

ASSESSMENT OF HEALTH EFFECTIVENESS AND SAFETY INTERVENTIONS IN MITIGATING CONSTRUCTION SITE ACCIDENTS: A CASE STUDY OF TERTIARY INSTITUTIONS IN SOUTH-SOUTH, NIGERIA

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ABSTRACT

This study identifies significant deficiencies in safety knowledge among construction workers, which contribute to high accident rates. Despite extensive training efforts, effectiveness remains limited due to impediments such as the temporary nature of the workforce, project timelines, language barriers, and ineffective instructional methods. Utilizing both quantitative and qualitative methods, including surveys and interviews, the research focused on medium and large construction firms in South-South Nigeria. Results indicate high overall satisfaction with training programs; however, engagement and practical application require improvement. The training's effectiveness is evident through a notable reduction in workplace incidents and enhanced compliance with safety regulations. Comparative analysis across different states reveals distinct strengths and weaknesses, emphasizing the need for tailored approaches to address specific regional challenges. For instance, while firms in Edo and Rivers exhibit lower incident rates, those in Bayelsa and Akwa Ibom display higher rates, indicating varying levels of training efficacy. The study highlights the importance of continuous feedback and iterative improvements in training programs. Strong supervisory support and real-world application of safety knowledge are crucial for sustaining these improvements. These findings underscore the critical role of ongoing evaluation and refinement of health and safety training to enhance overall safety performance and foster a positive safety culture in the construction industry.

KEYWORDS: Construction safety, training effectiveness, occupational health, safety culture, qualitative and quantitative analysis, regional comparison.

INTRODUCTION

Research consistently highlights significant deficiencies in safety knowledge among construction workers, which is a primary cause of construction-related injuries. Haslam et al. (2015).^[1] found that over 70% of such injuries were linked to inadequate safety knowledge. Despite substantial investments in training, estimates indicate that only 10-15% of these efforts yield tangible benefits.^[2,3] This discrepancy often leads to recommendations for increased training to prevent future injuries.^[4]

Exploring the failure of training initiatives in the construction industry reveals several factors. Idoro (2018) noted that the temporary nature of the workforce and project-based timelines deter comprehensive training

approaches.^[5,6] Other impediments include project scheduling constraints, conflicts, language barriers, and the challenge of quantifying training benefits (Wang et al., 2018). Ineffective instructional methods, unqualified instructors, and inappropriate training materials also contribute to the problem.^[7] Many programs rely on conventional classroom techniques, which fail to engage workers sufficiently.^[8]

To improve safety training effectiveness, Wilkins (2011) advocates for andragogical approaches that better engage adult learners. Abdullah et al. (2018) suggest methods that encourage dialogue, feedback, and action to enhance learning gains.^[9] The construction industry significantly contributes to economic development but is known for its high risk of accidents and injuries. Construction site

accidents can cause severe consequences, affecting worker well-being, project timelines, and finances. In Nigeria, particularly within the tertiary institutions of the South-South region, construction activities have surged, heightening the need for effective health and safety measures.

Nigeria's rapid urbanization and infrastructural development have positioned the construction industry as a pivotal economic force. The sector fuels economic growth, creating jobs and contributing to the Gross Domestic Product (GDP). As construction activities expand, especially within tertiary institutions in South-South Nigeria, the demand for both skilled and unskilled labor rises. The growth of the construction sector brings inherent risks and challenges related to occupational health and safety.^[5] Construction sites are dynamic, with multiple activities occurring simultaneously, increasing the likelihood of accidents. Common hazards include falls, electrocution, machinery accidents, and exposure to hazardous substances. These incidents cause physical harm to workers and result in project delays, increased costs, and reputational damage for involved institutions.^[10] The Nigerian government has implemented regulatory frameworks to address safety concerns in the construction industry. However, the frequency of accidents remains high, necessitating a closer examination of the effectiveness of these measures.

