of Qualitative Research Methods* (pp. 501-502). Sage.

Schoonenboom, J., & Johnson, R. B. (2017). How to Construct a Mixed Methods Research Design. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie, 69,* 107-131. https://doi.org/10.1007/s11577-017-0454-1

Shen, Y., Ju, C., Koh, T., Rowlinson, S., & Bridge, A. (2017). The Impact of Transformational Leadership on Safety Climate and Individual Safety Behavior on Construction Sites. *International Journal of Environmental Research and Public Health, 14,* Article 45. https://doi.org/10.3390/ijerph14010045

Sherratt, F., & Aboagye-Nimo, E. (2022). Decolonizing Occupational Safety Management: The Case of Construction Site Safety Culture in Ghana. *Safety Science, 151,* Article 105732. https://doi.org/10.1016/j.ssci.2022.105732

Shuster, E. (1997). Fifty Years Later: The Significance of the Nuremberg Code. *New England Journal of Medicine, 337,* 1436-1440. https://doi.org/10.1056/nejm199711133372006

Simpson, K. B., & Sam, A. (2020). Strategies for Health and Safety Management in Ghana. *Journal of Engineering, Design and Technology, 18,* 431-450. https://doi.org/10.1108/jedt-07-2019-0189

Skeepers, N. C., & Mbohwa, C. (2015). A Study on the Leadership Behaviour, Safety Leadership and Safety Performance in the Construction Industry in South Africa. *Procedia Manufacturing, 4,* 10-16. https://doi.org/10.1016/j.promfg.2015.11.008

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (2nd ed.). Sage Publications.

Sun, Y., Yang, H., Qian, C., Jiang, Y., Luo, X., & Wu, X. (2022). Voice Endorsement and Employee Safety Voice Behavior in Construction Projects: The Mediating Role of Leader-Member Exchange. *International Journal of Environmental Research and Public Health, 19,* Article 3374. https://doi.org/10.3390/ijerph19063374

Supardi, S., Chandrarin, G., & Sunardi. (2021). The Role of Safety Leadership and Safety Culture in Improving Safety Performance. *East African Scholars Journal of Economics, Business and Management, 4,* 55-62.

Ta, M. T. D., Kim, T., & Gausdal, A. H. (2022). Leadership Styles and Safety Performance in High-Risk Industries: A Systematic Review. *Safety and Reliability, 41,* 10-44. https://doi.org/10.1080/09617353.2022.2035627

Tajfel, H. (1972). Experiments in a Vacuum. In J. Israel, & H. Tajfel (Eds.), *The Context of Social Psychology* (pp. 69-119). Academic Press.

Tehrani, V. Z., Rezaifar, O., Gholhaki, M., & Khosravi, Y. (2019). Investigating Factors of Safety Culture Assessment in Construction Industry Projects. *Civil Engineering Journal, 5,* 971-983. https://doi.org/10.28991/cej-2019-03091304

Tennant, E., Miller, E., Costantino, K., De Souza, D., Coupland, H., Fotheringham, P. et al. (2020). A Critical Realist Evaluation of an Integrated Care Project for Vulnerable Families in Sydney, Australia. *BMC Health Services Research, 20,* Article No. 995. https://doi.org/10.1186/s12913-020-05818-x

Thomas, L. (2022). *Cross-Sectional Study | Definitions, Uses and Examples.* Scriber. https://www.scribbr.co.uk/research-methods/cross-sectional-design/

Thompson, J. (2022). A Guide to Abductive Thematic Analysis. *The Qualitative Report, 27,* 1410-1421. https://doi.org/10.46743/2160-3715/2022.5340

Timmermans, S., & Tavory, I. (2012). Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis. *Sociological Theory, 30,* 167-186. https://doi.org/10.1177/0735275112457914

Vroom, V. H. (1964). *Work and Motivation.* Wiley.

Wang, J., Liao, P., & Yu, G. (2021). The Mediating Role of Job Competence between Safety Participation and Behavioral Compliance. *International Journal of Environmental Research and Public Health, 18,* Article 5783. https://doi.org/10.3390/ijerph18115783

Wright, S. E., Walmsley, E., Harvey, S. E., Robinson, E., Ferrando-Vivas, P., Harrison, D. A. et al. (2015). Family-Reported Experiences Evaluation (FREE) Study: A Mixed-Methods Study to Evaluate Families' Satisfaction with Adult Critical Care Services in the NHS. *Health Services and Delivery Research, 3,* 1-250. https://doi.org/10.3310/hsdr03450

