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Identifying the Key Factors Affecting the Success of Occupational Health and Safety Management during the Implementation of Construction Projects for NGOs in Sana'a, Yemen

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Abstract

The critical role of Occupational Health and Safety (OHS) management in supporting construction project success is especially evident in fragile contexts such as Yemen. This study identifies the key factors affecting the success of OHS management during the implementation of construction projects executed by non-governmental organizations (NGOs) in Sana'a and explores the main challenges that hinder effective implementation. A quantitative design was employed using a closed-ended questionnaire derived from the requirements of ISO 45001:2018, which was distributed to professionals involved in NGO construction projects. Participants were selected through purposive (non-probability) sampling methods. A total of 384 questionnaires were distributed, and 171 valid responses were received and included in the analysis, yielding a response rate of 44.5%. Data were analyzed using the SPSS software. The instrument demonstrated excellent internal consistency (Cronbach's α = 0.972). The results indicate that top management commitment, strengthening the OHS culture, and allocating adequate resources are the most influential factors associated with successful OHS management. The most critical implementation challenges were related to the social and cultural context and the provision of personal protective equipment. This study recommends institutionalizing ISO 45001-based OHS management systems in NGO construction projects, strengthening leadership accountability, and ensuring adequate resourcing, training, and monitoring to improve OHS performance in construction projects in Yemen.

Article Info

Keywords:

Occupational health and safety management systems (OHSMS), ISO 45001, NGO construction projects, Yemen, Implementation barriers, Resource allocation, OHS culture.

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1. INTRODUCTION

Construction projects are essential for socioeconomic development; however, they are widely recognized as one of the most hazardous work environments. Occupational Health and Safety (OHS) management is a core component of project success, influencing productivity, schedule adherence, cost control, and stakeholder confidence. Evidence shows that safety climate, organizational culture, and management practices are strongly associated with safety performance and organizational outcomes [1, 2]. Unsafe work behavior and weak site controls are often linked to systemic issues, such as inadequate supervision, insufficient training, and poor communication [3].

In Yemen, construction projects are implemented under complex economic and institutional constraints that increase project risk. Studies on the Yemeni construction sector report that weak planning, resource constraints, and context-specific risk factors can significantly affect project time and cost performance [4]. In addition, construction failures and persistent operational challenges have been observed in Yemen's fragile environment [5]. Non-governmental organizations (NGOs) deliver a considerable share of construction and rehabilitation projects, often under urgent timelines and constrained budgets, making systematic OHS management even more critical.

Despite the importance of OHS management, empirical evidence on the factors associated with successful OHS management in NGO construction projects in Sana'a is limited. This study addresses this gap by identifying (i) the most influential factors perceived to support successful OHS management and (ii) the primary challenges and barriers that hinder effective implementation using a framework aligned with ISO 45001:2018 requirements [6].

From an operational perspective, robust OHS management is not limited to regulatory compliance; it directly affects productivity, accident-related costs, absenteeism, and the continuity of project delivery [2, 7]. In NGO settings, these performance effects have governance implications because demonstrable OHS performance can strengthen organizational credibility and stakeholder confidence.

However, humanitarian and conflict-affected settings introduce context-specific constraints that can undermine the systematic implementation of OHS management systems, including unstable supply chains, rapid project mobilization, fragmented subcontracting arrangements, and a heterogeneous workforce with varying literacy and technical competence. These realities require OHS interventions that are technically sound and contextually feasible.

Accordingly, this study makes three contributions to the literature. First, it operationalizes the ISO 45001:2018 requirements into empirically measurable success-factor dimensions suitable for NGO construction projects in Yemen. Second, it provides an evidence-based prioritization of both enabling factors and implementation barriers based on the perceptions of experienced stakeholders (n = 171). Third, it translates these findings into actionable recommendations aligned with leadership, planning, procurement, training, monitoring, and continuous improvement.

The remainder of this paper is organized as follows: Section 2 reviews the relevant literature and positions the study framework; Section 3 describes the methodology, measurement, and analysis procedures; Section 4 reports and discusses the results; and Section 5 concludes with recommendations, study strengths, limitations, and future research directions.

2. LITERATURE REVIEW

ISO 45001:2018 provides an internationally recognized framework for OHS management systems (OHSMS), emphasizing leadership and worker participation, risk-based planning, operational controls, performance evaluation, and continual improvement [6]. Organizations that adopt formal OHSMS approaches often report improvements in risk control, compliance, and structured decision-making. However, sustaining and improving OHSMS practices depends on the organizational context and management commitment, particularly in developing and conflict-affected settings [8].