Tertiary institutions, as centers of education and research, constantly expand and renovate infrastructure to accommodate growing student populations and evolving academic needs.^[11] These construction projects within university campuses present unique challenges due to the diverse workforce, including contractors, subcontractors, and university staff, complicating unified and effective health and safety approaches.^[12] Health and safety within tertiary institutions are crucial, not just for immediate construction sites but for the broader community. These institutions shape the future workforce and set ethical standards. Robust health and safety protocols protect workers and instill a culture of responsibility and accountability.

This research aimed to critically examine the health and safety landscape within construction sites of tertiary institutions in South-South Nigeria. By identifying areas for improvement, gaps in current practices, and innovative interventions, the study seeks to enhance overall safety performance in this vital sector.

METHODS

Research Design

This study utilized both quantitative and qualitative research methods, focusing primarily on assessing the efficacy of health and safety training within construction firms to improve training practices and safety performance in the industry. To achieve the research objectives, a quantitative approach was adopted,

involving an extensive literature review and a self-administered questionnaire survey. The literature review established a theoretical foundation, while the questionnaire survey provided numerical data crucial for meeting the study's aims.

The Quantitative Research Approach

Quantitative research methodologies were employed to collect factual information and explore relationships between these facts, aligning with existing theories and prior research. This approach focused on measurable aspects of phenomena, seeking to quantify the extent of phenomena, their impact, relationships, and causes. Various scientific techniques were used, including social surveys like self-administered questionnaires, to gather quantified data.

Research Population and Sampling

The study focused on construction firms in the south-south geopolitical zone of Nigeria, with business addresses registered at the Corporate Affairs Commission (CAC) in Abuja. Two groups were targeted: providers of health and safety training (safety managers) and recipients (workmen).

Research Population

The study targeted 245 medium and large construction firms registered with the CAC. The chosen respondents were safety managers and workmen, the latter being particularly vulnerable to hazards on construction sites. The study area was the south-south geopolitical zone of Nigeria, chosen for its significant construction activity and representation of the broader industry.

Study Area

The study area includes six states: Edo, Delta, Rivers, Bayelsa, Cross River, and Akwa Ibom. These states house numerous indigenous and multinational construction firms. The choice of area was due to its status as a major business hub in Nigeria, providing a diverse and representative sample of construction firms.

Sample Size

Sampling aimed to facilitate practical data collection and processing, ensuring representativeness. For a population of 245 firms, the sample size was calculated using Watson's (2011) formula

$$n = \frac{P(1-P)}{A^2 + \frac{P(1-P)}{Z^2 + N} \div R}$$

Where

P = estimated variance (0.5)

A = precision desired (0.05)

Z = confidence level (1.96 for 95% confidence)

R = response rate (0.75).

This yielded a sample size of 150 firms, increased to 200 to account for attrition.

Sampling Technique

Two sampling methods were used. Purposive sampling selected ten firms for the pilot study to validate the questionnaire. Random sampling selected respondents from the CAC list for the main survey. This ensured an unbiased selection, providing equal chances for inclusion and a representative sample size.

Method of Data Collection

Self-administered Questionnaire

A self-administered questionnaire survey was used, presenting a standardized set of questions to respondents. This approach allowed for consistent comparison across a broad range of potential respondents. Structured questionnaires were employed, featuring closed-ended questions for straightforward comparison and analysis.

Assessment of Workers' Reactions to Health and Safety Training

A combination of qualitative and quantitative methods assessed workers' reactions to training. Surveys, focus groups, observations, feedback forms, interviews, performance metrics, attendance rates, anonymous feedback platforms, and benchmarking were used to gather comprehensive insights. An iterative feedback loop ensured continuous improvement.

Assessment of the Effectiveness of Health and Safety Training Practices

A mixed-methods approach evaluated training effectiveness, incorporating surveys, observations, interviews, incident report analysis, feedback forms, and pre- and post-training assessments.

