



(RESEARCH ARTICLE)



SAFETY MANAGEMENT AND ORGANIZATIONAL SAFETY PRACTICES IN CONSTRUCTION PROJECTS IN LIBERIA: A LIBERIA-FOCUSED MIXED-METHODS EMPIRICAL ANALYSIS

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ABSTRACT

Construction remains a high-risk project-based industry, especially where formal safety systems, contractor controls, inspection capacity, and worker training are still developing. This article presents a Liberia-focused mixed-methods empirical analysis of safety management and organizational safety practices in construction projects. Primary data were drawn from two survey instruments: a practitioner questionnaire with 52 valid responses from engineers, project managers, site supervisors, safety officers, company owners/managers, and related technical staff, and an institutional questionnaire with 5 responses from organizations involved in engineering, construction supervision, public works, mining-related construction, and consulting. The study examines safety planning, design-stage risk identification, pre-work training, personal protective equipment (PPE), supervision, inspection, accident reporting, organizational structure, role allocation, safety communication, toolbox meetings, reporting culture, institutional response, and regulatory enforcement. Results show that safety awareness exists in Liberia, but implementation is uneven. Positive findings include high PPE provision, design/planning risk identification, formal safety structures, and worker willingness to report unsafe conditions. Weaker areas include accident recording and review, pre-work training consistency, toolbox meeting frequency, communication effectiveness, and enforcement of safety rules. Poor safety training, lack of protective equipment, weak supervision, lack of safety rules, and worker negligence were the leading perceived causes of safety risk. It concludes with practical company-level and policy-level recommendations for strengthening Liberia's construction safety culture, organizational accountability, and full-life-cycle safety management.

Keywords: Construction Safety Management; Organizational Safety; Liberia; Occupational Health and Safety; Safety Culture; Construction Projects

1 INTRODUCTION

Construction supports Liberia's housing, roads, public facilities, utilities, mining support works, commercial buildings, and post-conflict infrastructure recovery. At the same time, construction work creates recurring hazards because project sites are temporary, crews change frequently, work interfaces are complex, and pressures to complete tasks can encourage unsafe shortcuts. Accident causation research has long moved beyond single-worker blame. Early work emphasized unsafe acts and conditions [1], while later organizational accident theory stressed latent failures in planning, management, communication, and control systems [2]. Construction studies similarly connect accidents to planning failures, design decisions, supervision problems, site constraints, worker behavior, and poor coordination [3-6].

Safety in construction is therefore best understood as an organizational management function, not only as compliance with rules. Effective systems combine policy, leadership commitment, risk assessment, competence, training, PPE, inspection, reporting, emergency readiness, and continual improvement [7-10]. Prior research links improved performance to visible management commitment, structured safety programs, owner involvement, leading indicators, near-miss reporting, toolbox meetings, and corrective action [11-17].

The Liberian setting makes this issue especially important. National labor and public works instruments establish expectations for workplace safety and contractor control [18,19], while country development sources identify construction and infrastructure as important to Liberia's development trajectory [20,21]. However, localized empirical evidence on how safety is actually planned, supervised, communicated, recorded, and enforced on Liberian project sites remains limited. This study addresses that gap by using practitioner and institutional survey evidence from Liberia.

The objectives are to: (1) examine the current status of safety management practices in Liberian construction projects; (2) identify perceived causes of safety risk and common site-level challenges; (3) assess organizational safety arrangements, including safety roles, communication, reporting culture, and institutional response; and (4) develop Liberia-specific recommendations while using previous research only as thematic reference.

2 LITERATURE REVIEW AND RESEARCH POSITIONING

2.1 Safety management systems, culture, and project organization

Construction safety literature consistently shows that good safety outcomes depend on systems rather than isolated rules. Formal safety management includes clear responsibilities, hazard identification, training, operating procedures, inspections, accident investigation, feedback, and improvement cycles [16,22-25]. Safety culture and safety climate research adds that workers respond to what management actually rewards, communicates, and enforces. Shared perceptions of commitment, communication, and supervisor behavior influence safe behavior and accident outcomes [26-36].