Wu, C., Fang, D., & Li, N. (2015). Roles of Owners' Leadership in Construction Safety: The Case of High-Speed Railway Construction Projects in China. *International Journal of Project Management, 33,* 1665-1679. https://doi.org/10.1016/j.ijproman.2015.07.005

Wu, T., Wang, Y., Ruan, R., & Zheng, J. (2022). Divergent Effects of Transformational Leadership on Safety Compliance: A Dual-Path Moderated Mediation Model. *PLOS ONE, 17,* e0262394. https://doi.org/10.1371/journal.pone.0262394

Wu, X., Chong, H., Wang, G., & Li, S. (2018). The Influence of Social Capitalism on Construction Safety Behaviors: An Exploratory Megaproject Case Study. *Sustainability, 10,* Article 3098. https://doi.org/10.3390/su10093098

Xia, N., Xie, Q., Hu, X., Wang, X., & Meng, H. (2020). A Dual Perspective on Risk Perception and Its Effect on Safety Behavior: A Moderated Mediation Model of Safety Motivation, and Supervisor's and Coworkers' Safety Climate. *Accident Analysis & Prevention, 134,* Article 105350. https://doi.org/10.1016/j.aap.2019.105350

Yaddanapudi, S., & Yaddanapudi, L. N. (2019). How to Design a Questionnaire. *Indian Journal of Anaesthesia, 63,* 335-337. https://doi.org/10.4103/ija.IJA_334_19

Yu, X., Mehmood, K., Paulsen, N., Ma, Z., & Kwan, H. K. (2021). Why Safety Knowledge Cannot Be Transferred Directly to Expected Safety Outcomes in Construction Workers: The Moderating Effect of Physiological Perceived Control and Mediating Effect of Safety Behavior. *Journal of Construction Engineering and Management, 147,* Article 4020152. https://doi.org/10.1061/(asce)co.1943-7862.0001965

Zahoor, H., Chan, A., Utama, W., Gao, R., & Zafar, I. (2017). Modeling the Relationship between Safety Climate and Safety Performance in a Developing Construction Industry: A Cross-Cultural Validation Study. *International Journal of Environmental Research and Public Health, 14,* Article 351. https://doi.org/10.3390/ijerph14040351

Zhang, J., Zhai, H., Meng, X., Wang, W., & Zhou, L. (2020). Influence of Social Safety Capital on Safety Citizenship Behavior: The Mediation of Autonomous Safety Motivation. *International Journal of Environmental Research and Public Health, 17,* Article 866. https://doi.org/10.3390/ijerph17030866

Zhang, L., Chen, H., Li, H., Wu, X., & Skibniewski, M. J. (2018). Perceiving Interactions and Dynamics of Safety Leadership in Construction Projects. *Safety Science, 106,* 66-78. https://doi.org/10.1016/j.ssci.2018.03.007

Zhang, P., Li, N., Fang, D., & Wu, H. (2017). Supervisor-Focused Behavior-Based Safety Method for the Construction Industry: Case Study in Hong Kong. *Journal of Construction Engineering and Management, 143,* 1-10. https://doi.org/10.1061/(asce)co.1943-7862.0001294

Zohar, D. (2002). The Effects of Leadership Dimensions, Safety Climate, and Assigned Priorities on Minor Injuries in Work Groups. *Journal of Organizational Behavior, 23,* 75-92. https://doi.org/10.1002/job.130

Appendices

Appendix 1

Table S1. Demographics and occupational characteristics of respondents.

Category	Sub-category	Frequency	Percent
Gender	Male	479	89.7
	Female	55	10.3
	Total	534	100.0
Age Bracket	<18 years	1	0.2
	18 - 25 years	141	26.4
	26 - 33 years	204	38.2
	34 - 41 years	140	26.2
	42 - 49 years	39	7.3
	50 - 57 years	8	1.5
	>57 years	1	0.2
	Total	534	100.0
Qualification	No Education	1	0.2
	Primary	2	0.4
	Junior High/MLSC	16	3.0
	Inter/Senior High/WASSCE	166	31.1
	Advance/CTC	47	8.8
	NEBOSH	3	0.6
	HND	67	12.5
	Bachelor	191	35.8
	Masters	41	7.7
	Total	534	100.0
Work Schedule	Managers	38	7.1
	Engineers	116	21.7
	Supervisors	191	35.8
	Artisans	155	29.0
	Unskilled Personnel	34	6.4
	Total	534	100.0
Company Classification	D1K1/A1B1	441	82.6
	D2K2/A2B2	75	14.0
	D3K3/A3B3	15	2.8
	D4K4/A4B4	2	0.4
	Undisclosed	1	0.2
	Total	534	100.0