Prior research on construction safety has identified a set of critical success factors (CSFs) that consistently predict better safety program performance. These CSFs typically include top management commitment, clear responsibilities, communication, adequate resource allocation, training, and continuous monitoring. For example, Aksorn and Hadikusumo highlighted the central role of management commitment and safety promotion in construction projects [9]. Similar findings were reported by Bavafa et al., who emphasized the need for planning, supervision, and resource support for effective safety program implementation [10]. In fragile environments, Buniya et al. noted that leadership, stakeholder coordination, and competence development are decisive for successful safety implementation [11].

In addition to organizational CSFs, behavioral and sociocultural factors can significantly hinder OHS performance. Unsafe behaviors may persist when workers perceive low enforcement, limited incentives, or conflicting production pressures [3]. Therefore, identifying both organizational enablers (success factors) and context-driven constraints (implementation challenges) is essential for NGOs to design feasible OHS interventions that match local realities.

2.1. OHS MANAGEMENT SYSTEMS AND ISO 45001 IN CONSTRUCTION

ISO 45001:2018 adopts a Plan–Do–Check–Act (PDCA) logic that links organizational context and leadership to planning, operational control, performance evaluation, and continual improvement. In construction, this system perspective is particularly important because safety performance is shaped by interdependent factors such as subcontracting, dynamic site conditions, and time pressure decisions. ISO 45001 therefore emphasizes (i) hazard identification and risk assessment, (ii) operational planning and control, (iii) consultation and participation of workers, and (iv) evaluation of compliance and performance indicators [6].

Empirical research suggests that formal OHSMS implementation can strengthen safety governance by clarifying responsibilities, improving documentation and learning from incidents, and institutionalizing preventive controls. However, the effectiveness and continued improvement of OHSMS practices depend strongly on the organizational context and management commitment [8], [12]. In developing and conflict-affected settings, these dependencies can be intensified by resource constraints and operational instability [13].

Within construction settings, OHSMS maturity is often reflected in the consistency of risk-based planning, quality of supervision and communication, and discipline of corrective action follow-up. Evidence also links OHS

prevention investments and OHSMS practices with improved OHS performance and reduced accident costs, reinforcing the business and humanitarian cases for preventive systems, even under financial constraints [7].

2.2. Critical success factors for OHSMS implementation

Critical success factors (CSFs) refer to a limited number of organizational conditions and practices that, if effectively addressed, substantially increase the likelihood of achieving targeted performance outcomes. In construction safety, CSFs are commonly conceptualized as leadership-related factors (e.g., commitment and accountability), process-related factors (e.g., risk assessment and operational control), and people-related factors (e.g., competence, communication, and participation) [9–11].

Top management commitment is widely reported as the most influential CSF because leadership shapes priorities, allocates resources, and enforces standards despite competing project pressures. Aksorn and Hadikusumo [9] and Bavafa et al. [10] demonstrated that management commitment, safety promotion, and structured planning are strongly associated with safety program performance. In contexts where governance is weak, leadership becomes even more decisive because it substitutes for external enforcement mechanisms [11].

Competence development and training are additional CSFs because construction hazards are frequently controlled through human decision-making and behaviors. Innovations such as simulation-based training using BIM and 3D visualization can improve training effectiveness and hazard recognition, particularly for complex or high-risk tasks [14]. Such approaches may be valuable for NGOs that need to mobilize teams quickly while ensuring minimum competency for safe work conditions.

Finally, worker participation, consultation, and communication are emphasized by ISO 45001 as mechanisms for strengthening the safety culture and identifying operational risks early. A positive safety climate–characterized by shared perceptions of safety importance, openness to reporting, and consistent supervisory behavior–has been associated with improved safety compliance and reduced incident rates [1, 15].

2.3. Contextual barriers in developing and conflict-affected settings

Despite the availability of international standards, many construction projects in developing countries face persistent barriers that limit the adoption of systematic OHS practices. Typical constraints include limited budgets, insufficient regulatory enforcement, inadequate procurement mechanisms for safety equipment, weak contractor pre-qualification, and high labor informality. These barriers can result in reactive safety practices that focus on minimal compliance rather than prevention [3, 13, 16].