Studies on project organization, supervision, and safety programs also show that contractor management, qualified safety personnel, site audits, and management authority are decisive factors [13,37-41]. Training and PPE are equally central, but their effectiveness depends on method, quality, reinforcement, and worker acceptance [42-45]. Recent applied and review papers also emphasize safety plans, digital monitoring, smart PPE, VR/AR training, IoT tools, and predictive analytics, while noting that technology is useful only when supported by organizational commitment and implementation capacity [46-52].

2.2 Liberia-focused research gap and study contribution

Developing-context research repeatedly identifies safety constraints such as limited budgets, weak enforcement, insufficient training, inconsistent PPE, under-reporting, subcontracting complexity, and informal work practices [53-59]. Design-stage and pre-task research further shows that hazards can be reduced before site work begins when project teams connect design decisions, work methods, risk registers, temporary works, access planning, and construction sequencing [60-66].

The present study places Liberia's primary survey evidence within established construction-safety research. Its contribution is a Liberia-specific empirical baseline on how practitioners and institutions perceive safety planning, training, PPE, supervision, reporting, organizational structure, communication, enforcement, and improvement priorities.

3 METHODOLOGY

3.1 Research design, sample, and instruments

The study used a mixed-method survey design. The practitioner questionnaire generated 52 valid responses from engineers, project managers, site supervisors, safety officers, company owners/managers, architectural staff, and related technical participants working on construction and engineering projects in Liberia. A separate institutional questionnaire generated 5 responses from organizations involved in public works, engineering consulting, private construction, mining-related construction, and construction supervision. The two instruments were used together so that frontline practice could be interpreted alongside organizational and institutional perspectives.

The practitioner instrument captured demographic profile, role, experience, project type, pre-project safety planning, design/planning risk identification, training, PPE, supervision, inspections, accident recording, formal safety structure, role assignment, safety communication, toolbox talks, worker reporting culture, response to hazards, schedule/coordination risk, perceived causes of safety risk, improvement recommendations, and the perceived importance of strong project organization. The institutional instrument added questions on written safety policy, safety budgets, management review, contractor standards, contract safety requirements, government/public works inspection, enforcement, barriers, and public works support needs.

3.2 Measures, analysis, and scope of inference

Closed-ended items were coded as categorical variables. Frequency scales included responses such as Always, Often, Sometimes, Rarely, and Never; effectiveness scales included Very effective, Effective, Moderate, Poor, and Very poor. Multi-response items were counted as selections, meaning percentages can exceed 100% when respondents selected more than one cause or recommendation. Open-ended responses were reviewed thematically to identify recurring issues such as task-specific training gaps, poor PPE quality or non-use, supervisor authority limitations, unstable scaffolding, electrical hazards, fall risks, weak signage, limited first aid, under-reporting, production pressure, and uneven regulatory inspection.

Analysis included descriptive statistics, graphical summaries, institutional triangulation, and exploratory association tests using cross-tabulation and Cramer's V. The statistical tests are interpreted cautiously because the sample is exploratory and not designed to prove causality or national representativeness. The value of the study lies in creating a structured Liberia-focused empirical baseline that can guide larger future surveys, direct site observation, accident-record analysis, and intervention evaluation.

4 RESULTS

4.1 Respondent profile and project context

The practitioner sample was male-dominated but included meaningful female participation: 36 respondents were male (69.2%) and 16 were female (30.8%). Engineers were the largest professional group (59.6%), followed by project managers (15.4%) and site supervisors (13.5%). This profile is useful because engineers, project managers, and supervisors are directly involved in daily safety planning, work coordination, supervision, and communication with crews. The projects represented in the survey were concentrated in building and road construction, with additional participation from bridges, water and sanitation, electrical/mechanical work, marine construction, and other infrastructure activities.

4.2 Project-level safety management practices

The results show a mixed safety-management picture. Safety planning before project start was positive for 67.3% of respondents, and design/planning risk identification was positive for 73.1%. PPE provision was the strongest project-level indicator at 82.7%. However, only 55.8% reported pre-work worker safety training, 46.2% confirmed that accident reports are properly recorded and reviewed, 59.6% rated safety communication as very effective or effective, and 61.5% reported daily or weekly safety meetings/toolbox talks. These gaps indicate that Liberia's construction projects often have visible safety awareness but weaker learning, communication, and routine reinforcement systems.