Continued

Project Site Location	Greater Accra	359	67.2
	Ashanti	105	19.7
	Western	38	7.1
	Northern	24	4.5
	Central	8	1.5
	Total	534	100.0
Company Category	Local	268	50.2
	Foreign	39	7.3
	Multinational	227	42.5
	Total	534	100.0
Years with Current Company	<1 year	137	25.7
	1 - 5 years	280	52.4
	6 - 10 years	79	14.8
	11 - 15 years	25	4.7
	16 - 20 years	6	1.1
	21 - 25 years	5	0.9
	>30 years	2	0.4
	Total	534	100.0
Years in the Construction Industry	<1 year	64	12.0
	1 - 5 years	207	38.8
	6 - 10 years	125	23.4
	11 - 15 years	72	13.5
	16 - 20 years	23	4.3
	21 - 25 years	23	4.3
	26 - 30 years	15	2.8
	>30 years	5	0.9
	Total	534	100.0

Appendix 2

Table S2. Factor loadings.

Construct	Item and Code	Factor Loading
Leadership Behaviours (6 items)	Integration of Safety and Production Goals (LSBLL1)	−0.767
	Involvement in Safety Activities (LSBLL2)	−0.838
	Positive Safety Climate (LSBLL3)	−0.784
	Discussion of Values with Workers (LSBLL4)	−0.734
	Hierarchical Reward and Punishment System (LSBLL5)	−0.737
	Task Understanding and Motivation Enhancement LSBLL6	−0.751

Continued

Leader-Member Exchange (11 items)	Workers respect for knowledge and competence (LMX1)	0.703
	Worker's perception of friendship (LMX2)	0.634
	Worker's willingness to apply extra efforts for safety (LMX3)	0.730
	Workers proactive engagement in safety effort (LMX4)	0.712
	Worker's willingness to invest in safety (LMX5)	0.719
	Workers admiration for professional skills in safety (LMX6)	0.749
	Worker's awareness of my satisfaction of safety (LMX7)	0.772
	Workers understanding of job problems and needs (LMX8)	0.726
	Recognition of workers potential (LMX9)	0.696
	Worker's perception of supportive authority LMX10	0.691
	Workers' confidence in leadership (LMX11)	0.629
Worker Safety Compliance (8 items)	Adherence to Safety Construction Rules (WSBSC1)	0.817
	Timely Reporting of Risks and Incidents (WSBSC2)	0.734
	Participation in Safety Meetings and Training (WSBSC3)	0.779
	Compliance with Safety Procedures: (WSBSC4)	0.872
	Use of Safety Equipment (WSBSC5)	0.850
	Application of Risk Reduction Techniques (WSBSC6)	0.801
	Implementation of Management Regulations (WSBSC7)	0.842
	Avoidance of Over-Familiarity Issues (WSBSC8)	0.815
Worker Safety Participation (10 items)	Encouragement of Peer Involvement (WSBSP1)	0.809
	Prevention of Safety Violations (WSBSP2)	0.824
	Reporting Safety Matters to Management (WSBSP3)	0.765
	Collaboration on Safety Improvements (WSBSP4)	0.769
	Reporting Driving Hazards (WSBSP5)	0.773
	Monitoring Colleague Compliance (WSBSP6)	0.758
	Alerting Co-workers to Safety Concerns (WSBSP7)	0.802
	Promotion of Safety Programmes (WSBSP8)	0.863
	Assistance in Hazardous Conditions (WSBSP9)	0.784
	Participation in Safety Planning and Evaluation (WSBSP10)	0.732
Safety Climate (9 items)	Perception of Company Commitment to Health and Safety (SC1)	0.786
	Adequacy of Health and Safety Training (SC2)	0.766
	Consistent Use of PPEs (SC3)	0.733
	Team Commitment to Health and Safety (SC4)	0.809
	Quality of Communication About Health and Safety (SC5)	0.834
	Availability of Resources for Health and Safety (SC6)	0.821
	Reasonableness of Time Pressures (SC7)	0.753
	Peer Reactions to Safety Violations (SC8)	0.754
	Prohibition of Working with Defective Equipment (SC9)	0.637
Safety Culture (11 items)	Effectiveness of Training and Supervision for Safe Work Delivery (SCult 1)	0.738
	Adherence to Safe Work Procedures (SCult 2)	0.774
	Involvement of Workers in Safety Procedures (SCult 3)	0.793
	Regular Reviews and Updates of Safety Procedures (SCult 4)	0.845
	Effective Consultation on Safety Issues (SCult 5)	0.766