Analytical Approach

Descriptive Statistics

Data were presented using frequency tables, mean, and standard deviation. Key components of health and safety training were ranked on a 5-point Likert scale. The Relative Mean Score (RMS) was used to evaluate the implementation and compliance of health and safety training practices, aiding in the achievement of the study's objectives.

Inferential Statistics

Inferential statistics, using the Independent Samples t-test, assessed the significance of differences between respondents from medium and large firms. SPSS 23 was used for analysis, assuming normal distribution of observations due to the sample size.

Ethical Considerations

During the data collection process, strict adherence to ethical guidelines, including informed consent and confidentiality, is maintained to safeguard participants' rights and privacy. Furthermore, ethical approval may be obtained from relevant institutional review boards or ethics committees. By using a mixed-methods approach and following these ethical standards, this study aims to comprehensively understand the causes of accidents in the Nigerian construction industry. The insights gained will help enhance safety management practices and reduce the incidence of accidents on construction sites.

RESULTS

Table 1: Comparison of Occupational Incident Rates across Construction Firms in South-South.

Construction Firm	Total Hours Worked	Number of Occupational Incidents	Rate of Occupational Incidents (per 100,000 hours worked)
Edo	400,000	7	1.75
Delta	550,000	12	2.18
Bayelsa	800,000	20	2.5
Rivers	350,000	6	1.71
Cross River	600,000	9	1.5
Akwa Ibom	380,000	10	2.6

The results demonstrate variations in the Rate of Occupational Incidents across different construction firms. Firms such as those in Edo and Rivers exhibit relatively lower incident rates, suggesting potentially more effective health and safety training practices. In contrast, higher incident rates observed in firms like

Bayelsa and Cross Rivers may indicate areas requiring improvement in safety procedures and training. These findings highlight the importance of ongoing evaluation and enhancement of health and safety training practices within construction firms to mitigate occupational risks and promote a safer work environment.

Table 2: Assessment of Workers' Reactions to Key Elements of Health and Safety Training in Construction Firms.

Below is a structured tabular result that summarizes the outcome of assessed workers' reactions to key elements of health and safety training in construction firms within the study area

Assessment Method	Description	Outcome
Surveys	Online surveys were distributed to workers to gather feedback on various aspects of the training.	Overall satisfaction with the training program was high, with most workers finding the content relevant and the delivery methods effective.

Focus Groups	Focus group discussions were conducted to explore workers' experiences and suggestions.	Workers expressed appreciation for the interactive nature of the training but suggested more hands-on exercises to reinforce learning.
Observations	Training sessions were observed to assess engagement levels and participation.	Engagement varied across sessions, with some workers appearing disinterested during certain topics.
Feedback Forms	Feedback forms were provided after each training session.	Feedback was generally positive, with constructive criticism provided on the clarity of certain concepts and the need for more visual aids.
One-on-One Interviews	Individual interviews were conducted to gather in-depth insights.	Some workers expressed concerns about the relevance of certain topics and requested more practical examples tailored to their specific roles.
Performance Metrics	Key performance indicators related to health and safety incidents were tracked.	There was a noticeable reduction in the number of reported incidents following the implementation of the training program.
Attendance Records	Attendance records were analyzed to assess participation rates.	Participation rates were high, indicating strong interest and commitment from workers.
Anonymous Feedback	An anonymous feedback platform was implemented for workers to share their thoughts.	Workers utilized the platform to provide honest feedback on areas of improvement, such as the need for more frequent refresher sessions.
Benchmarking	Comparison with industry benchmarks and best practices was conducted.	The training program performed well compared to industry standards, but there were opportunities for innovation and alignment with emerging trends.
Iterative Feedback Loop	A continuous feedback loop was established to refine the training program over time.	Feedback gathered from various sources was used to make iterative improvements to the training content and delivery methods.

This table provides a concise overview of the assessment methods used, their respective outcomes, and the insights gained from each approach.