In fragile and conflict-affected contexts, additional challenges emerge, including supply chain disruptions, rapid changes in site security and access, limited availability of qualified OHS professionals, and competing humanitarian priorities. NGOs may also deliver projects under strict cost ceilings and accelerated schedules, which can create tensions between production and safety concerns. Studies in the Yemeni construction sector report context-specific factors affecting time, cost, and broader construction performance [4, 5], while labor productivity research further underscores the importance of adapting management practices to local operating conditions [17].

Sociocultural norms and risk perceptions can further influence safety behavior. Where workers perceive safety rules as secondary to productivity or where unsafe behaviors are normalized, formal procedures may not translate into safe practices. Research on unsafe work behavior highlights the roles of perceived enforcement, incentives, peer norms, and production pressure in shaping worker decisions [3], while recent studies emphasize the influence of safety behaviors at the trade level [18].

2.4. Research gap and study framing

Although a substantial body of research identifies CSFs and barriers for safety programs in construction, evidence remains limited for NGO-implemented construction projects in Yemen. Most prior studies have been conducted in private sector or state-led projects and in relatively stable regulatory environments. Moreover, many studies focus on generic safety factors without explicitly mapping them to the ISO 45001 requirements, which can limit the translation of findings into implementable system components.

To address these gaps, this study adopts an ISO 45001-aligned framework and empirically ranks (i) success factors that can be managed and strengthened by NGOs and (ii) contextual and organizational challenges that can hinder implementation. The underlying assumption is that effective OHS management in NGO construction projects depends on a combination of internal system capabilities (leadership, planning, resources, risk control, and performance evaluation) and external/contextual constraints (social norms, economic and organizational pressures, and supply limitations).

Accordingly, the study is guided by two research questions: (RQ1) Which ISO 45001-aligned success factors are perceived as most influential for OHS management success in NGO construction projects in Sana'a? and (RQ2) What are the most critical barriers that hinder the implementation of OHS practices in this context?

3. RESEARCH METHODOLOGY

3.1. Study design and context

This study was conducted in Sana'a, Yemen, focusing on construction and rehabilitation projects implemented by NGOs. Such projects are typically delivered under donor requirements, accelerated timelines, and budget ceilings, which can shape OHS planning, procurement, supervision, and learning. By focusing on NGO project environments, this study provides context-specific evidence for strengthening OHS management where institutional capacity and external enforcement may be limited.

A quantitative survey design was adopted to capture the professional perceptions of OHS management success factors and implementation challenges in NGO construction projects in Sana'a. This design is appropriate for examining patterns in stakeholder perceptions within a defined professional context [19].

3.2. Population, sampling, and indicative sample size

The target population comprised professionals involved in NGO construction projects and related roles, including project managers, site engineers, consultants, contractors, and safety personnel. Although laborers are the primary beneficiaries of OHS practices, they were excluded from this study's sample. This exclusion is methodologically justified because the study evaluated the OHS Management System at the strategic and operational levels using ISO 45001 clauses. Evaluating system compliance, resource allocation, and policy alignment requires respondents with managerial, supervisory or engineering expertise. Laborers' behaviors and compliance were evaluated through the observational lens of the site engineers and supervisors who managed them. Purposive (non-probability) sampling was used to ensure that the respondents had direct exposure to OHS practices within construction sites and project delivery processes in Sana'a. The questionnaire was administered electronically via Microsoft Forms and circulated through three prominent organizations leading construction and infrastructure rehabilitation in Yemen: the Social Fund for Development (SFD), the United Nations Office for Project Services (UNOPS), and the Public Works Project (PWP).

To provide context for field access planning, an indicative finite-population sample benchmark was calculated using Richard's standard proportion formula [19] for a 95% confidence level, 5% margin of error, p = 0.5, and an estimated total population size of N = 5600 (based on the cumulative workforce and contractor estimates provided by the targeted organizations: SFD, UNOPS, and PWP). This yields an indicative target of approximately 360 patients. Because purposive sampling was used due to field constraints, the finite population calculation was used only to estimate the desirable response volume and not to infer population representativeness. The achieved sample of 171 valid responses was considered adequate for descriptive analysis and ranking within the defined study context [19, 20].