4.3 Organizational, institutional, and risk-factor findings

Organizational indicators were stronger than some operational indicators. A formal safety structure was reported by 73.1% of practitioners, and 65.4% reported that roles were always or often assigned. Worker reporting culture was promising, with 76.9% reporting that workers feel free to report unsafe conditions without fear of punishment. At the same time, reported response quality was lower at 61.5%, meaning that freedom to report must be matched by timely corrective action. The leading perceived causes of safety risk were poor safety training, lack of protective equipment,

weak supervision, lack of safety rules, and worker negligence. Institutional responses showed stronger formal systems, including written policies and clear structures, but identified weak enforcement of safety rules as the main sector-level barrier.

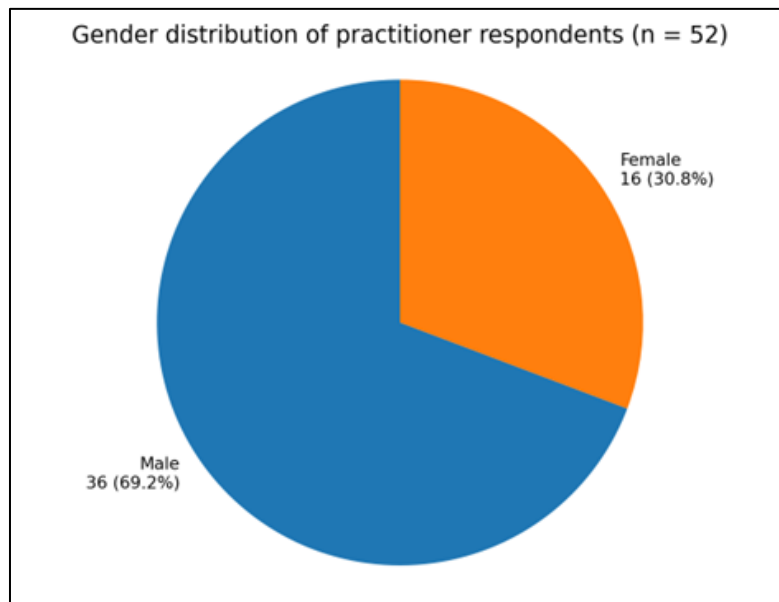


Figure 1: Gender distribution of practitioner respondents.