Table 3: Evaluation of the Effects of Health and Safety Training Practices of Construction Firms Concerning the Acquisition of Safety Knowledge by Workers during Training.

Valuation Aspect	Outcome
Content Relevance	95% of surveyed workers reported that the training materials adequately covered relevant safety topics.
Clarity of Information	85% of workers rated the clarity of training content as 'Excellent' or 'Good' in post-training surveys.
Delivery Method	Hands-on demonstrations received the highest satisfaction rating, with 90% of workers finding them effective in understanding safety procedures.
Engagement Levels	80% of trainers observed high levels of engagement and participation among workers during training sessions.
Knowledge Retention	Post-training assessment scores improved by an average of 20% compared to pre-training assessments, indicating improved knowledge retention.
Practical Application	During simulated emergency drills, 75% of workers correctly applied safety procedures learned during training.
Feedback from Workers	90% of workers provided positive feedback in anonymous surveys, stating that the training significantly improved their understanding of safety practices.
Incident Reports	A 30% reduction in the number of workplace incidents was observed in the six months following the completion of the training program.
Benchmarking	The training program met or exceeded industry benchmarks in all evaluated areas, indicating alignment with best practices and superior performance compared to peers.

The evaluation results of the above table demonstrate the effectiveness of health and safety training practices in construction firms. Areas of strength include content relevance, clarity of information, and practical

application. However, opportunities for improvement exist in enhancing engagement levels and further reducing workplace incidents.

Table 4: Evaluation of Health and Safety Training Practices in Construction Firms to Ensure the Transfer of Acquired Safety Knowledge by Workers.

Evaluation Aspect	Outcome
Training Content	90% of training content aligns closely with job-specific hazards and safety procedures, as assessed by safety experts and supervisors.
Interactive Learning	85% of workers reported high levels of engagement during training sessions, facilitated by interactive methods such as case studies and role-playing exercises.
Real-world Application	70% of workers successfully applied safety knowledge learned during training in their job environments, as observed during on-the-job assessments.
Supervisory Support	95% of supervisors actively reinforced safety practices learned during training through regular coaching and feedback sessions with workers.
Job-specific Training	Job-specific training modules were developed for 80% of roles within the construction firm, addressing unique hazards and safety procedures.
Refresher Training	75% of workers participated in regular refresher training sessions, resulting in sustained awareness and compliance with safety protocols.
Feedback Mechanisms	A feedback mechanism was established, with 85% of workers providing valuable insights for improving the effectiveness of the training program.
Performance Monitoring	Incident rates decreased by 25% in the six months following the implementation of the training program, indicating improved safety practices among workers.
Culture of Safety	A positive safety culture was fostered, with 90% of workers reporting increased awareness and commitment to safety in the workplace.

This table presents the outcome for each evaluation aspect in the field, demonstrating the effectiveness of health and safety training practices in facilitating the transfer of safety knowledge by workers in construction firms.

Table 5: Health and Safety Training Practices within Construction Firms on Key Organizational Objectives.

Organizational Objective	Outcome
Reduction in Workplace Accidents and Injuries	A 30% decrease in the number of workplace accidents and injuries was observed in the six months following the implementation of the training program.
Compliance with Regulations and Standards	100% of workers demonstrated understanding and compliance with relevant safety regulations and industry standards as assessed by regulatory audits.
Improved Safety Culture	Surveys revealed a significant improvement in safety culture, with 90% of workers reporting increased awareness and commitment to safety in the workplace.
Enhanced Employee Morale and Engagement	Employee satisfaction surveys indicated a 20% increase in morale and engagement levels following the implementation of the training program.
Cost Reduction	Cost analysis showed a 25% reduction in medical expenses, worker compensation claims, and downtime costs attributed to workplace accidents.
Improved Reputation and Stakeholder Confidence	Stakeholder surveys indicated a notable improvement in the organization's reputation and stakeholder confidence due to its commitment to safety and employee welfare.
Proactive Risk Management	Incident reports showed a 40% decrease in the number of near misses, indicating improved risk management practices among workers.
Retention and Recruitment of Talent	Employee turnover rates decreased by 15%, and the organization experienced a 10% increase in job applications from top talent post-implementation of the training program.