3.3. Instrument development and structure

The questionnaire was developed based on a structured review of OHSMS and construction safety literature, with explicit mapping to the ISO 45001:2018 clauses to ensure content coverage. The instrument operationalized 12 success-factor dimensions (36 items) reflecting leadership, planning, resources, operational control, performance evaluation, and improvement, and eight implementation-challenge dimensions (24 items) capturing contextual constraints relevant to NGO construction projects.

To strengthen content validity, the initial instrument was reviewed by experts in OHS management and construction project administration. Based on their feedback, the items were refined for clarity, relevance, and contextual appropriateness. A pilot test with 30 participants from the study population was conducted to identify ambiguous wording and verify the feasibility of administration in the field.

Following the pilot test, evidence of internal consistency was examined using Pearson correlations between each item and its corresponding dimension score. The item-dimension correlations ranged from 0.353 to 0.828. Values above 0.30 are generally considered acceptable in exploratory scale development, supporting the retention of contextually relevant items. This validation step supports the interpretability of the aggregated dimension means used in the subsequent ranking analysis.

3.4. Measurement scale and interpretation

A five-point Likert scale was used to measure perceived influence/impact, ranging from 1 (not influential at all) to 5 (very influential). To support the consistent interpretation of mean scores, the scale range ($5 - 1 = 4$) was divided into five categories, yielding a class length of 0.80. Table 1 presents the mean ranges used to interpret the degree of influence of the variables.

Table 1. Degree ranges of the five-point scale.

Mean	Degree of influence
1.00–1.80	Not influential at all
1.81–2.60	Not influential
2.61–3.40	Neutral
3.41–4.20	Influential
4.21–5.00	Very influential

3.5. Validity and Reliability

Face validity was ensured by expert review, focusing on the clarity and relevance of each statement. Evidence of internal consistency was further supported by acceptable positive item–dimension correlations, indicating that the items coherently reflected their intended dimensions for descriptive ranking purposes.

Reliability was assessed using Cronbach's α, which showed very high internal consistency for both axes and for the overall instrument (α = 0.972). These values indicate that the aggregated dimension scores provide a stable basis for ranking the success factors and implementation challenges.

3.6. Data Analysis

The inclusion criteria required respondents to be currently involved in, or to have recently contributed to, NGO construction projects in Sana'a with direct exposure to site operations or OHS management practices. This criterion ensured that the responses reflected informed professional judgement rather than general perceptions.

The final instrument comprised 60 items organized into two axes: (i) 12 ISO 45001-aligned success-factor dimensions (36 items) and (ii) eight implementation challenge dimensions (24 items) capturing contextual constraints. The internal consistency was excellent, with Cronbach's α values of 0.973 (Axis 1), 0.935 (Axis 2), and 0.972 for the overall questionnaire.

Data analysis included descriptive statistics (frequencies, percentages, means, and standard deviations) to summarize the respondents' characteristics and dimension scores. To prioritize factors and barriers, the mean ranking was complemented with the Relative Importance Index (RII = mean/5) to provide a normalized measure of perceived influence. The analysis was descriptive and ranking-oriented, and no causal or predictive modeling was undertaken. All statistical analyses were performed using IBM SPSS Statistics [20].

3.7. Ethical Considerations

Ethical approval was obtained from the Department of Civil Engineering at Sana'a University prior to data collection. Given the complex security context in Yemen, the research design ensured that no physical risk was imposed on the participants. Online questionnaire administration was utilized not only for efficiency but also to mitigate any security or safety risks associated with physical data collection. Consent was obtained from all participants, who were briefed on the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time without any consequences. To protect confidentiality, the responses were anonymized and stored securely. Data were reported in aggregate form, and access to datasets was restricted to the research team.

3.8. Methodological Limitations

Because the study used purposive (non-probability) sampling and relied on self-reported perceptions, the findings should be interpreted primarily as descriptive evidence reflecting informed stakeholders in NGO projects in Sana'a. Although the instrument showed excellent reliability, future research should triangulate perceptions with site observations, safety records, and qualitative interviews to strengthen inferences.

4. Results and Discussion

Respondents rated the ISO 45001-aligned success factors as very influential (overall mean = 4.27; RII = 0.854) and rated the implementation challenges as similarly high in impact (overall mean = 4.25; RII = 0.850). This pattern suggests that professionals view OHS management as central to project success in NGO construction projects in Sana'a, while simultaneously recognizing substantial contextual constraints that require targeted managerial and policy responses to address them.