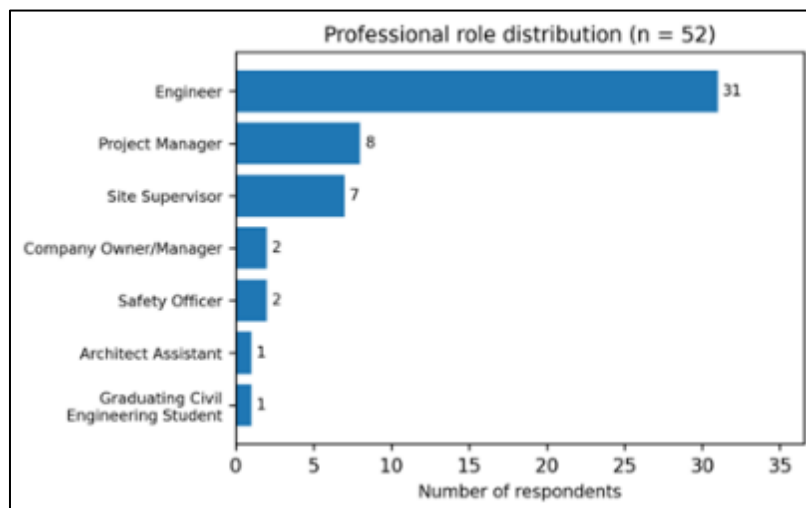


Figure 2: Professional role distribution among practitioner respondents

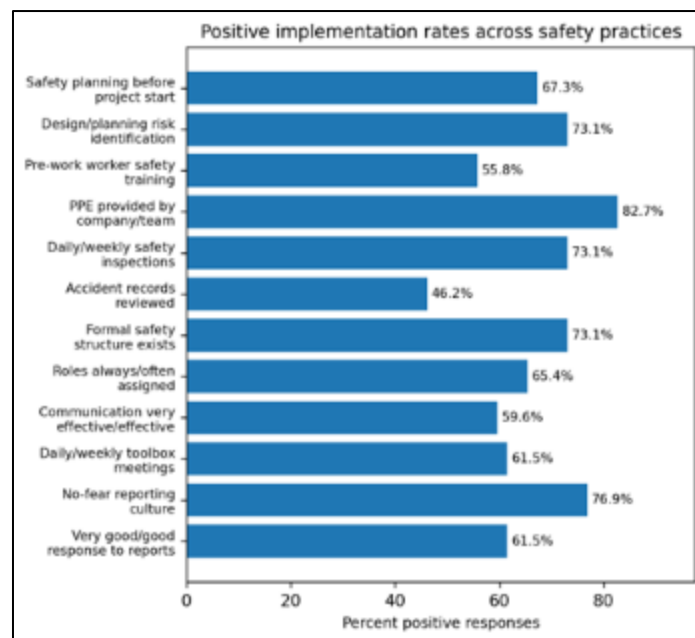


Figure 3: Positive implementation rates across selected safety practices

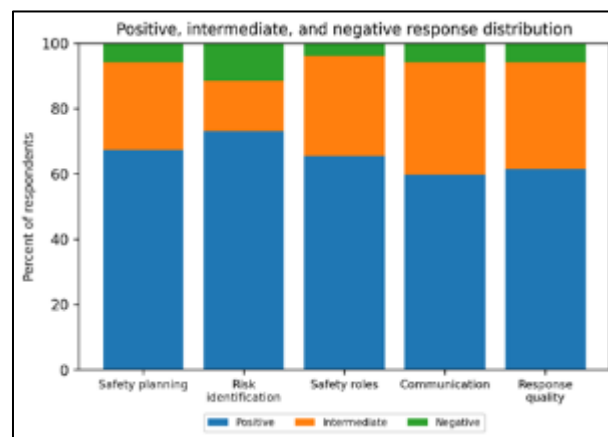


Figure 4: Positive, intermediate, and negative response distribution for selected organizational safety items.

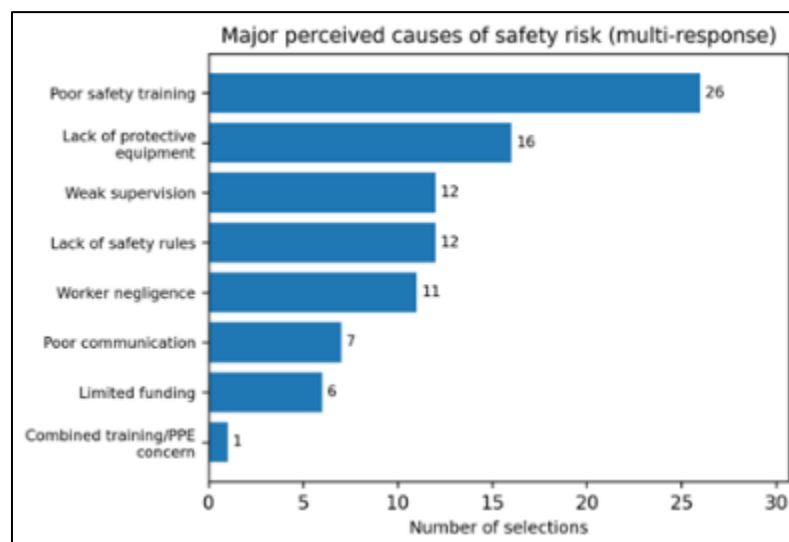


Figure 5. Major causes of safety risks identified by practitioner respondents

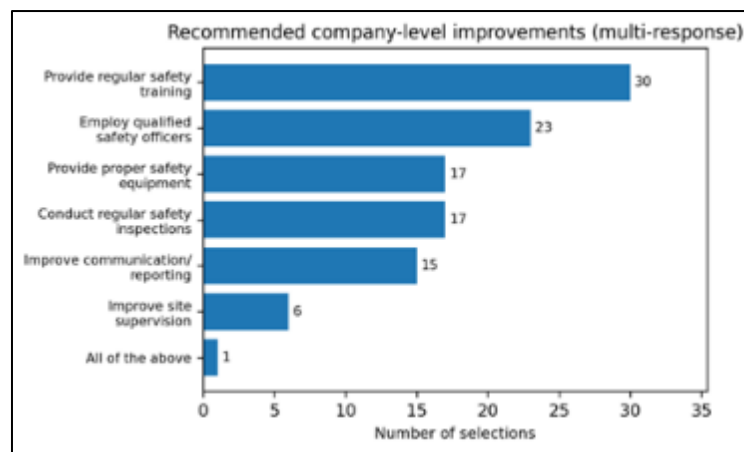


Figure 6: Practitioner recommendations for improving construction safety management.