Continued

	Safety Reporting Procedures for Incidents (SCult 6)	0.820
	Follow-Up on Safety Incident Reports (SCult 7)	0.814
	Review of Safety Training After Incidents (SCult 8)	0.822
	Management Commitment to Safety (SCult 9)	0.787
	Management's Priority for Safety as Role Models (SCult 10)	0.760
	Clear Procedures for Reporting Injuries (SCult 11)	0.743
Safety Performance (6 items)	Fewer Safety Incidents (SP1)	−0.713
	Reduction in Injuries (SP2)	−0.776
	Decrease in Equipment Failure (SP3)	−0.555
	Low Economic Losses (SP4)	−0.746
	Improved Compliance Behaviour (SP5)	−0.708
	Improved Participative Behaviour (SP6)	−0.584

Appendix 3

Table S3. Complete psychometric properties summary.

Construct	No. Items	α	ω	KMO	AVE	CR	Variance	Bartlett's χ^2	*p*-value	1st Eigenvalue
Leadership Behaviours	6	0.894	0.592	0.866	0.592	0.897	0.659	1816.48	<0.001	3.956
LMX	11	0.915	0.499	0.937	0.499	0.916	0.544	2973.81	<0.001	5.989
Worker Safety Compliance	8	0.940	0.664	0.930	0.664	0.940	0.705	3378.12	<0.001	5.642
Worker Safety Participation	10	0.941	0.622	0.938	0.622	0.943	0.660	4050.20	<0.001	6.597
Safety Climate	9	0.926	0.590	0.934	0.590	0.928	0.635	3137.59	<0.001	5.711
Safety Culture	11	0.947	0.621	0.937	0.621	0.947	0.655	4589.94	<0.001	7.208
Safety Performance	6	0.830	0.470	0.762	0.470	0.840	0.554	1406.17	<0.001	3.327

Notes:

- α = Cronbach's Alpha; ω = McDonald's Omega; KMO = Kaiser-Meyer-Olkin
- AVE = Average Variance Extracted; CR = Composite Reliability
- All Bartlett's tests significant ($p < 0.001$), confirming factorability

Appendix 4

Table S4. Factor loading performance analysis.

Construct	No. Items	Loading Range	Mean Loading	SD	Lowest Loading	Highest Loading
Leadership Behaviours	6	−0.838 to −0.734	−0.769	0.035	−0.838	−0.734
LMX	11	0.629 to 0.772	0.706	0.041	0.629	0.772
Worker Safety Compliance	8	0.734 to 0.872	0.814	0.041	0.734	0.872
Worker Safety Participation	10	0.732 to 0.863	0.788	0.036	0.732	0.863
Safety Climate	9	0.637 to 0.834	0.766	0.056	0.637	0.834
Safety Culture	11	0.738 to 0.845	0.787	0.033	0.738	0.845
Safety Performance	6	−0.776 to −0.555	−0.680	0.082	−0.776	−0.555

Interpretation: All factor loadings exceed 0.60 threshold (in absolute value), demonstrating strong indicator reliability.

Appendix 5

Table S5. Methodological quality and statistical significance.

Construct	Sample Size	Bartlett's χ^2	df	*p*-value	First Eigenvalue	Kaiser Criterion	Eigenvalue Ratio
Leadership Behaviours	534	1816.48	15	<0.001	3.956	Met (4.0×)	6.4:1
LMX	534	2973.81	55	<0.001	5.989	Met (6.0×)	7.4:1
Worker Safety Compliance	534	3378.12	28	<0.001	5.642	Met (5.6×)	10.1:1
Worker Safety Participation	534	4050.20	45	<0.001	6.597	Met (6.6×)	9.7:1
Safety Climate	534	3137.59	36	<0.001	5.711	Met (5.7×)	7.7:1
Safety Culture	534	4589.94	55	<0.001	7.208	Met (7.2×)	10.7:1
Safety Performance	534	1406.17	15	<0.001	3.327	Met (3.3×)	3.6:1

Interpretation: All factor loadings exceed 0.60 threshold (in absolute value), demonstrating strong indicator reliability.

Appendix 6

Table S6. Merged discriminant validity matrix (HTMT and Fornell-Larcker combined).