4.1. Respondent Profile

The final sample comprised 171 respondents with diverse roles and professional backgrounds, providing a multistakeholder view of OHS management in NGO construction projects. Table 2 summarizes the respondents' qualifications, specializations/roles, and practical experience in construction projects.

Table 2. Respondent demographic characteristics (n = 171).

Item	n (%)
Highest qualification	
Diploma	16 (9.4%)
Bachelor's degree	100 (58.5%)
Master's degree	40 (23.4%)
PhD	15 (8.8%)
Specialization / role	
Civil engineer	45 (26.3%)
Structural engineer	38 (22.2%)
Project manager	27 (15.8%)
Safety & health engineer	17 (9.9%)
Supervisor	4 (2.3%)
Quality engineer	3 (1.8%)
Site manager	2 (1.2%)
Electrical engineer	2 (1.2%)
Mechanical engineer	1 (0.6%)
Other	32 (18.7%)
Experience in construction projects	
Less than 1 year	28 (16.4%)
1–5 years	51 (29.8%)
6–10 years	28 (16.4%)
More than 10 years	64 (37.4%)

Note: The 'Other' category represents professionals from allied fields actively involved in projects, such as environmental engineers, construction management consultants, and procurement officers.

4.2. Instrument Reliability

The questionnaire demonstrated excellent internal consistency. Table 3 reports Cronbach's α coefficients for each axis and for the overall instrument, confirming the reliability of the aggregated dimension scores used in the analysis.

Table 3. Reliability of the study instrument (Cronbach's α).

Axis	Items	Cronbach's α
Axis 1: Success factors	36	0.973
Axis 2: Challenges	24	0.935
Overall questionnaire	60	0.972

Cronbach's α for each axis and for the overall questionnaire (60 items).

4.3. Ranking of ISO 45001-aligned success factors

Table 4 presents the ranked ISO 45001-aligned success factors based on dimension means and standard deviations. Factors were ranked descriptively based on mean scores; close differences were interpreted as broadly similar priorities rather than statistically distinct positions. Top management commitment and accountability ranked first (mean = 4.52, SD = 0.61; RII = 0.904), followed by strengthening the OHS culture (mean = 4.48, SD = 0.61; RII = 0.896) and allocating resources for the OHSMS (mean = 4.38, SD = 0.68; RII = 0.876). Overall, the results align with prior evidence that leadership commitment and resource support are prominent factors associated with safety program performance [9–11].

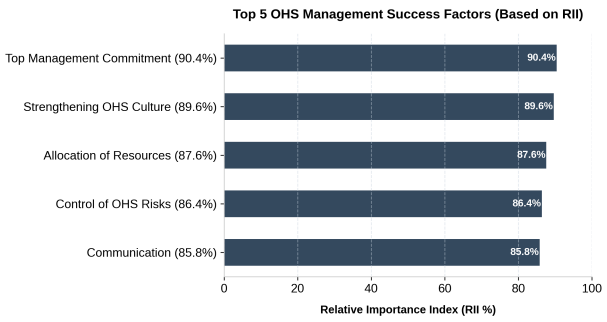

Figure 1. Top five OHS management success factors based on RII.

The prominence of leadership-related factors underscores that, in NGO projects, visible management involvement and accountability are necessary to institutionalize safe practices amid cost and time pressure. ISO 45001 explicitly assigns leadership responsibility for policy, roles, worker participation, and resource provision; therefore, weak leadership commitment can cascade into inconsistent supervision, under-resourcing, and poor corrective action follow-up [6]. High rankings for risk control

Table 4. Ranking of ISO 45001-aligned success factors (n = 171).

Rank	Success factor	Mean (SD)
1	Top management commitment and accountability	4.52 (0.61)
2	Strengthening an OHS culture (leadership-driven)	4.48 (0.61)
3	Allocation of resources for the OHSMS	4.38 (0.68)
4	Control of OHS risks (hazard identification and controls)	4.32 (0.73)
5	Communication (OHS information and reporting)	4.29 (0.65)
6	OHS policies aligned with organizational strategy	4.29 (0.71)
7	Continuous monitoring and evaluation of OHSMS performance	4.29 (0.74)
8	Continual improvement of the OHSMS	4.24 (0.75)
9	Alignment of OHS objectives with the OHS plan	4.22 (0.71)
10	Integration of OHSMS into organizational processes	4.16 (0.76)
11	Compliance with legal and other requirements	4.14 (0.80)
12	Worker participation and representation	4.00 (0.82)

Factors ranked by mean score. RII = mean/5 (e.g., rank 1: 4.52/5 = 0.904).

and continuous monitoring further indicate the need for systematic hazard identification, transparent reporting, and feedback loops to prevent incidents and strengthen adherence.