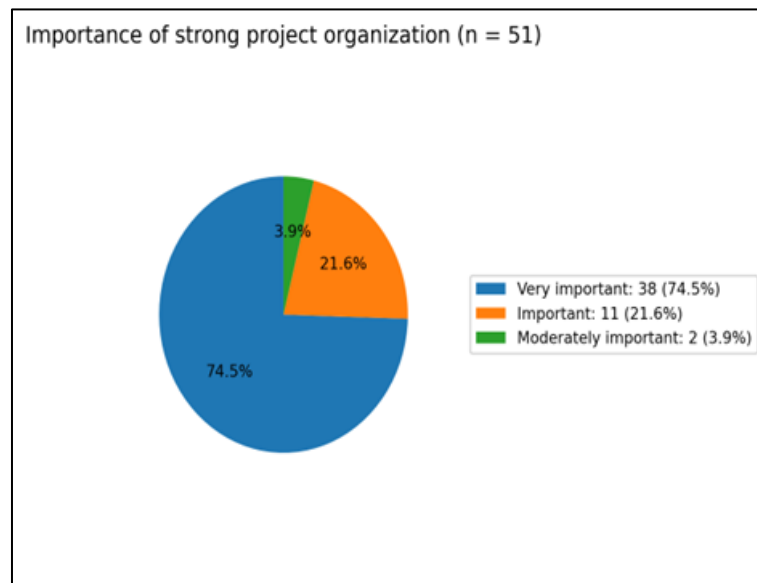


Figure 7: Respondent ratings of the importance of strong project organization



Figure 8: Institutional-level positive safety management indicators.

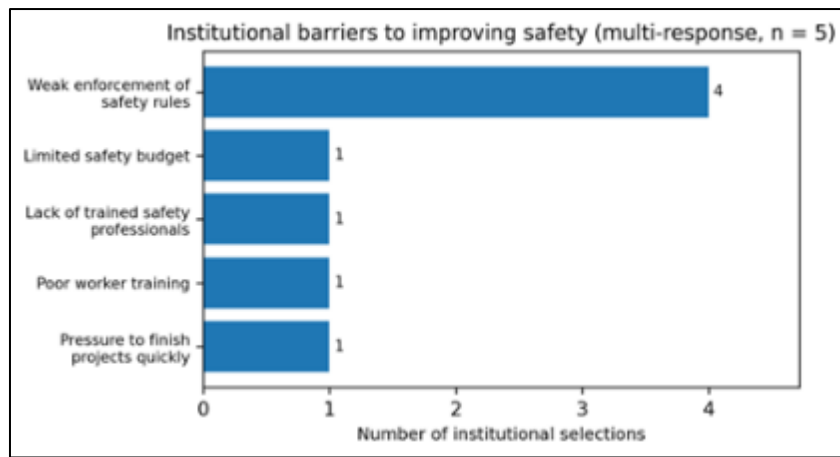


Figure 10: Public works support needed to improve project safety.

Table 1: Summary of practitioner respondent profile (n = 52).

Category	Response	Frequency	Percent
Gender	Male	36	69.2%
Gender	Female	16	30.8%
Professional role	Engineer	31	59.6%
Professional role	Project Manager	8	15.4%
Professional role	Site Supervisor	7	13.5%
Professional role	Company Owner/Manager	2	3.8%
Professional role	Safety Officer	2	3.8%
Professional role	Other technical roles	2	3.8%

Table 2: Key project-level safety-management indicators.

Indicator	Positive response rate	Interpretation
Safety planning before project start	67.3%	Positive but not universal
Design/planning risk identification	73.1%	Moderately strong
Pre-work worker safety training	55.8%	Needs improvement
PPE provided by company/team	82.7%	Strongest operational indicator
Daily/weekly safety inspections	73.1%	Moderately strong
Accident reports properly recorded/reviewed	46.2%	Weakest learning indicator
Formal safety structure exists	73.1%	Moderately strong
Safety roles always/often assigned	65.4%	Uneven role clarity
Communication very effective/effective	59.6%	Needs improvement
Daily/weekly toolbox meetings	61.5%	Needs routine strengthening
No-fear reporting culture	76.9%	Promising worker-engagement result
Very good/good response to reports	61.5%	Needs faster corrective action

Table 3: Institutional-level positive safety management indicators (n = 5).