Construct	LB	LMX	WSC	WSP	SC	SCult.	SP
Leadership Behaviours (LB)	**(0.769)**	0.708 (0.639)	0.706 (0.646)	0.696 (0.637)	0.766 (0.696)	0.714 (0.656)	0.339 (0.262)
Leader-Member Exchange (LMX)		**(0.707)**	0.728 (0.674)	0.805 (0.748)	0.795 (0.729)	0.741 (0.688)	0.394 (0.316)
Worker Safety Compliance (WSC)			**(0.815)**	0.825 (0.774)	0.810 (0.752)	0.762 (0.717)	0.363 (0.290)
Worker Safety Participation (WSP)				**(0.789)**	0.817 (0.761)	0.775 (0.733)	0.341 (0.273)
Safety Climate					**(0.809)**	0.864 (0.809)	0.392 (0.314)
Safety Culture						**(0.788)**	0.466 (0.384)
Safety Performance							**(0.685)**

Threshold: HTMT < 0.85 (conservative) or < 0.90 (liberal). Assessment: Most values below 0.85, with Climate-Culture (0.864) slightly above, suggesting generally adequate discriminant validity; **Fornell-Larcker Criterion:** The square root of AVE (diagonal) should exceed inter-construct correlations in parentheses. **Assessment:** Some correlations approach diagonal values (e.g., Climate-Culture: 0.809 vs √AVE: 0.768), indicating potential overlap but acceptable discriminant validity overall.

Appendix 7: Preamble for Data Collection

Akenten Appiah-Menka University of Skill Training and Entrepreneurial Development

Faculty of Technical Education

Department of Construction Technology and Management

Dear Respondent,

An integrative model for health and safety performance improvement of construction project sites in Ghana is the theoretical basis for our research at the aforementioned University. This study primarily not only seek to document but also to educate key figures and other stakeholders and in the building sector how Safety Leadership practices affect safety behaviours at construction sites and the need for improvement. The study subsequently intends to develop an integrative predictive model that takes into account Safety leadership behaviour, employee behaviour, and the extent to which such behaviours enable the proper Safety climate and culture which ultimately impact on the improvement of Safety performance at construction project sites and in the construction industry as a whole.

You are therefore cordially asked to answer the questions honestly and completely as a stakeholder in the construction industry in order to get a reliable result that will aid in improving the performance of construction health and safety. Please understand that this is primarily for academic purposes, and that any information you provide will be kept totally private and anonymous. However, if at any time during the study you change your mind, you are free to do so.

We appreciate your assistance in advance.

Appendix 8: Interview Guide for Construction Leadership

Section A: Bio Data and Personal Records of Interviewee

1) Please can you briefly tell me about yourself in terms of your

a) Age bracket ………………………………………………………………………………

b) Highest academic qualification…………………………………………………………

c) Years of experience in the construction industry………………………………………

d) Current company and your job schedule………………………………………………

Section B: Leadership Behaviour and Its Influence on Workers

2a) Please, what are some of the leadership behaviours at your sites in terms of:

1) Managing health and safety delivery?..

2) Influencing health and safety of workers with their leadership style?...........……………

2b) Please, how do your safety leaders' behaviours influence your workers' safety behaviours in terms of safety compliance and safety participation at your sites?....................................

2c) Please, how do the leadership behaviours at your sites influence the health and safety performance at your site?...

Section C: Satisfaction

3a) Please, how satisfied are you with regards to the safety behaviour and the safety performance at your sites?..

Section D: Challenges

4) Please, what are some of the challenges you face in health and safety delivery at your site?..

Section E: Recommendations

5) Please, kindly state your recommendations if any in an attempt to improve the health and safety performance at your site…………………………………………………………

Appendix 9: Interview Guide for Construction Workers

Section A: Bio Data and Personal Records of Interviewee

1) Please can you briefly tell me about yourself in terms of your

a) Age bracket ………………………………………………………………………………

b) Highest academic qualification…………………………………………………………

c) Years of experience in the construction industry………………………………………

d) Current company and your job schedule………………………………………………

Section B: Safety Leadership Behaviour and Their Influence

2a) Please, how do your safety leadership (managers, supervisors and gang leaders) behave towards health and safety management and performance at your sites?…………..……………

2b) How do their behaviours impact your own health and safety behaviour and that of your coworkers?………………………………………….………………………………………………

Section C: Satisfaction

3) Please, how satisfied are you with regards to the safety behaviour and the safety performance at your sites?…………………………………………………………………………………………

Section D: Challenges

4) Please what challenges do you face at your site as regards health and safety delivery?

……………………………………………………………...………………………………

Section E: Recommendations

Please indicate your recommendations as to how best health and safety performance can be holistically improved at your sites?………….…………………………………………………