Top management commitment was rated the highest, which is consistent with prior evidence that leadership shapes safety priorities and enforces standards when production pressures intensify [9, 10]. In NGO settings, leadership commitment is also reflected in how OHS requirements are embedded in contracts, procurement checklists, and contractor evaluations–mechanisms that can institutionalize safety beyond individual projects.

The second most influential factor was strengthening the OHS culture. A constructive safety climate involves consistent supervisory behavior, open reporting of near-misses, learning orientation, and fair enforcement. Meta-analytic and empirical studies have shown that safety climate and culture are linked to safety compliance and performance outcomes [1, 2, 15]. For NGOs, culture building can be accelerated through explicit leadership messaging, toolbox talks, supervisor coaching and recognition mechanisms aligned with donor expectations.

Resource allocation ranked among the top factors, highlighting that OHSMS implementation requires dedicated budgets for training, competent supervision, monitoring, and personal protective equipment. This aligns with research linking OHS prevention investments and OHSMS practices to improved safety performance and reduced accident costs [7]. In fragile contexts, resource planning must also account for procurement lead times and supply chain disruptions to avoid safety compro-

mises.

Risk control (hazard identification, assessment, and operational controls) was also highly ranked, reflecting the centrality of preventive mechanisms such as job hazard analysis, method statements, permit-to-work systems, and the hierarchy of controls. ISO 45001 emphasizes risk-based planning and operational control to eliminate hazards and reduce OHS risks at the source [6]. In construction sites with dynamic hazards, robust risk control depends on competent supervision and continuous verification.

Communication, monitoring, and continual improvement were rated consistently high, suggesting that OHS performance is sustained through feedback loops, such as incident reporting, audits, inspections, and management reviews. These mechanisms are particularly important in NGO projects, where teams may rotate across locations and learning must be transferred rapidly between projects to avoid repeating incidents.

Interestingly, worker participation, although still rated as influential, received the lowest mean score among the success factors. In practice, participation can be constrained by hierarchical site cultures, temporary labor, and limited consultation mechanisms. Strengthening participation is essential because workers hold tacit knowledge about hazards and workarounds; improving participation can enhance risk identification and practical control measures [6].

Collectively, the ranked success factors highlight that improving OHS outcomes in NGO construction projects requires both "system" interventions (leadership, planning, integration, evaluation) and "field" (supervision, risk controls, communication, and competence) interventions. The high overall mean indicates that stakeholders perceive a strong potential for improvement if these factors are addressed systematically.

Based on these results, a practical pathway for NGOs is to adopt an ISO 45001-aligned "minimum OHSMS package" for projects: (1) explicit leadership accountability and OHS objectives, (2) risk-based planning integrated into work schedules and procurement, (3) minimum competence and training requirements for key roles, and (4) routine monitoring and corrective action follow-up. This package can be scaled according to the project size and complexity while maintaining core preventive functions.

4.4. Ranking of OHS implementation challenges

Table 5 presents the ranked challenges of implementing the program. The social and cultural context was the most critical barrier (mean = 4.43, SD = 0.70; RII = 0.886), reflecting limitations in safety awareness, prevailing norms, and variable worker attitudes toward safe practices. The second-ranked barrier was the provision of personal protective equipment (PPE) (mean = 4.37, SD = 0.69; RII = 0.874), highlighting procurement constraints, inconsistent distribution, and improper use. Organizational and administrative barriers are also prominent, indicating that internal systems, supervision capacity, and monitoring mechanisms require strengthening to sustain OHS controls.

Table 5. Ranking of OHS implementation challenges in NGO construction projects (n = 171).

Rank	Challenge dimension	Mean (SD)	RII (%)
1	Social and cultural context	4.43 (0.70)	88.6%
2	Provision and use of PPE	4.37 (0.69)	87.4%
3	Organizational context	4.34 (0.63)	86.8%
4	Administrative context	4.32 (0.70)	86.4%
5	Training and qualification requirements	4.19 (0.66)	83.8%
6	Monitoring and evaluation mechanisms	4.19 (0.69)	83.8%
7	Economic and business context	4.10 (0.62)	82.0%
8	Research and development limitations	4.05 (0.79)	81.0%

RII (%) = (mean/5)× 100. Ranked by mean score of each challenge dimension.