Institutional indicator	Positive response rate
Written safety policy	100.0%
Top management support very strong/strong	80.0%
Safety in early planning/design always/often	100.0%
Specific safety budget always/often	60.0%
Formal risk assessment always/often	80.0%
Contractor standards always/often required	100.0%
Safety requirements in contracts always/often	100.0%
Clear safety management structure	100.0%
No-fear reporting permitted	100.0%
Management responds immediately	100.0%

Table 4: Exploratory association results among selected safety variables.

Association tested	Cramer's V	p-value	Interpretive note
Safety planning vs. design-stage risk identification	0.597	p < 0.001	Moderate exploratory association
Clear safety structure vs. communication effectiveness	0.389	p = 0.015	Moderate exploratory association
Safety meetings/toolbox talk vs. reporting freedom	0.388	p = 0.099	Suggestive but not statistically strong
Clear safety structure vs. reporting freedom	0.186	p = 0.406	Weak exploratory association
Safety meetings/toolbox talk vs. response quality	0.426	p = 0.005	Moderate exploratory association
Accident recording/review vs. response quality	0.444	p = 0.002	Moderate exploratory association

5 DISCUSSION AND IMPLICATIONS

The central finding is that Liberia's construction sector shows evidence of safety awareness but uneven safety-system maturity. Several formal elements are present: many projects report pre-start safety planning, risk identification, PPE provision, formal safety structures, and no-fear reporting. However, the lower results for training, accident recording, communication, toolbox talks, and response quality suggest that safety is not yet consistently embedded as a learning cycle. In practical terms, many projects appear to know that safety matters, but the system for converting that awareness into disciplined daily practice is still developing.

The Liberia results align with major safety-management themes in prior research without requiring a direct country-to-country comparison. The training gap supports the conclusion of Burke et al. [42] that training effectiveness depends on content and method, and it is consistent with African construction research that identifies limited training and contractor capacity as recurring concerns [53-55,59]. PPE findings also support studies showing that equipment provision must be paired with quality, fit, enforcement, and worker acceptance [37,43,44]. The communication and reporting findings connect with safety-climate research showing that management commitment, supervisor behavior, worker participation, and feedback loops influence safe behavior [26,29,32-35].

The most important Liberia-specific implication is that accident prevention should move from reactive response to proactive control. Design-stage safety thinking, pre-task planning, risk registers, and leading indicators are widely recommended in the literature [17,52,60-63]. The current findings suggest that these ideas should be localized through simple and affordable tools: pre-start safety plans, daily toolbox talks, weekly inspection close-out logs, near-miss registers, stop-work authority, basic incident investigation forms, and short task-specific training sessions. Advanced technologies such as BIM, wearable monitoring, sensors, AI analytics, VR training, and worker safety apps may be useful

over time, but they should support basic recordkeeping, supervision, and reporting systems rather than replace them [47-51].

Institutional findings point to enforcement as the bridge between written policy and site practice. Although institutional respondents reported written safety policies and clear safety structures, weak enforcement was the dominant barrier. This supports studies that connect safety compliance to predictable inspection, contractor qualification, clear penalties, and client demand for safety performance [56-58]. For Liberia, the policy priority is not only to write stronger rules, but to make safety expectations visible in permits, public contracts, contractor classification, site inspections, and project close-out reviews.

Table 5: Thematic comparison between the Liberia findings and selected safety-management research.