The above table provides a summarized view of the outcomes for each organizational objective, demonstrating the impact of health and safety training practices on the overall performance of construction firms in the study area.

Table 4.6: Comparative Examination of the Outcomes of Health and Safety Training Practices within Construction Firms in South-South States.

Organizational Objective	Bayelsa	Edo	Delta	Rivers	Akwa Ibom	Cross River
Reduction in Workplace Accidents and Injuries	30	47	53	35	54	35
Compliance with Regulations and Standards	95	73	64	25	65	34
Improved Safety Culture	90	53	24	65	34	56
Enhanced Employee Morale and Engagement	20	24	54	64	66	56
Cost Reduction	25	64	64	35	35	52

Proactive Risk Management	40	36	64	66	64	32
Retention and Recruitment of Talent	15	33	24	35	25	56

The table presents a comparative analysis of the outcomes of health and safety training practices among construction firms in South-South states. Bayelsa demonstrates relatively high compliance with regulations and standards, while Rivers exhibits significant improvement in safety culture. Akwa Ibom and Cross River stand out for their proactive risk management practices. However, there are notable variations across objectives, highlighting the need for tailored approaches to address specific challenges within each state. Overall, these findings underscore the importance of ongoing evaluation and refinement of health and safety training practices to ensure optimal outcomes across organizational objectives within the construction industry.

DISCUSSION

The comparison of occupational incident rates among construction firms in South-South Nigeria reveals significant disparities. Edo and Rivers firms exhibit the lowest rates of occupational incidents, with 1.75 and 1.71 incidents per 100,000 hours worked, respectively, suggesting their health and safety practices may be more effective. Conversely, Delta and Akwa Ibom, with incident rates of 2.18 and 2.6 respectively, show higher rates, indicating potential deficiencies in their safety protocols. Bayelsa, with an incident rate of 2.5, and Cross River, with the lowest rate at 1.5, highlight the need for targeted improvements despite Cross River’s commendable performance. These variations suggest that while some firms have effective safety training programs, others require significant enhancements to reduce occupational risks.

Workers' reactions to various elements of health and safety training, as assessed through multiple methods, present a detailed picture. Surveys indicate high overall satisfaction, with training content deemed relevant and delivery methods effective. Focus groups reveal workers' appreciation for interactive elements but call for more hands-on exercises to reinforce learning. Observations show varied engagement, underscoring the need for more dynamic sessions to maintain interest. Feedback forms highlight the need for clearer concepts and more visual aids, while one-on-one interviews reveal that some workers question the relevance of certain topics and request more practical examples tailored to specific roles. Performance metrics indicate a noticeable reduction in incidents post-training, reflecting the program's positive impact. High participation rates in training sessions, as shown by attendance records, reflect strong interest and commitment to safety.^[13,14] Anonymous feedback underscores the need for more frequent refresher sessions. Benchmarking shows that the training program performs well compared to industry standards but has room for innovation. The iterative feedback loop has led to continuous improvements,

demonstrating a commitment to refining training practices. These insights highlight the strengths and areas for improvement in health and safety training programs, emphasizing the importance of ongoing feedback and adjustments.

The effectiveness of health and safety training in terms of workers' acquisition of safety knowledge is also evaluated. A high percentage (95%) of workers find the training materials relevant to their safety needs. The clarity of information is rated as 'Excellent' or 'Good' by 85% of workers. Hands-on demonstrations receive high satisfaction ratings (90%), underscoring the importance of practical training. Trainers report high engagement levels (80%) during sessions, while post-training assessment scores improve by 20%, indicating effective knowledge retention. During simulated emergency drills, 75% of workers successfully apply safety procedures learned during training. Positive feedback from 90% of workers highlights improved understanding of safety practices. A 30% reduction in incidents post-training underscores the program's effectiveness. Benchmarking results show that the training exceeds industry standards, confirming its high quality. These findings illustrate that the health and safety training practices are generally effective, though continuous engagement and practical application can be further enhanced.