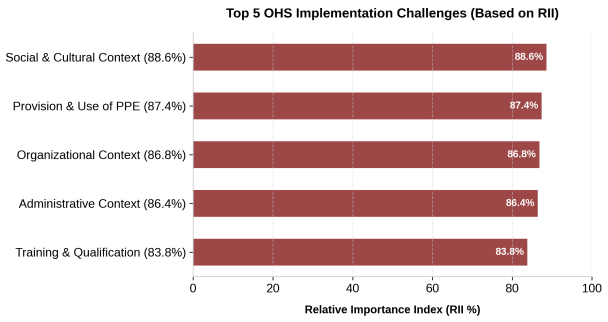

Figure 2. Top five OHS implementation challenges in NGO projects.

Overall, these findings indicate that NGOs must complement technical controls (procedures, inspections, and equipment) with culturally informed interventions that address safety attitudes, norms, and risk perceptions. At the project level, enforcing minimum PPE standards, ensuring quality control, and establishing consistent supervision and disciplinary mechanisms can reduce workers' exposure to hazards. At the organizational level, strengthening procurement systems, integrating OHS requirements into project planning and contractor management, and investing in training and monitoring capacity are key to reducing recurring barriers to OHS.

Social and cultural barriers were the highest-ranked challenges, suggesting that safety interventions should be designed not only for compliance but also for behavior change. Approaches such as behavior-based safety, peer-to-peer coaching, and culturally resonant messag-

ing can reinforce safe norms, especially when combined with leadership consistency and fair enforcement. Because subcontracted and temporary workers may join projects intermittently, repeated induction and simple visual safety communication are essential.

PPE provision emerged as a major barrier, which is consistent with prior studies that identified resource constraints, procurement limitations, and weak safety support as recurring barriers to construction safety implementation in developing settings [13, 16]. NGOs can mitigate this by forecasting PPE demand during planning, specifying minimum PPE standards in contracts, establishing supplier quality criteria, and allocating dedicated budget lines for safety issues. Effective PPE programs also require fit, comfort, and supervision; therefore, toolbox talks and spot checks should be used to ensure that PPE is worn correctly and consistently by workers.

Organizational and administrative barriers indicate that OHS success is undermined when safety roles are unclear, inspections are inconsistent, and corrective actions are not tracked. ISO 45001 emphasizes defined roles and responsibilities, competence, and performance evaluation [6]. Implementing simple management controls, such as weekly OHS checklists, near-miss reporting, and management review meetings, can create accountability and sustain improvement, even when resources are limited.

Training and qualification limitations highlight the need to strengthen the competence of site supervisors, foremen, and workers. Given the rapid mobilization and high turnover, NGOs may benefit from standardized “minimum training packages” tailored to high-risk activities (excavation, working at height, electrical work) and from using visual or simulation-based training to enhance comprehension [14].

The relatively high rating of monitoring and evaluation challenges suggests that even when procedures exist, performance tracking may be inconsistent. Establishing measurable indicators (e.g., inspection completion rates, near-miss reports, corrective action closure time, and training completion) and integrating them into project reporting can improve learning and donor visibility.

Finally, the lower-ranked but still substantial challenges related to research and development indicate a gap in systematic data collection and learning. NGOs can incrementally address this by maintaining basic incident databases, conducting post-incident learning reviews, and sharing lessons across projects and partners to reduce repeated incidents and improve preventive planning.

4.5. Implications for NGO project governance and donor compliance

Beyond site-level practices, the findings may have implications for NGO project governance and compliance-oriented reporting. ISO 45001 frames occupational health and safety management as a structured management system issue involving leadership accountability, operational control, performance evaluation, and continual improvement rather than a stand-alone site activity [6]. In construction settings in developing countries, guidance likewise emphasizes that health and safety should be integrated into planning, procurement, supervision, and contractor management [13].

Accordingly, in NGO construction projects, higher OHSMS maturity may be interpreted as an indicator of management robustness and implementation readiness, especially where projects are delivered through contractors and subcontractors, and where external reporting expectations are significant. This interpretation is consistent with the present findings, which ranked top management commitment, OHS culture, and resource allocation among the most influential success factors, and with prior studies emphasizing leadership and structured program support in safety performance [11, 16].