Theme	Finding from this Liberia study	Selected research alignment	Implication for Liberia
Training	Poor safety training was the leading risk cause; regular training was the top improvement recommendation.	Training quality and method affect outcomes; African construction studies repeatedly identify training constraints [42,53,54].	Introduce induction, task-specific training, refresher training, and short toolbox learning.
PPE and supervision	PPE provision was high, yet lack of protective equipment and weak supervision remained major risks.	PPE and supervision problems are central in safety-management research [37,43,44].	Pair PPE provision with quality control, replacement, fit, enforcement, and empowered supervisors.
Reporting and learning	Accident recording/review was the weakest key indicator.	Leading-indicator and intervention-evaluation research stresses near-miss records, inspections, and corrective action [17,52,67].	Use simple incident and near-miss registers and review lessons at project meetings.
Safety culture	No-fear reporting was promising, but communication and response quality were uneven.	Safety climate research connects management commitment and communication to safe behavior [26,29,32,33].	Protect workers who report hazards and respond quickly to maintain trust.
Design and planning	Risk identification before construction exists but must be linked to daily site controls.	Design-for-safety research shows that hazards can be reduced before construction begins [60-62].	Make design-stage risk registers part of method statements and supervision checklists.
Regulation and institutions	Weak enforcement was the strongest institutional barrier.	Enforcement and client demand influence safety investment and compliance [56-58].	Tie permits, contractor classification, public contracts, and inspections to safety performance.

Table 6: Summarized practical recommendations for Liberia.

Level	Recommended action	Suggested indicator
Companies and project teams	Prepare written project safety plans, risk registers, method statements, and role assignments before mobilization.	Approved safety plan; risk register; weekly review record
Training	Provide induction, task-specific training, refresher sessions, and toolbox talks in simple language.	Attendance records; toolbox talk logs; observed safe behaviors
PPE	Supply durable task-appropriate PPE, replace damaged items, and enforce correct use.	PPE inspection log; corrective-action records

Supervision	Employ qualified safety officers and give them authority to stop unsafe work.	Stop-work protocol; hazards corrected; supervisor safety walk records
Inspection and learning	Use structured inspections, near-miss reporting, incident investigation, and close-out tracking.	Inspection close-out rate; repeated-hazard count; lessons-learned notes
Communication	Create two-way reporting channels and respond quickly to worker concerns.	Hazard reports; response time; worker feedback
Public institutions	Require safety plans, competent HSE personnel, inspection records, and safety performance evidence in permits and public contracts.	Permit/contract compliance; inspection frequency; sanctions and incentives

6 CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH

This manuscript shows that Liberian construction projects have important safety foundations, including planning, PPE provision, formal structures, and worker willingness to report hazards. Despite these widespread challenges, the study confirms overwhelming consensus among local practitioners that strong organizational structure, standardized safety protocols and proactive safety management directly reduce construction accidents. Respondents also provided unified, practical recommendations for improvement at the company, project and government levels. For private construction firms and project teams, the highest-priority actions include delivering regular, task-specific safety training for all workers and supervisors, recruiting and empowering fully qualified professional safety officers with full authority to halt unsafe work, supplying durable, task-appropriate PPE and enforcing mandatory usage, establishing daily structured safety inspections with formal follow-up for identified hazards, creating clear written safety roles for every position on the organizational chart, and building a blame-free safety culture that encourages voluntary hazard reporting without punishment. For individual engineers, participants recommend integrating safety into project design from the outset, leading by example through full PPE compliance, conducting regular on-site risk assessments, participating in safety training and actively promoting safe work practices among peers and laborers.

Moving forward, sustained improvement in Liberia's construction safety will require joint effort from private construction companies, industry professionals and national regulators. Safety must transition from an afterthought to a core project objective embedded in planning, design, operations and organizational culture. By implementing the evidence-based recommendations outlined in this study, Liberia can gradually reduce construction-related accidents, protect its vital construction workforce, build a mature national safety culture and support the long-term safe and sustainable development of its expanding infrastructure sector.

Liberia's construction safety system requires predictable enforcement, clearer public works expectations, contractor qualification controls, stronger inspection practices, and incentives for good safety performance. At company level, safety should be treated as a core project objective from design and planning through construction and close-out. At regulatory level, safety plans, competent HSE personnel, inspection records, and accident reporting should become normal requirements for permits, contracts, and contractor assessment.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

All authors declare no financial or non-financial conflict of interest related to this research.

Statement of ethical approval

The present research work does not contain any studies performed on animals by any of the authors. The human-participant component consisted of voluntary questionnaire responses from adult construction and engineering professionals. The survey was anonymous, non-clinical, and involved no experimental intervention; therefore, formal ethical approval was not required under the minimal-risk survey design.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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