The assessment of how well training practices ensure the transfer of safety knowledge to the workplace shows promising results. Training content aligns closely (90%) with job-specific hazards, ensuring relevance and practicality. Interactive learning methods, such as case studies and role-playing, engage 85% of workers. Observations during on-the-job assessments reveal that 70% of workers successfully apply the safety knowledge they learned during training. Supervisory support is robust, with 95% of supervisors actively reinforcing safety practices through regular coaching and feedback sessions. Job-specific training modules have been developed for 80% of roles, addressing unique hazards. Regular refresher training sessions maintain high participation rates (75%), sustaining awareness and compliance. Feedback mechanisms are effective, with 85% of workers providing valuable insights for continuous improvement. Incident rates decrease by 25% post-training, indicating improved safety practices. A positive safety culture is reported by 90% of workers, reflecting increased awareness and commitment to safety. These outcomes demonstrate effective knowledge transfer, supported by strong supervisory engagement and real-world applications.

The impact of health and safety training on key organizational objectives is significant. There is a 30% decrease in workplace accidents and injuries, demonstrating the training's effectiveness in enhancing

safety. Compliance with safety regulations and industry standards is complete (100%) among workers. Surveys reveal a significant improvement in safety culture, with 90% of workers reporting increased awareness and commitment. Employee morale and engagement increase by 20% post-training. Cost analysis shows a 25% reduction in medical expenses, worker compensation claims, and downtime costs attributed to workplace accidents. Stakeholder surveys indicate a notable improvement in the organization's reputation and stakeholder confidence due to its commitment to safety and employee welfare. Incident reports show a 40% decrease in the number of near misses, indicating improved risk management practices among workers. Employee turnover rates decrease by 15%, and the organization experiences a 10% increase in job applications from top talent post-training. These outcomes demonstrate the comprehensive benefits of effective health and safety training, from improved safety and compliance to enhanced employee morale and cost savings.

A comparative analysis of outcomes across different states reveals distinct strengths and weaknesses. Bayelsa demonstrates high compliance with regulations and standards (95%) and a strong safety culture (90%) but needs to improve employee morale (20%) and talent retention (15%). Edo excels in accident reduction (47%) and cost reduction (64%), but has lower compliance (73%) and safety culture (53%). Delta is strong in accident reduction (53%) and proactive risk management (64%), but weak in safety culture (24%) and talent retention (24%). Rivers shows a robust safety culture (65%) and proactive risk management (66%), but needs better compliance measures (25%) and cost reduction (35%). Akwa Ibom stands out in safety culture (66%) and proactive risk management (64%), but requires improvement in compliance (65%) and cost reduction (35%). Cross River excels in talent retention (56%) and proactive risk management (32%), but needs to enhance compliance (34%) and cost reduction (52%). These comparisons highlight the need for tailored approaches to address specific challenges within each state.

CONCLUSION

In conclusion, the findings underscore the critical role of health and safety training in improving occupational safety, compliance, and overall organizational performance in construction firms in South-South Nigeria. Effective training practices lead to significant reductions in workplace incidents, enhanced safety culture, and improved employee morale and engagement. However, the disparities across different states highlight the need for customized training approaches to address unique challenges and optimize outcomes. Continuous feedback, iterative improvements, and strong supervisory support are essential to maintaining the effectiveness of training programs. By addressing the specific needs and challenges of each firm and state, construction companies can further enhance their safety practices,

reduce incidents, and foster a positive safety culture that benefits both employees and the organization as a whole.

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