In practical terms, NGOs may strengthen governance by embedding OHS requirements into procurement and contractor selection, defining explicit safety responsibilities for project managers and site supervisors, requiring routine reporting of OHS indicators, and using periodic compliance and performance reviews for higher risk projects [6, 13].

These actions do not guarantee compliance outcomes; however, they provide a more systematic basis for oversight, corrective action, and consistent documentation across projects. In this sense, the ranked success factors identified in the present study can be understood not only as operational enablers of safer worksites but also as management mechanisms that may support accountability and compliance-related assurance in NGO project delivery [6, 11, 13].

5. Conclusions and Recommendations

5.1. Key conclusions

This study investigated OHS management in NGO construction projects in Sana’a, Yemen, using an ISO 45001-aligned framework that captures leadership, planning, resources, operational control, performance evaluation, and improvement. The findings show that stakeholders most strongly associate OHS management success with leadership commitment and accountability, a strengthened safety culture, and adequate resource allocation–elements that support systematic risk control, communication, monitoring, and learning. Simultaneously, implementation was perceived to be constrained by social and cultural barriers and challenges in providing and enforcing PPE, indicating that technical controls must be complemented with behavior- and governance-oriented

interventions.

5.2. Recommendations for NGOs, contractors, and donors

Based on the ranked priorities, the following recommendations can strengthen OHS management and implementation in NGO construction projects.

- Adopt an ISO 45001-aligned project OHSMS package, including an OHS policy, defined roles, risk assessment, method statements, incident reporting, and management review.
- Strengthen leadership accountability by assigning OHS responsibilities to project managers and site supervisors, setting measurable OHS indicators, and regularly reviewing performance.
- Allocate dedicated OHS budgets covering training, supervision, monitoring activities, and PPE procurement with realistic lead times for fragile supply chains.
- Integrate OHS requirements into procurement and contracting (PPE specifications, contractor prequalification, supervision plans, and penalties for repeated non-compliance).
- Invest in competence development using practical, visual, and task-based training (including induction for temporary workers) and refresher training for high-risk activities.
- Implement routine monitoring and learning mechanisms (site inspections, near-miss reporting, corrective action tracking) and share lessons learned across projects and partners.
- Design culturally informed behavior-change interventions (toolbox talks, peer coaching, community-aware messaging) to address norms and attitudes that contribute to unsafe practices.
- Given Yemen's fragile economic context, characterized by supply chain disruptions, inflation, and conflict-related constraints, NGOs must adopt adaptive procurement strategies for safety equipment (PPE) by supporting local suppliers where possible and building contingency budgets for OHS to offset sudden economic fluctuations.

5.3. Strengths and contributions

This study offers several strengths and contributions that enhance both its academic value and practical relevance for NGO construction projects in Sana'a.

- ISO 45001 alignment: This study operationalizes an international OHSMS standard and translates it into implementable dimensions for NGO project settings.
- Contextual novelty: This study provides empirical evidence specific to NGO construction projects in Sana'a, a fragile and understudied environment.
- Multi-stakeholder perspective: Responses were obtained from a diverse set of professionals (n = 171) spanning qualifications, specializations, and experience levels.
- Methodological rigor: The instrument demonstrated excellent internal consistency (Cronbach's α = 0.972) and acceptable item–dimension validity for an exploratory ranking study.
- Actionable output: Findings are presented as ranked priorities and linked to governance and implementation mechanisms relevant to donors and project managers.

5.4. Limitations

- Non-probability sampling and focus on Sana'a may limit statistical generalization to all Yemeni construction contexts.
- This study examined stakeholder perceptions rather than objective safety performance indicators. Future studies should triangulate incident records, inspections and observational audits.
- This study ranked dimensions at an aggregate level; future work can examine causal pathways between specific OHSMS practices and safety outcomes.

5.5. Future research

Future research can build on this study by adopting mixed-method designs that triangulate survey findings with site observations, incident statistics, and interviews. Comparative studies across multiple Yemeni cities and different types of donors and contractors would improve external validity. In addition, longitudinal research could assess whether ISO 45001-aligned interventions (leadership accountability, PPE programs, and monitoring systems) lead to measurable improvements in safety outcomes over time.

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